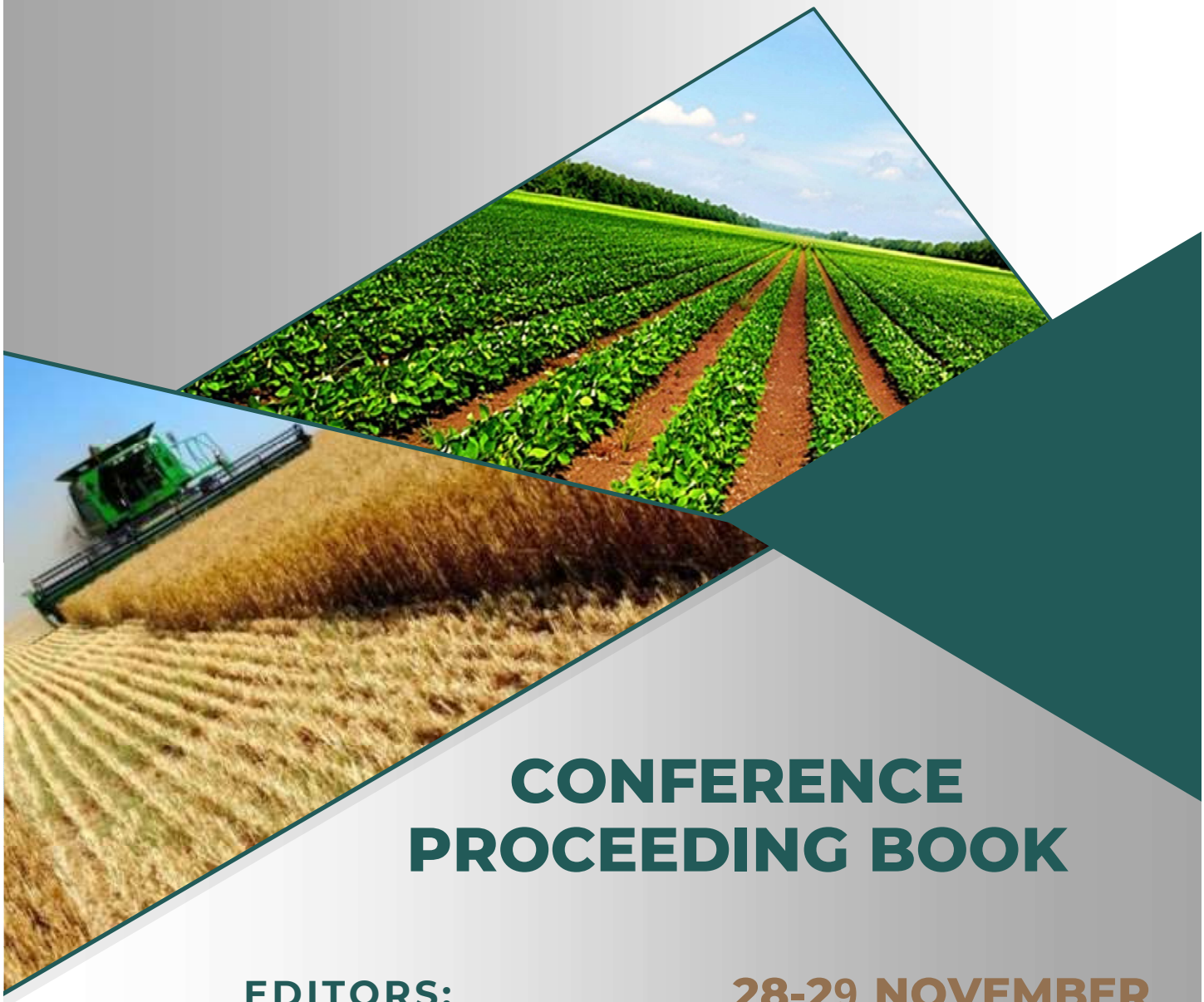
ISPEC 13. INTERNATIONAL CONFERENCE

ON AGRICULTURE, ANIMAL SCIENCE & RURAL DEVELOPMENT



CONFERENCE PROCEEDING BOOK

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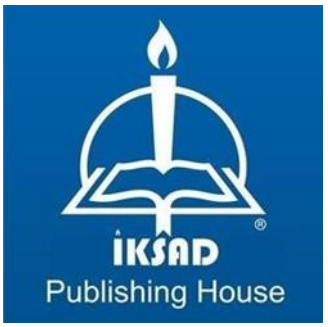
28-29 NOVEMBER

UŞAK

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T.C. UŞAK ÜNİVERSİTESİ 2006

13 th INTERNATIONAL CONFERENCE ON AGRICULTURE, ANIMAL SCIENCE AND RURAL DEVELOPMENT



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13 th INTERNATIONAL CONFERENCE ON
AGRICULTURE, ANIMAL SCIENCE AND RURAL DEVELOPMENT

13 th INTERNATIONAL CONFERENCE ON
AGRICULTURE, ANIMAL SCIENCE AND RURAL DEVELOPMENT

November 28-29, 2023 / Uşak, Türkiye

PROCEEDINGS BOOK
(Abstracts & Full Texts)

EDITORS

Doç. Dr. Ayşen Melda ÇOLAK
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Dr. Öğr. Üyesi Kerem MERTOĞLU

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13 th INTERNATIONAL CONFERENCE ON AGRICULTURE, ANIMAL SCIENCE AND RURAL DEVELOPMENT

EVALUATION PROCESS and POLICIES

All applications have undergone double blind peer review process. In addition, each paper was accepted and the process of publishing in the book was carried out through editorial oversight. The published papers were presented and discussed at the meeting.

Full texts and abstracts published in accordance with the Symposium Policy have been prepared in accordance with ethical rules and APA standards. Authors of all papers are both ethically and legally responsible.

PARTICIPANTS COUNTRIES

Türkiye, Algeria, Azerbaijan, Egypt, Ethiopia, Finland, Indonesia, India, Iran, Italy, Kazakhstan, Krgyzstan, Macedonia, Moldova, Morocco, Nigeria, Pakistan, Philippines, Russia, Romania, Ukraine, Uzbekistan

TOTAL ACCEPTED ARTICLES: 306

The Number of Accepted Papers from Türkiye: 145
The Number of Accepted Full Papers from Other Countries: 161
The Number of Total Papers:306

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13 th INTERNATIONAL CONFERENCE ON
AGRICULTURE, ANIMAL SCIENCE AND RURAL DEVELOPMENT

November 28-29, 2023

Uşak, Türkiye

SYMPOSIUM SCHEDULE

ISPEC

13. INTERNATIONAL CONFERENCE ON AGRICULTURE, ANIMAL SCIENCE & RURAL DEVELOPMENT

November 28-29, 2023 / Uşak, Türkiye



CONFERENCE PROGRAM

Online & In-person

PARTICIPATING COUNTRIES

Türkiye, Algeria, Azerbaijan, Egypt, Ethiopia, Finland, Indonesia, India, Iran, Italy, Kazakhstan, Kyrgyzstan, Macedonia, Moldova, Morocco, Nigeria, Pakistan, Philippines, Russia, Romania, Ukraine, Uzbekistan

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IMPORTANT

- To be able to make a meeting online, login via https://zoom.us/join site, enter ID instead of "Meeting ID or Personal link Name" and solidify the session.
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- The Zoom application is free and no need to create an account.
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- The application works on tablets, phones and PCs.
- Speakers must be connected to the session 15 minutes before the presentation time.
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- During the session, your camera should be turned on at least %70 of session period
- Moderator is responsible for the presentation and scientific discussion (question-answer) section of the session.

TECHNICAL INFORMATION

- Make sure your computer has a microphone and is working.
- You should be able to use screen sharing feature in Zoom.
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Before you login to Zoom indicate hall number and your surname (Hall-1, MELDA)

ÖNEMLİ

- Kongremizde Yazım Kurallarına uygun gönderilmiş ve bilim kurulundan geçen bildiriler için online (video konferans sistemi üzerinden) sunum imkanı sağlanmıştır.
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- Sunum yapacakların sunum saatinden 15 dk önce oturuma bağlanmış olmaları gerekmektedir.
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- Oturumdaki sunumlardan ve bilimsel tartışmalardan (soru-cevap) oturum başkanları sorumludur.
- Sunumlar için 15 dakika (soru ve cevaplar dahil) süre ayrılmıştır.

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- Bilgisayarınızda çalışır durumda mikrofon bulunmalıdır.
- Zoom'da ekran paylaşma özelliği kullanılabilmelidir.
- Katılım belgeleri kongre sonunda tarafınıza pdf olarak gönderilecektir.
- Kongre programında yer ve saat değişikliği gibi talepler dikkate alınmayacaktır.

Zoom'a girişte sırayla salon numarasını ve soyadınızı yazınız (Salon-1, MELDA)

Opening Speech

Date: 28.11.2023
Ankara Time: 10.00-12.00

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Dean of The Faculty of Agriculture

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28.11.2023

TUESDAY / 13.30-15.30

Uşak University, Recep Tayyip Erdoğan Congress and Culture Center

Hall 1

MODERATOR: Prof. Dr. Nuray ŞAHINLER

AUTHOR	AFFILITION	ABSTRACT TITLE
Nuray Şahinler	*Uşak University*	Bee Product Composition and Use of Areas
Nuray Şahinler	*Uşak University*	Effect of Heating and Storage on Honey Quality Criteria
Nuray Şahinler Serkan Alakuş Beyza Çetin	*Uşak University*	Astrategic Product; Bee Venom and its Use in Apitherapy
Nuray Şahinler Hülya Gülbaş Elmali Raziye Özdin Büşra Uyar Nazlı Kayhan	*Uşak University*	Effects of Storage Period, Heating Temperature and Heating Duration on The Quality of Honey in Different Honey Types Produced in The Aegean Region.
Zeynep Nur Karakuş Gülşah Çalişkan Koç Yasemin Çelebi	*Uşak University*	Chokeberry: Nutrition Values and Potential Health Effects
Esra Bilici Salih Sezer	*Uşak University*	The Role of The S-Ribosylhomocysteine (Luxs) Gene in The Histophilus Somni Bacteria
Şeref Hamarat	*Padok Livestock and Agricultural Products Ltd.*	Cows, Artificial Meat and Global Warming
Erten Akbel Mustafa Kara	*Uşak University*	Extraction of *Silybum marianum* (L.) Gaertner (Milk Thistle)

28.11.2023
TUESDAY / 13.30-15.30

Uşak University, Recep Tayyip Erdoğan Congress and Culture Center
Hall 2
MODERATOR: Assist. Prof. Dr. Sibel ALAPALA

AUTHOR	AFFILITION	ABSTRACT TITLE
Sibel Alapala Engin Kuldur	*Uşak University*	Sheep Breeding and Eşme Sheep in Uşak Province in Our Country
Sibel Alapala Engin Kuldur	*Uşak University*	Latest Situation of Pastures in Our Country and The Use of The Pastures By Sheep and Goats
Sibel Alapala Ömer Büyükyozgat	*Uşak University*	Breeding Studies in Cattle Breeding and Biotechnological Applications For Reproduction
Ömer Büyükyozgat Sibel Alapala	*Uşak University*	Simmental Cattle Breeding in Turkey and Its Importance in Meat Industry
Abidin Kemeç Ayşenur Altinay	*Uşak University*	Evaluating Urban Gardening Through Sustainable Development Goals From A Smart City Perspective
Ayşenur Altinay Abidin Kemeç	*Uşak University*	Examining The Role of Agricultural Activities in Rural Development From The Perspective of Sustainable Development Goals
Yasemin Sunucu Karafakıoğlu	*Uşak University*	A General Overview of Saffron
Betül Yücel Yeter Çilesiz	*Sivas University of Science and Technology*	Effect of Cooking Characteristics on Vitamin Content in Legumes
Hale Yıldız Yeter Çilesiz	*Sivas University of Science and Technology*	Evaluation of *Melissa officinalis* L. Plant in Terms of Antioxidant Properties

28.11.2023
TUESDAY / 13.30-15.30

Uşak University, Recep Tayyip Erdoğan Congress and Culture Center
Hall 3
MODERATOR: Prof. Dr. Sezai ERCİŞLİ

AUTHOR	AFFILITION	ABSTRACT TITLE
Osman Yüksel Bekir Saka	*Uşak University*	Determination of Feed Values of Some Field Crop Wastes Used As Roughage Source
Burcu Begüm Kenanoğlu Havva Dinler Derya Maral Gül Rengin Eltem Cennet Büşra Aydın	*Uşak University*	Effect of Biopriming and Hidropriming Treatments on Tomato Seed Viability
Burcu Begüm Kenanoğlu Özlem Özmutlu Nazife Şakin	*Uşak University*	Effect of Allelochemicals on Germination and Emergence Quality of Dill and Celery Seeds
Müge Şahin Salih Gökkür Deniz Aksoy	*Aegean Agricultural Research Institute*	Preliminary Study on Determining The Self-Fertility Status of Some Japanese Plum Variety Candidates
Erdi Can Aytar Yasemin Özdener Kömpe	*Uşak University*	Seed and Protocorm Morphology of Serapias orientalis, and Aminoacid Analysis of Aeroear Parts
Alper Durmaz Erdi Can Aytar	*Uşak University*	The Use of Halophytic Plants in Saline Agricultural Areas and Their İmpact on Bioremediation in Such Environments.
Namuk Ergün Ismail Sayim Sinan Aydoğan Melih Bilir Gülden Çetin Özkan Emre Karahan	*Directorate of Field Crops Central Research Institute*	Grain Yield and Stability of Feed Barley (*Hordeum vulgare* L.) Genotypes Under Dry Conditions of Central Anatolia
Alper Durmaz Erdi Can Aytar	*Artvin Çoruh University*	Aristolochia bodamae Plant's Antioxidant Activity and Bioactive Compound Content

28.11.2023

TUESDAY / 16.00-18.00

Uşak University, Recep Tayyip Erdoğan Congress and Culture Center

Hall 1

MODERATOR: Assist. Prof. Dr. Rahime CENGİZ

AUTHOR	AFFILITION	ABSTRACT TITLE
Kübra Özmen Kazım Mavi	*Hatay Mustafa Kemal University*	The Use of Nanomaterials in Vegetable Seed Treatments As An Innovative Approach in Sustainable Agriculture
Kübra Özmen Fulya Uzunoğlu Kazım Mavi	*Hatay Mustafa Kemal University*	Effects of Different Seed Treatments on Emergence Characteristics and Seedling Quality in *Solanum aethiopicum*
Hasibe Yildiz Ayşe Vildan Pepe Fatma Yildirim Bekir Şan	*Uşak University*	The Effect of Bap and Ga3 on in Vitro Seed Germination of White-Fleshed and Red-Fleshed Pitaya (*Hylocereus* spp.) Species
Zehra Yıldız Zakire Yücel Elanur Dursun Rahime Cengiz	*Sakarya Uygulamalı Bilimler University*	Determination of The Effect of Source Material on The Success of Obtaining Haploid in The in Vivo Maternal Haploid Technique
Müjgan Güney Servet Aras Murat Güney	*Yozgat Bozok University*	Potential of Jojoba in Agriculture: Addressing Cultivation Challenges and Turkey's Prospects
Müjgan Güney Gökçe Aydoner Çoban Hakan Keles	*Yozgat Bozok University*	Phytochemical Composition, Medicinal Properties, and Molecular Advances in Caper Bush
Hasibe Yildiz Kerem Mertoğlu	*Uşak University*	Evaluation Of Fruit Characteristics Together
Ilknur Eskimez Mehmet Polat	*Isparta Uygulamalı Bilimler University*	Volatile Oils in Ornamental Bulbous Plants and The Relationship Between Scent and Aesthetics
Ilknur Eskimez Mehmet Polat Abdullah Kankaya Kerem Mertoğlu	*Isparta Uygulamalı Bilimler University*	Adaptation of Stanley Plum Variety To The Ecological Conditions of Isparta

28.11.2023

TUESDAY / 16.00-18.00

Uşak University, Recep Tayyip Erdoğan Congress and Culture Center

Hall 2

MODERATOR: Assoc. Prof. Dr. Mehmet ÖTEN

AUTHOR	AFFILITION	ABSTRACT TITLE
Murat Güney Servet Aras Müjgan Güney	*Yozgat Bozok University*	Almond Genome Sequencing – Past, Present, And Future
Murat Güney Hakan Keles Gökçe Aydoner Çoban	*Yozgat Bozok University*	Transcriptome and Genomic Analysis of Apple (*Malus* × *domestica*)
Servet Aras Müjgan Güney Gökçe Aydoner Çoban	*Yozgat Bozok University*	Use of Nitric Oxide in Horticulture
Servet Aras Müjgan Güney Hakan Keles	*Yozgat Bozok University*	Effects of Flood Stress on Fruit Species
Hossein Kazemı Mehmet Uğur Yıldırım Tuba Arjumend Mohammad Hadi Fatemi	*Uşak University*	A Framework for Assessment of biological Nitrogen Fixation (BNF) Services by Rhizobium in Agroecosystems (BNF-MEA Framework)
Ferzat Turan Gamze Nida Güneş Zeynep Duran Bilal Karakaya	*Sakarya Uygulamalı Bilimler University*	Effect Of Liquid Organic Fertilizer Used in Different Developmental Periods on Yield and Yield Parameters of Sunflower (*Helianthus annuus* L.)
Mehmet Öten Mertcan Koç Alperen Gümüş	*Sakarya Uygulamalı Bilimler University*	The Effects of Different Mixture Ratios Of Common Vetch + Triticale Grown in Sakarya Ecological Conditions on Green Forage Yield and Silage Quality
Mehmet Öten Melike Köse	*Sakarya Uygulamalı Bilimler University*	Determination The Effects of Different Additives Added To Vetch-Triticale Silage Mixture on Silage Quality
Abdulrezzak Memon	*Uşak University*	Role of Small GTP-Binding Proteins in Root Nodule Formation in The Model Legume *Medicago truncatula*
Enes Irat Merve Yeke Nuriye Merakli Abdulrezzak Memon	*Uşak University*	Evaluation of the potential use of duckweed for cleaning up leather industry wastewater pollution

28.11.2023
TUESDAY / 16.00-18.00

Uşak University, Recep Tayyip Erdoğan Congress and Culture Center
Hall 3
MODERATOR: Assoc. Prof. Dr. Melekber SÜLÜŞOĞLU DURUL

AUTHOR	AFFILITION	ABSTRACT TITLE
Ebru Akyüz Çağdaş Okan Sarıtoprak Mehmet Polat	*Has Biotech Research Development Agriculture Industry and Trade A.Ş*	Effects of Plant Growth Regulators And Nutrient Medium on The Micropropagation of Garnem Rootstock
Gökçe Aydöner Çoban Müjgan Güney Murat Güney	*Yozgat Bozok University*	Currently Soilless Culture Systems in Vegetable Production
Gökçe Aydöner Çoban Servet Aras Hakan Keles	*Yozgat Bozok University*	The Effects of Lime Stress in Vegetables
Birsen Zeybek Zeliha Gökbayrak	*Tekirdağ Viticulture Research Institute*	Effects Of Plant Growth Regulators On Pollen Germination And Pollen Tube Development In Plum And Pears
Şehnaz Mertoğlu Cansu Karaca Gürsel Karaca	*Isparta Uygulamalı Bilimler University*	Use of Fungi in Sustainable Product Design
Melekber Sülüşoğlu Durul Mehmet Polat Hülya Ünver	*Kocaeli University*	The Importance of Mahaleb Cherry And Research on it
Birsen Geçioğlu Erincik	*Aydın Adnan Menderes University*	Importance of Vegetative Compatibility Groups of Cryphonectria Parasitica in Biological Control of Chestnut Blight
Nuriye Merakli Hüseyin Altundağ Abdulrezzak Memon	*Uşak University*	Chromium Tolerance, Bioaccumulation, and Localization in Different Varieties of *Brassica juncea*

28.11.2023
TUESDAY / 16.00-18.00

Uşak University, Recep Tayyip Erdoğan Congress and Culture Center
Hall 4
MODERATOR: Assoc. Prof. Dr. Ayşen Melda ÇOLAK

AUTHOR	AFFILITION	ABSTRACT TITLE
Fatma Alan Ayşen Melda Çolak	*Uşak University*	Pitaya (*Hylocereus* spp.) Importance of in Human Health
Fatma Alan Ayşen Melda Çolak	*Uşak University*	Pitaya (*Hylocereus* spp.) Flower Structure and Fertilization Biology
Kerem Mertoğlu	*Uşak University*	Aminoacids Variation According To Different Plant Organs in Cherry Cv. Starks Gold
Derya Öğüt Yavuz	*Uşak University*	The Effectiveness of Herbicides Oxyfluorfen and Pendimethalin in Controlling Redroot Pigweed (*Amaranthus retroflexus* L.) and Lamb's Quarters (*Chenopodium album* L.)
Ali Osman Lökçü Derya Öğüt Yavuz	*Uşak University*	Effects of Some Herbicides on Weed Species in Different Phenological Periods of Wheat
Havva Dinler Ercüment Osman Sarihan Mehmet Uğur Yildirim	*Uşak University*	Determination of The Vapor and Contact Effects of Sage (*Salvia Officinalis* L.) Oil Against Some Soil-Borne Pathogens of Strawberry in Vitro Conditions
Havva Dinler Derya Maral Gül Rengin Eltem	*Uşak University*	Antagonistic Effect of *Bacillus* Species Against *Fusarium* Wilt in Strawberry in Vitro Conditions
Kerem Mertoğlu	*Uşak University*	Hormone and Organic Acid Changes According To Different Plant Organs: An Example Of Cherry Cv. 0900 Ziraat
Ayşen Melda Çolak	*Uşak University*	Quince Wood Cuttings in Different Environments Rooting
Abdurrahman Özbek Aycan Özdemir Asuman Arslan Duru	*Uşak University*	The Effect of Urea Supplementation on Nutrient Contents and Some Fermentation Characteristics of Sugar Beet Leaves Silages
Sezai Ercişli	*Atatturk University*	Evaluation Of Fruit Genetic Resources
Sezai Ercişli	*Atatturk University*	Some Important Wild Edible Fruit Species Found In Flora Of Turkiye

28.11.2023

TUESDAY / 10.00-12.00

Zoom Meeting ID: 871 0713 9228
Zoom Passcode: 282923

SESSION-1, HALL-1 / OTURUM-1, SALON-1

MODERATOR: Assoc. Prof. Dr. Bahar ATEŞ ÇAKIR

AUTHOR	AFFILITION	ABSTRACT TITLE
Cengiz Türkay Filiz Baysal Cenap Yilmaz	*Alata Horticultural Research Institute*	Breeding of Sari Ulak Olive Variety By Selection
Tahir Karaşahin	*Aksaray University*	Effect of Thyroid Hormones on Reproduction in Farm Animals
Tahir Karaşahin	*Aksaray University*	Poultry Availability and Evaluation of Turkey By Years
Aybike Bayraktar Ismet Boz	*Ondokuz Mayıs University*	Participation of Women in Household Decision-Making and Factors İnfluencing Their Choices: A Case Study Of Rural Communities in Samsun Province
Sedat Behrem Sabri Gül	*Aksaray University*	Some Environmental Factors Affecting The Medullated and Non-Medullated Fiber Diameter Characteristics in Central Anatolian Merino Sheep
Roza Yerezhepkyzy Aruzhan Zholmakhan Ayazhan Ibragim	*Kazakh National University*	Legal Support of Economic Methods of Environmental Law and Order Management in The Republic of Kazakhstan
T. I. Süleymanov S. I. Jafarova	*Baku City*	The Future of Marine Fuels in Azerbaijan: Aligning with IMO Climate Actions Through the Deployment of LNG, LPG, and Hydrogen
Maliha Gohar	*Kohat University of Science and Technology*	Classification of Second Order Ordinary Differential Equations Using Lambda Symmetries
Yusuf, Aisha Bilyaminu	*Hassan Usman Katsina Polytechnic*	Incidence of Diabetes Mellitus in Patients (25 Years Above) At Genegal Hospital Katsina State, Nigeria From January to June 2020
Iftikhar Yasin	*The University of Lahore*	Assessing Sustainable Growth: ICT and Natural Resource Rent Impact on Environmental Eminence in BRICS Nations

28.11.2023

TUESDAY / 10.00-12.00

Zoom Meeting ID: 871 0713 9228
Zoom Passcode: 282923
SESSION-1, HALL-2 / OTURUM-1, SALON-2

MODERATOR: Asocc. Prof. Dr. Şefik Baran TARHAN

AUTHOR	AFFILITION	ABSTRACT TITLE
Aysun Altikat	*Iğdır University*	Advancements in Green Advanced Oxidation Processes
Erdal Zengin	*The Ministry of Agriculture and Forestry, Provincial Directory of Uşak*	A New Pest in Maize For Uşak (Türkiye): Spodoptera frugiperda (J. E. Smith, 1797) (Lepidoptera: Noctuidae)
Ruziye Karaman Cengiz Türkay	*Isparta University of Applied Sciences*	Determination of Changes in Sweet Corn Applied Different Nitrogen Doses During Storage
Funda Dökmen	*Kocaeli University*	Use of Polymers in Water Conservation in Agriculture
S. Can Cengiz Mustafa Okant M. Izzet Türkoğlu	*Harran University*	Determination of The Effect of Different Plant Density on Some Yield Values in Gap Pink Fodder Nut (*Pisum arvense* L.) Cultivar Improved As A Winter Intercrop
Pooja Rasal Gaurav Kasar	*JES's SND College of Pharmacy*	A Review on Models Used in Assessment of Neuropathic Pain
R.Thanya Suganthan C	*Vellore Institute of Technology*	Analysing The Effectiveness of Using Multimodal Tools and Materials in English Language Classroom: A Systematic Review
Nataliia Korbych Oksana Liubenko Olena Vedmedenko Sergiy Lavrenko	*Kherson State Agrarian and Economic University*	Productive Qualities of The Different Breeds Geese For The Direction of The Fatty Goose Liver Production
Olena Vedmedenko Nataliia Korbych Oksana Liubenko	*Kherson State Agrarian and Economic University*	Prospects of Native Mare's Milk Production Under The Conditions of Ukraine
Sergiy Lavrenko Maria Rizak Nataliia Lavrenko	*Kherson State Agrarian and Economic University*	Vegetable Pepper As A Technical Culture

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TUESDAY / 10.00-12.00

Zoom Meeting ID: 871 0713 9228
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SESSION-1, HALL-3 / OTURUM-1, SALON-3

MODERATOR: Fatma KAYAÇETİN

AUTHOR	AFFILITION	ABSTRACT TITLE
Ersin Gülsoy Seda Can Başoğlu	*Iğdır University*	Pre-Selection of Rose Hip (*Rosa* spp.) Genotypes Growing Naturally in Iğdir
Fatma Kayaçetin	*Ankara University*	Correlation Among Germination And Seedling Growth Of Brassica Nigra L. Under Priming Applications
Fatma Kayaçetin Oğuzhan Aydin	*Ankara University*	Yield And Quality Of Black Mustard Lines Under Autumn Sowing Season In Ankara
Elif Yürümez Canpolat Şükrü Canpolat Cemil İşlek	*Niğde Ömer Halisdemir University*	The Biological Activities of *Hypericum Perforatum* L.
Bahadır Yilmaz Sedanur Yilmaz Aslıhan Çilingir Tütüncü Harun Özer	*Ondokuz Mayıs University*	Mikrobiyal Gübre Uygulamasinin Organik Maydanoz Yetiştiriciliğinde Verim ve Kaliteye Etkisi
Oksana Liubenko Nataliia Korbych	*Kherson State Agrarian and Economic University*	Importance of Iodine and Selenium in Poultry Feeding
Sergiy Lavrenko Andriy Serbinov	*Kherson State Agrarian and Economic University*	Technological Aspects of Growing Tomatoes With Drip Irrigation
Sergiy Lavrenko Yaroslav Smirnov	*Kherson State Agrarian and Economic University*	Prospects For Growing Soybeans in Ukraine
Sergiy Lavrenko Andriy Maksimov Nataliia Lavrenko	*Kherson State Agrarian and Economic University*	Cultivation of Plants in Vertical Farms By Hydroponic Method
Gusthyta Putri Nabila Naila Tamamil Asna Hendri Hermawan Adinugraha	*UIN K.H. Abdurrahman Wahid Pekalongan*	The Use of Paylatter in Describing Business According To Islamic View

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Zoom Meeting ID: 871 0713 9228
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SESSION-1, HALL-4 / OTURUM-1, SALON-4

MODERATOR: Research Assistant Dr. Berker NACAK

AUTHOR	AFFILITION	ABSTRACT TITLE
Mehmet Altun Ustun Sahin	*Atatürk University*	Determination of CO_2 Emission From Soils With Sewage Sludge Application Under Different Irrigation Regimes Through Carbon Stock Changes
Hayriye Göknur Ağca Küçükaydin Göksel Tirpanci Sivri Ömer Öksüz	*Kırklareli University*	A New Approach To Sustainable Food Supply: Cellular Agriculture
Gülay Olcabey Ergin	*Niğde Ömer Halisdemir University*	An Eco-Friendly Approach To Control Insect Pests : Nanopesticides
Songül Yildiz Muharrem Özcan	*Recep Tayyip Erdoğan University*	Effects of Global Warming on Tea Farming
Özkan Sedat Karaman Fatma Karakaş Oğuz Ruziye Karaman	*Burdur Mehmet Akif Ersoy University*	Investigation of Alternative Forage and Silage Potential of Mung Bean
H.U. Muhammad E. Nwafor O.J. Ajayi Y. Muhammed	*Federal University of Technology*	Effects of Recommended Cocoyam Production Technologies on Output of Farmers in Enugu State, Nigeria
Valbona Cinaj	*Albanian University*	The Challenges of Implementing an e-Government ALBANIA System The case of the publication of sensitive data for Albanian citizens
Wajahat Ali Shakeel Javaid Mohammad Nabeel	*Albanian University*	A New Fermatean Fuzzy Programming Approach To Optimize The Mathematical Muti-Objective Multi-Level Solid Transportation Problem
Arunkumar R V. Kalirajan	*Tamil Nadu Agricultural University*	Turmeric Farmers and Their Extension Agency Contact Level in Tamil Nadu
Pankaj Tagad	*Kolpe Institute of Pharmacy*	An In-vitro evaluation of the anthelmintic activity of Aegle Marmelos on the Pheritima Posthuma model

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SESSION-1, HALL-5 / OTURUM-1, SALON-5

MODERATOR: Assoc. Prof. Dr. Erol SAKALLI

AUTHOR	AFFILITION	ABSTRACT TITLE
Şule Erkovan Hanife Afacan	*Eskişehir Osmangazi University*	Adaptation of some so rghum Genotypes To Eskisehir Ecological Condition
Hasan Basri Karayel	*Kütahya Dumlupınar University*	The Effect of Natural Boron Mineral Use on Essential Oil Content and Components of Fennel (*Foeniculum vulgare* Mill.)
Ertan Yildirim Melek Ekinci Metin Turan Selda Ors	*Atatürk University*	Mitigating Effect of Chrysin on Salt Stress in Cucumber (*Cucumis sativus* L.) Seedling
Melek Ekinci Ertan Yildirim Metin Turan Selda Ors	*Atatürk University*	Investigation of The Effects of Humic and Fulvic Acid on Plant Growth in Cauliflower Seedlings Grown in Herbicide-Contaminated Soil
Abdoul Nasser Aboubacar Dan Badaou Üstün Şahin	*Atatürk University*	Determination of CO2 Emission from Soil with Farm Manure Application under Different Irrigation Regimes through Carbon Stock Changes
Laila AFIA Rachid SALGHI Abdelileh MABROUK	*Ibnou Zohr University*	Enhancement of Three Curcumin Derivatives As Ecofriendlies Corrosion Inhibitors For Carbon Steel in Hcl Solution
Laila AFIA Rachid SALGHI	*Ibnou Zohr University*	Valuation of Argan Leaves Extract As Green Corrosion İnhibitor For Steel in 1m Hcl
Dipanwita Ghosh	*Maulana Abul Kalam Azad University of Technology*	Machine Learning for Early Glaucoma Detection: A Comparative Analysis of Predictive Models
V.Sandhiya R.Devi Raman R.Srinivasan	*Bharath Institute Of Higher Education And Research*	Recycling Waste Polythene Materials To Useful Products Via Pyrolysis.
Puniparthi Sunitha Elavarasi.E	*Bharath institute of higher education and research*	Human Prohibits of *Bacillus* Strains: Characterization, Safety, Microbiome, And Probiotic Carrier

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SESSION-2, HALL-1 / OTURUM-2, SALON-1

MODERATOR: Dr. Hüseyin Berk TÜRKER

AUTHOR	AFFILITION	ABSTRACT TITLE
Sefa Altikat	*Iğdır University*	Industrial Pellet Fuel Production: Conversion From Raw Materials To Energy
Elif Yürümez Canpolat Şükrü Canpolat	*Niğde Ömer Halisdemir University*	Antifungal Activity of Zinc Oxide (Zno) Nanoparticles
Gamze Kaya	*The Ministry of Agriculture and Forestry, Provincial Directory of Eskişehir*	The Effect of Different Periods of Waterlogging on Morphological and Some Physiological Characteristics of Melon
Eren Özden	*Iğdır University*	Determination of Some Morphological and Physiological Characteristics of Iğdır Şalak Melon
Eren Özden Mustafa Akbaba	*Iğdır University*	Determination of Some Morphological, Viability and Physiological Characteristics of Iğdır Super Tomato Local Genotype Seeds
Fatima Rehman Shamsa Rana Ahmed Faiz Akbar	*Government College University*	Effect of nitric oxide and hydrogen peroxide on growth, physiological and biochemical attributes of wheat (Triticum aestivum L.) plant under cadmium stress
I .Zakariya'u	*Sokoto state university*	Electrical and Optical Properties of Poly Methyl Methacrylate Incorporated With Salt For Edlc Application
Pooja.K Elavarasi.E	*Bharath Institute Of Higher Education And Research*	Agriculture and Food security in the agricultural production
Ajesh Chauhan	*IITM College of Pharmacy*	Role Of Ai in Pharma

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SESSION-2, HALL-2 / OTURUM-2, SALON-2

MODERATOR: Prof. Dr. Deniz UÇAR

AUTHOR	AFFILITION	ABSTRACT TITLE
Sema Leblebici Murat Karaer Erdem Gülümser	*Bilecik Şeyh Edebali University*	Allelopatic Effect of Forage Turnip (Brassica rapa L.) on Buckwheat (*Fagopyrum esculentum* Moench)
Yunus Emre Uslu Serap Açıkgöz	*Aydın Adnan Menderes University*	Effect of Suppression of Mechanical Transmission in Plant Viruses
Murat Olgun Muhammed Ibrahim Sayim	*Eskişehir Osmangazi University*	Assessment of Yield and Quality Traits of Advanced Barley (*Hordeum vulgare* L.) Breeding Materials in The Rainfed Conditions of The Central Anatolia Region
Sarra Zouaoui Rachid Rouabhi	*Bioactive Molecules and Applications Laboratory*	Imidacloprid's Impact on Neurotoxicity: Illuminating The Consequences of Pesticides on Biodiversity and Health
R. Srilatha Podila Padmaja	*P.V.P. Siddhartha Institute of Technology*	Voice Emotion and Gender Recognition
Anita Yasin	*Universiti Teknologi MARA*	Prevalence of Overweight in Culinary Arts Students of Vocational College A
Sushovan Khatua Debashis De	*Maulana Abul Kalam Azad University of Technology*	Optimizing Traffic Routing For Minimized Emissions in Vehicular Networks
Kannadasan Karuppaiah Ezhilvanan Mani Vinoth Raman	*Melmaruvathur Adhiparasakthi Institute of Medical Sciences and Research*	Statistical Models For Evaluate To Efficacy of Chronic Kidney Disease Control Measure

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SESSION-2, HALL-3 / OTURUM-2, SALON-3

MODERATOR: Assist. Prof. Dr. Tuba ARJUMEND

AUTHOR	AFFILITION	ABSTRACT TITLE
Berna Efe Sabahaddin Ünal Hacer Mintaş Erdal Eren Yeler	*Field Crops Central Research Institute*	Observation on Morphological and Agronomic Traits of Sheep Fescue Genotypes (Festuca ovina) in Semi-Arid Conditions
Havva Eylem Polat Ahmet Cengiz Yildirim	*Ankara University*	The Role of Geographical Indication Products in Rural Development: The Case of Kalecik District
Zeynep Nur Karakuş Yasemin Çelebi Gülşah Çalişkan Koç	*Uşak University*	Pharmacological Effects of Mullberry Leaves on Human Health
Canan Kop Bozbay Miraç Mert Yildirim Nuri Can Karaoğlu Büşra Özdöngül	*Eskisehir Osmangazi University*	Growth Performance, Digestive System Development, Relative Meat And Organ Weights, Meat Quality And Some Blood Characteristics In Japanese Quails (Coturnix Coturnix Japonica) Fed Diets Containing Goldenseal (*Helichrysum Arenarium*) Essential Oil
Bahadır Yilmaz Sedanur Yilmaz Aslıhan Çilingir Tütüncü Harun Özer	*Ondokuz Mayıs University*	Effect of Microbial Fertilizer Application on Efficiency and Quality in Organic Parsley Growing
Gita Oktavia Rosita Muhammad Usman Ariffianto Kholimah Agung Muhammad Taufiq Abadi	*State Islamic University K.H. Abdurrahman*	History of Classical Economic Thought
Elda Purwanti Khulaelatudil Azzah Lutfiyanti	*State Islamic University K.H*	Economic Thought of Classical Muslim Scientists (Zaid Bin Ali, Abu Hanifah, Abu Yusuf,Abu Ubaid)
Ihor Ponomarenko Daria Pelypenko	*State University of Trade and Economics*	Marketing Promotion of Rural Companies in The Digital Environment
Ihor Ponomarenko Sofiia Freidun	*State University of Trade and Economics*	Functioning of Rural Companies in The Electronic Trade Market
Idoko Alexander Parker Joshua Elija Njoku Obioma Uzoma	*Caritas University*	Docking Assessment of Flavonoids on Adiponectin Protein and Fat Mass and Obesity Associated (FTO) Protein as Anti-Obesity Agents: An İn-Silico Investigation

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Zoom Meeting ID: 871 0713 9228
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SESSION-2, HALL-4 / OTURUM-2, SALON-4

MODERATOR: Research Assistant Rabia GÜLİSTAN OKUTAN

AUTHOR	AFFILITION	ABSTRACT TITLE
Murat Karaer Erdem Gülümser Sema Leblebici	*Bilecik Şeyh Edebali University*	Relationship Between Bilecik Province Drought Analysis and Wheat Yield Using Standardized Precipitation Evapotranspiration Index
Özge Karadeniz Elif Demiral	*Kayseri University*	Determination of Physicochemical and Antioxidant Properties of Ice Cream With Coconut and Oat Milk
Selma Kösa Sibel Mansuroğlu Nihansu Karaçöne	*Akdeniz University*	Determination of The Effect of Two Different Growth Period on Plant Growth Characteristics in Silene Compacta
Lale Aksoy Esin Kılıç	*Eskişehir Osmangazi University*	Evaluation of Strawberry Production in Sason and its Effects on Local Development
Fatih Hancı	*Erciyes University*	An Outlook of The World Jerusalem Artichoke Market
Mustafa Çirka	*Iğdır University*	Defense Mechanisms of Plants Against Drought
Halid Sheriff Adegbusi	*Nigeria Police Academy Wudil*	Evaluation of Nutritional Quality of Nigerian Soybean (*Glycine Max*)
Halid Sheriff Adegbusi	*Nigeria Police Academy Wudil*	Improving Complementary Feeding in Nigeria: A Review of Crayfish's Nutritive and Health Values
Tutan Ghosh	*Maulana Abul Kalam Azad University of Technology*	Federated Learning-Based Intrusion Detection System For IOT
Lakshmi Devi.B.	*Bharath institute of higher education and research*	Long Non Coding Rnas (Lncrnas) in Neurodegenerative Diseases-Diagnosis and Therapeutics

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SESSION-2, HALL-5 / OTURUM-2, SALON-5

MODERATOR: Assoc. Prof. Dr. Mehmet Uğur YILDIRIM

AUTHOR	AFFILITION	ABSTRACT TITLE
Nebahat Aytuna Çerçi Meryem Burcu Külahci Betül Aydin Ebru Beyzi Abdülkadir Arslan Sevinç Demir	*Kırıkkale University*	Determination of The Biological Properties of *Aronia Melanocarpa* (Michx.) Elliott Fruit and Leaf Extracts
Sultan Karahan Azize Atik	*Çiftçiler Oil Industry and Trade LTD.*	Lupin Flour Uses in The Food Industry
Sevdiye Yorganci Serap Açikgöz	*Aydın Adnan Menderes University*	The Relationship Between Vector Transmission of Plant Viruses and Genome Organization
Canan Kop Bozbay Miraç Mert Yildirim Gökçe Bilge Ipek	*Eskisehir Osmangazi University*	Evaluation of Some Aromatic Plant Pulps As Silage
Batuhan Türkbay Safiye Pınar Tunali	*Aydın Adnan Menderes University*	Pulse Drip Irrigation Applications in Combating Drought
Ristina Siti Sundari Farhan Ahmad D Yadi Heryadi Budhi Wahyu Fitriadi Lucyana Trimo Iwan Setiawan	*University of Perjuangan Tasikmalaya*	Added Value of Coconut Sap to be Coconut Sugar
Clement Okechukwu Attamah Joy Chinenye Udenwagu	*University of Nigeria*	Assessment of Farmers' Access and Use of Agricultural Credit Facilities in Enugu West Senatorial Zone of Enugu State, Nigeria
El Houssaine Benaddi Rachid Laamari	*Analytical and molecular chemistry laboratory*	A New Biomass-Based Activated Carbon For The Removal of Cationic Dyes From The Aqueous Environments: Characterization, Kinetics, Isotherm, Thermodynamics
Wilson, Emmanuel Okon Idiong, Kokoette E	*Akwa Ibom State Polytechnic*	Electrochemical Potential-Based Diagnostics of Steel Rebar Corrosion in Concrete
Kaysa Aulia Venanda	*UIN K.H. Abdurrahman Wahid Pekalongan*	Potensi Perkembangan Perekonomian Kota Pemalang

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SESSION-3, HALL-1 / OTURUM-3, SALON-1

MODERATOR: Lecturer Volkan DENERİ

AUTHOR	AFFILITION	ABSTRACT TITLE
Sevim Atmaca Ali Endes Yusuf Yanar	*Yozgat Bozok University*	Important Soil-Borne Fungal Diseases That Cause Phytopathological Damage in Lentil Plants
Sevim Atmaca Ali Endes Yusuf Yanar	*Yozgat Bozok University*	Foliar Fungal Diseases That Cause Phytopathological Damage in Lentil Plants
Ali Endes Sevim Atmaca Güngör Yilmaz	*Yozgat Bozok University*	Significant Fungal Pathogens Impacting The Economic Viability of Hemp Cultivation
Ali Kilinç Rukiye Zengin Nurhan Keskin	*GAP International Agricultural Research Training Center*	Berry Quality Characteristics of Some Native Grape Varieties Of Sivrice (Elazığ) Ecology
Ali Kilinç Nurhan Keskin Birhan Kunter	*GAP International Agricultural Research Training Center*	Total Phenolic Compound Content and Antioxidant Activity of Some Grape Varieties Grown in Battalgazi (Malatya) Ecology At Maturity
Abdulkarim D. Kurfi Sada Ibrahim Kabir M. Galadanchi Muhammad M. Rumah	*Umaru Musa Yar'adua University Katsina*	Study of Mechanical Properties of Particle Filled Waste Bast Fiber and Epoxy Resin Composite
Malihe Jahani Sedighe Jahani	*Shandiz Institute of Higher Education*	A Review of The Role of Phenolic Compounds in Plants Under Environmental Stresses
Gbenga J. Olatunji, Funmilayo G. Adebiyi Olufemi A. Adebiyi Oyebiodun G. Longe	*University of Ibadan*	The effect of graded level of dietary supplementation of citric acid on performance and serum lipids of broiler chickens
Umaru Mohamed Gassama	*Njala University*	The Impact of Village Saving Loan Association on Small Holder Farmers in Taiama, Kori Chiefdom, Moyamba District
Umar Bello Ahmed Salisu Aliyu D. Mohammed	*Umaru Musa Yar'adua University*	Improvement of Mechanical Properties of Polymeric Wastes Composites Using Charcoal Produced From Doum Palm (*Hyphane Thebaica* L.) Fruit As Reinforcement

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SESSION-3, HALL-2 / OTURUM-3, SALON-2

MODERATOR: Assist. Prof. Dr. Tuba ARJUMEND

AUTHOR	AFFILITION	ABSTRACT TITLE
Gülden Çetin Özkan Meryem Sağkol Hümeyra Yaman Ersin Akşor Oğuzhan Aydin	*Directorate of Field Crops Central Research Institute*	Production of Haploid Plants From Hybrid Combinations of Different Safflower (*Carthamus Tinctorius* L.) Genotypes By Anther Culture Method
Gülden Çetin Özkan Yusuf Coşkun Kutay Yilmaz Hümeyra Yaman	*Directorate of Field Crops Central Research Institute*	Using of Speed Breeding Technique To Develop New Flax (*Linum Usitatissimum* L.) Genotypes
Ali Endes Sevim Atmaca	*Yozgat Bozok University*	Potential Threat on Chickpea Production Areas: Anthracnose (Ascochyta rabiei) Disease
Sibel Boysan Canal Hilal Yilmaz	*Van Yuzuncu Yil University*	Effect of Selenium Applications on Micro Element Content in Lupinus (*Lupinus Albus* L) and Soil Under Cadmium Stress Conditions
Hilal Yilmaz Sibel Boysan Canal	*Van Yuzuncu Yil University*	The Role of Iron in Drought Tolerance
Pratishtha Thakur Vinod Kumar	*Sushant University*	Nutrition & Dietetics
John Bamidele Isaac Adekunle Olufemi Ade Adegorite Solomon O. Olatunde Emmanuel S.	*College of Science*	Studies on the Performance of organic and Inorganic Fertilizer on the Growth and Yield of Cucumber (*Cucumis sativus*)
Orhena, Elizabeth Nguemo Charles-Odili, Veronica Nnamaka Ekwueme, Chika Maureen Ezoem, Uche Blessing	*Federal College of Education*	Perception of Business Education Students on Effectiveness of Siwes Administration in Federal Colleges of Education in The South-South
Besnik Hajdari	*University "Isa Boletini" Mitrovica*	The Impact of Human Resource Management on The Development of Innovative Businesses

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SESSION-3, HALL-3 / OTURUM-3, SALON-3

MODERATOR: Research Assistant Erdi Can AYTAR

AUTHOR	AFFILITION	ABSTRACT TITLE
Ismail Demir	*Kırşehir Ahi Evran University*	Rısks and Trends in World Sugar Beet Farmıng
Ismail Demir	*Kırşehir Ahi Evran University*	Changes and Trends in World Potatoes Agrıculture
Hatice Ulusoy Hüseyin Peker	*Artvin Çoruh University*	Use of Various Natural Oils in Wood Material Protection and Their Effects of Wood Materials on Some Mechanical Properties
Hatice Ulusoy Hüseyin Peker	*Artvin Çoruh University*	Use of Immortal Plant Extract in Wood Material and Its Effects on Thermogravimetric Analysis (Tga)
Şeyda Yayla M. Mesud Hürkul	*Ankara University*	Light Microscopy Analysis of Some Important Anatomical Characters of Paronychia Angorensis
Şeyda Yayla M. Mesud Hürkul	*Ankara University*	Examınatıon Of Some Anatomıcal Features of Endemıc Lycıum Anatolıcum (Solanaceae)
Al -Musbahu Abdulrahim Abdulyekeen Tunde Adebisi Jamiu Garba Sikirulai Abolaji Akande	*Kkyungpook National University*	Optimizing Crop Selection and Allocation for Maximum Yield: A QUBO Approach
Saghouri El Idrissi Imane Kettani Rajae Khalfi Chemsdoha Ferrahi Moha El Fechtali Mohamed Ziri Rabea Brhadda Najiba	*National Institute of Agronomic Research (INRA)*	Effect of Environment and Genotype on Durum Wheat : Responses of Genotypes, Yield, and Quality Parameters
Ajagbe, S.W. Yekinni, L.O., Babatunde, S.I. Bakare, M.T. "	*Federal College of Education*	Attitude, Motivation and Academic Performance of High Achieving Junior Secondary School Students in Social Studies in Oyo East Local Government, Nigeria

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SESSION-3, HALL-4 / OTURUM-3, SALON-4

MODERATOR: Assistant. Prof. Dr. Hülya ELMALI GÜLBAŞ

AUTHOR	AFFILITION	ABSTRACT TITLE
Buğra Güvercin Faruk Akyazi	*Ordu University*	Fauna of Plant Parasitic Nematodes in World Hazelnut Soils
Hakan Keles Murat Güney Gökçe Aydöner Çoban	*Yozgat Bozok University*	Summary of Walnut Cultivation in Yozgat 2018-2023
Hakan Keles Servet Aras Müjgan Güney	*Yozgat Bozok University*	Growing Potential of Jujube (*Ziziphus Jujuba* Mill.) Plant Under Yozgat Conditions
Fatma Akyüz Selçuk Gülten	*Uşak University*	Agricultural (Food) Supply Security in An Environment of Increasing Global Risk
Serhat Yıldız	*Van Yüzüncü Yıl University*	Alternative Forage Plant in Animal Nutrition; Teff (Eragrostis tef [Zucc.] Trotter)
Hülya Elmali Gülbaş	*Uşak University*	The Potential Chemosensor Fluorescent Compounds in order to Determination Of Heavy Metals contamination in Agricultural Irrigation Water
Yekinni, L.O., Kareem, K. K., Abdulrahmon, M. O., Bakare, A. O.	*Federal College of Education*	Effectiveness of Modelling on The Verbal and Arithmetic Skills of Children With Intellectual Disability in Akure South Local Govenrment of Ondo State, Nigeria
Aicha El Oualkadi Ahmed Lamarti Mohammed Mouhib Ahlam Hamim	*Nuclear Technique and Quality Research Unit*	Gamma Irradiation Effects on Fortuna Strawberry Cultivar: A Comprehensive Study of Growth, Morphology, and Genetic Implications
Nugraha Edhi Suyatma Rani Yunia Putri Fahim Muchammad Taqi Subarna	*IPB University*	Application of Nanocoating Made From Chitosan and Zno Nanoparticles To Extend The Shelf Life of Meatball
Ukpabi-Ugo, Jacinta Chigozie Anosike, Chioma Assumpta	*Michael Okpara University of Agriculture*	GCMS Profiling and In Silico Investigation of Bioactive Compounds of Hexane Extract of Sesamum Indicum Seeds to identify fertility agent: Potent Inhibitors of Angiotensin Converting Enzymes and Phosphodiesterase 1A Receptors
Pratishtha Thakur Vinod Kumar	*Sushant University*	Diabetes Mellitus: Pandemic in India

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Zoom Meeting ID: 871 0713 9228
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SESSION-3, HALL-5 / OTURUM-3, SALON-5

MODERATOR: Assist. Prof. Dr. Barış KAKİ

AUTHOR	AFFILITION	ABSTRACT TITLE
Mehmet Nur Çiftsüren Suna Akkol	*Van Yüzüncü Yıl University*	Determination of The Relationship Between Egg Production in Geese and Some Climate Factors
Mehmet Nur Çiftsüren Suna Akkol	*Van Yüzüncü Yıl University*	Determination of Relationships Between Live Weight and Some Morphological Characteristics in Norduz Sheep Using Path Analysis
Nizamettin Erbaş	*Yozgat Bozok University*	Investigation of Investments in Fixed Capital in Terms of General and Rural Employment: Yozgat Province Example
Barış Kaki	*Uşak University*	Examının The Effects of Some Clımate Characterıstıcs on Honey Productıon
Ilhan Özer Ilhan Senem Akkoç Nilgün Baysal	*Erciyes University*	The Effectiveness Of Herbal Extracts In The Fight Against Mastitis Disease And Cancer In Cattle
Suwantoko Ridhotul Hairi Ganung Nalendra Marthinus Hutabarat Thania Theresia Pangaribuan Erwin Tampubolon Satria Gumay Ilham Hapmi Yoga Putra	*University of Bengkulu*	"The Authority, Duties, and Functions of The National Human Rights Commission (Komnas HAM) in Upholding Human Rights in Indonesian"
Adeniyi B.M Kyenge B.A Adah C.A Ogungbemi K Samoh T.F	*Benue State University*	Toxicological Effects of *Heliotropium Indicum* Leaf Extracts on Albino Rat Tissues
Hilmi Dzaki Uswatun Khasanah Hilda Safitri M Farhan Ahnaf Muhammad Aris Syafi'i M. E. I	*State Islamic University K.H. Abdurrahman*	Economic Thought of Contemporary Muslim Scientists
Sanae Zriouel	*CADI AYYAD University*	Magnetic Nanoparticles for Biomedical applications
Katarina Stanojević Dragana Pavlović Jelena Matejić Aleksandra Milenković Ljiljana Stanojević	*University of Niš*	Waste Material of Wild Carrot (*Daucus carota* L.) Seeds As A Source of Natural Antiinflammatory Agents

29.11.2023

WEDNESDAY / 10.00-12.00

Zoom Meeting ID: 871 0713 9228
Zoom Passcode: 282923
SESSION-1, HALL-1 / OTURUM-1, SALON-1

MODERATOR: Assist. Prof. Dr. Erten AKBEL

AUTHOR	AFFILITION	ABSTRACT TITLE
Osman Nezih Kenanoğlu Sevdan Yilmaz Mustafa Karga Soner Bilen	*Kastamonu University*	Safe Dose Range That Can Be Used in Nettle and Green Olive Tree Ethanolic Extracts in Artemia Enrichment
Nihan Akinci Kenanoğlu Şefika Nur Demir Sinem Öztürk Ahmet Ali Berber	*Çanakkale Onsekiz Mart University*	The Examination of The Eco-Genotoxic Effects of Pesticides on Daphnia Magna
Muhammet Ali Gündeşli	*Gaziantep University*	Essential Oil Extraction Methods: A Review
Muhammet Ali Gündeşli	*Gaziantep University*	The Phytochemical Composition of *Matricaria* L. (Chamomile): A Review
Hülya Ünver	*Düzce University*	Fruit culture in duzce province
Şakir Burak Bükücü Yakup Kadir Kömür	*Selcuk University*	Current Status of Greenhouse Fruit Growing in Türkiye
Onur Özbaş Kevser Tosun Duygu Arslan Hakan Aktaş	*Isparta Uygulamalı Bilimler University*	Effects of Old Gold Crimson (Ogc), Old Gold (Og), Hp1 And Hp2 Genes on Fruit Quality in Beef Segment Tomatoes
Aleksandra Milenković Katarina Stanojević Dragana Pavlović Jelena Matejić Jelena Stanojević Ljiljana Stanojević	*University of Niš*	Anti-inflammatory Activity of Wild Carrot (*Daucus Carota* L.) Seed Hydrolate
Iliya Ibrahim Sanda, B.Yahaya Isyaku, N.T Joseph, E.Kamba	*Kebbi State University of Science and Technology Aliero*	Studies On Some Heavy Metals and Using of Some Selected Phyco-Chemical Parameter in Zuru Dam, Kebbi Staste, Nigeria.
Ahmad Mohammad Zuru Abdullahi Abdu Muhammad Chika Mu'azu Musa Shuaibu Ishaka Muhammad	*The American University of Beirut*	Optimization of Biogas Production and Compression From Co-Digestion of Animal Dungs

29.11.2023

WEDNESDAY / 10.00-12.00

Zoom Meeting ID: 871 0713 9228
Zoom Passcode: 282923

SESSION-1, HALL-2 / OTURUM-1, SALON-2

MODERATOR: Dr. Müge ŞAHİN

AUTHOR	AFFILITION	ABSTRACT TITLE
Iliya Ibrahim. Obaroh I.O. Isyaku, N.T.	*Kebbi State University of Science and Technology*	Assessment of Omega -3 Fatty Acid on Blood Pressure of Some Group of Students in Kebbi State University of Science and Technology, Aleiro
Chaima Mouffouk Soumia Mouffouk Hamada Haba Leila Hambaba	*University Of Batna-2*	Anti-inflammatory, antioxidant and antibacterial effects of the medicinal plant Scabiosa stellata L.
Olawale Oyemade Oyekanmi Olusoga Rasheed Otelaja	*School of Arts and Social Sciences*	Effects of Two Models Instructional Strategies on Students' Knowledge of Climate Change Concepts in Social Studies For Sustainable Development
Hafsah A. Klfout Abdullah M. Asiri Khalid A. Alamry Mahmoud A. Hussein	*King Abdulaziz University*	Synthesis of a new Polybenzoxazine-based Arylidene Moiety
Aboubakr Ben Hamou Salaheddine Farsad Ayoub Chaoui Amane Jada El Alem Noureddine	*Ibn Zohr University*	Nitric Acid Activation for Tuning the Pore Structure of Sewage Sludge Digestate Biochar Adsorbent: Implications on Methylene Blue Adsorption
Alexandrov V.S	*Kazan National Research Technical University*	Analysis of The Soil Composition of The Substance and Improvement of its Quality Using New Data Processing Approaches
Smart M.O Ibironke O.H Okumodi B.O Adeoye A.S Opawuyi M.M	*Federal College of Forestry*	Risk Assessment of Heavy Metals Concentration in Well Waters Around Metal Recycling Industries of Ikorodu South West Nigeria
Jothi Lakshmi R. Srinivasan	*Bharath Institute of Higher Education and Research*	An Over Review of Pharmacological Aspects of Diabetes Mellitus of Indian Medicinal Plants
Muninggar Nafisah Asnal Muna Shafiyya Zahra Wiwit Anisa Muhammad Sultan Mubarok Ade Gunawan	*State Islamic University K.H Abdurrahman*	Maisir in The Digital Age: An Analysis Of The Phenomenon Of Cryptocurrentcy Gambling And Its Implications
V.Sandhiya , R.Devi Raman R.Srinivasan,	*Bharath Institute Of Higher Education And Research*	Recycling Waste Polythene Materials To Useful Products Via Pyrolysis.

29.11.2023

WEDNESDAY / 10.00-12.00

Zoom Meeting ID: 871 0713 9228
Zoom Passcode: 282923
SESSION-1, HALL-3 / OTURUM-1, SALON-3

MODERATOR: Assist. Prof. Dr. Pelin BARAN

AUTHOR	AFFILITION	ABSTRACT TITLE
Sheila Ojei Michael	*Admiralty University of Nigeria*	Iron deficiency anaemia in pregnancy: reexamining the nature and magnitude of this public heath concern
P. Sivaraj, K.S.Naveen C. M. Raguraman	*Annamalai University*	Implementation and testing of a solar declinatorwith water preheating
K.R.Padma K.R.Don	*Bharath University*	Wild Edible Mushrooms and Their Bioactive Compound Production Possess Antibacterial Activity
Kaila Zulfa Khoirurrizki Zakia Khoirunnisa Putri Karina Sabila M. Aris Safii M. Taufiq Abadi	*State Islamic University K.H. Abdurrahman*	Islamic Macro Concepts: Tw0 Sector Economy
Intan Athiyatul Maula Dian Nofitasari Karina Atha Nabila Muhammad Sultan Mubarok, M.E	*Fakultas Ekonomi Bisnis Dan Islam Uin K.H Abdurrahman Wahid*	The Role of Zakat in Islamic Economic Axiology
Syeda Sabika Zahra Naqvi Syed Mohsan Raza Shah	*University of Education*	Morpho-Anatomical modification in with aniaso mnifera (L.) Dunal from punjab, Pakistan: Insight into adaptation
Mita Lusari	*UIN K.H. Abdurrahman Wahid Pekalongan*	Stabilitas Perekonomian di Desa Mulyorejo
Kheloufi Abdenour Mansouri Lahouaria Mounia	*University of Batna*	Effect of Varied Temperatures on Seed Germination and Seedling Emergence in Cherimoya (Annona cherimola Mill.)
Iram Liaqat	*Govt. College University*	AI-2 QS signalling and inhibition in dental unit water line biofilm isolates

29.11.2023

WEDNESDAY / 10.00-12.00

Zoom Meeting ID: 871 0713 9228
Zoom Passcode: 282923
SESSION-1, HALL-4 / OTURUM-1, SALON-4

MODERATOR: **Prof. Dr. Abdulrezzak MEMON**

AUTHOR	AFFILITION	ABSTRACT TITLE
Adeel Sattar Najam-Ul-Lail Muhammad Ovais Omer Mian Abdul Hafeez Muhammad Abubakr Shabbir Sammina Mahmood Muhammad Adil Rasheed Qamar Niaz	*University of Veterinary and Animal Sciences*	Biosynthesis and Characterization of Zinc oxide Nanoparticles using *Nigella sativa* against Coccidiosis in Commercial Poultry
Matej Babič	*Novo Meto*	3d Visibility Network Using For Analyzing Complexity of Microstructure of Robot Laser Hardened Specimens
R. Robert S. Meenakshi	*Vellore Institute of Technology*	An In-Depth Analysis of Multifarious Determinants Impacting English Speaking Proficiency Attainment among Rural Students in India
Chhaya Patel	*Sankalchand Patel University*	Impact of Fiscal Policy on India's Economic Growth
Vaibhav Kant Singh Kapil Kumar Nagwanshi	*Central University*	Proposing the State of the Art Data Mining Methodologies for performing Energy Audit and Management
Vaibhav Kant Singh Kapil Kumar Nagwanshi	*Central University*	Proposing the State of the Art methodologies for Conservation of Energies
Vaibhav Kant Singh Kapil Kumar Nagwanshi	*Central University*	Proposing the State of the Art Machine Learning Algorithms for the Notion of Clean and Sustainable Energy
Amina Ghaffar Sammina Mahmood Adeel Sattar	*University of Education*	Effect of Bacillus Cereus on Growth of Tomato (*Solanum Lycopersicum* L.) Irrigated With Textile Waste Water
Mubashir Mehdi	*MNS University of Agriculture Multan*	E-commerce and Consumer Buying Behavior for Agricultural products in developing countries: A case of Pakistan.
Talha Mashhood Muhammad Ibrahim Akbar Ali	*Government College University Faisalabad*	Potential anticancer and antioxidant lauric acid based hydrazones synthesis and computational slant towards the electronic properties

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WEDNESDAY / 10.00-12.00

Zoom Meeting ID: 871 0713 9228
Zoom Passcode: 282923

SESSION-1, HALL-5 / OTURUM-1, SALON-5

MODERATOR: Dr. Hüseyin Berk TÜRKER

AUTHOR	AFFILITION	ABSTRACT TITLE
Thanh-Dung Nguyen Huu-Nghia Duong Thi-Pha Nguyen Huu-Hiep Nguyen Huu-Thanh Nguyen	*Can Tho University*	Antibacterial Activities of Endophytic Bacteria Isolated From Adenosma Bracteosum Bonati Against Vibrio Parahaemolyticus
Angga Candra Winata Minkhatul Maula Ridwan Abu Djibran Aris Syafi'i	*State Islamic University K.H. Abdurrahman*	Economic Thought of Indonesian Muslim Scientists (Cokroaminoto, Syfrudin Prawiranegara, Moh. Hatta, H. Abdul Malik Karim Amrullah)
Laila Ameliya Muhammad Taufiq Abadi Muhammad Sultan Mubarok	*State Islamic University KH. Abdurrahmad*	Feasibility Study Analysis of Puring Fabric in Pakisputih Village Kedungwuni Subdistrict
Habil. Cristina Raluca Gh. Popescu	*Romania and The Bucharest University of Economic Studies*	Applying The Principles of Green Economy: Focusing on Circular Economy and Sustainable Development
Habil. Cristina Raluca Gh. Popescu Gheorghe N. Popescu	*Romania and The Bucharest University of Economic Studies*	Agriculture, Rural Development, and Land Reform: Recent Advances and Contributions To Environmental Sustainability
Nailun Naja Annayya Putri Sabilla Najwa Azima Muhammad Sultan Mubarok Ade Gunawan	*State Islamic University K.H Abdurrahman*	Human Nature, Ethics of Freedom and Socio-Economic Responsibility
Shinta Dewi Fitri Mukarromah	*Uin Kh Abdurrahman Wahid Pekalongan Indonesia*	Analysis of The Benefits of Purwaceng As A Medicinal Plant
Vidya Padmakumar	*Bangalore University*	Ecological Factors Shaping the Evolution and Behavior of Spoonbills: Insights for Conservation and Management
Ajayi, Olayemi T. Adeniji, Adebukola T.	*The Federal Polytechnic*	Lens and Culinary Brilliance: A Visual Journey into Food Photography's Influence on Gastronomy and Dietetics

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WEDNESDAY / 12.30-14.30

Zoom Meeting ID: 871 0713 9228
Zoom Passcode: 282923

SESSION-2, HALL-1 / OTURUM-2, SALON-1

MODERATOR: Assist. Prof. Dr. Erten AKBEL

AUTHOR	AFFILITION	ABSTRACT TITLE
Fargham Ahmed Kashish Nadeem	*COMSATS University*	Joint Family System
Angel Sara Thangamuni Naga Harika Korrapati Hiba Fathimathul Harshiba Joysha Mohan Adiba Farhin Nitol Nabeel Muhammed Rafi	*Tbilisi State Medical University*	Beauty From Within: An Interplay Between Gut and Skin Health
Wafika Erininda Givan Mauzarima Fortuna Hendri Hermawan Adinugraha	*UIN K.H. Abdurrahman Wahid Pekalongan,*	Islamic Economics: Broadening Horizons Justice and Humanity
Sholadoye Qazeem Oyeniyi	*Nigeria Police Academy*	Heavy Metals Assessment of Farmland Soil in Bagega Mining Community
Stogova Mariia Gennadievna Kopylova Maria Dmitrievna	*The Kosygin State University of Russia*	Analysing The Range of School Uniforms For Overweight Primary School Children
Omar Benamari Amina Labhar Amin Salhi Mhamed Ahari Soufian El Barkany Hassan Amhamdi	*Abdelmalek Essaadi University*	Medicinal Plants Utilized in Conventional Diabetes Treatment in Rif Issaguen District, Northern Morocco.
Sobia Maqsood Saira Akhtar Sabrina Carvalho Zeyneb Kılıç	*University of Agriculture*	Women Role in Sustainable Rural Development in Pakistan: A Systematic Review
Vaishnavi G.Sapte Sushma V.Datir Archana R. Jagtap, Abhale D.M Vivekanand Kashid	*GSS's Dr. Kolpe Institute of Pharmacy*	Formulation and Evaluation of Antimicrobial cream from tribulas terrestris ethanolic extract
Zahra Rezapour	*Islamic Azad University*	Microplastics in Aquatic Food: A Hidden Threat to Human Health
Septya Wulan Savitri Lu'luil Karomah Suci Fitria Safira Faula Arima Muhammad Sultan Mubarok	*State Islamic University K.H. Abdurrahman Wahid*	The Importance of Understandıng Maqashıd Sharıa As The Maın Goal of Islamıc Law

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WEDNESDAY / 12.30-14.30

Zoom Meeting ID: 871 0713 9228
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SESSION-2, HALL-2 / OTURUM-2, SALON-2

MODERATOR: Assoc. Prof. Dr. Bahar ATEŞ ÇAKIR

AUTHOR	AFFILITION	ABSTRACT TITLE
Deven S. Aspalani Samiksha B. Bachkar Abhishek M. Aher Sujata K. Sonawane Kuldipak R. Parkhe Vivekanand A. Kashid	*GSS's Dr. Kolpe Institute of Pharmacy*	Analytical Method Development and Validation of Thiazolidenediones Derivative by RP-HPLC
Anuja V. Pathade Kalyani P. Parkhe Nilesh T. Parkhe Varun V. Joshi Vivekanand A. Kashid	*GSS's Dr. Kolpe Institute of Pharmacy*	Review on: Neurocosmetics: The Skin-Brain Connection
Meshal Nasser Alnefaıe	*King Abdulaziz University*	"Harnessing Dextrin Derivatives for Targeted Drug Delivery with Nanofibers"
Aarti R. Sanap Prajakta A. Halnor Ratna D. Nikum Vivekananda A. Kashid	*GSS's Dr. Kolpe Institute of Pharmacy*	A Review on Mouth Dissolving Tablet
Shivam Rajput Rishabha Malviya Chetan Vashist Manju Kamra	*IITM College of Pharmacy*	The Application of Herbal Extract-Loaded Nano-formulations for Pest Control in Agriculture: A Review
Ahmed K. Usman Saidat O. Abdulrasheed Yusuf A. Hassan Echeche Onuh Yahaya Aliyu	*Ahmadu Bello University*	A Review of Economic Importance and Viability of Gold: A Case Study of Ilesha Schist Belt, Southwestern Nigeria
Mousami Das Binod Chandra Tripathy Omer Kisi	*Tripura University*	Characterization of Lacunary -Convergent Sequences in Credibility Space
Salek Lagdali Youssef Miyah Mohamed El-Habacha Guellaa Mahmoudy Mohammed Benjelloun Soulaiman Iaich Mohamed Zerbet Mohamed Chiban Fouad Sinan	*Ibnou Zohr University*	Optimal Preparation of Low-cost Phongitic Clay Microfiltration (MF) Membrane for Real-wastewater Treatment from Clothes Washing
Tamanna Rai Rishabha Malviya	*United College of Engineering and Research*	Anticancer Agent from Marine Source
Abdelileh Mabrouk Laila Afia	*University of Sfax*	Application of Pid Control in Greenhouse Temperature Regulation For Crop Growth Optimization

29.11.2023

WEDNESDAY / 12.30-14.30

Zoom Meeting ID: 871 0713 9228
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SESSION-2, HALL-3 / OTURUM-2, SALON-3

MODERATOR: Assoc. Prof. Dr. Yaser AÇIKBAŞ

AUTHOR	AFFILITION	ABSTRACT TITLE
Hammouti Marwane El Haım Mohamed	*Abdelmalek Essaâdi University*	Anticipating Risk Mapping for Land Movements in Morocco's Middle Rif Region
Firas Alali Marwa Jawad Asaad Sh.	*University of Kerbala*	Identification of Passalurus Ambiguus in Domestic Rabbits (Oryctolagus cuniculus) in Karbala Province, Iraq.
Clement Okechukwu Attamah Jane Mbolle Chah	*University of Nigeria*	Impact of Rural Finance Institution Building Programme on Socio-Economic Life of Beneficiaries in Anambra State, Nigeria
Ajayi, Olayemi T. Busari, Waheed B.	*Lead City University*	Media Literacy and Agricultural Sustainability: Empowering Rural Communities through Communication Education
Sujata Sonawane	*savitribai phule Pune University*	Development of Validated Rp-Hplc Method For Quantitative Estimation of Pioglitazone Hcl in Bulk And Formulation By Using Quality By Design Approach
Luis Angel Kalpana Nanjareddy Miguel Lara Flores Manoj-Kumar Arthikala	*Luis Angel ENES Unidad-León, Universidad Nacional Autónoma de México*	Unveiling The Impact of Mad41 Overexpression on Mycorrhizal Symbiosis in Common Bean
Lakshmi Devi.B	*Bharath institute of higher education and research*	Long Non Coding Rnas (Lncrnas) in Neurodegenerative Diseases-Diagnosis and Therapeutics
A.Lourdu Terancia	*Bharath Institute of Higher Education and Research*	Micrornas – Biogenesis,Mechanism of Action and Role in Breast Cancer – Overview
Rama Andika Madya Agus Setiawan Dian Iswandaru Yulia Rahma Fitriana	*University of Lampung*	Bird Diversity and Feed Guild in The Way Kambas National Park Buffer Zone (Case Study of Labuhan Ratu Vii Village)
Sulaiman S.Y. Hafsat M.	*Umaru Musa Yar'adua University*	Biosorption of Ni2+ and Pb2+ from waste water using doum palm nut shell activated carbon

29.11.2023

WEDNESDAY / 12.30-14.30

Zoom Meeting ID: 871 0713 9228
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SESSION-2, HALL-4 / OTURUM-2, SALON-4

MODERATOR: Asocc. Prof. Dr. Şefik Baran TARHAN

AUTHOR	AFFILITION	ABSTRACT TITLE
Siddhantika S. Jadhav Madhuri E.Kawade, Sakshi P. Deore, Snehal S. Kasar, Dipak D. Nalawade, Vivekanand A. Kashid	*GSS's Dr. Kolpe Institute of Pharmacy*	Review on: To study the Pharmacognostic and Pharmacological Activities of *Datura Stramonium* Linn
Vaishnavi D. Charmal Mayuri B. Gaikwad Vaibhav U. Lasure Vivekanand A. Kashid	*GSS's Dr. Kolpe Institute of Pharmacy*	Review on: Pharmacological Activity of *Selaginella Bryopteris* L.
Sundy Alagba Obazi Chiamaka Eucharia Ubachukwu Samuel Esheya Esheya	*University of Nigeria*	Knowledge of Farmers on Pesticide Safety Practices in Nsukka Local Government Area, Enugu State, Nigeria
Madhumithasekar Elavarasi E, R Srinivasan	*Bharath institute of higher education and research selaiyur*	The Future of Agriculture: Unleashing the potential of Digital Technologies
Abhijit Chatterjee Pintu Das Sanjeev Kumar Sinha	*Sarala Birla University*	Groundwater Quality Assessment in Rural Area of Ranchi: A Case Study
J.Jayadurka Elavarasi E, R Srinivasan	*bharath institute of higher education and research chennai*	New Agriculture Technology in Modern Farming - A Review
Snehal Kolpe	*Savitribai phule pune University*	Formulation and Evaluation of Anti Ageing Cream Using *Tinospora Cordifolia* (Giloy)
Nur Kholifah Dewi Nurul Alfianah Nabila Maydina Ma Farotul Jannah Muhammad Sultan Mubarok Muhammad Shulthoni	*State Islamic University K.H Abdurrahman*	Islamic Economic Principles and Their Implementation in Everyday Life
Malihe Jahani Sedighe Jahani	*Shandiz Institute of Higher Education*	A Review of The Importance of Hydroponic Cultivation in Plants
Muhammad Tahir Khan Madeeha Shahzad Lodhi Dong Qing Wei	*The University of Lahore*	Novel mutations in LdtB, PonA1, and PonA2 in pyrazinamide resistance clinical isolates of Mycobacterium tuberculosis

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WEDNESDAY / 12.30-14.30

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SESSION-2, HALL-5 / OTURUM-2, SALON-5

MODERATOR: İlknur ESKİMEZ

AUTHOR	AFFILITION	ABSTRACT TITLE
Samreen Gul Khan Naheed Akhtar Fozia Anjum Kiran Aftab	*GC University*	Synthesis and Antiseizure Potential of 1,3,4-Oxadiazole Based Derivatives
Beraich Abdessamad Anass Choukoud El Farissi Hammadi El Bachiri Ali Talhaoui Abdelmoneam	*Mohammed First University*	Comparison of the volatile compounds of essential oil extracted from Pistacia Lentiscus stems via hydrodistillation, and microwave and their effects on its antioxidant, and antifungal activity
Salisu Nuhu	*Hussaini Adamu Federal Polytechnic Kazaure*	Optimization of Quicklime Production from Eggshells Using Response Surface Methodology
Tayebi Amani Moumou Mohammedine Harnafi Hicham	*Mohammed Premier University*	Determination of Total Phenolic, Total Flavonoid Content, and Antioxidant Activity in Basil Extracts (*Ocimum basilicum* L).
Andrey Popatanasov	*Bulgarian Academy of Sciences*	Effects of hormopriming with cytokinins on the germination of Solanum lycopersicum cv. Ideal
Akande, Sikirulai Abolaji Ishaq, Maimuna Abdullahi Ishaq, Zainab Abdulrahim, Al-Musbahu Adedayo, Olufemi Adesola	*Federal University of Technology*	Exploring The Intuitive Impact of Optimization Techniques on The Control of Food Security and Agricultural Profit Margins
Kabiru Hamisu Abdullahi Taufeeq Lawal Ahmad Usman Shu'aib Zaharadeen Abdullahi Yusuf Hassan Ali	*Kano University of Science and Technology*	Structural Analysis of Wudil Cattle Market (Kara) Wudil Local Government of Kano State-Nigeria

SYMPOSIUM PHOTOS





SYMPOSIUM PHOTOS





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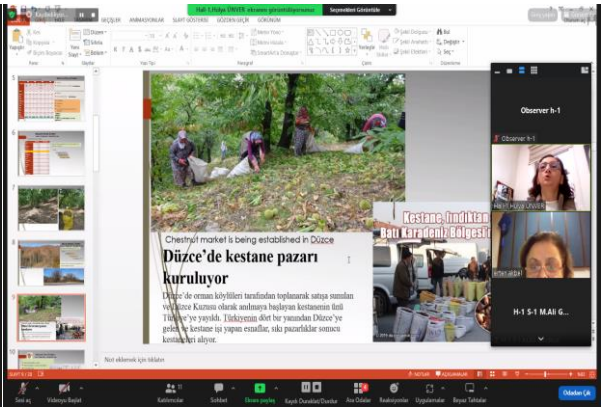




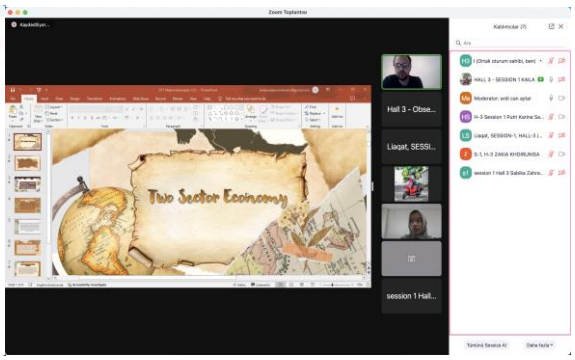


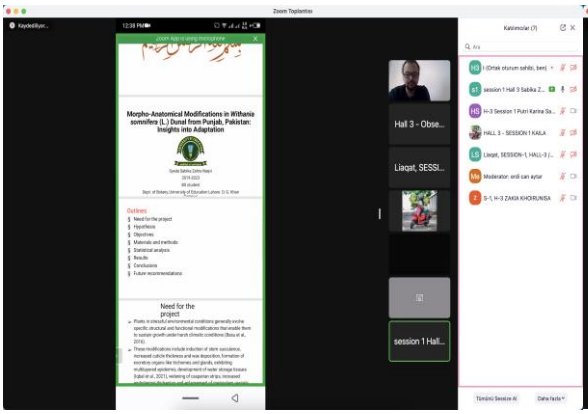
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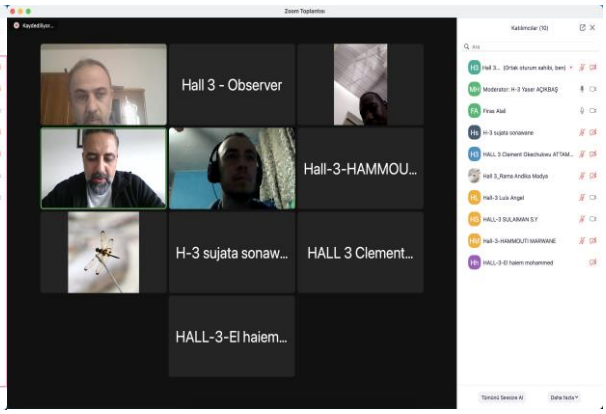




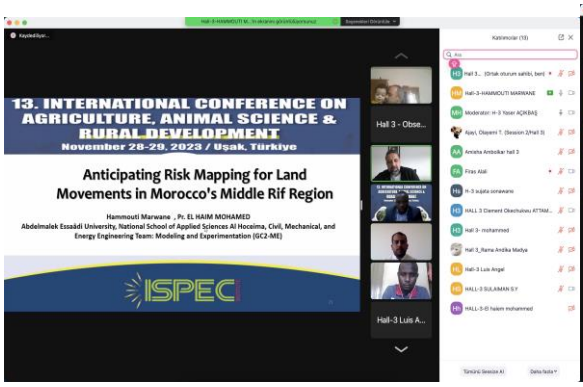


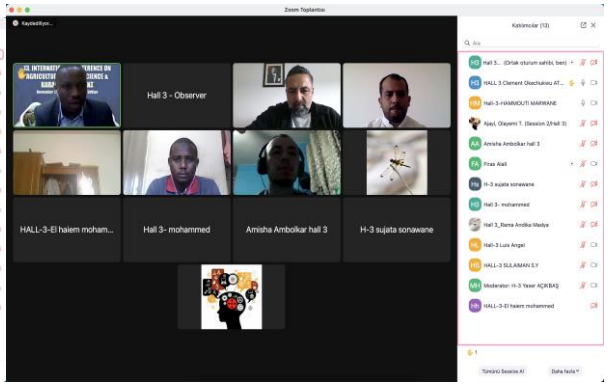


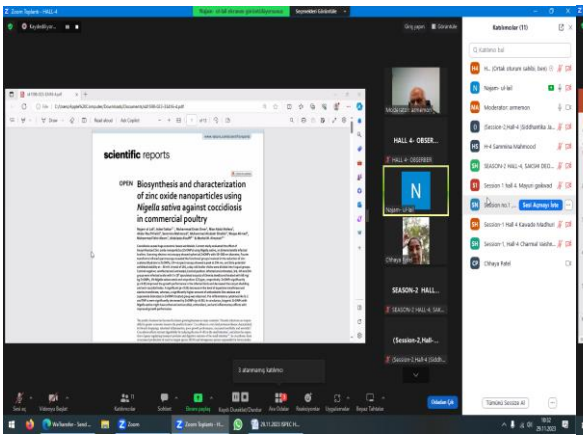


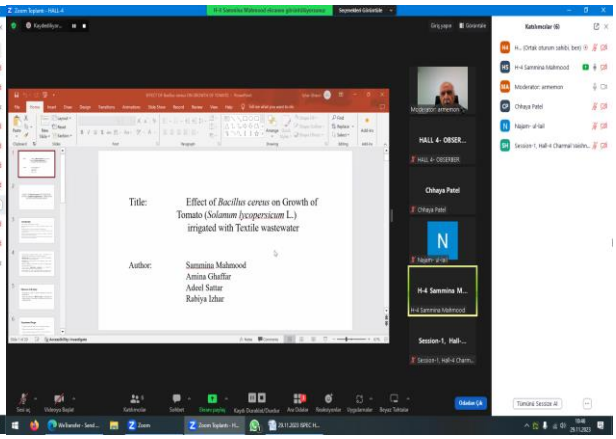


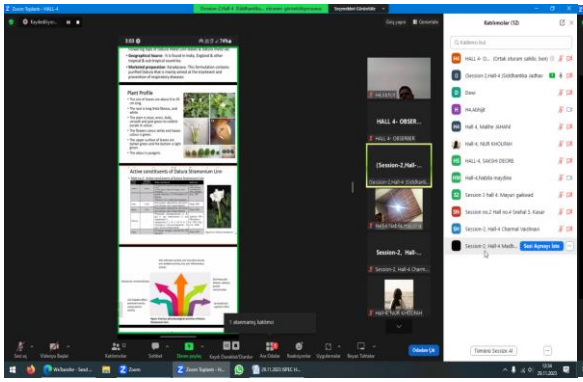
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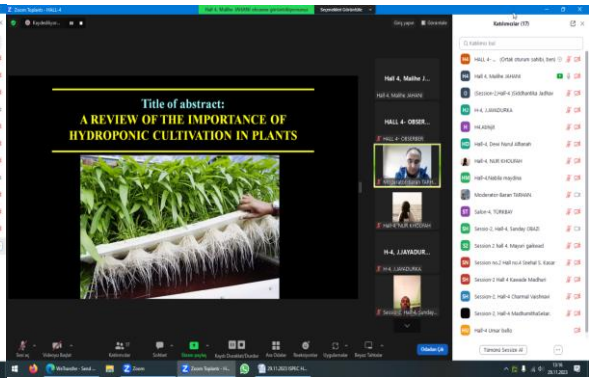




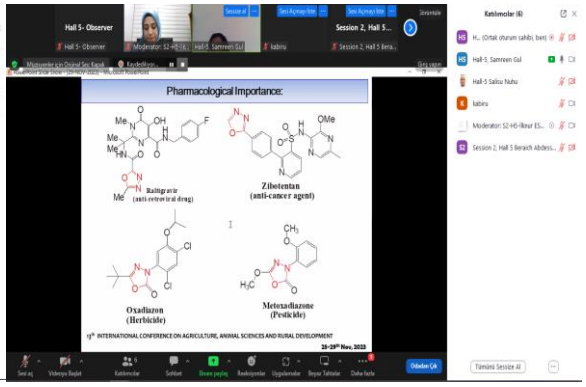












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ABSTRACT

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A NEW FERMATEAN FUZZY PROGRAMMING APPROACH TO OPTIMIZE THE MATHEMATICAL MUTI-OBJECTIVE MULTI-LEVEL SOLID TRANSPORTATION PROBLEM

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Özet
In this paper, we propose a novel approach to developing mathematical models for transportation problems by incorporating fermatean fuzzy parameters. We introduce the concept of the fermatean fuzzy score function to convert the traditional TP model into crisp form. Additionally, we present a new mathematical multi-objective multi-level uncertain solid transportation (MOMLUST) model, which extends the multi-objective multi-level solid transportation (MOMLST) model by incorporating uncertain parameters. We employ the expected value approach to convert the MOMLUST model into a deterministic form. Furthermore, introduce the multi-objective multi-level solid transportation with fermatean fuzzy parameter (MOMLSTPWFF) model, which combines the MOMLST model with the fermatean fuzzy score function. We can convert MOMLSTPWFF model into a deterministic form by utilizing the new score function. To facilitate the optimization process, we convert the fermatean fuzzy (total transportation cost, total transportation time, deterioration cost during transportation, availability and demand) into deterministic form. The main objective of our study is to optimize the multi-objective functions and its constraints, all of which are formulated with fermatean fuzzy numbers. By employing the fermatean fuzzy programming approach, we aim to find the optimal solutions for each objective function. Our proposed approach offers a comprehensive framework for addressing transportation problems, considering the uncertainty associated with fermatean fuzzy parameters. Through our models and optimization techniques, we aim to improve decision-making processes in transportation planning and management. Todays, transportation models and techniques contribute to air pollution and greenhouse gas emissions, leading to adverse environmental effects, but sustainable transportation options and policies can mitigate these impacts and promote a cleaner, healthier environment.
Keywords: New fermatean fuzzy score function, multi-level multi-objective programming, solid transportation problem, fermatean fuzzy environment, fermatean fuzzy programming

ALTIN OTU (*Helichrysum arenarium*) UÇUCU YAĞI İÇEREN RASYONLARLA BESLENEN JAPON BILDIRCINLARINDA (COTURNIX COTURNIX JAPONICA) BÜYÜME PERFORMANSI, SİNDİRİM SİSTEMİ GELİŞİMİ, ORANSAL KARKAS PARÇA VE ORGAN AĞIRLIKLARI, ET KALİTESİ VE BAZI KAN PARAMETRELERİ

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Özet

Bu çalışma bıldırcın (Coturnix coturnix japonica) rasyonlarına farklı düzeylerde ilave edilen altın otu (*Helichrysum italicum)* uçucu yağının büyüme performansı, sindirim sistemi gelişimi, karkas özellikleri, et kalitesi ve bazı kan parametreleri üzerine olan etkilerinin belirlenmesi amacıyla yapılmıştır. Çalışmada günlük yaşta 400 adet bıldırcın civcivi 4 tekerrür halinde ve tekerrür başına 20 civciv olacak şekilde tesadüf parselleri deneme desenine göre 5 muamele grubuna ayrılarak bölmelerine yerleştirilmiştir. Bıldırcınların beslenmesinde civciv başlangıç (3000 kcal/kg ve %24 ham protein; 0-21. günler) ve büyütme (3100 kkal/kg ve %22 ham protein; 22-42. günler) rasyonları kullanılmıştır. Deneme planına göre gruplandırma Kontrol, A50, A100, A150 ve A200 şeklinde yapılmış ve grupların rasyonuna sırasıyla 0, 50 ppm, 100 ppm, 150 ppm ve 200 ppm altın otu uçucu yağı ilave edilmiştir. Deneme 42 gün sürmüştür. Rasyona altın otu uçucu yağ ilavesi yem tüketimini düşürmüştür ($P<0.05$). A150 ve A200 grubu hayvanlarında YYO Kontrol grubundan daha düşük bulunurken karkas randımanı daha yüksek bulunmuştur ($P<0.05$). Oransal karkas parça ağırlıklarından boyun A150 grubunda Kontrol ve A50 grubundan, pectoralis majör A200 ve A100 gruplarında Kontrol grubundan, tüm pectoralis A50, A100 ve A200 gruplarında Kontrol grubundan ve tibia kas A100 grubunda Kontrol ve A50 gruplarından daha yüksek bulunurken ($P<0.05$), kuyruk, pectoralis minör, but, femur, tibia, femur kas, but special ve kanat ağırlıkları muamelelerden etkilenmemiştir ($P>0.05$). Göğüs ve but eti STK, pH ve CIELab değerleri ile kan değerlerinde muameleler arasında farklılık bulunmamıştır ($P>0.05$). Toplam sindirim sistemi oransal ağırlık ve uzunluğu

muamelelerden etkilenmezken (P>0.05), metabolik organlardan pankreas A200 grubunda Kontrol ve A100 gruplarından, sindirim organlarından bezel mide ise A150 grubunda Kontrol ve A100 gruplarından daha yüksek bulunmuştur (P<0.05). Sonuç olarak bıldırcın rasyonlarına 200 ppm düzeyinde altın otu uçucu yağı ilavesinin et kalitesinde herhangi bir etki yaratmaksızın performans ve karkas özelliklerini iyileştirdiği görülmüştür.
Anahtar kelimeler: Uçucu yağ, Altın otu, bıldırcın

GROWTH PERFORMANCE, DIGESTIVE SYSTEM DEVELOPMENT, RELATIVE MEAT AND ORGAN WEIGHTS, MEAT QUALITY AND SOME BLOOD CHARACTERISTICS IN JAPANESE QUAILS (COTURNIX COTURNIX JAPONICA) FED DIETS CONTAINING GOLDENSEAL (*Helichrysum arenarium*) ESSENTIAL OIL

Abstract
This study was carried out to determine the effects of golden grass (*Helichrysum italicum*) essential oil added to quail (Coturnix coturnix japonica) diets at different levels on growth performance, digestive system development, carcass characteristics, meat quality, and some blood parameters. A total of 400 day-old quail chicks were allocated to five treatment groups according to a randomized experimental design with four replicates of 20 chicks each. Chick starter (3000 kcal/kg and 24% crude protein; days 0-21) and grower (3100 kcal/kg and 22% crude protein; days 22-42) diets were used to feed the quails. Five groups were formed as control, A50, A100, A150 and A200, and golden grass essential oil was added to the diets of these groups at levels of 0, 50 ppm, 100 ppm, 150 ppm, and 200 ppm, respectively, under the experimental plan. The experiment lasted for 42 days, during which it was observed that the addition of golden grass essential oil to the ration resulted in decreased feed intake ($P<0.05$). In the A150 and A200 group animals, while the FCR was lower than the control group, carcass yield was higher ($P<0.05$). Additionally, the total pectoralis weight was higher in the A50, A100, and A200 groups than in the control group, and tibia muscle weight was higher in the A100 group than both the control and A50 groups ($P<0.05$). The treatments had no effect on the tail, pectoralis minor, thigh, femur, tibia, femur muscle, thigh special, and wing weights ($P>0.05$). There were no significant differences found between treatments in terms of the WHC, pH, and CIELab values of the breast and thigh meat, as well as the blood values ($P>0.05$). The treatments did not have a significant effect on the relative weight and length of the total digestive system ($P>0.05$). However, the A200 group had a higher pancreas weight compared to the control and A100 groups, and the A150 group had a higher proventriculus weight compared to the control and A100 groups, which is a digestive organ ($P<0.05$). In conclusion, adding golden grass essential oil to quail diets at the 200 ppm level improved performance and carcass characteristics without affecting meat quality.
Keywords: Essential oil, Goldenseal, quail

THE ROLE OF THE S-RIBOSYLHOMOCYSTEINE (LuxS) GENE IN THE HISTOPHILUS SOMNI BACTERIA

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Abstract
Histophilus somni is a Gram-negative bacterium belonging to the Pasteurellaceae family that can cause various clinical syndromes predominantly in cattle but also in sheep (Agnes et al, 2013; Yatsentyuk et al, 2023). Histophilus lives in bovine mucosal membranes and is described as an opportunistic pathogen (Sandal et al, 2007; Angel, 2015; Pogoutse and Moraes, 2020). It can cause various diseases such as respiratory and reproductive diseases, myocarditis, polyarthritis, mastitis, eye diseases and sepsis (Pan et al, 2018). Additionally, H. somni forms a biofilm in systemic disease sites such as the lungs and myocardium (Sandal et al., 2009). Several bacterial species closely related to H. somni possess a luxS gene (Daines et al, 2005). Bacteria are known to release a wide variety of small molecules (Chen et al, 2002). They also produce and can respond to diffusible signal molecules (autoinducers or pheromones) (Chen et al, 2011). Cell-to-cell communication in bacteria has been reported to be achieved through the exchange of extracellular signaling molecules called autoinducers (Pereira et al, 2013). The autoinducer-2 (AI-2) group of signaling molecules is produced by both Gram-positive and Gram-negative bacteria as a byproduct of a metabolic transformation carried out by the LuxS enzyme (Bodor et al, 2008). This process is known as quorum sensing (QS), in which bacteria are allowed to coordinate gene expression (Waters and Bassler, 2005). It can act concertedly by coordinating gene expression of populations above a certain cell density through the production and perception of small diffusible signaling molecules called autoinducers, in a process termed quorum sensing (Sturme, 2002).
Keywords: BRDC, Histophilus Somni, LuxS Gene

Silybum marianum (L.) GAERTNER (DEVE DİKENİ) EKSTRAKSİYONU

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Özet
Bitkiler ve bitkilerden elde edilen ürünler insan yaşamının birçok bölümünde her zaman yer almaktadır. Bitkilerin ilaç olarak kullanımı yazılı insanlık tarihinde çok eskilere dayanır. Bitkiler âlemi, doğal ilaçlar için mükemmel bir kaynaktır ve son yıllarda şifalı bitkilerin değeri konusunda giderek artan bir ilgi vardır. *Silybum marianum* (L.) Gaertner (süt devedikeni) ve türevleri başta karaciğer hastalıkları olmak üzere birçok hastalığın tedavisinde kullanılmaktadır. Silymarin, devedikeni tohumlarından elde edilen, silybin, silydianin ve silychristin şeklinde üç flavonolignan izomerinden oluşan lipofilik en yüksek biyolojik aktiviteye sahip bir ekstrakttır. Devedikeni tohumları ayrıca az miktarda flavonoid (taksifolin) ve yaklaşık %20-35 oranında yağ asidi ve diğer polifenolik bileşikler içerir. Ekstraksiyon, uygun çözücü sistemler yardımı ile organik dokuların tıbbi açıdan aktif bileşenlerinin inaktif veya inert bileşenlerden şeklinde ayrılması işlemidir. Bu çalışmada birçok hastalığın tedavisinde kullanılabilecek özelliklere sahip *Silybum marianum* (L.) Gaertner'in endüstriyel prosesi için gerekli ekstraksiyon değişkenleri laboratuvar ölçekli ekstraktörde araştırılmıştır. Bu amaçla belirli parçacık büyüklüğündeki meyvelerle soxhlet, aparatında, hekzan kullanılarak yapılan ekstraksiyonda sabit yağ içeriği yaklaşık %27 olarak belirlenmiştir. Yağı uzaklaştırılan meyvelerin %96'lık etanol ile soxhlet, perkolatör ve karıştırıcılı ekstraktörlerde yapılan ekstraksiyonlarında ise sıcakta karıştırıcılı ekstraktörün en uygun olduğu görülmüş ve elde edilen total kuru ekstre verimi kuru madde temeline göre ağırlıkça %15 olarak saptanmıştır. Elde edilen ekstrakttaki başlıca aktif bileşen olan silymarin miktarı, silybin miktarının ölçülmesiyle yaklaşık %4 olarak belirlenmiştir. Yapılan literatür araştırmaları ve çalışma sonuçları tohum türü ve değişkenliği, solvent seçimleri ve kritik sıcaklıklar deve dikeni ekstraksiyonunu ciddi şekilde etkileyebileceklerini göstermektedir. *Silybum marianum* (L.) Gaertner (deve dikeni) gibi tıbbi bitkilerin kültürel tarım koşullarını ve etkilerini belirlemeye yönelik bilimsel çalışmaların sürdürülmesi, bu bitkilerin daha geniş alanlarda kullanılmasını sağlayacaktır.
Anahtar Kelimeler: Deve Dikeni, *Silybum marianum* (L.) Gaertner, Silybin, Ektraksiyon.

EXTRACTION OF *Silybum marianum* (L.) GAERTNER (MILK THISTLE)

Abstract
Plants and products derived from plants are always present in many parts of human life. The use of plants as medicine dates back to ancient times in written human history. The plant kingdom is an excellent source of natural medicines, and in recent years there has been a growing interest in the value of medicinal plants. *Silybum marianum* (L.) Gaertner (milk thistle) and its derivatives are used in the treatment of many diseases, especially liver diseases. Silymarin is a lipophilic extract from milk thistle seeds with the highest biological activity, consisting of three flavonolignan isomers: silybin, silydianin and silychristin. Thistle seeds also contain small amounts of flavonoids (taxifolin) and about 20-35% fatty acids and other polyphenolic compounds. Extraction is the process of separating the medically active components of organic tissues from inactive or inert components with the help of appropriate solvent systems. In this study, the extraction variables required for the industrial process of *Silybum marianum* (L.) Gaertner, which has properties that can be used in the treatment of many diseases, were investigated in a laboratory scale extractor. For this purpose, the fixed oil content was determined to be approximately 27% in the extraction performed using hexane in the soxhlet apparatus with fruits of certain particle sizes. In the extraction of the defatted fruits with 96% ethanol in soxhlet, percolator and agitator extractors, the hot agitator extractor was found to be the most suitable and the total dry extract yield was determined as 15% by weight on dry matter basis. The amount of silymarin, the main active ingredient in the extract obtained, was determined to be approximately 4% by measuring the amount of silybin. Literature research and study results show that seed type and variability, solvent choices and critical temperatures can seriously affect milk thistle extraction. Continuing scientific studies to determine the cultural farming conditions and effects of medicinal plants such as Silybum marianum (L.) Gaertner (milk thistle) will enable these plants to be used in wider areas.
Keywords: Milk Thistle, *Silybum marianum* (L.) Gaertner, Silybin, Extraction.

DEREOTU VE KEREVİZ TOHUMLARININ ÇİMLENME VE ÇIKIŞ KALİTESİ ÜZERİNE ALLELOKİMYASALLARIN ETKİSİ

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Özet
Çalışmamızda, iki farklı dereotu ve kereviz çeşitlerinin tohum partilerine %5 ve %10 oranında farklı bitkisel allelokimyasalların su ekstraktlarının priming uygulamasının farklı vigor testlerinde çimlenme ve fide çıkış performansları üzerine etkisinin belirlenmesi amaçlanmıştır. Bunun için, dereotu (*Anethum graveolens*), rezene (*Foeniculum vulgare*), zakkum (*Nerium oleander*) ve kimyon (*Cuminum cyminum*) gibi allelokimyasallar içeren bitkilerin yaprak ekstraktları ile dereotu (*Anethum graveolens*) ve kerevizin (*Apium graveolens*) iki çeşidinin tohumlarının uygulanmasının canlılık oranlarına etkisi belirlenmiştir. %5-10 oranında hazırlanan ekstraktlarda tohumlar 12 saat boyunca oda sıcaklığında bekletilmiştir. Daha sonra çimlenme (24 °C'de, 14 gün), çıkış (25 °C'de 21 gün), kontrollü bozulma (KB) (%18 nem, 45 °C'de 24 saat) ve hızlı yaşlandırma (HY) (42 °C'de 48 saat) testleri ile EC testi (2-4-6-24 saat, 20 ^{0}C) yapılmıştır. Denemede normal-anormal çimlenme oranı (%) ve ortalama çimlenme-çıkış süresi (gün) belirlenmiştir. Genel olarak dereotu ve kereviz tohumlarının çimlenme oranı %78-64 arasında, fide çıkış oranı ise %36-12 arasında belirlenmiştir. EC değeri dereotu çeşitlerinin tohumlarında 134-284 µscm^{-1} arasında iken kereviz tohumlarında 84-67,5 µscm^{-1} (2sa) olarak ölçülmüştür. Her iki tür ve çeşit için, bitki ekstraktlarının %5-10'luk dozlarının 12 saat uygulanmasından sonra değerler 25-50 µscm^{-1} civarında bulunmuştur. Bu nedenle, EC değerleri daha düşük bulunmuş ve hücre zarı canlılığı üzerinde olumlu bir etki tespit edilmiştir. HY ve KB testlerinden sonra, özellikle kereviz tohumlarında çimlenme oranı daha fazla azalmıştır. %5'lik kimyon ve zakkum ekstraktları 12 saatlik priming uygulamasının ardından dereotu tohumu çimlenmesini artırsa da kereviz tohumu çimlenme oranları en aza inmiştir. Kullanılan bitki ekstraktlarının tohum canlılığı üzerindeki etkisi incelendiğinde; HY testi sonrasında canlılık yok denecek kadar az iken, KB testi sonrasında her iki tür için de, özellikle dereotu için, yüksek oranlar elde edilmiştir. Dereotu çeşitlerinin KB testi sonrası fide çıkış sonuçlarında tüm bitki ekstraktı gruplarında (%5) aynı olumlu etki gözlenmiştir. Ancak, ortalama çıkış süresi ortalama 3-4 gün uzamıştır. Bitki ekstraktlarının %10'luk uygulama dozu canlılık ve kuvvet üzerinde olumsuz bir etkiye sahip olmuştur. Çalışmada, serin iklim sebze türlerine ait tohumlarda kullanılan bitki ekstraktlarının farklı allelopatik etkisi ile priming kavramını ortak noktada buluşturabilecek sonuçlar bulunmuştur.
Anahtar Kelimeler: Dereotu, kereviz, allelokimyasal, tohum canlılığı**,** hızlı yaşlandırma

EFFECT OF ALLELOCHEMICALS ON GERMINATION AND EMERGENCE QUALITY OF DILL AND CELERY SEEDS

Abstract
In our study, it was aimed to determine the effect of priming application of water extracts of 5% and 10% different herbal allelochemicals in seed lots of two different dill and celery cultivars on germination and seedling emergence performances in different vigor tests. For this, the application of leaf extracts of plants containing allelochemicals such as dill (*Anethum graveolens*), fennel (*Foeniculum vulgare*), oleander (*Nerium oleander*) and cumin (*Cuminum cyminum*) and the seeds of two varieties of dill (*Anethum graveolens*) and celery (*Apium graveolens*) effectson vigor ratios were determined. In the 5-10% prepared extracts, the seeds were kept at room temperature for 12 hours. Then, germination (at 24 °C, 14 days), emergence (21 days at 25°C), controlled deterioration (CD) (18% humidity, 24 hours at 45 °C) and accelerated aging (AA) (48 hours at 42 °C) tests and EC test (2-4-6-24 h, 20 ^{0}C) were established. Normal-abnormal germination rate (%) and mean germination-emergence time (days) were determined in the experiment. In general, the germination rate of dill and celery seeds was determined between 78-64%, and the seedling emergence rate was between 36-12%. While the EC value was between 134-284 µscm^{-1} in seeds of dill varieties, it was measured as 84-67.5 (2h) in celery seeds. For both species and varieties, the values were found to be around 25-50 µscm^{-1} after 12 hours of 5-10% doses of plant extracts. Therefore, EC values were found lower and a positive effect on cell membrane viability was determined. After the AA and CD tests, especially in celery seeds germination rate was more decrease. Although 5% kimyon and zakkum extracts enhanced dill seed germination after 12 hours of priming, celery seed germination rates minimized. When the effect of the plant extracts used on seed vigour was analysed; while the vigour was almost negligible after the AA test, the rates were high for both species, especially for dill, after the CD test. The same positive effect was observed in all plant extract groups (5%) in the seedling emergence results of dill varieties after the CD test. However, the mean emergence time was prolonged by 3-4 days on average. 10% treatment dose of plant extracts had a negative effect on viabilty and vigour. In this study, results were found that could bring together the concept of priming with the different allelopathic effects of plant extracts used in seeds of cool climate vegetable species.
Keywords: Dill, celery, allelochemical, seed viability, accelerated aging

BIOPRIMING VE HYDROPRIMING UYGULAMALARININ DOMATES TOHUM CANLILIĞINA ETKILERİ

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Özet

Çalışmada, Narcan (N) ve Almila (A) domates çeşitlerine ait tohum partilerinin canlılığı üzerine biyo ve hidropriming yöntemlerinin etkileri incelenmiştir. Bu amaçla *Bacillus amyloliquefaciens* (Acession number: ON722563) izolatı ile biyopriming, üç farklı (4, 8 ve 24 sa, 24 ^{0}C) sürede ise hidropriming uygulaması yapılmıştır. Denemeler Uşak Üniversitesi Ziraat Fakültesi Tohum Fizyolojisi ve Mikrobiyoloji laboratuvarlarında yürütülmüştür. Biyopriming uygulamasında izolatın 10^8 cfu/ml süspansiyonuna tohumlar 30 dakika 27 °C'de çalkalayıcıda bekletilmiştir. Tohum partilerinin nem değerleri (130 ^{0}C, 1 saat) Narcan (N) için %8, Almila (A) için ise %6 olarak bulunmuştur. Tohum çimlenme (4x25 tekerrür/tohum, 24 ^{0}C, 14 gün) ve çıkış (4x25 tekerrür/tohum, 25 ^{0}C, 21 gün) performanslarını her iki priming uygulamasının etkilerini karşılaştırmak amacıyla anormal ve toplam çimlenme oranı (%), ortalama çimlenme ve çıkış zamanları (gün), kök boyu (cm), hipokotil boyu (cm), fide yaş ve kuru ağırlığı (gr) belirlenmiştir. Ayrıca tohum gücünü belirlemek için kontrol ve priming uygulanmış tohum partilerine kontrollü bozulma (4x25 tekerrür/tohum, 45 ºC, %18 nem) testi uygulanmıştır. Çalışma sonuçlarına bakıldığında; kontrol gruplarında çimlenme oranları %60 (N)-%82 (A), çıkış oranları %49 (N)- %66 (A), kontrollü bozulma testi sonucu çimlenme oranları %60 (N)-%67 (A), kontrollü bozulma testi sonucu fide çıkış oranları ise %20, 38 (N, A) olarak bulunmuştur. Hidropriming uygulaması sonucu çimlenme oranları ortalama %73-86 (N-A) civarı olurken, fide çıkış oranı ise %49-66 (N-A) arasında belirlenmiştir. Hidropriming yapılan tohum partilerinin kontrollü bozulma test sonucunda çimlenme oranı ortalama %73, çıkış oranı ise ortalama %47,5 olarak belirlenmiştir. *B. amyloliquefaciens* izolatı ile yapılan biyopriming sonucu çimlenme oranları %77 (N)-%100 (A) olarak tespit edilmiştir. Biyopriming uygulaması sonucu morfolojik ölçümler ele alındığında kontrol grubuna göre bir miktar yükselmiştir. Kök

boyu 31-81 mm, gövde boyu 57-67 mm, yaş ağırlık 0,8-0,7 gr ve kuru ağırlık ise 0,6-0,4 gr (N-A) olarak ölçülmüştür. Sonuç olarak, yapılan priming uygulamaları kontrol değerlerine göre çeşide bağlı olarak farklı etkiler göstermiştir.
Anahtar Kelimeler: Domates, biyopriming, hidropriming, tohum gücü**,** *Bacillus sp*.

EFFECT OF BIOPRIMING AND HIDROPRIMING TREATMENTS ON TOMATO SEED VIABILITY

Abstract
In this study, the effects of bio and hydropriming methods on the viability of seed lots of Narcan (N) and Almila (A) tomato varieties were investigated. For this purpose, biopriming with *Bacillus amyloliquefaciens* (Acession number: ON722563) isolate and hydropriming at three different times (4, 8 and 24 h, 24 ^{0}C) were applied. The experiments were carried out in Uşak University, Faculty of Agriculture, Seed Physiology and Microbiology laboratories. In the biopriming treatment, seeds were placed in 108 cfu/ml suspension of the isolate for 30 min at 27 °C on a shaker. Moisture contents of seed lots (130 ^{0}C, 1 h) were 8% for Narcan (N) and 6% for Almila (A). Abnormal and total germination rate (%), mean germination and emergence times (days), root length (cm), hypocotyl length (cm), seedling wet and dry weight (g) were determined to compare the effects of both priming treatments on seed germination (4x25 replicates/seed, 24 ^{0}C, 14 days) and emergence (4x25 replicates/seed, 25 ^{0}C, 21 days) performances. In addition, controlled deterioration test (4x25 replicates/seed, 45 ºC, 18% humidity) was applied to control and primed seed lots to determine seed vigor. Following an analysis of the study's data, it was found that the control groups' germination rates were 60% (N)-82% (A), emergence rates were 49% (N)-66% (A), germination rates as a result of the controlled deterioration test were 60% (N)-67% (A), and seedling emergence rates as a result of the controlled deterioration test were 20, 38% (N, A). Mean germination rates of 73-86% (N-A) was found following hydropriming treatment, but the emergence rates of seedlings ranged from 49-66% (N-A). The hydropriming seed lots performed a controlled deterioration test, which showed a mean germination rate of 73% and an emergence rate of 47.5%. As a result of biopriming with *B. amyloliquefaciens* isolate, germination rates were determined as 77% (N)-100% (A). Morphological measurements showed a small increase following the application of biopriming in comparison to the control group. Root length was 31-81 mm, stem length 57-67 mm, wet weight 0.8-0.7 g and dry weight 0.6-0.4 g (N-A). Consequently, with comparison to the control values, the priming treatments showed different effects based on the variation.
Keywords: Tomato, biopriming, hidropriming, seed vigor, *Bacillus sp*.

BAZI JAPON ERİĞİ ÇEŞİT ADAYLARININ KENDİNE VERİMLİLİK DURUMLARININ BELİRLENMESİ ÜZERİNE ÖN ÇALIŞMA

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Özet
Japon eriklerinde (*Prunus salicina* Lindl.), diğer Prunus türlerinde olduğu gibi, gametofitik uyuşmazlık gözlemlenmektedir ve çoğu Japon eriği çeşidinin de bu özelliği taşıdığı bildirilmektedir. Bu nedenle Japon eriği çeşitlerinin geliştirilmesinde, gerek ıslah amaçlarında gerekse sonrasında, ön plana çıkan melez bireylerin kendine verimlilik özelliklerinin belirlenmesi oldukça önemli bir aşama olarak karşımıza çıkmaktadır. Bu çalışmada TAGEM tarafından finanse edilen "Ege Bölgesi Erik Çeşit Geliştirme Projesi" kapsamında melezleme, kendileme ve serbest tozlanma uygulamaları sonucunda elde edilerek ön plana çıkan 36 Japon eriği çeşit adayından 8 tanesinin kendine verimlilik durumlarının belirlenmesi amaçlanmıştır. Denemeler Seleksiyon I parselinde yer alan 6-8 yaşlı ağaçlarda 2023 yılında gerçekleştirilmiştir. Her melez birey için kendileme ve serbest tozlanma uygulaması yapılacak dallar işaretlenerek, kendileme yapılan dallarda dal izolasyonu yapılmış ve tozlamalar fırça yardımıyla, her melez bireyin balon aşamasındaki tomurcukların suni ışık altında patlatılmasıyla elde edilen polenleriyle yapılmıştır. Serbest tozlama uygulamasında ise sadece çiçekler sayılmış, tozlanma tozlayıcı böcekler yardımıyla gerçekleşmiştir. Her uygulama için 4 tekerrür ve her tekerrürde ortalama 150 çiçek olacak şekilde deneme dizayn edilmiştir. Uygulamalardan 5 hafta sonra meyve tutum oranları belirlenmiştir. Melezlerin serbest tozlanma uygulamasında meyve tutum oranları % 0-12,58 arasında değişim göstermiştir. Kendileme çalışmalarında ise melez bireylerin 7'si % 0 meyve tutum oranı ile kendine verimsiz olarak belirlenirken, Black Diaomond çeşidinin serbest tozlanmasından elde edilen "18-26" kodlu çeşit adayı % 9,82 meyve tutum oranı ile kısmen kendine verimli olarak tespit edilmiştir. Melez bireylerin çeşit olarak tescil aşamasında bu bulguların dikkate alınarak uygun tozlayıcı çeşit&çeşit adayı belirleme çalışmaları ile desteklenmesi gerekmektedir.
Anahtar Kelimeler: *Prunus salicina* Lindl., Kendine verimlilik, Melezleme ıslahı, İzolasyon

PRELIMINARY STUDY ON DETERMINING THE SELF-FERTILITY STATUS OF SOME JAPANESE PLUM VARIETY CANDIDATES

Abstract
Gametophytic incompatibility is observed in Japanese plums (*Prunus salicina* Lindl.), as in other Prunus species, and it is reported that most Japanese plum varieties have this feature. For this reason, determining the self-fertility characteristics of prominent hybrid individuals is a very important stage in the development of Japanese plum varieties, both for breeding purposes and afterwards. In this study, it was aimed to determine the self-fertility status of 8 of the 36 Japanese plum variety candidates that were obtained as a result of hybridization, self-pollination, and open-pollination practices within the scope of the "Aegean Region Plum Variety Development Project" financed by TAGEM. The trials were carried out in 2023 on 6-8 year old trees located in the Selection I parcel. For each hybrid individual, the branches for self-pollination and open-pollination applications were marked, branch isolation was made on the self-pollination branches, and pollination was done with the help of a brush, using the pollen obtained by bursting the balloon stage buds of each hybrid individual under artificial light. In the open-pollination applications, only flowers were counted and pollination took place with the help of pollinators. The experiment was designed with 4 replications for each application and an average of 150 flowers in each replication. Fruit setting rates were determined 5 weeks after the applications. In open-pollination application of hybrids, fruit set rates varied between 0-12.58%. In self-pollination studies, while 7 of the hybrid individuals were determined to be self-infertile with a 0% fruit set rate, the variety candidate coded "18-26" obtained from free pollination of the Black Diaomond variety was determined to be partially self-fertile with a fruit set rate of 9.82%. During the registration phase of hybrid individuals as varieties, these findings should be taken into consideration and supported by studies to determine the appropriate pollinator variety and variety candidate.
Keywords: *Prunus salicina* Lindl., Self-fertility, Crossbreeding, Isolation.

Aristolochia bodamae BİTKİSİNİN ANTİOKSİDAN AKTİVİTESİ VE BİYOAKTİF BİLEŞİK İÇERİĞİ

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Özet
Bitkiler, genellikle bitki büyümesi ve üremesi için gerekli olmayan ancak gıda ve ilaç endüstrisinde çeşitli roller oynayan fenoller, alkaloidler, flavonoidler, tanen, saponinler ve uçucu yağlar gibi ikincil metabolitlerin farklı bir karışımını üretirler. Bitkiler, biyomoleküllerin zengin olduğu çeşitli kısımlarında bulundukları için çeşitli biyolojik aktivite ajanları olarak kullanılmaktadır. *Aristolochia* L. cinsi, Aristolochiaceae familyasına ait olup dünya genelinde ılıman ve tropik bölgelerde yaklaşık 400 türü içermektedir. *Aristolochia* türleri, antik çağlardan beri tıbbi amaçlarla kullanılmaktadır. *Aristolochia bodamae* ise Batı Karadeniz ve Marmara bölgelerinde yetişir. Ancak, *A. bodamae* ile ilgili yapılan fitokimyasal ve biyokimyasal araştırmaların sayısı oldukça sınırlıdır. Bu çalışma, A. *bodamae* bitkisinin metanol ekstraktlarının antioksidan aktivitesini belirleme ve flavonoidler, flavanoller, tanenler ve proantosiyaninlerin toplam içeriğini ölçme amacı taşımaktadır. Elde edilen sonuçlar, *A. bodamae* bitkisinin yüksek miktarda biyoaktif bileşik içerdiğini ve güçlü bir DPPH serbest radikal temizleme etkisi sergilediğini göstermektedir (41,15±14,69 mg/ml IC_{50} değeri). Ayrıca, toplam flavonol içeriğinin 81,27 ± 7,56 mg QE/g ekstrakt, toplam flavonoid içeriğinin 38,31 ± 1,77 mg QE/g ekstrakt, toplam fenolik bileşik içeriğinin 17,65 ± 1,05 mg GAE/g ekstrakt, toplam proantosiyanidin içeriğinin 69,89 ± 21,95 mg CAE/g ekstrakt ve toplam tanen içeriğinin 3,25± 0,55 mg GAE/g ekstrakt olduğu belirlenmiştir. Bu sonuçlar, *A. bodamae* bitkisinin yüksek antioksidan aktiviteye sahip olduğunu ve bu özelliklerinin, serbest radikallerin zararlı etkilerini nötralize etmek için önemli bir rol oynayan redoks özelliklerinden kaynaklandığını göstermektedir. *A. bodamae*'nin metanol ekstresi hakkında sunulan bu ön bilgiler, bu bitkinin umut verici bir ikincil metabolit kaynağı olabileceğini ve bu nedenle çeşitli terapötik ajanların doğal kaynağı olarak potansiyelini teşvik etme açısından faydalı olabileceğini göstermektedir.
Anahtar Kelimeler: *Aristolochia bodamae*, Biyolojik Aktivite, DPPH, Fenolik Madde

Aristolochia bodamae PLANT'S ANTIOXIDANT ACTIVITY AND BIOACTIVE COMPOUND CONTENT

Abstract
Plants typically produce a diverse mixture of secondary metabolites such as phenols, alkaloids, flavonoids, tannins, saponins, and volatile oils, which are not usually necessary for plant growth and reproduction but play various roles in the food and pharmaceutical industries. Due to the abundance of biomolecules in various parts of plants, they are utilized as diverse biological activity agents. The *Aristolochia* genus, belonging to the Aristolochiaceae family, comprises approximately 400 species distributed in temperate and tropical regions worldwide. *Aristolochia* species have been used for medicinal purposes since ancient times. *Aristolochia bodamae* is found in the Western Black Sea and Marmara regions. However, there is limited phytochemical and biochemical research related to *A. bodamae*. This study aims to determine the antioxidant activity of methanol extracts of *A. bodamae* and measure the total content of flavonoids, flavanols, tannins, and proanthocyanidins. The results indicate that *A. bodamae* contains a high level of bioactive compounds and exhibits a strong DPPH free radical scavenging effect (41.15 ± 14.69 mg/ml IC_{50} value). Furthermore, the total flavonol content was found to be 81.27 ± 7.56 mg QE/g extract, total flavonoid content was 38.31 ± 1.77 mg QE/g extract, total phenolic compound content was 17.65 ± 1.05 mg GAE/g extract, total proanthocyanidin content was 69.89 ± 21.95 mg CAE/g extract, and total tannin content was 3.25 ± 0.55 mg GAE/g extract. These findings suggest that *A. bodamae* possesses high antioxidant activity, and these characteristics are attributed to its redox properties, which play a crucial role in neutralizing the harmful effects of free radicals. The preliminary data presented for *A. bodamae* methanol extract provide valuable insights into the potential of this plant as a promising source of secondary metabolites and may encourage further exploration of its natural potential as a source for various therapeutic agents.
Keywords: *Aristolochia bodamae*, Biological Activity, DPPH, Phenolic Compounds

HALOFİT BİTKİLERİN TUZLU TARIMSAL ALANLARDA KULLANIMI VE BU TİP ALANLARIN BİYOREMİDASYONUNA ETKİSİ

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Özet
Toprak tuzlanması, tarımsal gelişimi ve ekosistem çeşitliliğini sınırlayan ciddi bir çevresel sorundur. Bu sorun, arazi ıslahı ve sürdürülemez sulama uygulamaları nedeniyle giderek yaygınlaşmaktadır. Küresel gıda talebini hafifletmek için tuzlanmış arazilerin en iyi şekilde kullanılması amacıyla ilerlemenin yolu, tuza daha dayanıklı olan bitkileri yetiştirmektir. Halofitler, yüksek tuzlu ortamlarda gelişebilen bitkilerdir. Tuzlu alanda gelişen bitki türleri, farklı halofitik adaptasyonlar geliştirerek, bu ortamlarda başarılı hale gelmiştir. Halofitik bitkilerde görülen birçok farklı adaptasyonun morfolojik, anatomik ve fizyolojik boyutları vardır ve bunlar birlikte işlev görür. Halofitlerin tuzcul ortamlarda hayatlarını sürdürmelerini sağlayan tüm adaptasyon çeşitlerini su şekilde özetleyebiliriz:1. Sukkulentlik. 2. Vakuollerinde yüksek oranda tuz tutabilmeleri 3. Yaprakların küçülmesi, su depolayan tüy ve aerenkima geliştirilmesi. 4. Sentezledikleri Ozmoregülatörler sayesinde daha yüksek içsel tuz oranlarına dayanabilmeleri. Halofit türler tuzlu topraklara iyi uyum sağlayabilir ve tuzlanmış toprakların geliştirilmesinde kullanılabilir. Halofit türlerin genleri, tuz toleransı ve azot verimliliği için tuzlu tarım için bitki yetiştirme sürecinde kullanılabilir. Halofit gelen mikroorganizmalar, rizosfer toprağın fiziksel ve kimyasal özelliklerini iyileştirebilir, bitkiyi oksidatif osmotik stresten koruyabilir ve böylece tuz stresi altında bitki büyümesini teşvik edebilir. Tuzu bünyelerinde depo edebilen halofit bitkiler, tuzlu toprakların iyileştirilmesinde yüksek değere sahiptir. Örneğin, *Salicornia* sp. *Suaeda* sp. *Sarcocornia* sp. *Mertensia* sp. gibi türlerden izole edilen mikroorganizmalar, ağır metaller ve organik kirleticilerle kontamine olmuş tuzlu toprakların iyileştirilmesine katılır. Halofit bitkiler topraklardan tuzları uzaklaştırma kapasitesine sahiptir ve ilaç geliştirme, yem uygulama ve sebze olarak potansiyele sahiptir. Sonuç olarak, halofitleri kullanarak genlerden ekosisteme kadar tuzlu toprakları iyileştirmek için teorik temeli ve pratik uygulamayı keşfetmek için değerli bir aday olarak yüksek değerlere sahiptir.
Anahtar Kelimeler: Halofit bitkiler, Tuzlu Toprak, Biyoremidasyon, Tuza direnç

THE USE OF HALOPHYTIC PLANTS IN SALINE AGRICULTURAL AREAS AND THEIR IMPACT ON BIOREMEDIATION IN SUCH ENVIRONMENTS

Abstract
Soil salinization poses a serious environmental problem, limiting agricultural development and ecosystem diversity. This issue is becoming increasingly widespread due to land reclamation and unsustainable irrigation practices. To address the growing global food demand, the key to progress lies in cultivating plants that are more salt-resistant on saline lands. Halophytes, plants capable of thriving in high-salinity environments, offer a promising solution. Different plant species that have developed successful adaptations in saline environments exhibit various halophytic traits. These adaptations encompass diverse morphological, anatomical, and physiological features, all of which function together. Some notable adaptations in halophytes can be summarized as follows: 1. Succulence. 2. High salt accumulation in vacuoles. 3. Reduction in leaf size, development of water-storing trichomes, and aerenchyma formation. 4. Ability to tolerate higher internal salt concentrations due to the synthesis of compatible osmolytes. Halophyte species can adapt well to saline soils and be utilized in the development of salinized soils. Genes from halophyte species can be employed in the process of cultivating plants for saline agriculture, enhancing both salt tolerance and nitrogen efficiency. Microorganisms derived from halophytes can improve the physical and chemical properties of rhizosphere soil, protect plants from oxidative osmotic stress, and thereby promote plant growth under salt stress conditions. Halophyte plants capable of storing salts within their tissues hold significant value in the remediation of saline soils. For instance, microorganisms isolated from species such as Salicornia sp., Suaeda sp., Sarcocornia sp., and Mertensia sp. participate in the remediation of saline soils contaminated with heavy metals and organic pollutants. Halophyte plants have the capacity to remove salts from soils and hold potential applications in drug development, feed production, and as vegetables. In conclusion, exploring the theoretical foundations and practical applications of improving saline soils from genes to ecosystems using halophytes.
Keywords: Halophyte Plants, Saline Soil, Bioremediation, Salt Tolerance

Serapias orientalis'İN TOHUM VE PROTOKORM MORFOLOJİSİ VE TOPRAK ÜSTÜ KISIMLARININ AMİNOASİT ANALİZİ

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Özet
Orchidaceae, 736'den fazla cins ve 28.000'den fazla türü içeren kapalı tohumlu bitkilerin büyük bir ailesidir. Bu familya, dünya genelinde tropik bölgelerden yüksek Alplere kadar yayılmıştır. Orkideler, gösterişli çiçekleriyle tanınır ve hem estetik hem de tıbbi açıdan büyük öneme sahiptir. Ayrıca, ekolojik göstergeler olarak kabul edilirler. Çünkü habitat bozulmalarına karşı hassas bir yapıları vardır. Orkide tohumları son derece küçüktür ve ince bir ölü hücre tabakası ile çevrelenmiş çok hücreli bir embriyodan oluşurlar. Orkide tohumları, küçük boyutlarından dolayı endospermden yoksundur ve tohum çimlenmesi ve erken fide büyümesi için su, karbon ve diğer gerekli besin maddelerini elde etmek için mikorizal mantarlara bağımlıdır Tohum yapıları ve testa hücreleri bazı türlerde ayırt edici morfolojik karakter olarak kullanılır. Bu çalışma, Orta ve Doğu Karadeniz bölgesinde deniz seviyesinden 100 metreye kadar yayılan *Serapias orientalis* (Greuter) Bauman & Künkele, *ex vitro* koşullar altında yetiştirilen ergin bireylerin toprak üstü kısımlarının LC-MS analizi ile amino asit içeriğini ve kalitesini incelemiştir. Bitkilerin en önemli karakterlerinden biri olan tohum ve orkide gelişiminin başlangıç aşaması olan protokorm yapılarının taramalı elektron mikroskop görüntüleri alınmıştır. LS-MS analiz verileri, *S. orientalis*'in toprak üstü kısımlarında, toplam amino asit miktarının (TA) %82,95 ve esansiyel amino asit miktarının da (EA) %35,12 olduğunu ortaya koymuştur. Bu amino asitler arasında en yüksek miktar, 12,30 mg/g ile glutamik asit aminoasidine ait iken en düşük miktar ise 0,845 mg/g ile gama-aminobütirik asit olarak tespit edilmiştir. Ayrıca sindirilebilir vazgeçilmez amino asit skoru (DIAAS) 2,31 olarak hesaplanmıştır. DIAAS sonuçları hayvansal proteinler ile karşılaştırıldığında düşük olmasına rağmen bitkilere kıyasla yüksek bir değerdedir. Bu sonuçlar, *S. orientalis* bitkisinin toprak üstü kısımlarının yüksek amino asit içeriği bakımından değerli bir besin kaynağı olabileceğini göstermektedir.
Anahtar Kelimeler: Aminoasit miktarı, LC-MS, *Serapias orientalis*

SEED AND PROTOCORM MORPHOLOGY OF *Serapias orientalis*, AND AMINOACID ANALYSIS OF AEROEAR PARTS

Abstract
Orchidaceae is a large family of angiosperm plants, comprising over 736 genera and more than 28,000 species. This family is distributed worldwide, from tropical regions to high alpine areas. Orchids are known for their showy flowers and are of significant importance both aesthetically and medicinally. They are also considered ecological indicators due to their sensitivity to habitat disturbances. Orchid seeds are extremely tiny and consist of a multicellular embryo surrounded by a delicate layer of dead cells. Due to their small size, orchid seeds lack endosperm and are dependent on mycorrhizal fungi to obtain water, carbon, and other essential nutrients for seed germination and early seedling growth. Seed structures and testa cells are used as distinctive morphological characters in some species. This study investigated the amino acid content and quality of the above-ground parts of mature individuals of *Serapias orientalis* (Greuter) Bauman & Künkele, which are distributed from sea level to 100 meters in the Middle and Eastern Black Sea region, under *ex vitro* conditions using LC-MS analysis. Scanning electron microscope images of protocorm structures, which are the initial stage of seed and orchid development and one of the most important characteristics of plants, were obtained. The LC-MS analysis data revealed that in the above-ground parts of *S. orientalis*, the total amino acid content (TA) was 82.95%, and the essential amino acid content (EA) was 35.12%. Among these amino acids, the highest amount was found to be 12.30 mg/g for glutamic acid, while the lowest amount was 0.845 mg/g for gamma-aminobutyric acid. Additionally, the Digestible Indispensable Amino Acid Score (DIAAS) was calculated as 2.31. Although DIAAS results are lower compared to animal proteins, they are relatively high compared to other plant sources. These findings suggest that the above-ground parts of *S. orientalis* may serve as a valuable food source due to their high amino acid content.
Keywords: Amino acid content, LC-MS, *Serapias orientalis*

İÇ ANADOLU BÖLGESİNİN KURU KOŞULLARINDA YEMLİK ARPA (*Hordeum vulgare* L.) GENOTİPLERİNİN TANE VERİMİ VE STABİLİTELERİ

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Özet

Türkiye'de arpa buğdaydan sonra ikinci sıradaki en önemli tahıl cinsidir ve arpa üretilen alanların yarısından fazlası kurak ve yarı kurak alanları kapsamaktadır. Artan nüfus ve buna bağlı olarak artan ihtiyaçların kesintisiz olarak karşılanması için verimin düzenli olarak arttırılması gerekmektedir. Bunun en etkili yollarından birisi yüksek verim ve tane kalitesine sahip çeşitlerin ıslah edilmesidir. Türkiye gibi dar alanlarda çok farklı alt ekolojik koşullara sahip ülkelerde geliştirilecek çeşitlerin farklı ekolojik koşullarda verim stabilitelerini korumaları adaptasyon sınırlarının genişliği açısından önemlidir. Bu çalışmada, 2021-2022 yetiştirme sezonunda İç Anadolu Bölgesi'ndeki altı lokasyonda (İkizce, Altınova, Gözlü, Malya, Ulaş ve Polatlı) yirmi yemlik arpa hattının tane verimi ve stabiliteleri, dört yemlik (Tarm-92, Burakbey, Sayim 40 ve Larende) tescilli arpa çeşidiyle karşılaştırılmış ve farklı agro-ekolojik koşullara tepkileri incelenmiştir. Altı lokasyondaki verim denemelerinin genel ortalaması 335,8 kg/da olurken, 375,7 kg/da tane verimiyle Hat 116 tüm genotipleri geride bırakmış, onu 367,3 kg/da ile Burakbey çeşidi ve 364,9 kg/da ile Hat 103 takip etmiştir. En yüksek verimli lokasyon 399,7 kg/da ile İkizce (Ankara) olurken, En düşük tane verimin gerçekleştiği lokasyon Altınova olmuştur (266,3 kg/da). Doğrusal regresyona dayalı stabilite analizi, en stabil ve yüksek verimli genotiplerin 102, 113 ve 110 numaralı ileri yemlik arpa hatları olduğunu ortaya koymuştur. Ayrıca, Tarm-92 ve Burakbey çeşitleri elverişsiz koşullar için daha istikrarlı çeşitler olmakla birlikte, Hat 116, Hat 103 ve Sayim 40 çeşitleri iyi çevre koşullarına en iyi uyum sağlayan arpa genotipleri olarak bulunmuştur. Orta Anadolu'da en

yaygın olarak yetiştirilen çeşit olan Tarm-92, genel ortalamaya yakın verim potansiyeli ile en istikrarlı genotip olmaya devam etmiştir. Yeni çeşitler arasında Burakbey ve Sayim 40, Orta Anadolu Bölgesi'nde yüksek tane verim potansiyeline sahip çeşitler olarak bulunmuştur. Bu çalışmanın bulgularına göre, yüksek ve stabil bir tane verimine sahip olan hatlar olan, Hat 116 ve Hat 103 Orta Anadolu Bölgesi için en umut verici yemlik arpa hatları olarak tespit edilmiştir.
Anahtar Kelimeler: Yemlik arpa, İç Anadolu Bölgesi, tane verimi, adaptasyon ve stabilite

GRAIN YIELD AND STABILITY OF FEED BARLEY (*Hordeum vulgare* L.) GENOTYPES UNDER DRY CONDITIONS OF CENTRAL ANATOLIA

Abstract
Barley is the second most important cereal crop in Turkey, after wheat, and more than half of the barley production area is located in arid and semi-arid regions. In order to meet the increasing population and consequently increasing needs without interruption, it is necessary to increase the yield regularly. One of the most effective ways to do this is to develop high yielding and high grain quality cultivars. In countries with very different sub-ecological conditions over short distances, such as Turkey, it is important for the cultivars to be developed to maintain yield stability under different ecological conditions in terms of the broadening of adaptation limits. During the 2021-2022 growing season, the grain yield and stability of twenty feed barley lines were evaluated in comparison to four registered feed barley cultivars (Tarm-92, Burakbey, Sayim 40, and Larende) across six locations in the Central Anatolia Region (Ikizce, Altinova, Gozlu, Malya, Ulash, and Polatli). The objective of this study is to examine how these feed barley lines and cultivars respond to different agro-ecological conditions. The grand mean of the feed barley yield trials over six locations was 3358 kg/ha, while the Line 116 outyielded all the genotypes with 3757 kg/ha grain yield, followed by cv. Burakbey with 3673 kg/ha and Line 103 with 3649 kg/ha, respectively. The high yielding environment was İkizce (Ankara) with 3997 kg/ha while Altinova was the unfavorable condition with 2663 kg/ha. Stability analysis based on linear regression revealed that the most stable and high yielding genotypes were advance feed line 102, 113 and, 110. Furthermore, cvs.Tarm-92 and Burakbey were the more stable cultivars for unfavorable conditions however, advance feed Line 116, Line 103, and cv. Sayim 40 were in good adaptability to favorable conditions. Tarm-92, the most widely cultivated cultivar in Central Anatolia, remained the most stable genotype with yield potential near to the grand mean. Among the new varieties, Burakbey and Sayim 40 had a higher grain yield potential in Central Anatolia Region. According to the findings of this study, advance Line 116 and Line 103, which has a high and stable grain yield, are the most promising feed barley lines for Central Anatolia.
Keywords: Feed barley, Central Anatolia, grain yield, adaptation and stability

IN VIVO MATERNAL HAPLOİD TEKNİİĞİNDE HAPLOİD ELDE ETME BAŞARISINA KAYNAK MATERYALİN ETKİSİNİN BELİRLENMESİ

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Özet
Mısır gerek tanesi gerek silaj elde etmek için yetiştirilen gerek insan beslenmesinde gerekse hayvan beslenmesinde kullanılan önemli bir bitkidir. Ülkemizde üretilen tane mısırın %80 i yem sanayinde %18 i ise nişasta sektöründe kullanılmaktadır. Mısırda yüksek verimli ve kaliteli hibritlerin geliştirilmesi için sürekli olarak yeni durulmuş hatların geliştirilmesi gerekir. Geleneksel metotlar ile durulmuş hatların elde edilmesinde oldukça uzun süreye ihtiyaç duyulmaktadır. Bu sürenin kısaltılmasında haploid tekniği önemli avantajlar sağlamaktadır. Mısır bitkisinde embriyodan haploidlerin elde edilmesinin bilinen iki farklı yöntemi vardır. Bunlar maternal haploid ve paternal haploidlerdir. İndirgeyici hatların tozlayıcı olarak kullanıldığı maternal haploid yöntemi in vivo gynogenesis olarak tanımlanır. Haploid indükleme için kullanılacak donör veya kaynak materyalin seçimi ıslah programının amacına bağlıdır. Ülkemizde melez mısır ıslahında in vivo maternal haploid tekniğinin kullanımı giderek yaygınlaşmaya başlamıştır. Bu çalışma; in vivo maternal haploid tekniğinde kullanılan donör genotiplerin haploid indirgeme oranına etkisini belirlemek amacıyla yapılmıştır. In vivo maternal haploid tekniği için kaynak materyal olarak 30 adet F1 (tek melez) ve bunlardan elde edilen 30 adet F2 kullanılmıştır. F1 ve F2 genotiplerinin çiçeklenme dönemi geldiği zaman koçan taslakları henüz püskül çıkarmadan izolasyon kağıtları ile kapatıldı. Kapatılan koçanlarda püskül 3-5 cm olduğunda, indirgeyici polinatörün tepe püskülündeki izolasyon kâğıtları toplanarak polen bir araya getirildi. Donörlerin önceden izole edilmiş koçan püskülleri üzerine döküldü. Her bir genotipe ait koçanlar tanelendi ve yönteme göre R1-nj renk markörü dikkate alınarak haploid tohum seçimi yapıldı. Elde edilen verilere göre F1 lere ait ortalama haploid indirgeme oranı (HİO) % 7,1 hesaplanırken F2 lere ait oran % 6,5 olmuştur. Daha önce yapılan çalışmalarda da F1 lerden elde edilen HİO F2 lerden daha yüksek bulunmuştur. Bu durum F2 lerin kullanılmaması gerektiği anlamı taşımamakta ıslahın amacına ve F2 açılan popülasyonun özelliğine göre kullanılabileceğini göstermektedir.
Anahtar Kelimeler: Mısır, maternal haploid, haploid indirgeme oranı, donor, indirgeyici hat.

DETERMINATION OF THE EFFECT OF SOURCE MATERIAL ON THE SUCCESS OF OBTAINING HAPLOID IN THE IN VIVO MATERNAL HAPLOID TECHNIQUE

Abstract
Maize is an important plant grown both for grain and to obtain silage and used for both human nutrition and animal nutrition. 80% of the corn produced in our country is used in the feed industry and 18% in the starch sector. In order to develop high-yield and quality hybrids in corn, new established lines must be constantly developed. It takes a long time to obtain stable lines with traditional methods. The haploid technique provides significant advantages in shortening this period. There are two different known methods of obtaining haploids from embryos in the corn plant. These are maternal haploid and paternal haploids. The maternal haploid method in which reducing lines are used as pollinators is defined as in vivo gynogenesis. The choice of donor or source material to be used for haploid induction depends on the purpose of the breeding program. The use of in vivo maternal haploid technique in hybrid maize breeding has become increasingly widespread in our country. This work; was conducted to determine the effect of donor genotypes used in the in vivo maternal haploid technique on the haploid reduction rate. For the in vivo maternal haploid technique, 30 F1 (single hybrid) and 30 F2 obtained from them were used as source material. When the flowering period of F1 and F2 genotypes came, the cob stems were covered with isolation papers before removing the tassels. When the tassel on the closed cobs was 3-5 cm, the isolation papers on the top tassel of the reducing pollinator were collected and the pollen was brought together. It was poured onto previously isolated cob tassels of the donors. The cobs of each genotype were grained and haploid seed selection was made according to the method, considering the R1-nj color marker. According to the data obtained, the average haploid reduction rate (HIR) of F1s was calculated as 7.1%, while the rate of F2s was 6.5%. In previous studies, HIR obtained from F1s was found to be higher than F2s. This does not mean that F2s should not be used but shows that they can be used according to the purpose of breeding and the characteristics of the F2 population.
Keywords: Maize, maternal haploid, haploid reduction ratio, donor, reducing line.

FARKLI GELİŞİM DÖNEMLERİNDE KULLANILAN SIVI ORGANİK GÜBRENİN AYÇİÇEĞİ (*Helianthus annuus* L.)'NİN VERİM VE VERİM PARAMETRELERİ ÜZERİNE ETKİSİ

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Özet
Ayçiçeği (*Helianthus annuus* L.) genellikle ılıman bölgelerde yetişen bitkilerden biridir ancak farklı türleri farklı hava koşullarında da yetiştirilebilir. Ayçiçeğinin yüksek yağ verimi ve yüksek besin değeri nedeniyle ekim alanı giderek artmakta ve bu özellikleri sebebiyle de dünyanın en önemli yağlı tohumlarından birisi olarak sayılmaktadır. Tarımda toprakların organik madde miktarını arttırmanın yollarından biri, iyi olgunlaşmış hayvan gübresinin toprağa verilmesidir. Ancak, hayvan gübreleri tarlaya götürüldükten sonra hemen toprak yüzeyine serilmeli ve toprağa karıştırılmalıdır. Toprak yüzeyinde uzun süre öbek halinde bırakılan hayvan gübrelerinden besin maddesi ve organik madde kaybı meydana gelir. Bu araştırma organik gübrelerin ayçiçeği verimi ve morfolojik özellikleri üzerine etkisini incelemek ve kimyasal gübre tüketimini azaltmak amacıyla 2023 yılında Sakarya Uygulamalı Bilimler Üniversitesi Ziraat Fakültesi Tarla Bitkileri Bölümü deneme tarlasında yürütülmüştür. Araştırma Tesadüf Bloklarında Faktöriyel deneme desenine göre üç tekerrürlü olarak kurulmuştur. Çalışmada materyal olarak patent tescilli olan PlantiPell sıvı organik gübresi kullanılmıştır. Denemede gübre dozları dört farklı konsantrasyonda (kontrol, 15, 30 ve 45 ml/l), bitkilere uygulama şekli ise 4 farklı şekilde (2-4-6 yapraklı olduğu dönemlerde ayrı ayrı ve hem 2, 4, 6 yapraklı dönemlerde olmak üzere) gerçekleştirilmiştir. Çalışmanın amacı, uygulanan farklı gübre dozlarının farklı gelişme dönemlerinde tohum verimi, yağ oranı ve diğer morfolojik özellikler üzerine etkilerinin belirlenmesidir. Elde edilen verilere göre; araştırmada gübre dozları ile yaprak dönemleri arasında tüm özelliklerde önemli bir interaksiyon olduğu belirlenmiştir. Doğru gübre dozu ve uygun yetiştirme döneminin kullanılmasıyla, başta verim olmak üzere morfolojik özelliklerin arttığını göstermiştir. Bu çalışma sonucunda; incelenen özellikler bakımından uygulanan gübre dozları arasında en uygun sıvı gübre dozu bitkilerin 6 yapraklı olduğu dönemde verilen 30 ml/l gübre olduğu tespit edilmiştir.
Anahtar Kelimeler: Ayçiçeği, organik gübre, gelişme dönemleri, verim.

EFFECT OF LIQUID ORGANIC FERTILIZER USED IN DIFFERENT DEVELOPMENTAL PERIODS ON YIELD AND YIELD PARAMETERS OF SUNFLOWER (*Helianthus annuus* L.)

Abstract
Sunflower (*Helianthus annuus* L.) is a plant that generally grows in temperate regions; however, different types can also be grown under different weather conditions. The cultivation area of sunflower is gradually increasing due to its high oil yield and high nutritional value, and due to these features, it is considered one of the most important oil seeds in the world. One of the ways to increase the organic matter content of soil in agriculture is to add mature animal manure to the soil. However, after animal manure is applied to the field, it should immediately spread on the soil surface and be mixed into the soil. Nutrient and organic matter losses occur from animal manure left in piles on the soil surface for a long time. This research was carried out in the trial field of Sakarya University of Applied Sciences, Faculty of Agriculture, Department of Field Crops in 2023, in order to examine the effect of organic fertilizers on sunflower yield and morphological characteristics and to reduce chemical fertilizer consumption. The research used a factorial trial design in randomized blocks with three replications. Patent-registered PlantiPell liquid organic fertilizer was used in this study. In the trial, fertilizer doses were applied at four different concentrations (control, 15, 30, and 45 ml/l), and the application method to the plants was carried out in four different ways (separately in the periods when they had 2-4-6 leaves and both in the periods with 2, 4, and 6 leaves). This study aimed to determine the effects of different fertilizer doses on seed yield, oil content, and other morphological characteristics during different developmental periods. According to the data obtained, there was a significant interaction between fertilizer dose and leaf period in all characteristics. It has been shown that morphological characteristics, especially yield, increase with the use of the correct fertilizer dose and appropriate growing period. As a result of this study, among the fertilizer doses applied in terms of the examined characteristics, the most appropriate liquid fertilizer dose was determined to be 30 ml/l fertilizer given when the plants had six leaves.
Keywords: Sunflower, organic fertilizer, development periods, yield.

FİĞ-TRİTİKALE SİLAJ KARIŞIMINA EKLENEN FARKLI KATKI MADDELERİNİN SİLAJ KALİTESİ ÜZERİNE ETKİLERİNİN BELİRLENMESİ

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Özet
Bu araştırma, adi fiğ (*Vicia sativa* L.) ve tritikale (*xTriticosecale* Wittmack) bitkilerinin yalın ve farklı oranlardaki karışımlarına ilave edilen melas (M), peynir altı suyu (PAS) ve turunçgil posası (TP) olmak üzere üç farklı silaj katkı maddesinin silaj kalitesi üzerine etkilerinin belirlenmesi amacıyla Sakarya Uygulamalı Bilimler Üniversitesi Ziraat Fakültesi Tarla Bitkileri Laboratuvarı'nda yürütülmüştür. Çalışmaya konu olan bitkiler yalın, %25, %50 ve %75 oranlarında karıştırılmıştır. Yalın silajlar ve karışımlar 3 tekerrür olarak kurulmuş olup, karışımlara; %4 melas, %3 peynir altı suyu ve %2 turunçgil posası ilave edilmiştir. Silajların ham protein (HP), asit deterjan lif (ADF), nötr deterjan lif (NDF), kuru madde (KM), pH, ham kül (HK), fosfor (P), potasyum (K), kalsiyum (Ca) ve magnezyum (Mg) içerikleri incelenmiştir. Ayrıca flieg puanı ve fiziksel analiz kriterleri de (koku, renk ve strüktür) tespit edilmiştir. Özellikler arasında; HP, K, P ve pH özellikleri açısından uygulamalar istatistiksel olarak %1, HK, ADF, NDF, Ca, Mg ve KM parametrelerinde ise %5 düzeyinde farklılıklar saptanmıştır. Yapılan analizler sonucunda en yüksek HP oranı %17.51 ile (%75 F+%25 T)+PAS, en yüksek ADF oranı %40.81 ile (%50 F+%50 T)+M, en yüksek NDF oranı ise %57.46 ile (%50 F+%50 T)+PAS katkı maddeli silaj karışımlarından elde edilmiştir. Flieg puanlarına göre değerlendirme yapıldığında; (%75F+%25T)+TP, (%75F+%25T)+PAS, %100F+TP ve %100F+PAS silaj karışımlarının memnuniyet verici olarak değerlendirildiği, fiziksel analiz kriterlerine göre yapılan değerlendirmede ise puanlamanın 3.75-18.25 arasında değişiklik gösterdiği tespit edilmiştir. Silaj katkı maddesi özelinde; karışımda fiğ oranının artmasına paralel olarak ham protein, ham kül, K, P, Mg ve Ca içeriğinde olumlu, buna karşın pH değerinde ise olumsuz etki ettiği tespit edilmiştir. Melas ilave edilen silajlarda; NDF oranın daha düşük, Mg oranının ise daha yüksek olduğu saptanmıştır. Sonuç olarak yem bitkilerinden yalın halde silaj yapmak yerine baklagil-buğdaygil karışım halinde yapılmasının silaj kalitesini olumlu yönde etkilediği, karışım halinde yapılan silajlara katkı maddelerinin ilavesinin silaj kalitesini olumlu yönde etkileyeceği söylenebilir.
Anahtar Kelimeler: Adi fiğ, Tritikale, Silaj kalitesi, Sialj katkı maddesi

DETERMINATION THE EFFECTS OF DIFFERENT ADDITIVES ADDED TO VETCH-TRITICALE SILAGE MIXTURE ON SILAGE QUALITY

Abstract
This research was conducted at the Field Crops Laboratory of Sakarya University of Applied Sciences, Faculty of Agriculture, with the aim of determining the effects of three different silage additives, namely molasses (M), whey (W), and citrus pulp (CiP), added to pure and mixtures of common vetch (*Vicia sativa* L.) and triticale (*xTriticosecale* Wittmack) plants on silage quality. The plants involved in the study were mixed in pure form and at ratios of 25%, 50%, and 75%. The pure silages and mixtures were established with three replications, and three different silage additives (4% molasses, 3% whey, and 2% citrus pulp) were applied to each mixture. The silages were analyzed for crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), dry matter (DM), pH, crude ash (CA), phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg) contents. In addition, Flieg point and physical analysis criteria (odour, color, and structure) were determined. The statistically significant differences were observed among the silages in terms of CP, K, P, and pH parameters at a 1% level, and CA, ADF, NDF, Ca, Mg, and DM parameters at a 5% level. As a result of the analyses, the highest CP content was obtained from (%75 V+%25 T)+W with 17.51%. The highest ADF content was (%50 V+%50 T)+M eith 40.81%, while the highest NDF content was (%50 V+%50 T)+W with 57.46%. According to the Flieg scores, (%75 V+%25 T)+CiP, (%75 V+%25 T)+W, %100V+CiP, and %100V+W silage mixtures were evaluated as satisfactory, while the evaluation based on the physical analysis criteria resulted in scores ranging from 3.75 to 18.25. Regarding the silage additives, it was determined that as the ratio of common vetch in the mixture increased, it had a positive effect on CP, CA, K, P, Mg, and Ca contents, but had a negative effect on pH. Silages with molasses added had a lower NDF content and a higher Mg content. In conclusion, it can be stated that making silage mixture of legumes and cereals, rather than in pure form, has a positive effect on silage quality. Additionally, the addition of additives to silages made in mixture form has a positive effect on silage quality.
Keywords: Common vetch, Triticale, Silage quality, Silage additives

SAKARYA EKOLOJİK KOŞULLARINDA YETİŞTİRİLEN ADİ FİĞ+TRİTİKALE'NİN FARKLI KARIŞIM ORANLARININ YEŞİL OT VERİMİ VE SİLAJ KALİTESİ ÜZERİNE ETKİLERİ

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Özet
Bu çalışma ile Sakarya ili koşullarında saf fiğ, saf tiritikale, %75 fiğ+%25 tiritikale, %50 fiğ+%50 tiritikale, %25 fiğ+%75 tiritikale olacak şekilde ekilerek, karışım oranlarının ot verimi üzerine etkisi ortaya konmuştur. Ayrıca elde edilen karışımlardan silaj yapılıp, uygulanan karışım oranlarının silaj kalitesi üzerine etkisi de belirlenmiştir. Araştırmanın tarla denemeleri Sakarya Uygulamalı Bilimler Üniversitesi Ziraat Fakültesi uygulama alanlarında yürütülmüştür. Denemede bitki boyu, yeşil ve kuru ot verimi gözlemleri alınmıştır. Her parselden 2 şer kilogramlık kaplarda silaj yapılmış olgunlaşma süresi sonunda silaj kalite kriteri olarak; silaj kuru madde oranı, silaj pH'sı, ham protein oranı, ADF ve NDF gözlemleri alınmıştır. Silaj kalitesini belirlemede kullanılan fiziksel ve duyusal analizlerle flieg puanı hesaplaması da yapılarak, karışımlardan elde edilen silajların detaylı olarak tanımlanması yapılmıştır. Elde edilen değerlere göre bitki boyu; yalın tritikalede 83.22 cm, %75 Fiğ + %25 Tritikale karışımında ise 98.33 cm olarak belirlenmiştir. Benzer şekilde yalın fiğde 127.00 cm iken, %25 Fiğ + %75 Tritikale karışımında 142.67 cm olarak tespit edilmiştir. Denemede en yüksek yeşil ot verimi yalın ekilen fiğden elde edişlmiştir. En düşük yeşil ot verimi ise %75 Fiğ + %25 Tritikale karışımından elde edilmiştir. En yüksek ADF, NDF, HP, Kül, Ca, Mg, P ve pH değerleri sırasıyla %100 Tritikale (%40.69), %100 Tritikale (%63.77), %100 Fiğ (%19.16), %100 Fiğ (%20.72), %100 Fiğ (%1.40), %100 Fiğ (%5.28), %100 Fiğ (%0.40), %100 Fiğ (%0.42) ve %100 Fiğ (5.25). Flieg puanlamalarına göre yapılan değerlendirmede %50F+%50T karışımından elde edilen silajın iyi, fiziksel analize göre ise tritikalenin yalın silajının pekiyi, diğer bütün karışım silajlarının memnuniyet verici olduğu tespit edilmiştir. %75 Fiğ + %25 Tritikale karışımından birim alandan yüksek yeşil ve kuru ot elde edileceği ve bu karışımdan elde edilecek silajın da iyi kalitede olacağı söylenebilir.
Anahtar Kelimeler: Fiğ, Tritikale, Karışık ekim, Silaj, Verim ve kalite

THE EFFECTS OF DIFFERENT MIXTURE RATIOS OF COMMON VETCH + TRITICALE GROWN IN SAKARYA ECOLOGICAL CONDITIONS ON GREEN FORAGE YIELD AND SILAGE QUALITY

Abstract
This study was conducted in the conditions of Sakarya province to investigate the effect of different ratios of pure vetch, pure triticale, 75% vetch+25% triticale, 50% vetch+50% triticale, and 25% vetch+75% triticale on forage yield. Additionally, the impact of the applied mixture ratios on silage quality was determined by making silage from the obtained mixtures. Field trials of the research were carried out in Sakarya University of Applied Sciences Trial Area, in experiment; plant height, green forage yield, and dry forage yield were observed. Silage quality criteria, including silage dry matter content, silage pH, crude protein content, ADF, and NDF, were measured by taking 2-kilogram samples from each plot after the maturity of silage. Silages obtained from the mixtures were thoroughly characterized through chemical, physical, and sensory analysis as well as Flieg point, to determine their quality. According to the results, in pure sowing, triticale had a plant height of 83.22 cm, while the mixture of 75% vetch + 25% triticale had a plant height of 98.33 cm. Similarly, pure sowing vetch had a plant height of 127.00 cm, whereas the mixture of 25% vetch+75% triticale had a plant height of 142.67 cm. The highest values for ADF, NDF, crude protein, ash, calcium (Ca), magnesium (Mg), phosphorus (P), and pH were recorded in 100% triticale (40.69%), 100% triticale (63.77%), 100% vetch (19.16%), 100% vetch (20.72%), 100% vetch (1.40%), 100% vetch (5.28%), 100% vetch (0.40%), 100% vetch (0.42%), and 100% vetch (5.25%), respectively. According to the Flieg scoring, the silage obtained from the 50% vetch + 50% triticale mixture was rated as "good," while the sole triticale silage was rated as "excellent" based on the physical analysis. All other mixed silages were found to be "satisfactory." It can be concluded that the mixture of 75% vetch+25% triticale provides a high green and dry forage yield per unit area, and the silage obtained from this mixture is of good quality.
Keywords: Commen vetch, Triticale, İntercroping, Silage, Yield and quality

ROLE OF SMALL GTP-BINDING PROTEINS IN ROOT NODULE FORMATION IN MODEL LEGUME PLANT *Medicago truncatula*

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Abstract
Legumes are a large family of plants that, because of their capacity to fix atmospheric nitrogen in symbiosis with rhizobia, are essential components of agricultural ecosystems and an important source in producing food, feed, forage, and other compounds with strong industrial and commercial relevance. During the last decade, the 'omics' technologies of legumes, especially the model legumes, have provided and still provide an unprecedented amount of molecular information that has to be understood in a physiological, developmental, and organismal context. New technologies, for example, high-throughput sequencing, high multiplexed mapping techniques, and rapid development of new bioinformatics tools, have provided further information about current model systems and emerging new models. The latest information on the status of the development of genomic resources and related information in model legumes and some other economically important legume crops are summarized in this presentation. The infection of the plant root by rhizobia triggers several important events in the root cell, forming a nodule - a nitrogen-fixing compartment. Some of the signal molecules involved in the communication between the symbiotic partners have been studied, but little is known about the genes and proteins involved in membrane and protein trafficking and targeting towards the symbiosome, the cellular compartment containing the nitrogen-fixing bacteria in the nodule, which is one of the most important processes in nodule formation and development. The central point of this presentation is to summarize the recent developments in the functional genome, transcriptome, and proteome of model legume plants, especially *Medicago truncatula.* A multidisciplinary approach, including plant and bacterial genetics, molecular biology, life cell imaging, biophysics, and bioinformatics, has been taken to understand the plant-microbe interaction and the biogenesis of root nodules and the genes and proteins involved in nodule formation and efficient nitrogen fixation. Vesicular trafficking plays an important role in rhizobia-root interaction, infection thread formation, and the development of root nodules. I have described the role of several small GTP-binding proteins in symbiosome formation and root nodule development. Furthermore, there is an increasing need to convert scientific results into practical applications or products efficiently. The economic and environmental costs of the heavy use of chemical N fertilizers in agriculture are a global concern. Sustainability considerations mandate that alternatives to N fertilizers must be urgently sought. Nitrogen-fixing biological systems represent an economically attractive and ecologically sound means of reducing external inputs and improving internal resources. I hope the scientific information given in this presentation will be helpful to molecular geneticists, plant breeders, and agronomists to carry out their research efficiently.
Keywords: Small GTP-binding proteins, Symbiosome, root nodule, *Medicago truncatula*, legumes

EVALUATION OF THE POTENTIAL USE OF DUCKWEED FOR CLEANING UP LEATHER WASTEWATER POLLUTION

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ABSTRACT
Domestic or industrial wastewater treatment technologies are being used to recycle and eliminate harmful effects. The treatment methods to be applied vary depending on the nature of the wastewater. Different ways are applied to the treatment of the water used, including physical, chemical, biological, and other treatment methods. In this context, duckweed, a small, freely floating aquatic plant in the family Lemnaceae, was used to decontaminate wastewater from Cr pollution. This project aimed to evaluate the potential use of duckweed, which has a high capacity to remove some organic matter and heavy metals from the wastewater of the leather industry. In this case, Na, P, as well as some heavy metals (Cr, Fe) and some organic components in the wastewater, were analyzed in the duckweed cultivated at different wastewater concentrations (0 ppm, 10 ppm, and 100 ppm). Our results showed that duckweed could be grown safely in wastewaters containing Cr up to 100 ppm.
Keywords: Leather Industry Wastewater, Cr and other metals pollution, Organic Pollution, *Lemna minor*

KESTANE KANSERİNİN BİYOLOJİK KONTROLÜNDE *CRYPHONECTRİA PARASİTİCA*'NIN VEJETATİF UYUM GRUPLARININ ÖNEMİ

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Özet
Cryphonectria parasitica adlı bir fungal patojenin sebep olduğu Kestane Kanseri kestanenin en önemli hastalıklarından biri olarak bilinmektedir. Etkili mücadele yöntemlerinin sınırlı olması nedeniyle hastalık birçok yerde hastalığın kontrol edilememiş ve ciddi sayıda ağaç ölümleri meydana gelmiştir. Hastalığın bilinen en etkili kontrol yöntemi hipovirülent ırkların kullanıldığı (hipovirülenslik) biyolojik kontroldür. Hipovirülent ırkların doğal olarak bulunduğu ya da yapay olarak bulaştırıldığı alanlarda kestane kanserinin şiddeti baskılanmakta ve ağaçlar iyileştirilerek sürdürülebilir bir üretim sağlanabilmektedir. Başlangıçta çok basit gibi görülen hipovirülenslik aslında çok karmaşık bir sistemi içinde barındırmaktadır. Kestane, patojen, hipovirüs ve çevre şartları olmak üzere dört ana bileşen ve bunların interaksiyonları hipovirülensliği farklı yönlerden etkilediği bilinmektedir. Bu çalışmada hipovirülensliği en fazla etkileyen faktörlerin başında gelen *Cryphonectria parasitica*'nın vejetatif uyum (vc) grup çeşitliliği biyolojik mücadele ile ilişkisi yönünden ele alınmıştır. *C. parasitica*'da hipovirülensliğe sebep olan hypovirüslerin bir bireyden diğerine taşınması aynı vc gruplar arasında sorunsuz gerçekleşirken farklı vc gruplar arasında engellenir. Bir populasyonda vc grup sayısı arttıkça hipovirülent bireylerin kendilerine vejetatif yönden uyumlu bireyler ile karşılaşma şanslarının düşmesi nedeniyle biyolojik kontrol olumsuz etkilenir. Vejetatif uyum grup çeşitliliği düşük olan popülasyonlar ise biyolojik mücadele açısından en uygun populasyonlardır. Türkiye de vc grup çeşitliliği düşük sayılabilecek ülkeler arasında yer almakta olup biyolojik kontrolün uygulanabilirliği açısından oldukça avantajlı bir ülkedir. Bu korunabilmesi için vc grup çeşitliliğini arttıracak faktörler olan patojenin eşeyli üremesi ve yeni ırk girişleri gibi hususlar hastalık yönetimi içerisinde mutlaka dikkate alınmalıdır. Özellikle, Ege Bölgesi gibi etmenin henüz eşeyli üremediği ve vc grup çeşitliliğinin düşük olduğu yerlerde, iki eşey tipini bir araya getirecek uygulamalardan kaçınılmalıdır. Bu bölgede yapılacak hipovirülent ırk uygulamalarında kanserli dokulardan alınacak örneklerle patojenin eşey/vc tip analizi yapılmalı ve eşey/vc tip yönünden uygun hipovirülent ırk izolatları uygulamalarda kullanılmalıdır.

Anahtar Kelimeler: Kestane Kanseri, *Cryphonectria parasitica*, Hipovirülenslik, Vejetatif Uyum Grupları, Biyolojik Mücadele

IMPORTANCE OF VEGETATIVE COMPATIBILITY GROUPS OF *CRYPHONECTRIA PARASITICA* IN BIOLOGICAL CONTROL OF CHESTNUT BLIGHT

Abstract
Chestnut blight, caused by a fungal pathogen called *Cryphonectria parasitica*, is known as one of the most important diseases of chestnut. Due to the limited availability of effective control methods, the disease could not be controlled in many places and a significant number of tree deaths occurred. The most effective control method known for the disease is biological control mediated by hypovirulent strains (hypovirulence). In the areas where hypovirulent strains occur naturally or are artificially introduced, the pressure of chestnut blight is suppressed and sustainable production can be achieved by healing the trees. Although hypovirulence seems very simple in appearance, it actually occurs as a result of a very complex system. The four main components, namely chestnut as a host, *C. parasitica* as a pathogen, hypovirus and environmental conditions, and their interactions affect hypovirulence in different ways. In this study, the vegetative compatibility (vc) group diversity of *C. parasitica*, one of the factors that most affects hypovirulence, was discussed in terms of its relationship with the success of biological control. The transmission of hypoviruses from one individual to another in *C. parasitica* occurs freely within the same vc group, but is prevented between different vc groups. As the number of vc groups increases in a population, biological control is negatively affected because hypovirulent individuals have a reduced chance of encountering vegetatively compatible individuals. Populations with low vc group diversity are the most ideal populations in terms of biological control. Turkey with low vc group diversity has a great advantage in terms of the applicability of biological control. To sustain this advantage, factors, such as sexual reproduction of the pathogen and new race introductions, which play important roles in increasing vc group diversity, must be considered in chestnut blight management. As in the Aegean region, where *C. parasitica* does not reproduce sexually and where vc group diversity is low, any practices that bring the two sexual mating types together should be avoided. The mating/vcg genotyping analysis of the pathogen isolate taken from the canker should be determined before the treatment and hypovirulent strains with the appropriate mating/vcg genotype should be applied.
Keywords: Chestnut blight, *Cryphonectria parasitica*, Hypovirulence, Vegetative Compatibility Groups, Biological Control

CHROMIUM TOLERANCE, BIOACCUMULATION, AND LOCALIZATION IN DIFFERENT VARIETIES OF *BRASSICA JUNCEA*

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Abstract
Brassica juncea, also known as Indian mustard or Brown mustard, is one of the world's major industrial oil crops. It is valuable commercially because it provides raw materials for many industries, including animal feed, biodiesel, cooking oil, and medicine. Interestingly, compared to other *Brassica* spp., *Brassica juncea* has a high potential for metal accumulation and tolerance and high biomass output. By assessing Cr bioaccumulation and localization in plant tissues under varied Cr levels, this study investigated the capabilities of some well-known *B. juncea* varieties for Cr tolerance and remediation. In addition, bioaccumulation and localization of Cr were analyzed in plants grown at different Cr levels (0, 10, 50, 100, 200, 500, and 1000 µM). The accumulation of Cr in roots, leaves, and stems was measured using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES). The results showed that some *Brassica juncea* varieties had high Cr tolerance and played an important role in extracting soil Cr, while roots were the main compartments of Cr accumulation. Our results showed that *B.juncea* Sindh raya was Cr-tolerant, and *B.juncea* early Raya was Cr-sensive. Cr- accumulated more in the root tissues than in the shoot and leaf tissues in *B. juncea* var. early Raya. Since they can thrive in soils with elevated Cr concentrations, these plants could be considered metal excluders or tolerants. We propose that Cr excluder or tolerant varieties of *B. juncea* could be cultivated in Cr-polluted areas surrounding Uşak's industrial zones and other mining areas throughout Turkey.
Keywords: phytoremediation, *Brassica juncea*, chromium (Cr), inductively coupled plasma optical emission spectroscopy (ICP-OES)

BUĞDAYIN FARKLI FENOLOJİK DÖNEMİNDE BAZI HERBİSİTLERİN YABANCI OT TÜRLERİNE ETKİLERİ

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Özet
Dünya gıda ürünleri alanında birinci derecede öneme sahip olan tahıllar, özellikle gelişmekte olan ülkelerde beslenme ve kalori alımının temel kaynağı olduğu için, artan nüfusun küresel gıda talebini karşılamak için hayati öneme sahiptir. Buğday üretim ve verimi, çeşitli biyotik ve abiyotik faktörlerden doğrudan etkilenmekte olup bu faktörlerden biri de yabancı otlardır. Su, besin maddeleri ve ışık için ürün ile rekabet eden ve verim kaybına neden olan yabancı otlar; sadece verimi düşürmekle kalmaz, aynı zamanda ürünün kalitesini de bozarak pazar değerini düşürmektedir. Bu amaçla buğdayın üç farklı fenolojik döneminde (BBCH skalasına göre kardeşlenme başlangıcı (21-22), kardeşlenme ortası (24-25) ve kardeşlenme sonu (29-30)) herbisit uygulamalarının etkinliğinin değerlendirildiği çalışmada herbisitlerin tavsiye dozları ele alınmıştır. Çalışma Tesadüf Blokları Deneme desenine göre 4 tekerrürlü olarak yürütülmüştür. Buğdayın farklı fenolojik döneminde herbisit uygulamaları sonucu elde edilen veriler *G. tricornutum* mücadelesinde ele alındığında; etkinlik değerlerinde değişkenlik görülmüştür. Herbisit uygulamaları sonucunda yoğunluk azalışında 2.4-D asite eşdeğer dimethyl amin tuzu, Aminopyralid+Florasulam, Pyroxsulam+Florasulam+Cloquintocet-mexyl kontrolden ve diğer herbisitlerden farklı bulunmuş ve % 90 üzerinde etkinlik sağlayarak önemli görülmüştür. % kaplama azalışında elde edilen değerler bakımından tüm herbisitler kontrole oranla farklı bulunmuştur.
Anahtar Kelimeler: *Galium tricornutum*, Yabancı ot Kontrol, Herbisit, Buğday, Farklı Fenolojik Dönem

EFFECTS OF SOME HERBICIDES ON WEED SPECIES IN DIFFERENT PHENOLOGICAL PERIODS OF WHEAT

Abstract
Cereals are of primary importance in the world's food supply. They are vital to meet the global food demand of a growing population, as they are the main source of nutrition and caloric intake, especially in developing countries. Various biotic and abiotic factors, including weeds directly influence wheat production and yield. Weeds, which compete with the crop for water, nutrients, and light and cause yield loss, reduce the yield and quality of the product and reduce its market value. In this study, the effectiveness of herbicide applications was evaluated at three different phenological stages of wheat (according to the BBCH scale: tillering initiation (21-22), tillering middle (24-25), and tillering end (29-30)). The recommended doses of herbicides were discussed. The study was conducted with 4 replicates according to the Randomized Block Design. When data obtained as a result of herbicide applications in different phenological period of wheat were considered in the control of *Galium tricornutum*; variability in efficacy values was observed. As a result of herbicide applications, 2.4-D, Aminopyralid+Florasulam, Pyroxsulam+Florasulam+Cloquintocet-mexyl were found to be different from control and other herbicides and were considered important by providing over 90% efficacy. All herbicides were different compared to the control in terms of % cover reduction values.
Keywords: *Galium tricornutum*, Weed Control, Herbicide, Wheat, Different Phenological Period

ÇİLEKTE TOPRAK KAYNAKLI BAZI PATOJENLERE KARŞI ADAÇAYI (*Salvia officinalis* L.) UÇUCU YAĞININ İN VİTRODA GAZ VE KONTAK ETKİLERİNİN BELİRLENMESİ

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Özet

Tüm dünyada olduğu gibi ülkemizde de çilek üretiminde aynı ekim alanlarının yıllardır kullanılması ile birlikte bazı toprak kaynaklı hastalık etmenlerinin çilek üretimini tehdit ettiği bilinmektedir. Çileklerde taç ve kök çürüklüğüne sebep olan bu funguslar ülke ve bölgelere göre değişmekle birlikte genel olarak *Rhizoctonia*, *Fusarium*, *Phytophthor*a, *Macrophomina*, *Pythium* cinslerini kapsamaktadır. Pestisitlerin kullanımı, bitki hastalıklarına karşı kısa vadede etkili olmasına rağmen insan, hayvan ve çevre sağlığına ve birçok organizmaya zarar vermektedir. Bu hastalıklar ile mücadele sentetik kimyasal fungisitlerin kullanıldığı geleneksel kimyasal mücadele stratejileri, bazen çilek üretim alanlarında fungisite dirençli izolatların ortaya çıkmasına neden olmuştur. Bu fungisitlerin kullanımı azaltmak amacıyla çevre dostu ve sürdürülebilir alternatif ürün arayışı ortaya çıkmıştır. Uçucu yağlar, bitkiler tarafından sentezlenen, tozlayıcıları çeken ve zararlı mikroorganizmalara karşı savunma mekanizmaları da dahil olmak üzere çeşitli ekolojik işlevlere sahip olan kompleks yapıda birçok uçucu aromatik bileşenden oluşmaktadır. Monoterpenler, aldehitler, alil fenoller, alkoller, asitler ve esterler bitki uçucu yağlarının ana bileşenleridir. Birçok çalışmada bitki uçucu yağlarının patojenlere karşı antifungal etkisinin olduğu bilinmektedir. Bu çalışmada kimyasal fungisitlerin yerine daha etkili ve güvenli bir yaklaşım olabilecek diğer alternatif uygulamaların potansiyel kullanımlarını araştırmak amacıyla in vitro koşullarda yürütülmüştür. Bu çalışmada çilek üretim alanlarında patojen olan *Fusarium proliferatum, F. oxysporum, F. arthrosporoides, F. oxysporum fsp. fragariae ve Macrophomina phaseolina*'ya karşı adaçayı (*Salvia officinalis* L.) uçucu yağının *in vitro* koşullarda farklı dozlarının kontak ve gaz etkisinin patojenlerin miseliyal gelişimine etkisini belirlemek amacıyla yapılmıştır. Bu amaçla patojen izolatların, Patates Dekstroz Agar (PDA) besiyerinde 25°C' de gelişen 7 günlük kültürleri kullanılmıştır. Uçucu yağın gaz etkisinin belirlenmesinde antibiyogram disk yöntemi kullanılmıştır. İçerisinde PDA (10 ml/petri) bulunan steril petri kaplarına (70 mm çapında) patojenlerin 7 günlük gelişen kültürlerinden alınan 5 mm çapındaki miselyum disklerinin ekimi yapılmıştır. Ekim yapılan petrilerin kapaklarına yerleştirilen antibiyogram disklere mikropipet yardımıyla uçucu yağın 1; 2,5; 5 ve 10 mg/L dozları verilmiştir. Kapaktaki antibiyogram diske uçucu yağ ilave edilmeyenler kontrol olarak kullanılmıştır. Kontak etkisinin belirlenmesin de uçucu yağın 2.5, 5, 10 ve 20 mg/L dozları doğrudan besiyerine uygulanmış homojen olarak karışması sağlanmış

ve patojenlerin benzer şekilde ekimi yapılmıştır. Besiyerine uçucu yağ ilave edilmeyen petriler kontrol karakteri olarak kullanılmıştır. Her iki yöntem ile uygulama yapılan petriler etrafı parafilm ile kapatılarak 25 °C' de 7 gün inkubasyona bırakılmıştır. Deneme sonunda patojenlerin 3, 5,7, 9 ve 11. günlerde miseliyal gelişimi (mm) ölçülmüş ve kontrollere göre bitki uçucu yağlarının % engelleme oranları hesaplanmıştır. Deneme tesadüf parsellerinde bölünen bölünmüş parseller demene desenine göre 4 tekerrürlü olarak kurulup yürütülmüştür. Denemede adaçayının patojene karşı gaz ve kontak etkisi istatistiksel olarak değerlendirilmiş ve ortalama miseliyal gelişim değerleri arasındaki farkların kontrole göre önemli olduğu belirlenmiştir ($p<0.01$). Denemede kullanılan adaçayı uçucu yağının bileşen analizleri GC-MS cihazıyla tespit edilmiştir. Yapılan analizde uçucu yağın 27 farklı bileşenden oluştuğu ve ana bileşen olarak en fazla % 20,08 oranında *Camphor* bulunduğu, ayrıca % 13,94 *α-thujone*, %11.77 *β-thujone* ve % 9,54 *1,8 cineole* bulunmuştur. Elde edilen sonuçlara göre uçucu yağın gaz etkisi patojenlerin miseliyal gelişimi açısından değerlendirildiğinde; inkübasyondan sonra 3. günde yapılan ölçümlerde en yüksek dozda (10 mg/L) en fazla engelleme etkisi göstermiştir. Buna göre sırasıyla *F. arthrosporoides* (%71,91), *F. proliferatum* (%67,57), *F. oxysporum*'un (%66,9) miseliyal gelişimini en fazla engellerken, *M. phaseolina*'nın (%22,03) ve *F. oxysporum* f.sp. *fragariae* (%21,03) miseliyal gelişimini ise en az engellemiştir. Uçucu yağın kontak etkisinde ise benzer şekilde inkübasyondan sonra 3. günde en yüksek dozda (20 mg/L) en fazla engelleme etkisi göstermiştir. *F. oxysporum*'un miseliyal gelişimini %100 engellerken, sırasıyla *F. proliferatum* (%94,78), *M. phaseolina* (% 93,64), *F. arthrosporoides* (%83,25), *F. oxysporum* f.sp. *fragariae*'nın (%78,58), miseliyal gelişimini en fazla engellemiştir. Her iki uygulamada da miseliyal gelişimi en az engellenen patojen *M. phaseolina* olmuştur. Uçucu yağın etkisinin her iki uygulamada da tüm dozlarda inkubasyondan sonra 5,7, 9 ve 11. günlerde azaldığı belirlenmiştir. Çalışmada adaçayı uçucu yağının gaz ve kontak uygulamalarının patojenlere karşı etkileri artan dozlarda ve ve günlerde farklı oranlarda olmuştur. Sonuç olarak daha sonra yapılacak çalışmalarda patojenlere karşı antifungal etkisi yüksek olan bitki uçucu yağlarının sinerjistik etkilerinin ortaya konması uygun olacaktır.

Anahtar Kelimeler: *Macrophomina phaseolina*, *Fusarium oxysporum* f.sp. *fragariae*, *F. oxysporum, F. arthrosporoides, F. proliferatum*, uçucu yağ, kimyasal yapı, antifungal aktivite

DETERMINATION OF THE VAPOR AND CONTACT EFFECTS OF SAGE (*Salvia officinalis* L.) OIL AGAINST SOME SOIL-BORNE PATHOGENS OF STRAWBERRY IN VITRO CONDITIONS

Abstract

As in the whole world, some soil-borne disease agents threaten strawberry production with the use of the same cultivation areas in strawberry production in Turkey. These fungi that cause crown and root rot in strawberries vary according to countries and regions, but generally include *Rhizoctonia*, *Fusarium*, *Phytophthora*, *Macrophomina*, *Pythium* genus. Although the use of pesticides is effective against plant diseases in the short term, it harms human, animal and environmental health and many organisms. Conventional chemical control strategies using synthetic chemical fungicides to control these diseases have sometimes led to the emergence of fungicide-resistant isolates in strawberry production areas. In order to reduce the use of these fungicides, the search for environmentally friendly and sustainable alternative products has emerged. Essential oils are complex mixtures of many volatile aromatic compounds synthesized by plants that have various ecological functions, including pollinators and providing defense mechanisms against harmful microorganisms. Monoterpenes, aldehydes, allyl phenols, alcohols, acids, and esters are the main components of plant essential oils. Many studies have found that plant essential oils have antifungal effect against pathogens. This study was carried out under in vitro conditions to investigate the potential use of other alternative applications that may be a more effective and safer approach to replace chemical fungicides. This study was conducted to determine the contact and vapour effects of sage (*Salvia officinalis* L.) essential oil against *Fusarium proliferatum*, *F. oxysporum*, *F arthrosporoides*, *F.oxysporum* fsp.*fragariae* and *Macrophomina phaseolina* pathogens in strawberry in vitro conditions. For this objective, 7-day cultures of pathogen isolates grown in Potato Dextrose Agar (PDA) medium at 25°C were used. Antibiogram disk method was used to determine the vapor effect of essential oil. Mycelium discs of 5 mm diameter obtained from 7-day-old cultures of pathogens were inoculated into sterile petri dishes (70 mm diameter) containing PDA (10 ml/petri dish). The antibiogram disks placed on the lids of the inoculated petri dishes were injected with 1, 2.5, 5 and 10 mg/L doses of essential oil using a micropipette. The antibiogram disks without essential oil were used as control. In the determination of the contact effect, 2.5, 5, 10 and 20 mg/L doses of essential oil were applied directly to the medium, homogeneous mixing was ensured and pathogens were inoculated similarly. Petri dishes in which essential oil was not added to the medium were used as control. Petri dishes prepared with both methods were covered with parafilm and incubated at 25 °C for 7 days. At the end of the experiment, mycelial growth (mm) of pathogens was measured on days 3, 5, 7, 9 and 11 and the % inhibition rates of plant essential oils were calculated compared to the controls. The experiment was established and conducted according to the split split plots design with 4 replicates. In the experiment, the vapor and contact effect of sage against the pathogen was statistically evaluated and it was determined that the differences between the mean mycelial growth values were significant compared to the control ($p<0.01$). Component analysis of sage essential oil used in the experiment was conducted by GC-MS device. The analysis determined that the essential oil consisted of 27 different components and the main component was Camphor with 20.08%,

13.94% α-thujone, 11.77% β-thujone and 9.54% 1.8 cineole. According to the results, when the vapor effect of essential oil was evaluated in terms of mycelial growth of pathogens, it showed the highest inhibition at the highest dose (10 mg/L) in the measurements made on the 3rd day after incubation. Accordingly, mycelial growth of *F. arthrosporoides* (71.91%), *F. proliferatum* (67.57%), *F. oxysporum* (66.9%) was inhibited the highest. Mycelial growth of *M. phaseolina* (22.03%) and *F. oxysporum* f.sp. *fragaria* (21.03%) was least inhibited. Similarly, the contact effect of essential oil showed the highest inhibition effect at the highest dose (20 mg/L) on day 3 after incubation. While it inhibited the mycelial growth of *F. oxysporum* 100%, it inhibited the growth of *F. proliferatum* (94.78%), *M. phaseolina* (93.64%), *F. arthrosporoides* (83.25%), *F. oxysporum* f.sp. *fragariae* (78.58%), respectively. *M. phaseolina* was the least inhibited pathogen in both treatments. The effect of essential oil decreased at 5, 7, 9 and 11 days after incubation at all doses in both treatments. In the study, the effects of vapor and contact applications of sage essential oil against pathogens were at different rates at increasing doses and days. In conclusion, synergistic effects of plant essential oils with high antifungal activity against pathogens also should be revealed in future studies.
Keywords: *Macrophomina phaseolina*, *Fusarium oxysporum* f.sp. *fragariae*, *F. oxysporum, F. arthrosporoides, F. proliferatum*, essential oil, chemical composition, antifungal activity

ÇİLEKTE FUSARİUM SOLGUNLUĞUNA KARŞI BACİLLUS TÜRLERİNİN İN VİTRO KOŞULLARDA ANTAGONİSTİK ETKİSİ

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Özet

Dünya genelinde çilek üretimi ve ihracatının artması iç ve dış pazarda çileğin ekonomik olarak önemini de arttırmaktadır. Tüm dünyada çilek üretimini tehdit eden ve verim kayıplarına yol açan en önemli hastalıklardan biri de *Fusarium oxysporum*'un neden olduğu Fusarium solgunlu hastalığıdır. Bir tür kompleksi olarak tanımlanan *Fusarium oxysporum*'un geniş bir konukçu dizisinde vasküler solgunluğa neden olduğu bilinmektedir. Bununla birlikte bu tür konukçu bitkiye özgü patojenisite esasına dayalı forma speciales'e ayrılmıştır. Günümüzde konukçuya spesifik olan 150 forma speciales bulunmaktadır. Çileklerde Fusarium Solgunluğuna neden olan forma specialis 'in f.sp. *fragariae* olduğu bilinmektedir. *Fusarium oxysporum* f.sp. *fragariae*' nın kökler yoluyla çilek bitkilerini penetre ettiği, kök ve tacın enfeksiyonu sonrası bitkinin hızlı bir şekilde solarak öldüğü belirtilmektedir. Bu hastalıkla mücadelede genel strateji önleyici tedbirlere dayanmaktadır. Hastalıklı bitkiler için etkili bir terapötik tedavi bulunmamaktadır. Dayanıklı çeşitlerin yetiştirilmesi, konukçu olmayan bitkilerle rotasyon, solarizasyon ve çeşitli kültürel uygulamaların hayata geçirilmesini içeren bir IPM yaklaşımı, Fusarium solgunluğundan kaynaklanan ürün kaybını en aza indirmek amacıyla kullanılabilir. Sentetik kimyasalların hastalıkları kontrol etmek için uzun yıllardır kullanılması, insan ve çevre sağlığına zararı ve direnç oluşumuna neden olması ve ayrıca kimyasalların kalıntı sorunları da pazarlamada ciddi sıkıntılara sebep olmaktadır. Son yıllarda hastalıklarla mücadelede kimyasalların kullanımını azaltmak amacıyla yeni alternatif yöntemler oldukça gerekli hale gelmiştir. Bu nedenle bitki hastalıklarıyla mücadele ilk akla gelen yöntemlerden biri de sürdürülebilir, çevre dostu ve uzun süre etkili olabilecek biyolojik mücadele olmaktadır. Toprak kaynaklı patojenlerle mücadelede etkili, uygun fiyatlı ve ticari olarak temin edilebilen biyokontrol ürünleri arayışı ciddi bir şekilde devam etmektedir. Çalışmada *F. oxysporum* f.sp. *fragariae*'ya karşı *Bacillus velezensis*, *B. amyloliquefaciens*, *B. subtilis* ve *Bacillus* spp. izolatlarının *in vitro* koşullarda antagonistik etkinliği değerlendirilmiştir. Bu amaçla ikili kültür testleri yapılmıştır. İnkübasyondan sonra 3, 5, 7, 9 ve 11.günlerde patojenin miseliyal gelişimi ölçülmüştür. Kontrol ile karşılaştırıldığında patojenin miseliyal gelişimi artan günlerde de artarak devam etmiş ve 7 günden sonra tüm *Bacillus* izolatlarının ortalama engelleme etkisi % 50'nin üzerinde olmuştur. Son ölçümde (11.gün) sırasıyla *B. amyloliquefaciens* (%60,13), *Bacillus* spp (%59,06). *Bacillus velezensis* (%57,79), *B. subtilis* (%57,41) patojene karşı en

yüksek antagonistik etkinlik göstermiştir. Çalışma sonucunda belirlenen potansiyel biyolojik mücadele etmenleri *in vivo* koşullarda da gerek tek başına gerekse karışımları patojene karşı denenerek etkileri ortaya konmalıdır.
Anahtar Kelimeler: *Fusarium oxysporum* f.sp. *fargariae*, *Bacillus velezensis, B. amyloliquefaciens, B. subtilis* Antagonizm

ANTAGONISTIC EFFECT OF *BACILLUS* SPECIES AGAINST FUSARIUM WILT IN STRAWBERRY IN VITRO CONDITIONS

Abstract
The increase in strawberry production and exports worldwide increases the economic importance of strawberries in national and international markets. One of the most important diseases that limit strawberry production and cause yield losses all of the world is Fusarium wilt disease caused by *Fusarium oxysporum*. *Fusarium oxysporum*, which is defined as a species complex, is known to cause vascular wilt in a wide host range. However, this species has been divided into forma speciales based on host plant-specific pathogenicity. Today, there are 150 forma speciales that are host-specific. It is known that the forma specialis causing Fusarium wilt in strawberries is f.sp. *fragariae*. *Fusarium oxysporum* f.sp. *fragariae* penetrates strawberry plants through the roots and after infection of the roots and crown, the plant wilts and dies. The general strategy for the management of this disease is based on preventive methods.There is no effective therapeutic treatment for diseased plants. An IPM approach including the cultivation of resistant varieties, rotation with non-host crops, solarization and various cultural practices can be used to minimize crop loss due to Fusarium wilt. The use of synthetic chemicals for controlling diseases for many years has caused serious problems in marketing due to the damage to human and environmental health, the formation of resistance, and the residue problems of chemicals. In recent years, new alternative methods have become essential to reduce the use of chemicals in disease control. For this reason, one of the first methods that comes to mind in the control of plant diseases is biological control, which is sustainable, environmentally friendly and effective for a long time. The need for effective, affordable and commercially available biocontrol products to control soilborne pathogens continues in serious ways. In this study, antagonistic activity of *Bacillus velezensis*, *B. amyloliquefaciens*, *B. subtilis* and *Bacillus* spp. isolates against *F. oxysporum* f.sp. *fragariae* was determined under *in vitro* conditions. For this purpose, dual culture tests were conducted. Mycelial growth of the pathogen was measured on days 3, 5, 7, 9 and 11 after incubation. Compared to the control, mycelial growth of the pathogen continued to increase on increasing days and the average inhibition effect of all *Bacillus* isolates was above 50% after incubation 7 days. In the last evaluation (11th day), *B. amyloliquefaciens* (60.13%), *Bacillus* spp. (59.06%), *Bacillus velezensis* (57.79%), *B. subtilis* (57.41%) showed the highest antagonistic activity against the pathogen, respectively. The potential biological control agents identified as a result of the study should be tested against the pathogen both single and in a mixtures under in vivo conditions and their effects should be investigated.
Keywords: *Fusarium oxysporum* f.sp. *fargariae*, *Bacillus velezensis, B. amyloliquefaciens, B. subtilis* Antagonism

SARI ULAK ZEYTİN ÇEŞİDİNİN SELEKSİYON YOLUYLA ISLAHI

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Özet
Türkiye, 194 milyon ağaç varlığı ile dünyanın önemli zeytin üretici ülkeleri arasında yer almaktadır (Tüik, 2022). Ağaç başına verim ise oldukça düşüktür. Birim alandan elde edilen verimin yükseltilmesi ancak verimli ve kaliteli çeşitlerin veya klonların kullanılmasıyla mümkün olacaktır. Türkiye, zeytinin anavatanında yer almasından dolayı genetik çeşitlilik adına yeterli potansiyele sahiptir. Türkiye'nin genetik zenginliğini ekonomik anlamda ortaya çıkarmak için bu gibi çalışmaların önemi büyüktür. Akdeniz Bölgesinin en önemli yeşil salamuralık çeşidi olan Sarı ulak çeşidinde seleksiyon çalışmasının I. aşaması Adana ve Mersin illerinde yapılarak; meyve verimi, verimde düzenlilik, meyve et oranı ve kg'da bulunan meyve sayısı yönünden puanlamaya tabi tutulmuş ve en yüksek puanları alan 7 klon belirlenmiştir. Seleksiyon-2 aşamasında da Alata ve Gaziantep'te genetik kaynak ve adaptasyon parselleri kurulmuştur. İlk 4 yılda fenolojik gözlemler yapılmış ve morfolojik değerler ölçülmüştür. Bitkilerimizde son 6 yıl itibariyle meyveler görülmeye başlanmış, fenolojik gözlemler, morfolojik özellikler, pomolojik veriler ve yağ özellikleri değerleri alınmıştır. Bu çalışmanın sonunda Sarı Ulak zeytin çeşidinin üstün özellikli klonu belirlenmiştir.
Anahtar Kelimeler: Zeytin, Sarı Ulak, Klon Seleksiyonu.

BREEDING OF SARI ULAK OLIVE VARIETY BY SELECTION

Abstract
Our country is among the world's important olive producing countries with 194 million trees. The yield per tree is quite low. Increasing the yield obtained per unit area will only be possible by using productive and high-quality varieties or clones. Turkey has sufficient potential for genetic diversity due to its location in the homeland of olives. Such studies are of great importance in order to reveal Turkey's genetic richness in economic terms. The first phase of the selection study on the Sarı Ulak variety, the most important green pickled variety of the Mediterranean Region, was carried out in Adana and Mersin provinces; The samples were scored in terms of fruit yield, regularity in yield, fruit-to-flesh ratio and number of fruits per kg, and 7 clones with the highest scores were determined. In the selection-2 phase, genetic resource and adaptation parcels were established in Alata and Gaziantep. In the first 4 years, phenological observations were made and morphological values were measured. Fruits started to appear in our plants in the last 6 years, and phenological observations, morphological characteristics, pomological data and oil properties values were taken. At the end of this study, a superior clone of the Sarı Ulak olive variety was determined.
Keywords: Olive, Sarı Ulak, Clonal Selection.

KIRSAL TOPLUMLARDA YAŞAYAN KADINLARIN HANE İÇİ KARARLARA KATILIMI VE KADINLARIN KARARLARINI ETKİLEYEN FAKTÖRLERİN BELİRLENMESİ: SAMSUN İLİ ÖRNEĞİ

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Özet
Kırsal topluluklarda yaşayan kadınlar hane içinde alınan kararlarda önemli bir rol oynamakta, bu durum aile refahı ve kırsal ekonomi açısından önem taşımaktadır. Kırsal alanlarda kadınların karar alma süreçlerine aktif olarak katılmaları, kırsal kalkınma açısından dolayısıyla da bölge ve ülke kalkınması açısından da katkı sağlayacaktır. Bu nedenle kırsal alanlarda yaşayan kadınların karar alma süreçlerine katılımını etkileyen faktörlerin tespit edilmesi gerekmektedir. Bu çalışmada, Samsun ilinde kırsal alanlarda yaşayan kadınların hane içi kararlara katılma durumları ve bu kararlara katılmalarını etkileyen faktörlerin tespit edilmesi amaçlanmıştır. Bu temel amaç altında Samsun ili kırsalında yaşayan ve basit tesadüfi örnekleme yöntemi ile seçilen 431 kadın ile yüz yüze anket çalışması yapılmıştır. Araştırmanın kalitatif verilerini araştırma alanında gerçekleştirilen derinlemesine görüşmeler ve araştırmacıların gözlemleri oluştururken, kantitatif verilerini ise araştırma alanında yapılmış olan anket çalışmasından elde edilmiş olan veriler oluşturmuştur. Verilerin analiz edilmesinde tanımlayıcı istatistiklerden ve karşılaştırmalı analizlerden yararlanılmıştır. Araştırma bulguları kırsal alanda yaşayan kadınların büyük çoğunluğunun bitkisel üretimde yetiştirilecek ürün çeşidinin belirlenmesi ve bitkisel ve hayvansal ürünlerin pazarlamasında etkin bir şekilde kararlara katıldığını, hane içinde ise evde yapılan büyük ve küçük harcamalarda söz sahibi olduğunu göstermektedir. Bununla beraber, araştırma bölgesindeki kadınların tarım dışı işlerde, kredi ve finansman kullanımı ile ilgili kararlarda daha pasif olması araştırmanın önemli bulguları arasındadır. Bulunan diğer bir önemli bulgu ise karar almada aktif olarak söz sahibi olan ve olmayan kadınların sosyo-demografik özelliklerinde farklılıklar olması ve bölgenin kültürel yapısının kadınların karar alma süreçlerine katılmasında etkisinin olduğunu göstermektedir. Bu çalışmanın sonuçlarının politika yapıcılar, sivil toplum kuruluşları ve araştırmacılar tarafından kadınların karar alma süreçlerinde aktif ve pasif kaldığı alanların detaylı olarak tespit edilerek kırsal kalkınma politikalarının şekillenmesine yardımcı olacağı düşünülmektedir.
Anahtar Kelimeler: Karar Alma, Kırsal Kalkınma, Kırsal Kadın, Katılım

PARTICIPATION OF WOMEN IN HOUSEHOLD DECISION-MAKING AND FACTORS INFLUENCING THEIR CHOICES: A CASE STUDY OF RURAL COMMUNITIES IN SAMSUN PROVINCE

Abstract
Women living in rural communities play an essential role in household decisions, which is vital for family welfare and the rural economy. The active participation of women in decision-making processes in rural areas will contribute to rural development and, thus, the development of the region and the country. Therefore, it is necessary to identify the factors affecting the participation of women living in rural areas in decision-making processes. This study aimed to determine the participation of women living in rural areas in Samsun province in household decisions and the factors affecting their participation in these decisions. Under this primary objective, a face-to-face survey was conducted with 431 women living in rural Samsun province and selected by simple random sampling method. The qualitative data of the study consisted of in-depth interviews and observations of the researchers in the research area, while the quantitative data consisted of the data obtained from the questionnaire study conducted in the research area. Descriptive statistics and comparative analysis were used to analyze the data. The research findings show that most women living in rural areas actively participate in deciding the type of crops to be grown in crop production, and marketing of plant and animal products and have a say in large and small expenditures made at home within the household. However, women in the study area are more passive in non-agricultural work, credit and financing decisions. Another important finding is that there are differences in the socio-demographic characteristics of women who have an active voice in decision-making and those who do not and that the region's cultural structure impacts women's participation in decision-making processes. It is thought that the results of this study will help policymakers, civil society organizations and researchers to shape rural development policies by identifying in detail the areas where women remain active and passive in decision-making processes.
Keywords: Decision-making, Rural Development, Rural Women, Participation

CLASSIFICATION OF SECOND ORDER ORDINARY DIFFERENTIAL EQUATIONS USING LAMBDA SYMMETRIES

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Abstract
This research investigates the application of differential equations (DEs) in modeling dynamic phenomena across scientific domains. Nonlinear DEs, common in natural processes, pose significant challenges, but Lie symmetries offer effective solutions by transcending order, linearity, and homogeneity constraints. Identifying symmetries simplifies both partial and ordinary DEs, streamlining problem-solving. The study also delves into λ-symmetries, which extend Lie symmetries and provide new avenues for tackling nonlinear ODEs and PDEs. It conducts a comparative analysis of Lie and λ-symmetries, focusing on categorizing second-order linear and nonlinear ODEs through symmetry identification. By solving equations using both approaches, the research enhances our understanding of the interplay between Lie and λ-symmetries in solving complex differential equations.
Keywords: Lie symmetries; Lambda Symmetries; Nonlinear Dynamics; Classification.

INCIDENCE OF DIABETES MELLITUS IN PATIENTS (25 YEARS ABOVE) AT GENEGAL HOSPITAL KATSINA STATE, NIGERIA FROM JANUARY TO JUNE 2020

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Abstract
A study was aimed to investigate the incidence of diabetes mellitus (DM) in patients aged 25 years and above at General Hospital Katsina during the first six months of the year from January to June 2020. A total of 250 cases were identified during this period. The findings revealed a significant burden of DM, with 28.4% of cases occurring in individuals aged 31-40, indicating that this age group is particularly susceptible to the disease. Gender disparities in DM incidence were also evident, with 56.4% of the cases observed in females and 43.6% in males. This suggests that females in the region are more vulnerable to DM, warranting further investigation into potential contributing factors. Recommendations for diabetes prevention and management were also provided, emphasizing the importance of lifestyle modifications and early detection to reduce the burden of this chronic disease. This study highlights the concerning incidence of diabetes mellitus among individuals aged 25 years and above in General Hospital Katsina during the first half of 2020. It calls for concerted efforts to address this health challenge and improve the overall well-being of the community.
Keywords: Diabetes Mellitus, Katsina, Patient, Disease, Gender

ASSESSING SUSTAINABLE GROWTH: ICT AND NATURAL RESOURCE RENT IMPACT ON ENVIRONMENTAL EMINENCE IN BRICS NATIONS

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Abstract
The natural environment has been significantly affected by global economic growth patterns during the past three decades, because of the adverse consequences of climate change. The objective of this study is to examine the impact of natural resource rent, information, and communication technology (ICT), and democracy on the economic growth of the BRICS countries (Brazil, Russia, India, China, and South Africa) during the period spanning from 1990 to 2019. The authenticity of the data was confirmed through the application of econometric techniques, specifically the cross-sectional dependency test and the second-generation panel unit root test. The Driscoll-Kraay estimate technique was employed to do the panel data analysis. The findings indicate that the presence of natural resource rent exacerbates the degradation of environmental quality through the stimulation of carbon emissions and ecological footprint. However, information and communication technology (ICT) plays a role in reducing the severe environmental harm, albeit mostly in situations when natural resource rent is relatively modest. The available empirical evidence indicates that Information and Communication Technology (ICT) plays a crucial role in facilitating the sustainable development of the BRICS nations. There is a pressing call for policymakers to enhance information and communication technology (ICT) to mitigate the adverse impacts of natural resource rent.
Keywords: Natural Resource Rent, ICT, Democracy, Carbon Emissions, Ecological Footprint, BRICS

YEŞİL İLERİ OKSİDASYON PROSESLERİNDE GELİŞMELER

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Özet
Son yıllarda, yeşil ileri oksidasyon prosesleri (İOP) çevresel kirliliğin kontrolü ve organik kirleticilerin eliminasyonu konusunda önemli bir rol oynamaktadır. Bu prosesler, su ve hava matrislerinde bulunan dirençli ve toksik organik bileşenleri etkili bir şekilde parçalamak ve gidermek için tasarlanmıştır. Yeşil İOP, kimyasal, biyolojik ve fiziksel metotlarla yapılan geleneksel arıtma proseslerinin aksine, çoğunlukla enerji yoğun ve zaman alıcı olmamaları sebebiyle tercih edilmektedir. Yeşil İOP, Fenton, foto-Fenton, ozonlama, ultraviyole ışınımı ve titanyum dioksit fotokataliz gibi çeşitli metotlardan oluşmaktadır. Bu prosesler, yüksek reaktiviteye ve geniş spektrumlu kirletici eliminasyon kapasitesine sahip hidroksil radikalleri üretir. İnovatif araştırmalar, hidroksil radikallerini daha etkin ve kontrol edilebilir bir şekilde üretme ve kullanma metodolojilerini geliştirmeye odaklanmaktadır. Teknolojik ve bilimsel gelişmeler sayesinde, yeşil İOP'nin etkinliği ve uygulanabilirliği genişlemekte ve optimize edilmektedir. Nano teknolojinin entegrasyonu, proses verimliliğini ve radikal üretimini artırmaktadır. Aynı zamanda, yeni katalizörler ve reaktör tasarımları, reaksiyon hızını ve kirletici madde bozunumu etkinliğini iyileştirmektedir. Hibrid sistemler ve karma metodlar, yeşil İOP'nin performansını artırma konusunda umut vadetmektedir. Bu sistemler, çeşitli ileri oksidasyon proseslerini birleştirerek sinerjik etkiler yaratmakta ve böylece kirleticilerin daha hızlı ve etkin bir şekilde eliminasyonunu sağlamaktadır. Ayrıca, bu hibrid sistemler enerji verimliliğini artırmakta ve işletme maliyetlerini azaltmaktadır. Yeşil İOP'nin çevre bilimi ve mühendisliği alanında sağladığı bu yenilikler, sürdürülebilir çevresel yönetim ve kirliliğin kontrolü açısından önemli bir ilerleme sunmuştur. Bu prosesler, gelecekte daha temiz, daha güvenli ve daha sürdürülebilir bir çevre inşa etmek için anahtar bir rol oynayabilir. Çalışmalar, bu teknolojilerin optimizasyonu ve geniş kapsamlı uygulamalarının, mevcut ve gelecekteki çevresel zorluklarla başa çıkmak için etkili bir strateji olabileceğini göstermektedir. Bu çalışmada yeşil ileri oksidasyon tür ve mekanizmaları, kullanım alanları ve son gelişmeler detaylarıyla sunulmuştur.
Anahtar Kelimeler: Yeşil ileri oksidasyon prosesleri, hidroksil radikali, nanoteknoloji, hibrit prosesler, kirletici giderimi

ADVANCEMENTS IN GREEN ADVANCED OXIDATION PROCESSES

Abstract
In recent years, green advanced oxidation processes (AOPs) play an important role in controlling environmental pollution and eliminating organic pollutants. These processes are designed to effectively break down and remove persistent and toxic organic compounds found in water and air matrices. Green AOPs is preferred because it is not energy-intensive and time-consuming, unlike traditional treatment processes using chemical, biological and physical methods. Green AOPs consists of various methods such as Fenton, photo-Fenton, ozonation, ultraviolet irradiation and titanium dioxide photocatalysis. These processes produce hydroxyl radicals with high reactivity and broad-spectrum contaminant elimination capacity. Innovative research focuses on developing methodologies to produce and use hydroxyl radicals in a more effective and controllable way. Thanks to technological and scientific developments, the effectiveness and applicability of green AOPs is being expanded and optimized. Integration of nanotechnology increases process efficiency and radical production. At the same time, new catalysts and reactor designs are improving reaction rate and pollutant degradation efficiency. Hybrid systems and mixed methods show promise in improving the performance of green AOPs. These systems create synergistic effects by combining various advanced oxidation processes, thus providing faster and more effective elimination of pollutants. Additionally, these hybrid systems increase energy efficiency and reduce operating costs. These innovations provided by the Green AOPs in the field of environmental science and engineering have provided significant progress in terms of sustainable environmental management and pollution control. These processes can play a key role in building a cleaner, safer and more sustainable environment in the future. Studies show that optimization and wide-ranging applications of these technologies can be an effective strategy for tackling current and future environmental challenges. In this study, green advanced oxidation types and mechanisms, areas of use and recent developments are presented in detail.
Keywords: Green advanced oxidation processes, hydroxyl radical, nanotechnology, hybrid processes, pollutant removal

UŞAK İÇİN MISIRDA YENİ BİR ZARARLI: *Spodoptera frugiperda* (J. E. Smith, 1797) (Lepidoptera: Noctuidae)

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Özet
Dünyada buğday ve pirincin ardından en önemli üçüncü ürün olan mısırın 80 civarında zararlısı olmasına rağmen bu türlerden sadece birkaç tanesi ana zararlı durumundadır. Amerika kıtasının tropikal ve subtropikal bölgelerine özgü olan Güz tırtılı, *Spodoptera frugiperda* (J.E.Smith) (Lepidoptera: Noctuidae), 2016 yılında Batı Afrika ülkelerinde tespit edilmiş ve hızla yayılarak 2020 ve 2021 yıllarında sırasıyla Ürdün ve Suriye'ye ulaşmıştır. Ülkemizde ilk kez 2022 yılında Adana'da tespit edilen bu istilacı türün, 2023 Eylül ve Ekim aylarında Uşak ili Merkez 13 köyünde ikinci ürün mısır ekiliş alanlarında yapılan sürveyleri sonucunda 9 köyde tespiti yapılmış ve larvaların morfolojik olarak incelenmesi sonucunda *S. frugiperda* olduğu saptanmıştır. Ayrıca tespiti yapılan bu tür Ege Bölgesi için yeni kayıt niteliğindedir.
Anahtar Kelimeler: İstilacı Tür, Güz Tırtılı, Ege Bölgesi, Sürvey

A NEW PEST in MAIZE FOR UŞAK (TÜRKİYE): *Spodoptera frugiperda* (J. E. Smith, 1797) (Lepidoptera: Noctuidae)

Abstract
Despite there being around 80 insect pests affecting corn, which is the third most important crop in the world after wheat and rice, only a few of them are considered primary pests. Fall armyworm (Güz tırtılı in Turkish), *Spodoptera frugiperda* (J.E.Smith) (Lepidoptera: Noctuidae), native to America's tropical and subtropical regions, was detected in West African countries in 2016 and rapidly spread to Jordan and Syria in 2020 and 2021, respectively. Surveys related to this invasive species, first identified in Adana, Türkiye in 2022, were conducted in the second crop corn fields in 13 villages of Uşak province during September and October 2023. As a result of morphological examination of the larvae detected in 9 villages, it was determined that they were *S. frugiperda*. Additionally, this species is a new record for the Aegean region.
Keywords: Invasive Species, Fall Armyworm, Aegean Region, Survey

A REVIEW ON MODELS USED IN ASSESSMENT OF NEUROPATHIC PAIN

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Abstract
The focus of this review is on how natural products and their bioactive ingredients can treat neuropathic pain disorders by acting as neuroprotective agents which includes information about neuropathic pain and their types, namely central neuropathy and peripheral neuropathy with their mechanistic involvement of various pathways may contribute to the development of neuropathic pain. It also includes information about treatment modalities for peripheral neuropathy i.e., first-line therapy includes, tricyclic antidepressant, antiepileptic, anticonvulsants and serotonin- noradrenaline reuptake inhibitors (SNRIs) and second-line therapy (opioids, topical capsaicin, lidocaine patch). Several alternative remedies exist, includes non-pharmacological treatments that play a key part in the reduction of neuropathic pain. Bioactive ingredients, provide great efficacy with minimal side effects correlated with synthetic compounds. The main focus is on animal models utilised for the evaluation of neuropathic pain, which include several animal models such as, Streptozotocin Induced diabetic neuropathy in rats and mice is a widely used animal model for assessment of neuropathic pain. Other animal models include, Alloxan-Induced Diabetic Neuropathy, the Spinal Cord Injury (SCI) model, the Chronic Construction Injury model (CCI), the Partial sciatic Nerve Injury model (PNI), Anticancer agents induced neuropathy (vincristine and paclitaxel and Oxaliplatin-induced Neuropathic pain and spinal nerve ligation (SNL) model of neuropathic pain.
Keywords: Neuropathic pain, Streptozotocin, CCI, Oxaliplatin, SCI

ANALYSING THE EFFECTIVENESS OF USING MULTIMODAL TOOLS AND MATERIALS IN ENGLISH LANGUAGE CLASSROOM: A SYSTEMATIC REVIEW

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Abstract
Since the 1990s and up until the early 2010s, systematic reviews of multimodal education in English language classrooms have been done. However, no systematic review has addressed the thematic issues associated with multimodal learning in English language classes. This review seeks to bridge this gap by examining research articles published from 2010 to 2021 on multimodal learning tools and materials used in English language classroom settings. The use of multimodal tools and materials in the English language classroom was shown by a qualitative study of 20 articles found in the search using PRISMA guidelines. Which includes the use of creative and culturally sensitive multidimensional educational tools, multimodal materials, the explicit teaching of multidimensional literacy, the role of influence in multidimensional learning, and multimodal assessments. This article examines the effectiveness of using multimodal tools and materials in current review studies that look at multimodality in English language classrooms. It also makes suggestions for future research.
Keywords: English Language classroom, Multimodal tools, multimodal materials, Multimodal Teaching

FORMATION OF WATER AND NUTRIENT REGIMES FOR CORN UNDER DIFFERENT METHODS OF IRRIGATION AND TILLAGE

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Abstract
According to the results of the analytical review of regulation water, air and nutrient regimes of soils in climate change under different land use systems, it is established that many works are devoted of this topics, but the available results do not cover new climate change conditions. Therefore, there is a growing need to update research on agricultural production against the background of rapid growth in the use of various irrigation methods, tillage technologies, etc. and today this issue needs more detailed and extensive study. The target of our research is to determine the properties of the soil and its biological activity, to calculate the balance of moisture supply, to determine the yield of the crops, and to justify the use of technologies of traditional tillage (TT) and no-till. The objects of research are the soil, its properties changing under TT and no-till, and the production process of crop. The importance of the research is to improve the existing and justify the new management practice, the modern structure of sown areas, taking into account the market situation of products and raw materials; improvement of tillage technologies, minimizing or abandoning tillage; optimization of the fertilizer system and protection of plants from pests; introduction of reclamation complex and soil protection measures; establishment new technologies for growing crops, taking into account advances in genetics, breeding, biotechnology. General methods were used to solve the main goals of research, in particular analytical, calculation-comparative, system analysis, as well as field and laboratory methods, remote sensing methods. The field experiment was established on the basis

of the state enterprise "Experimental Farm" Velyki Klyny" of Institute of Water Problems and Land Reclamation in Kherson region in the Dry Steppe zone of Ukraine. The placement of options in the experiment is successively with three times repetition. Research factors were (i) tillage technologies (no-till & TT; (ii) irrigation methods (drip irrigation – DI & subsurface drip irrigation – SDI). At the experimental area, according to the variants of the experiment according to DI and SDI, the regime of humidification in the layer of 0-50 cm was observed, equal to 75-80% of the lowest soil moisture capacity. The irrigation pipelines (IP) are located on the surface of the soil with 100 cm distance between each of them for DI and IP located in 20 cm deep of soil with 100 cm distance between each of them for SDI. Agrotechnical conditions of corn cultivation were generally accepted for the conditions of the Steppe, except the study factors. Technological operations were carried out using specially designed equipment depending on the methods of tillage. No mechanical operations were performed except for sowing for no-till. Traditional tillage technologies included autumn plowing, double cultivation up to 10 cm. With almost the same amount of irrigation (for 1 watering more under SDI), the total water consumption of corn did not differ significantly and was higher than under DI (6637.1 m^3/ha), i.e. by 2.7% compared to SDI. The balance of soil moisture in the layer of 0-100 cm during the growing season was higher under DI (507.1 m^3/ha), which is 1.4 times higher than under SDI. The highest content of organic matter in the layer of 0-40 cm was under SDI, which was 9.7% higher than under DI and 35% compared to the control (without irrigation). The content of nitrogen (more available for corn) and mobile forms of phosphorus and potassium were characterized as low in all experimental variants, but the highest content was recorded under SDI. Corn plants accumulated biomass and developed better under no-till with SDI compared to no-till with DI. The formation of a high-quality yield of corn grain was noted under SDI with no-till. The weight of 1000 seeds was 405.6 g, which is 1.01 higher than under DI and 1.64 higher than in control plots (without irrigation). Stocks of soil moisture at the end of the growing season in the layer 0-100 cm were higher under no-till (856.8 m^3/ha) by 46.2% compared to TT. Total water consumption was differed by 1.1 times and was more by TT. The organic matter content of TT was 1.20%, which is 6.0% less than under no-till. At TT, the content of nitrogen was higher; the content of mobile forms of phosphorus and potassium was lower compared to plots with no-till. Microorganisms (amino acids, streptomycetes, oligotrophs, and bacteria that use mineral nitrogen), which are early indicators of changes in soil biological properties, had higher rates under no-till compared to TT. The results of the first year of research allowed correcting the impact of different irrigation methods (DI and SDI) on water, air, and nutrient regimes of the soil and the dynamics of the production process of corn under no-till.

Keywords: tillage, no-till, drip irrigation, soil analysis, corn yield.

PROSPECTS OF NATIVE MARE'S MILK PRODUCTION UNDER THE CONDITIONS OF UKRAINE

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Abstract
The quality of mare's milk as a food and raw material is determined by the content of organic matter, it contains enzymes, hormones, immune bodies, in addition, it contains a significant amount of fat- and water-soluble vitamins and trace elements. So, it contains 5 to 10 times more vitamin C than cow's milk. Of the proteins in milk contains casein, albumin and globulin, the ratio of which allows you to form a clot. When fermenting mare's milk, the concentration of the liquid practically does not change, because casein falls out in the form of small flakes. At the same time, mare's milk contains 3 times more albumin than cow's milk, and mare's milk fat has bactericidal properties, including antituberculosis. Due to the special properties of mare's milk, its attractiveness as a food and medicinal product is constantly growing. In Germany, it produces more than thirty types of products, including baby formula. For Example, in the post-Soviet space, the greatest development of the dairy horse breeding is characterized by countries such as Kazakhstan, Kyrgyzstan, the Autonomous Republic of Bashkortostan. While in the post-Soviet space and in Asia the main product of mare's milk processing has always been kumis, in European countries such as Germany and Belgium since the late nineteenth century developed a milk mare farm, whose main product was native mare's milk. The production of native mare's milk is becoming especially important due to the high prevalence of food allergies to cow's milk protein, which now affects about 3% of children under 3 years of age. For therapeutic purposes, mare's milk is increasingly recommended to use fresh. In the conditions of Ukraine, the production of such milk is expedient when using draft mares, which can be used at the same time to obtain young horses and perform light work lasting 2 - 4 hours, or in leisure horse breeding. The economic efficiency of mare's milk production primarily depends on the productivity of mares, which directly affects the payback period of dairy equipment. Productivity of Novoalexandrian heavy draft breed mares for full lactation (210 days), according to various authors, ranged from 1,562-4,870 kg, an average of 2,161-3,035 kg with an average daily milk yield of 8.6-11.8 kg. Such productivity allows at the cost of the maintenance of 1 conditional head of 53.2 thousand UAH and the purchase price

from 29.24 UAH/kg to receive from it up to 35.5 UAH thousands of total income. Thus, the production of native mare's milk is a promising way to increase economic efficiency and social attractiveness of heavy draft horse breeding in Ukraine.

Key words: horses, mare's milk, Novoalexandrian heavy draft breed, mares, daily milk

VEGETABLE PEPPER AS A TECHNICAL CULTURE

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Abstract
Vegetable pepper (*Capsicum annum L.*) is a promising vegetable crop for technical use as a natural dye. This is due to the high content of carotenoids in peppers, which give the fruits of the plant a red color. Depending on the variety, the carotene content in ripe peppers can range from 0.5 to 16.7 mg per 100 g of raw material. A large number of coloring pigments affects the uniformity of grinding of the dye, the saturation and brightness of its color, and accordingly the quality. Therefore, the quality of the dye can be determined visually by the ASTA scale (American Spice Trade Association), which ranges from 40 to 220 ASTA. On the scale, the lighter the color of the powder, the lower the scale, and hence the quality of the dye. According to production standards, quality dye should contain pigment in the range of 140-220 ASTA. Also, according to research conducted at the Department of Agriculture of Kherson State Agrarian University, the quality of natural dye depends on the degree of ripeness of pepper, the presence of crushed seeds in the fruit, partitions and petioles, the content of which reduces product quality. The experiments used a hybrid of Chinese selection with a growing season in the field of 110 days. In appearance, the hybrid corresponds to more spicy varieties, but in terms of taste it belongs to sweet varieties and hybrids. In the freshly ground state the dye has a bright smell of paprika, the taste of the dye powder is absent, the sharpness is absent. In the course of research, the quality and stability of color was tested in the food industry by adding natural dye to bakery and pasta products. By adding different amounts of dye, you can get a color scheme from bright orange to deep dark red. The dye is stable, does not wash out and does not lighten under the influence of high temperatures. However, it is better to store the powder in a dark place or opaque container, as in dry form, with prolonged storage and exposure to direct sunlight, the dye may burn out and lighten.
Keywords: natural dye, food industry, ASTA scale, hybrid.

IMPORTANCE OF IODINE AND SELENIUM IN POULTRY FEEDING

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Abstract
Recently, many countries around the world are conducting a number of studies to establish the norms of mineral nutrition of poultry, finding new sources of mineral supplements. The concentration of iodine in the body of birds ranges from 0.3 to 0.7 mg per 1 kg of live weight. Iodine is found in all tissues and fluids of the bird, but most of it is concentrated in the thyroid gland. Iodine is one of the most important micronutrients needed by poultry. Iodine and the thyroid gland are inextricably linked. This gland has the best antiseptic that kills all resistant and unstable microbes. Iodine is involved in the synthesis of thyroid hormones (thyroxine and triiodothyroxine). Thyroid hormones normalize body functions: regulate growth and activate metabolism, accelerate energy release and normalize the functioning of functional systems. Thyroid hormones affect metabolism: increase amino acid permeability of membrane cells and stimulate synthesis; activate lipolysis, oxidation of fatty acids, increase energy (this action of hormones reduces the concentration of triglycerides, lipoproteins and cholesterol in the blood, increases heat); activate glucose oxidation, glucose resorption in the small intestine; accelerate oxidation and basic metabolism, so the need for oxygen increases, blood circulation and heat transfer become more intense. Iodine deficiency causes hypertrophy of the thyroid gland, slows growth. Iodine and selenium enhance each other's action, normalize metabolic processes, help protect the body. Selenium is part of specific proteins of the body that regulate the permeability of cell membranes, are involved in the destruction of peroxides and free radicals, enhances non-specific resistance and immune reactivity of birds, and stimulates the formation of active thyroid hormones. Lack of iodine and selenium leads to severe diseases of the bird. The use of potassium iodide in combination with selenium and tocopherol allows you to get a dietary egg of the highest category; the iodine content in the egg increases 2-3 times; the weight of eggs increases, its fight decreases; the composition of the shell changes (eggs become thicker); carotene content increases by 18%. Reduced feed consumption - by 18-20%, also noted better preservation of poultry.
Keywords: iodine, selenium, poultry, feeding, norms.

TECHNOLOGICAL ASPECTS OF GROWING TOMATOES WITH DRIP IRRIGATION

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Abstract
South of Ukraine is a unique region in the country. Here there is the greatest amount of sunlight, natural heat, the duration of the frost-free period, various soils, which ensures the effective cultivation of all vegetables, melon crops and other agricultural crops with the highest quality of harvest. The only drawback of the region is the lack of precipitation. The hydrothermal coefficient is equal to 0.6-0.7, that is, for the formation of the planned harvest, 1.5-2 times more water is needed than is provided by precipitation. Therefore, irrigation in the South of Ukraine, which has been known since ancient times, began with vegetables. Currently, almost all vegetables in the region are grown only under irrigation. Melon, grain, industrial, and fodder crops are grown on large areas under irrigation. At the same time, they mainly used sprinkler irrigation, less - surface irrigation along the furrow. At the same time, the indicated methods of irrigation have a very unproductive use of water, during sprinkling, about 30% of the irrigation water evaporates during irrigation, during irrigation in furrows, especially on sandy soils, a portion of the water also filters into the lower layers of the soil and is inaccessible to the roots. Sprinkling and watering in furrows, in addition to the unproductive use of irrigation water, have a number of disadvantages, the agrophysical and chemical properties of the soil deteriorate, and the biological processes in it shift in a negative direction. In recent years, when irrigation water became more expensive due to the energy crisis, world scientists were forced to create an alternative method of irrigation - micro-irrigation, in which irrigation water is used more productively and does not negatively affect the soil. One of the leading places belongs to tomato among vegetable crops. In irrigated vegetable production in the southern region of Ukraine, the leading crop is seeded tomato, which occupies 50-60% of the structure of the planted area of vegetable crops. In modern conditions, the ecological situation in the country has significantly deteriorated. At the same time, the gross harvest of tomato fruits also decreased. In addition, there is a catastrophic decrease in the use of fertilizers, which significantly affect the indicators of fruit quality. However, it is known that only by increasing the dry matter content of fruits by 1%, the yield of tomato products of the canning industry increases by 15-20%, their quality improves, and the cost price decreases. In this regard, there was a need to increase the gross harvest of tomatoes at the expense of new high-yielding varieties, more rational use of fertilizers, the use of irrigation and at the same time obtaining ecologically clean tomato products in the conditions of the southern Steppe of Ukraine, where the main production is concentrated. That is why research on increasing the productivity and quality of tomato fruits in modern conditions due to the use of a complex of agricultural techniques in the south of Ukraine is relevant.
Keywords: tomato, agricultural techniques, irrigation, productivity, quality.

PROSPECTS FOR GROWING SOYBEANS IN UKRAINE

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Abstract
Soybean is one of the most valuable agricultural crops. Among leguminous plants, it has no equal protein content, and in terms of oil content, it is second only to peanuts. It ensures the production of food products useful for humans, highly nutritious fodder for animals, and is an important raw material for the processing industry. The high value of soybeans is determined primarily by the high content of complete protein, which in terms of amino acid composition is close to proteins of animal origin and is well absorbed by humans and animals. Soybean is the main grain legume crop in the world in terms of cultivated area and gross grain yield. It is grown in more than 40 countries on a total area of more than 50 million hectares. Such a wide distribution of soybeans is explained by the universality of its use as an important food, technical, and fodder crop. This is due to the exceptionally favorable combination of organic and mineral substances in the seeds. Soybeans in Ukraine still occupy a small area - up to 75,000 ha or more, depending on the year. In the future, it is planned to bring the soybean plen in Ukraine to at least 500,000 hectares. Grain production in the Kherson region is characterized by certain changes, which in recent years are associated with the appearance of a fairly clear trend of its decrease. The main areas of culture were concentrated on irrigated lands. The development of quantitative approaches to the assessment of plant adaptation to various growing conditions in specific soil and climatic conditions is an important condition for ensuring purposeful adaptation of the plant world in the direction of the most effective adaptation to certain environmental conditions. Therefore, the study of soybean productivity under different methods of main tillage, especially in the conditions of the Southern Steppe of Ukraine, is extremely relevant.
Keywords: Soybean, growing conditions, tillage, Southern Steppe of Ukraine.

CULTIVATION OF PLANTS IN VERTICAL FARMS BY HYDROPONIC METHOD

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Abstract
Peppermint (*Mentha piperita*) of the family *Lamiaceae* is an important crop in the pharmaceutical industry. Vegetative parts of the plant are rich in micro- and macroelements and organic substances, such as carotene, rutin, flavonoids, menthol, in large quantities - potassium. The nutrient-rich chemical composition determines the pharmacological properties of peppermint stems and leaves, such as sedative, antiemetic, antiseptic and analgesic effects. To grow peppermint in conditions of reduced fertile soil, it is advisable to build vertical farms using the method of hydroponics - the latest technology in which plants are grown in a soilless environment. Vertical hydroponics farms are systems in which plants are grown on a substrate, most often foam pallets, their roots are immersed in water, which can be enriched with macro-, micronutrients and organic matter for intensive plant growth and development. Soilless cultivation systems are independent of the climatic conditions of the area where the vertical trusses are installed, so they can be installed both in the industrial zone and in large cities and towns. Plants are grown on sterile substrate, so their defeat by parasitic fungi and parasites, infection of the crop with viral diseases is minimized. Peppermint is an herbaceous plant that is ideal for growing in a hydroponic system. Thanks to vegetative propagation, peppermint can be harvested several times during the growing season without replacing the substrate, which is economically and environmentally feasible. Vertical trusses are able to solve the problem of reducing the area of fields and help to make the most efficient use of working space with minimal impact on the environment. Growing peppermint on vertical farms using the hydroponics method is a solution that should rationalize and green the process of growing this medicinal crop in the context of global environmental change, overpopulation and global urbanization.
Keywords: mint, hydroponics, cultivation technology, vertical farms.

THE BIOLOGICAL ACTIVITIES OF *HYPERICUM PERFORATUM* L.

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Abstract
The most common and popular among the *Hypericum* species is *Hypericum perforatum* L.. It is one of the medicinal plant species whose value has rapidly increased in recent years. This species is used extensively in clinical and laboratory studies. Today, it is widely used in the treatment of many diseases, especially mild and moderate depression, as well as skin diseases, internal and external inflammatory wounds, neurological disorders and the metabolism-disrupting effects of free radicals. This plant is a representative of the Hypericaceae family, which has therapeutic effects such as antidepressant, antiviral, wound healing, analgesic effect on burns, bruises, swelling, anxiety and depression. Antibiotic resistance developed by pathogenic bacteria has reached alarming levels, and with the decline of many existing treatment options, new treatment methods are needed. In this study, the amount of total phenolic compounds, antioxidant activity and in vitro antimicrobial effect of *H. perforatum* plant were investigated. The antimicrobial effect of the plant extract was investigated by the disk diffusion method. Gram-negative bacteria; *Escherichia coli, Pseudomonas aeruginosa, Salmonella typhimurium,* Gram-positive bacteria; *Staphylococcus aureus*, *Bacillus subtilis* and the fungus *Candida albicans* were used as test microorganisms. It was determined that the highest and the lowest antimicrobial effect occurred against *P. aeruginosa* and *S. typhimurium*, respectively. The amount of total phenolic compounds and antioxidant activity of *H. perforatum* methanolic extract were determined by Folin-Ciocalteu's phenol reagent method, and DPPH scavenging activity method, respectively. While *H. perforatum* extract showed 76.49±0.14% DPPH scavenging activity, its total phenolic compound content was calculated as 1538.98±11.88 µg GAE/mL. The methanol extract of *H. perforatum* was found to exhibit remarkable antagonistic activity against tested pathogen bacteria.
Keywords: *Hypericum perforatum*, antimicrobial activity, total phenol content, antioxidant activity.

THE USE OF PAYLATTER IN DESCRIBING BUSINESS ACCORDING TO ISLAMIC VIEW

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Abstract
This research discusses the use of PayLatter in exposing businesses from an Islamic perspective. PayLatter is an online credit service that is gaining popularity in the business world. This research aims to explore whether the use of PayLatter is in accordance with sharia principles in Islam.The research methods used were literature analysis, interviews with Islamic economists, and a survey of entrepreneurs who use PayLatter in their businesses. The results show that the use of PayLatter can be mixed with sharia principles, especially in terms of interest charges and elements of usury. The research also presents Islamic-compliant financing alternatives, such as murabahah or mudharabah contracts, which can be used as more suitable options in the context of Islamic business. In order to conduct business in accordance with Islamic values, entrepreneurs are expected to consider financing alternatives that comply with sharia law. In conclusion, the use of PayLatter in business should be carefully analyzed from an Islamic perspective, taking into account the sharia principles underlying Islamic economics. In this regard, it is important for entrepreneurs to look for financing solutions that comply with Islamic teachings and avoid elements that are considered unauthorized in Islam, such as interest and usury.
Keywords: PayLast, Islamic Business, Sharia Principles, Financing, Literature analysis, Economic expert interview, Entrepreneur supervision, and Financing and Usury.

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ÖZET
Küresel ısınma, tarım alanlarında ve tarımsal üretimde çeşitli sorunlara yol açan önemli bir faktördür. Dünyada önemli çay üreticileri olan Çin, Hindistan, Kenya, Sri Lanka gibi ülkelerdeki çay tarımında küresel ısınma etkileri son zamanlarda artış göstermiştir. Ülkemizde de çay tarım alanlarında bu etkiler son yıllarda gözlemlenmeye başlamıştır. Küresel ısınmanın çay tarımına etkileri ülkelere göre farklı şekil ve düzeylerde görülmekle birlikte kendisini göstermektedir. Çin'de küresel ısınmanın etkisi öncelikli olarak verim ve kalitede azalma olarak görülmektedir. Hindistan'da ise, çay veriminde azalma, sel ve su baskını, toprak erozyonu, kuraklık ve kıyı erozyonu gibi farklı şekillerde çay tarımını etkilemektedir. Afrika kıtasında en fazla çay üreten ülke olan Kenya'da, küresel ısınmaya bağlı olarak yağışların da azalması ile çay bahçelerinde alan kayıpları oluşmaya başlarken; Sri Lanka'da düşük rakımlarda çay bahçelerinin azalacağı ve yüksek rakımların yeni çay bahçelerine elverişli hale gelerek bu alanlarda çay tarımının yoğunlaşacağı bildirilmektedir. Türkiye çay tarım alanlarında, değişen sıcaklık ortalamaları, yağış miktarı ve yağış düzensizliği sonucunda çay üretiminde rakımlara bağlı olarak farklı düzeylerde etkilerin oluşmaya başladığı görülmektedir. Bu çalışma kapsamında yapılan anket çalışmasının sonuçlarına göre, kıyı kesimlerde ve özellikle ilk sürgün hasatta verim kayıplarının oluşmasına karşın, yüksek rakımlarda ikinci ve üçüncü hasatta verim artışlarını teşvik ettiği görülmektedir. Küresel ısınmanın ülkemiz çay bahçelerinde su baskını stresi, düz ve düze yakın arazilerde kurumalar, eğimli arazilerde ise toprak kaymaları gibi etkiler yaptığı görülmektedir. Ülkemiz çay alanlarında küresel ısınmanın etkilerinin azaltılmasına yönelik olarak, çay üreticilerinin bilgilendirilmesi, eğimli alanlarda eğim düzeyine göre değişen genişliklte setlerin oluşturulması ve toprak kaymalarını önlemek amacıyla toprak tutucu ağaç dikimi gibi kültürel önlemlerin alınması gerekmektedir. Kalıcı çözümler için, halen devam eden ve yapılacak ıslah çalışmalarıyla, su baskını ve sıcaklık stresine yönelik verimli ve dayanıklı çeşitlerin geliştirilmeli ve bunların ülkemiz çay bahçelerinin yenilenmesinde öncelikle kullanılması sağlanmalıdır. Bu çalışmanın amacı; küresel ısınmanın çay tarımına etkilerinin en büyük çay üreticisi beş ülke ele alınarak incelenmesi, ülkemizde çay üreticileri ile yapılan kürsel ısınmanın çay tarımına etkilerine yönelik anket çalışması sonuçlarına göre mevcut durum analizi, sorunların ortaya konulması ve çözüm önerilerinin oluşturulmasıdır.
Anahtar Kelimeler: Çay, küresel ısınma, verim, kalite, kuraklık.

EFFECTS OF GLOBAL WARMING ON TEA FARMING

Abstract
Climate change is a major factor that causes various problems in agricultural areas and agricultural production. In recent years, the effects of climate change on tea cultivation in countries such as China, India, Kenya, and Sri Lanka, which are major tea producers in the world, have increased. In our country, these effects have also begun to be observed in tea cultivation areas in recent years. The effects of climate change on tea cultivation are seen in different ways and levels depending on the country. In China, the impact of climate change is primarily seen as a decrease in yield and quality. In India, it affects tea cultivation in different ways, such as a decrease in tea yield, floods and inundation, soil erosion, drought, and coastal erosion. In Kenya, which is the largest tea producer in the African continent, area losses are starting to occur in tea gardens as rainfall also decreases due to climate change; in Sri Lanka, it is reported that tea gardens will decrease at low altitudes and high altitudes will become suitable for new tea gardens, and tea cultivation will intensify in these areas. In Turkey's tea cultivation areas, it is seen that different levels of effects are starting to occur in tea production depending on the altitudes as a result of changing average temperatures, rainfall amounts, and rainfall irregularity. According to the results of the survey conducted within the scope of this study, while yield losses are occurring in coastal areas and especially in the first shoot harvest, it is seen that it encourages yield increases in the second and third harvest at high altitudes. It is seen that climate change has effects such as waterlogging stress, drying in flat and near-flat areas, and soil slides in sloping areas in our tea gardens. In order to reduce the effects of climate change in our tea areas, cultural measures such as informing tea producers, creating sets of varying widths depending on the slope level in sloping areas, and planting soil-holding trees to prevent soil slides are required. For permanent solutions, with the ongoing and future breeding studies, efficient and resistant varieties for waterlogging and temperature stress should be developed and their use should be prioritized in the renewal of our tea gardens. The aim of this study is to examine the effects of global warming on tea production by considering the five largest tea-producing countries, to analyze the current situation, identify the problems, and propose solutions based on the results of a survey conducted with tea producers in our country on the effects of global warming on tea production.
Keywords: Tea, Global warming, Yield, Quality, Drought

MAŞ FASULYESİNİN ALTERNATİF KABA YEM VE SİLAJ POTANSİYELİNİN ARAŞTIRILMASI*

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Özet
Araştırmada Adıyaman ve Karaman'dan elde edilen maş fasulyesi genotiplerinde çiçeklenme ve bakla bağlama dönemlerinde biçilmesi ile önce kaba yem potansiyeli ve ardından farklı katkı maddeleri ilave edilerek hazırlanan silaj fiziksel özellikleri üzerine etkileri incelenmiştir. Bu amaçla maş fasulyesi genotiplerinin vejetasyon süresi boyunca 15'er gün arayla bitki boyları, ardından çiçeklenme ve bakla bağlama dönemlerin sonunda yeşil ve kuru ot verimleri belirlenmiştir. Maş fasulyesi silajında arpa ve melas katkı maddeleri ayrı ayrı ve birlikte (arpa+melas) ilave edilerek silaj hazırlanmıştır. Her gruptan 7 tekerrür halinde hazırlanan cam kavanozlar içindeki maş fasulyesi silajlarının örneklerinde fiziksel analizler (renk, koku, tat ve DLG puanlaması) yapılmıştır. Çalışma sonuçlarına göre bitki boyu her iki genotipte de en yüksek 135. günde ve Karaman genotipinde (70.67 cm) tespit edilmiştir. Yeşil ve kuru ot verimi bakımından ise her iki genotipte de bakla bağlama dönemi; genotipler kıyaslandığında Karaman genotipi Adıyaman genotipi (yeşil ve kuru ot verimi sırasıyla Karaman 2787,33 kg/da ve 436,70 kg/da; Adıyaman 2064,33 kg/da ve 281,77 kg/da) en yüksek değerleri almıştır. Maş fasulyesi silajı melas ilave edilen gruplarda önemli bir fiziksel özellik kriteri olan DLG puanlarının arttığı ve 'çok iyi' sınıfına katıldığı belirlenmiştir. DLG puanları yönünden genotipler kıyaslandığında Karaman genotipi Adıyaman genotipine nazaran her bir uygulamada daha yüksek değerlere sahip olmuştur. Sonuç olarak, maş fasulyesinden başarılı silaj yapabilmek için Karaman genotipine melas + arpa kırması katkı maddesi kullanılarak silolanması, bakla döneminde biçimin yapılması önerilebilir.
Anahtar Kelimeler: Maş fasulyesi, hasat dönemi, ot verimi, silaj, DLG puanı

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INVESTIGATION OF ALTERNATIVE FORAGE AND SILAGE POTENTIAL OF MUNG BEAN*

Abstract
In this study, the effects of mung bean genotypes obtained from Adıyaman and Karaman on forage potential and physical properties of silage prepared by adding different additives were investigated. For this purpose, plant heights of mung bean genotypes were determined at 15-day intervals throughout the vegetation period, followed by green and dry herbage yields at the end of flowering and pod-filling periods. Barley and molasses additives were added separately and together (barley + molasses) in mung bean silage and silage was prepared. Physical analyses (color, odor, taste and DLG scoring) were performed on the mung bean silage samples in glass jars prepared in 7 replicates from each group. According to the results of the study, the highest plant height was determined in both genotypes at 135th day and Karaman genotype (70.67 cm). In terms of green and dry herbage yields, both genotypes had the highest values at the podding period; when the genotypes were compared, Karaman and Adıyaman genotypes had the highest values (Karaman 2,787.33 kg/da and 436.70 kg/da; Adıyaman 2064.33 kg/da and 281.77 kg/da for green and dry herbage yields, respectively). It was determined that DLG scores, which is an important physical trait criterion, increased in the groups to which molasses was added to mung bean silage and they were classified as 'very good'. When the genotypes were compared in terms of DLG scores, Karaman genotype had higher values in each treatment compared to Adıyaman genotype. As a result, in order to make successful silage from mung bean, it can be recommended that Karaman genotype should be ensiled using molasses + barley crumb additive and harvesting should be done in the pod period.
Keywords: Mung bean, harvest period, grass yield, silage, DLG score

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**This study is summarized from the first author's master's thesis.

TURMERIC FARMERS AND THEIR EXTENSION AGENCY CONTACT LEVEL IN TAMIL NADU

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Abstract
Turmeric is scientifically called as *Curcuma longa* and belongs to the family Zingiberaceae. According to the Bureau of Indian Standards, 63 spices including turmeric are grown in India. India is the largest producer of turmeric, producing 100,000 tonnes of cured turmeric annually, of which 94 to 97 per cent is consumed at home. India is the largest producer and consumer and exporter country of turmeric out of total production in the world. Tamil Nadu ranks second in both production and area under turmeric cultivation among all the states in India. The principal turmeric producing districts in Tamil Nadu are Erode, Dharmapuri, Villupuram, Salem and Namakkal. The present investigation was done in Pappireddipatti taluk of Dharmapuri district. It ranks second in area and production in the state after Erode district. The major turmeric cultivating areas in Dharmapuri are Pappireddipatti, Harur, Nallampalli, Karimangalam, Dharmapuri, Palacode and Pennagaram. Major turmeric producing villages are Venkatasamuthiram, Menasi, Molayanur, A. Pallipatti, Bommidi and Devarajapalayam. So, these six villages were selected for this invesrigation. Sample sizes of 120 turmeric growers were considered sufficient for the study. Nearly fifty per cent of the respondents had medium (54.17 per cent) level of extension agency contact followed by low (32.50 per cent) level of extension agency contact. Only 13.33 per cent of the respondents had high level of extension agency contact. This may due to many of the farmers have sufficient contact with the extension perosnnel.
Keywords: Turmeric Farmers, Extension Agency Contact, Pappireddipatti, Tamil Nadu.

AN IN-VITRO EVALUATION OF THE ANTHELMINTIC ACTIVITY OF *AEGLE MARMELOS* ON THE *PHERITIMA POSTHUMA* MODEL

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Abstract
The aim of the present study was to evaluate the anthelmintic activity of ethanolic extract of leaves of *Aegle Marmelos* using *Pheretima posthuma* as test worms. *Aegle marmelos L.* (Family: Rutaceous) commonly known as Bael in Hindi is an essential food plant of India. Traditionally the fruit was used to treat diabetes, respiratory problems, inflammation, dysentery, and diarrhea. The fruits of *Aegle marmelos* are rich in flavonoids, terpenoids, carotenoids, and coumarins. The major bioactive constituents include imperatorin, aegelin, lupeol, eugenol, cineol, citronellal, etc. The ethanolic extract were used for the activity in different concentrations (2, 4, 6, 8, and 10 mg/ml). The Albendazole concentrations (10 mg/ml) were used as a reference standard and normal saline (0.9 % NaCl) was used for the control treatment. The results were expressed in terms of time in minutes to report the paralysis and time of death of the earthworms. The results obtained from the study indicate the anthelmintic activity. The wormicidal activity of the ethanolic extract against earthworms suggests that it is effective against parasitic infections in humans. It would be interesting to identify the active principle responsible for the anthelmintic activity and to study its further pharmacological actions.
Keywords: Albendazole, anthelmintic activity, *Aegle Marmelos, Pheretima posthuma.*

BAZI SORGUM GENOTİPLERİNİN ESKİŞEHİR EKOLOJİK KOŞULLARINA ADAPTASYONU

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Özet
Sorgum yetiştiriciliği yapılan bitki türleri içerisinde kuraklığa dayanıklı önemli bitkilerdendir. Sorgum tane, şeker, süpürge ve ot üretimi amacıyla yaygın olarak kullanılan türleri bulunmaktadır. Son yıllarda kuraklığa dayanıklılığı nedeniyle hayvan yemi olarak kullanımı öne çıkmaktadır. Bu amaçla geliştirilen çeşitler ve melezler bulunmaktadır. Geliştirilen çeşitlere ilave olarak çeşit geliştirme çalışmaları devam etmektedir. Araştırma Eskişehir ekolojik koşullarında Osmangazi Üniversitesi Ziraat Fakültesi deneme alanında Şansa Bağlı Tam Bloklar deneme deseninde 3 tekerrürlü olarak yürütülmüştür. Denemede 12 çeşit ve 10 hat kullanılmıştır. Ele alınan çalışmada çiçeklenme gün sayısı, bitki boyu, bitkide kardeş sayısı, bitki çapı, yaprak oranı, sap oranı, kuru madde oranı ve yaş ot verimi özellikleri incelenmiştir. İncelenen tüm özellikler bakımından çeşitler arasında önemli farklılıklar tespit edilmiştir. Genotiplerin %50 çiçeklenme süreleri 72,00 ile 87,67 gün arasında olup ortalama çiçeklenme gün sayısı 78 gün olarak belirlenmiştir. Sorgum çeşit ve hatların ortalama bitki boyu 209 cm olup, en uzun bitki boyu K311 (315,00 cm) hattında, en kısa bitki boyu Aldarı (122,67cm) ve Öğretmenoğlu (127,00 cm) çeşitlerinde ölçülmüştür. Genotipler arasında ortalama kardeş sayısı 2,64 (adet/bitki), ana sap kalınlığı 14,68 mm yaprak oranı %15,88 ve sap oranı %83,89 olarak tespit edilmiştir. Ortalama kuru madde oranı %21,77 olup, en düşük %15,36 ile tanesi için yetiştirilen Öğretmenoğlu çeşidinde, en yüksek %30,85 ile Gözde-80 çeşidinde tespit edilmiştir. Kuru madde oranı en düşük %15,36 ile tanesi için yetiştirilen Öğretmenoğlu çeşidinde, en yüksek %30,85 ile Gözde-80 çeşidinde tespit edilmiştir. Ortalama kuru madde verimi ise %21,77 olarak hesaplanmıştır. B305 (%39,33), 304 (%27,94), 32-1 (%26,64), 8 (%24,40) ve G310 (%23,48) numaralı hatlar yüksek kuru madde oranları ile dikkat çekmektedir Yaş otta en yüksek verimi 5614,07 kg/da ile Erdurmuş çeşidinde gözlemlenirken, en düşük yaş ot verimi 2152,02 kg/da ile G310 hattında gözlemlenmiştir. İncelenen genotipler içerisinde en iyi performans gösteren ve öne çıkan hat Erdurmuş, Gözde -80 çeşitleri ve K311 numaralı hat olarak kaydedilmiştir.
Anahtar Kelimeler: Sorgum, genotip, performans

ADAPTATION OF SOME SORGHUM GENOTYPES TO ESKISEHIR ECOLOGICAL CONDITION

Abstract
Sorghum is one of the most important drought-resistant plants among the cultivated plant species. There are species commonly used for sorghum grain, sweet sorghum, broom, and grass production. In recent years, its use as animal feed has come to the fore due to its resistance to drought. There are varieties and hybrids developed for this purpose. In addition to the developed varieties, variety development studies continue. The research was carried out in Eskişehir ecological conditions in the trial area of the Osmangazi University Faculty of Agriculture in a randomized complete block trial design with three replications. 12 varieties and 10 lines were used in the experiment. In the study, the number of days to flowering, plant height, number of tillers per plant, plant diameter, leaf ratio, stem ratio, dry matter ratio, and fresh grass yield characteristics were examined. Significant differences were detected among the varieties in terms of all examined characteristics. The 50% flowering times of the genotypes were between 72.00 and 87.67 days, and the average number of flowering days was determined to be 78 days. The average plant height of sorghum varieties and lines was 209 cm; the longest plant height was measured in the K311 (315.00 cm) line, and the shortest plant height was measured in the Aldarı (122.67 cm) and Teacheroglu (127.00 cm) varieties. Among the genotypes, the average number of tillers was 2.64 (pcs/plant), the main stem thickness was 14.68 mm, the leaf ratio was 15.88%, and the stem ratio was 83.89%. The average dry matter rate was 21.77%; the lowest was 15.36% in the Teacheroglu variety grown for its grain, and the highest was 30.85% in the Gözde-80 variety. The lowest dry matter content was found in the Teacheroglu variety grown for its grain, with 15.36%, and the highest was in the Gözde-80 variety, with 30.85%. The average dry matter yield was calculated at 21.77%. Lines numbered B305 (39.33%), 304 (27.94%), 32-1 (26.64%), 8 (24.40%), and G310 (23.48%) attract attention with their high dry matter ratios. The highest fresh grass yield was observed in the Erdurmuş variety with 5614.07 kg/da, while the lowest fresh grass yield was observed in the G310 line with 2152.02 kg/da. Among the genotypes examined, the best-performing and most prominent lines were recorded as Erdurmuş, Gözde-80 varieties, and line number K311.
Keywords: Sorghum, genotype, performance

ENHANCEMENT OF THREE CURCUMIN DERIVATIVES AS ECOFRIENDLIES CORROSION INHIBITORS FOR CARBON STEEL IN HCL SOLUTION

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Abstract
Acid solutions are generally used for the removal of undesirable scale and rust in several industrial processes. Hydrochloric and sulphuric acids are widely used in the pickling processes of metals. The use of inhibitors is the most practical methods of protection against corrosion, especially in acidic solutions. Large numbers of organic compounds were studied and are being studied to investigate here corrosion inhibition potential. But, most of them are highly toxic to human beings and has the potential to degrade the environment. The known hazardous effects of most synthetic organic inhibitors and restrictive environmental regulations have compelled and motivated researchers to focus on the need to develop cheap, non-toxic and environmentally benign natural products as corrosion inhibitors. Three Curcumin Derivatives: Chloride, Fluoride and Dichloride are investigated as corrosion inhibitors for carbon steel in HCl solution using impedance spectroscopy, polarization curves measurement, and SEM studies. Polarization curves showed that the three Curcumin derivatives behave as mixed-type inhibitors. EIS spectra exhibit one capacitive loop and confirm the inhibitive ability. The effect of concentration and temperature for Curcumin Dichloride on the corrosion behavior of carbon steel in 1M HCl was also studied and a Langmuir adsorption isotherm was found.
Keywords: Corrosion, Steel, Inhibitors, Curcumin derivatives, Langmuir.

VALUATION OF ARGAN LEAVES EXTRACT AS GREEN CORROSİON İNHİBİTOR FOR STEEL İN 1M HCL

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Abstract
Corrosion is a fundamental process playing an important role in economics and safety, particularly for metals and alloys. Mild steel alloys is exposed to the action of acid in industrial processes where acids play important roles such as in oil well acidizing, acid pickling, acid cleaning and acid descaling. The use of inhibitors is the most practical methods of protection against corrosion, especially in acidic solutions. Large numbers of organic compounds were studied and are being studied to investigate here corrosion inhibition potential. But, unfortunately most of these compounds are not only expensive but also toxic to living beings. However, study on the inhibition efficiency of natural products for mild steel in acidic medium is still lacking. In our laboratories, many studies have been investigated on the corrosion inhibition by natural plant extract and their oils on steel in acidic solutions. The effect of Argan leaves extract (ALE) on the corrosion of steel in hydrochloric acid medium was studied using gravimetric, electrochemical polarisation and electrochemical impedance spectroscopy (EIS) measurements. Inhibition efficiency increases with ALE concentration to attain 95%. We note good agreement between gravimetric and electrochemical methods (potentiodynamic polarisation and EIS). Effect of temperature is also made in the 298–328K range. Polarisation measurements show also that ALE act as mixed inhibitors. ALE is adsorbed on the steel surface according to a Langmuir isotherm adsorption model.
Keywords: Corrosion, Steel, Inhibition, Argan Leaves, Langmuir.

MACHINE LEARNING FOR EARLY GLAUCOMA DETECTION: A COMPARATIVE ANALYSIS OF PREDICTIVE MODELS

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Abstract
Glaucoma, a leading cause of irreversible blindness, is often asymptomatic in its early stages, making early detection and intervention critical for preserving vision. This study investigates the efficacy of machine learning-based approaches for the early detection of glaucoma, focusing on a comparative analysis of predictive models. The primary objective of this research is to assess the performance of various machine learning algorithms in identifying individuals at risk of developing glaucoma before the onset of clinical symptoms. Leveraging retinal imaging data, including optical coherence tomography (OCT) scans and fundus photographs, we explore a diverse set of predictive models, encompassing deep learning, ensemble methods, and traditional classifiers. Through a comprehensive evaluation using a large dataset of both glaucoma and non-glaucoma subjects, we compare the sensitivity, specificity, and overall accuracy of these predictive models. Additionally, we assess their ability to provide interpretable insights into the key features contributing to glaucoma risk. The findings of this study provide a variation understanding of the strengths and limitations of different machine learning approaches for early glaucoma detection. It offers insights into the potential integration of these models into clinical practice for proactive screening and timely intervention. By facilitating early diagnosis, this research contributes to the ongoing efforts to reduce the global burden of glaucoma-related blindness and underscores the role of machine learning in preventive healthcare.
Keywords: Glaucoma, Machine Learning, Blindness.

RECYCLING WASTE POLYTHENE MATERIALS TO USEFUL PRODUCTS VIA PYROLYSIS

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Abstract
Plastic materials have been crucial to the development of science, technology, and almost all aspects of modern progress since the mid-twentieth century. However, the increasingly unsustainable culture of plastic consumption and the accumulation of plastics in landfills, oceans, and broader ecosystems has also made negative, potentially irreversible environmental impacts. In recent decades, scientists and engineers have spent significant time and resources searching for more effective plastic waste management techniques based on thermochemical routes like pyrolysis. Indeed, plastic to fuel conversion has the potential to severely limit plastic pollution and to contribute to the circular economy, but industrial scale plastic pyrolysis has not been achieved. Therefore, this paper presents a bibliometric analysis and systematic literature review of pyrolysis-related articles in the Web of Science database published between 2001–2020. The resulting articles (n = 670) show that Spain is the most productive country in terms of total output and that there are an increasing number of researchers focused on this topic worldwide. The results also highlight the current landscape and future directions of plastic pyrolysis research based on the following hot topics: i) kinetic triplets as a vital component of plastic pyrolysis and scaling up processes, ii) catalysts syntheses and performance, iii) co-pyrolysis of plastic/biomass mixtures, and iv) reactor design and reaction parameters. In conclusion, the study offers a comprehensive overview of plastic pyrolysis progress, which will remain a major area of research for chemists and engineers in the coming decade and a powerful tool for environmental management. Plastics are cheap, pliable, and moldable materials. Since the 1940s, communities worldwide have developed a “plastic culture”. The material has improved quality of life for many, but also changed global consumption patterns, increased demand for resources and production, and generated almost incalculable tons of waste and pollution. From food packaging to aerospace to medical instruments, our lives are metaphorically, and sometimes literally, wrapped in plastic. In fact, plastic consumption has increased twentyfold since the 1950s, and it is expected to reach to 720 million tons in the next 20 years . To address this issue, in 2018 the European Commission the EU Strategy for Plastics in the Circular Economy, which establish the main goals for plastic design, manufacture, use, re-use, and end-of-life management by 2030 . Despite the significant development of various technologies to handle homogeneous and relatively clean plastic waste in primary and secondary recycling, converting plastic waste into building block molecules, fuels, and energy remains a significant challenge . Part of the challenge is separating plastic waste from other solid waste components; without this step, it is not possible to process used plastic and obtain high-quality outputs. Several tertiary recycling methods and technologies have attracted

attention and have the potential to be useful on the commercial stage. These include depolymerization (chemical feedstock recovery), as well as plasma arc gasification, and pyrolysis . Among the available processes for converting plastics into fuel or any other value-added product, pyrolysis has drawn the most scientific attention between early-stage and mature technologies. Recently, Solis and Silveira provided an extensive TRL assessment on eight technologies available for plastic recycling and reviews recent technological developments in pyrolysis, catalytic cracking, and gasification for TRL 8-9. Nevertheless, the full potentials of these technologies and their impact on the circular economy of plastics is still unclear and requires more full-scale projects to be subjected to critical examinations. Meanwhile, another review by Qureshi et al.argues that pyrolysis can be an effective management tool that will complement mechanical recycling. Some of the primary challenges with elevating plastic to fuel pyrolysis to the industrial scale are feedstock quality, segregation of materials, reactor operations, and stability and standardization of the end products. Finally, Spreafico et al.recently reviewed the innovations and the evolution of different technologies for plastic pyrolysis. Their analysis of patents and articles further indicates that pyrolysis technologies are changing from macro to micro, especially with the use of laser or microwave pyrolysis systems. Efforts to optimize raw material and energy input are advancing quickly. Therefore, the present review aims to offer further insights into how the state-of-the-art has and will develop.

Keywords: Plastic pyrolysisWaste managementCircular economyThermochemical conversionPlastic-to-fuel.

HUMAN PROHIBITS OF BACILLUS STRAINS: CHARACTERIZATION, SAFETY, MICROBIOME, AND PROBIOTIC CARRIER

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Abstract
Bacillus strains have garnered attention as potential probiotics for human consumption due to their unique characteristics and health benefits. These spore-forming bacteria exhibit resilience against harsh environmental conditions, making them well-suited for survival in the digestive tract. Bacillus strains have demonstrated promising probiotic properties, including the ability to modulate gut microbiota, enhance nutrient absorption, and stimulate the immune system. Several Bacillus species, such as Bacillus coagulans, Bacillus subtilis, and Bacillus clausii, have been extensively studied for their probiotic potential. Research suggests that these strains may contribute to improved digestive health, reduced gastrointestinal discomfort, and even the prevention of certain gastrointestinal disorders. Moreover, Bacillus strains have exhibited antimicrobial activity against pathogenic bacteria, adding an extra layer of protection to the gut. Furthermore, their spore-forming nature allows for long-term stability in probiotic formulations. In summary, Bacillus strains show promise as human probiotics, offering resilience, potential health benefits, and a valuable addition to the toolbox of probiotic options. However, further research is needed to fully elucidate their mechanisms of action and to establish specific recommendations for their use in promoting human health.
Keywords: probiotics, Bacillus subtilis, Bacillus clausii

EFFECT OF NITRIC OXIDE AND HYDROGEN PEROXIDE ON GROWTH, PHYSIOLOGICAL AND BIOCHEMICAL ATTRIBUTES OF WHEAT (*Triticum aestivum L.*) PLANT UNDER CADMIUM STRESS

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Abstract
Nitric oxide (NO) is involved in physiological processes like the germination of seeds, development, flowering, senescence, stomatal movement in plants and abiotic stress tolerance. H_2O_2-priming improves abiotic stress tolerance by detoxifying reactive oxygen species (ROS) activity by regulating multiple stress-responsive pathways. The experiment was conducted at Government College University, Faisalabad, to examine the effect of exogenously applied NO (0.1 mM), H_2O_2 (1 mM) and their combined treatment (NO + H_2O_2) on wheat plants under cadmium stress. Seeds of two wheat varieties (Galaxy-13 and FSD-2008) were obtained from wheat section of Ayub Agricultural Research Institute (AARI) Faisalabad Pakistan. For pre-sowing treatment, seeds of both cultivars were soaked for 16 hours in nitric oxide (0.1 mM), hydrogen peroxide (1 mM) and their combined solution. Cadmium stress markedly decreased the plant growth, grain yield, leaf photosynthetic pigments, total phenolic content, total soluble proteins, leaf water potential (Ψ_w), leaf turgor potential (Ψ_p), osmotic potential (Ψ_s), and leaf relative water content, while it increased the activities of enzymatic antioxidants and the accumulation of leaf ascorbic acid, proline, glycine betaine, malondialdehyde, and H_2O_2. However, exogenously applied nitric oxide and hydrogen peroxide mitigated the deleterious effects of cadmium stress on growth and yield by improving the photosynthetic pigments, osmolytes accumulation and the antioxidative defense mechanism. The results revealed that exogenous application of nitric oxide, hydrogen peroxide and combined application was effective in increasing the tolerance of wheat plants under cadmium stress in terms of growth and grain yield by regulating plant antioxidative defense mechanism, and accumulation of osmolytes, and by reducing the membrane lipid peroxidation.
Keywords: Nitric oxide, wheat, cadmium stress

ELECTRICAL AND OPTICAL PROPERTIES OF POLY METHYL METHACRYLATE INCORPORATED WITH SALT FOR EDLC APPLICATION

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Abstract
The primary aim of the current study is to fabricate a polymer electrolyte that has been doped with salt. The researchers employed a solution casting process to fabricate a solid polymer electrolyte using poly (methyl methacrylate) (PMMA) as the host polymer and potassium hydroxide (KOH) as the dopant salt. The use of salt enhances the amorphous nature and uniformity, while reducing surface roughness. In addition, the use of salt (KOH) as a dopant enhances the conductivity of the polymer electrolyte sheet. The use of salt doping is shown to significantly boost the conductivity of a material, as evidenced by a four-order-of-magnitude increase, as revealed through the utilisation of electrochemical impedance spectroscopy (EIS). Fourier Transform Infrared Spectroscopy (FTIR) is a technique that reveals the intricate process of complexation and the composite structure of films. The utilisation of polarised optical microscopy (POM) reveals a decrease in crystallinity, a finding that is subsequently corroborated by the results obtained from differential scanning calorimetry (DSC).
Keywords: Polymer electrolyte, conductivity, DSC

AGRICULTURE AND FOOD SECURITY IN THE AGRICULTURAL PRODUCTION

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Abstract
Countries with different levels of economic growth are finding it important to ensure food security, while the agricultural sector plays a vital role in increasing food availability. The purpose of this paper is to establish links between the undernourishment scale and selected characteristics that describe the agricultural sector in particular clusters of developing countries. Using ward's technique, typological groups of countries were separated. According to the results of the surveys, the most difficult situations for maintaining food security are observed in developing countries with a large share of agriculture in their gross domestic product (gdp), adverse conditions limiting agricultural production, and deficient infrastructure. Based on the findings of the study, appropriate and targeted strategies for food security improvement in particular clusters were devised. Key drivers of growth seem to be the promotion of investments in agricultural infrastructure and extension services, as well as adopting policies aimed at increasing the households' purchasing power, particularly in rural areas. The paper focuses not only on identifying the causes of hunger, but also aims to highlight the most effective ways to solve the hunger epidemic in a country's unique circumstances. It provides a comprehensive picture of policy formulation in many countries around the world, which may be of interest to scholars and policy makers.
Keywords: food security, agriculture, production

ROLE OF AI IN PHARMA

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Abstract
Artificial intelligence use in pharmaceutical technology has increased over the years, and the use of technology can save time and money while providing a better understanding of the relationships between different formulations and process parameters. Artificial intelligence is a branch of computer science that deals with problem-solving with the aid of symbolized programming. It has greatly evolved into a science of problem-solving with huge applications in business, health care, and engineering. The article describes drug discovery, tools of AI, manufacturing execution systems automated control processes systems, AI to predict new treatment, development of novel peptides from natural foods, treatment and management of rare diseases, drug adherence, and dosage, and challenges to adoption of AI in pharma. Keywords: Drug Discovery, tools of AI, MES, ACPS, treatment, and management of rare diseases, drug adherence, and dosage challenges to adoption of AI in pharma.
Keywords: pharmaceutical technology, rare diseases, AI in pharma

EFFECT OF SUPPRESSION OF MECHANICAL TRANSMISSION IN PLANT VIRUSES

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Abstract
Plant viruses are obligate-parasites that cause major yield losses in economical agricultural products. Plant viruses can pass from plant to plant through different ways such as vector, seed, pollen and mechanical transmission. The transmission mechanism, which plays an important role in the spread of infections, usually occurs through mechanical movement. Mechanic transmission is the natural mechanism of spread by which biologically active virus can infect living cells through small wounds on the plant surface. As a result of this contact, viruses can easily enter plant cells and infection begins. The protein that is the determinant of mechanical transmission in plant viruses is often called "movement protein (MP)". MP is a protein that facilitates the entry of virus particles into plant cells and the integration of virus genetic material into plant cells. The effect of such viruses can be great, especially on plants with high economic value for agricultural products. Therefore, suppressing mechanical transmission is important to limit the spread of plant viruses and maintain plant health. For this purpose, cultural measures, conventional measures, new generation approaches and other preventive measures are important. Focusing more on research and applications on the mechanical action and suppression of plant viruses is of great importance in preventing the spread of the virus.
Keywords: Mechanical transmission, plant viruses, resistance

İÇ ANADOLU BÖLGESİ KURU KOŞULLARINDA İLERİ KADEME ARPA (*Hordeum vulgare* L.) ISLAH MATERYALLERİNİN VERİM VE KALİTE ÖZELLİKLERİNİN DEĞERLENDİRİLMESİ

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Özet
Bu çalışma, 19 ileri kademe arpa ıslah materyali ve 5 standart arpa çeşidi kullanılarak, tesadüf blokları deneme desenine göre 4 tekerrür halinde, Ankara ve Kırşehir lokasyonlarında yürütülmüştür. 2021 yılında, bitki boyu, başak boyu, başaktaki tane sayısı, m2 deki bitki sayısı, başaklanma gün sayısı, kış zararı, tane verimi, hektolitre ağırlığı 1000 tane ağırlığı, tane iriliği ve protein oranı dahil toplamda 11 verim ve kalite özelliği değerlendirilmiştir. Tek yıllık veriler, 2021 yılında, tüm ileri kademe hatların ve standart çeşitlerin verim bağlantılı özellikler açısından Kırşehir lokasyonuna kıyasla Ankara'da önemli ölçüde daha yüksek performans gösterdiğini ortaya koymuştur. Toprak özellikleri, çevre ve genotip-çevre interaksiyonu gibi parametreler, performans farklılıklarının ($p<0,05$) ana nedenleri olarak değerlendirildi. Ankara-İkice' de en fazla tane verimi Hat 11'den (454,5 kg/da) elde edilirken, en düşük tane verimi Hat 7'den (228,6 kg/da) Kırşehir-Boztepe'de elde edilmiştir. Bitki boyu verileri 69,1 ile 91,4 cm arasında değişmektedir. Hat 15 ve Sinanbey çeşidi, 24 genotip arasında en yüksek 1000 tane ağırlığına (49,0) sahip genotiplerdi. M^{2}' deki başak sayısı 220,3 ile 310,0 arasında değişirken, başaktaki tane sayısı 23,32 ile 29,25 tohum aralığında değişmiştir. Başaklanma gün sayısına ilişkin aralık 210,1 ile 219,1 gündü. Kalite parametrelerinde ise hektolitre değeri 65-72 gr aralığında gözlemlenmiştir. Her iki lokasyonda, ortalama tane iriliği verilerine göre en yüksek Hat 13 (8.5 mm) olurken, Sinanbey standart çeşidi, 2.0 mm ile en düşük değere sahipti. Ankara'da en yüksek protein oranı sahip genotip Hat 7 (%16,7) olurken, her iki lokasyonda da Hat 17 (%11,2-%14,0) en düşük protein oranına sahiptir. Varyans analizinde gözlemlenen tüm özelliklerde genotip ve genotip-çevre etkileşimlerinin istatistiksel olarak anlamlı ($p<0,05$) olduğu görülmüştür.
Anahtar Kelimeler: *Hordeum vulgare* L., arpa ıslahı, tane verimi.

ASSESSMENT OF YIELD AND QUALITY TRAITS OF ADVANCED BARLEY (*Hordeum vulgare* L.) BREEDING MATERIALS IN THE RAINFED CONDITIONS OF THE CENTRAL ANATOLIA REGION

Abstract
The experiment was conducted according to the randomized complete block design, using 19 advanced barley lines and 5 standard varieties as 4 replications in Ankara and Kırsehir locations. In 2021, a total of 11 yield-related and quality traits were assessed including plant height, spike length, number of grains per spike, number of plants per m2, days to heading, winter damage, grain yield, hectolitre, 1000 kernel weight, kernel size, and protein content. Single-year data showed that all advanced lines and standard cultivars performed higher in Ankara than in the Kırsehir location for all yield-related traits in 2021. The soil properties, environment, and genotype-environment interactions were considered as the main parameters for different genotypic performance of lines over two locations. While Line 11 had the highest grain yield (454,5 kg/da) in the Ankara-Ikizce location, Line 7 had the lowest grain yield with 228,6 kg/da in the Kırsehir-Boztepe location. Plant height data varied between 69,1 and 91,4 cm. Line 15 and the Sinanbey variety were the genotypes with the highest 1000-grain weight (49,0 gr) among a total of 24 genotypes. The number of spikes per m^2 ranged from 220,3 to 310,0 spikes, while the number of grains per spike ranged from 23,3 to 29,2 seed. The interval for the number of days to heading was between 210,1 and 219.1 days. As for the quality parameters, the hectolitre weight varied between 65 and 72 gr. According to kernel size data, Line 13 has the highest size with 8.5 mm while the Sinanbey variety performed very poorly (2,0 mm). In Ankara, Line 7 had the highest protein ratio with 16,7 % while Line 17 performed the poorest protein ratio varying between 11,2-14,0% over the two locations. Genotypes and genotype-environment interactions were found to be statistically significant ($p<0,05$) for all traits observed.
Keywords: *Hordeum vulgare* L., barley breeding, grain yield.

IMIDACLOPRID'S IMPACT ON NEUROTOXICITY: ILLUMINATING THE CONSEQUENCES OF PESTICIDES ON BIODIVERSITY AND HEALTH

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Abstract
Pesticides have long played a crucial role in modern agriculture, but their excessive use has raised concerns about their impact on both human health and the environment. One such pesticide, Imidacloprid, an environmental pollutant, has been implicated in causing significant harm. The present study aimed to assess the neurotoxicity of Imidacloprid through repeated oral administration over a 90-day period using *Wistar* rats as an experimental model. Two different doses of Imidacloprid (5 and 50 mg/kg/day) were administered to evaluate its effects on neurobehavior, brain enzymes, and oxidative stress markers. The control group, which did not receive Imidacloprid, was used as a reference for comparison. The findings of this study reveal several alarming effects of Imidacloprid exposure on *Wistar* rats. First, the neurobehavioral abilities of the rats were significantly altered, with indications of anxiety, memory disturbance, and learning difficulties observed. Cognitive standard testing conducted at the end of the exposure period showed significant deviations from the control group. Moreover, Imidacloprid exposure led to a noticeable inhibition of body growth, with a reduction in total weight and a decrease in relative brain weight. This suggests that Imidacloprid affects not only the neurological functions of the rats but also their overall physical development. Biochemical assessments of the rats' brains demonstrated disruptions in the levels of key macromolecules such as proteins, carbohydrates, and lipids. These changes further highlight the impact of Imidacloprid on the physiological functions of the brain. In addition, stress biomarkers indicated a significant induction of glutathione S-transferase (GST) and glutathione peroxidase (GPx) activities, along with a decrease in glutathione (GSH) levels. These findings indicate that Imidacloprid exposure induces oxidative stress in the brain, a phenomenon that can have long-lasting detrimental effects on neurological health. Further evidence of oxidative stress was found in the increased levels of malondialdehyde (MDA), a marker of lipid peroxidation. This confirmed the presence of oxidative damage in the brain following Imidacloprid exposure.
Keywords: Neonicotinoid, Imidacloprid, Neurobehavioral, Oxidative stress.

VOICE EMOTION AND GENDER RECOGNITION

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Abstract
As human beings speech is amongst the most natural way to express ourselves. We depend so much on it that we recognize its importance when resorting to other communication forms like emails and text messages where we often use emojis to express the emotions associated with the messages. As emotions play a vital role in communication, the detection and analysis of the same is of vital importance in today's digital world of remote communication. Emotion detection is a challenging task, because emotions are subjective. There is no common consensus on how to measure or categorize them. We define a SER (speech emotion recognition) system as a collection of methodologies that process and classify speech signals to detect emotions embedded in them. In this study we attempt to detect underlying emotions in recorded speech by analyzing the acoustic features of the audio data of recordings. The speech entailed in human voice comprises essentially paralinguistic information used in many voice-recognition applications. Gender voice is considered one of the pivotal parts to be detected from a given voice, a task that involves certain complications. In order to distinguish gender from a voice signal, a set of techniques have been employed to determine relevant features to be utilized for building a model from a training set. This model is useful for determining the gender (i.e., male or female) from a voice signal. Pitch, median, frequency, and other auditory data can be used to determine gender. Based on the acoustic properties of the voice and speech, this project trains computer software to identify a voice as male or female. The voice samples are pre-processed in R using acoustic analysis, and then processed with AI/ML algorithms to learn gender-specific features for categorizing the voice as male or female.
Keywords: Gender voice, AI/ML algorithms, voice emotion

PREVALENCE OF OVERWEIGHT IN CULINARY ARTS STUDENTS OF VOCATIONAL COLLEGE A

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Abstract
The increase in overweight problems among adolescents today is particularly worrisome due to a lack of awareness of healthy eating habits and a lack of physical activity. The pattern of adolescent nutrition practices is now more of a fast food practice and this has an impact on the nutritional habits of Vocational College students. Therefore, excess weight is increasing among adolescents. This study assessed the prevalence of overweight in a sample of students from Vocational College A. The *snow ball* sampling procedure was used. Respondents consisted of 30 diploma students from a focusedly selected Linear Arts program. This study is quantitative. Data collection includes questionnaires and anthropometric measurements carried out to obtain student weight. The findings of this study show a correlation between excess body weight and dietary habits with *a Pearson Correlation* value of 0.585 and significant at a value of 0.001. Then, the form of correlation between Estim kendiri with eating habits with a Pearson Correlation value of 0.540 and significant with 0.002 and *finally a form of correlation between excess body weight and estim kendiri with a Pearson Correlation value of 0.573 and a significant value of 0.001.* There is a difference between gender and overweight. However, there is no relationship between SES and overweight.
Keywords: Overweight, eating habits, self-reliance and overweight.

OPTIMIZING TRAFFIC ROUTING FOR MINIMIZED EMISSIONS IN VEHICULAR NETWORKS

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Abstract
In the context of the Internet of Vehicular Things (IoVT), optimizing traffic routing holds the potential to significantly reduce emissions and enhance the overall environmental sustainability of modern transportation systems. This paper explores the development of routing strategies specifically designed to minimize emissions within vehicular networks. The primary objective of this research is to address the challenge of reducing the environmental impact of IoVT, particularly in urban and densely populated areas where traffic congestion and emissions are of growing concern. We propose innovative routing algorithms that prioritize routes which minimize fuel consumption and greenhouse gas emissions, while still ensuring efficient and reliable communication. Through an extensive evaluation involving simulations and real-world data analysis, we demonstrate the effectiveness of these emissions-aware routing strategies in reducing the carbon footprint of IoVT. Additionally, we investigate the potential synergies between emissions reduction and traffic decongestion strategies, presenting a holistic approach to environmentally responsible vehicular networking. The findings this investigation not only shed light on the possibility of substantial emissions reductions in vehicular networks but also offers a blueprint for the integration of green routing policies into emerging transportation infrastructures. As societies worldwide seek to address the urgent issue of climate change, these emissions-minimizing routing strategies represent a proactive and promising approach to making IoVT networks more environmentally responsible. This research contributes to the broader conversation surrounding sustainable and low-emission transportation solutions and provides valuable insights for both policymakers and technologists working on the future of connected vehicles and smart transportation systems.
Keywords: Vehicular Network, Routing, Carbon Emission.

YARI KURAK KOŞULLARDA KOYUN YUMAĞI GENOTIPLERININ (*Festuca ovina*) MORFOLOJIK VE AGRONOMIK ÖZELLIKLERI ÜZERINE GÖZLEMLER

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Özet
Buğdaygiller familyasındaki bitkiler, yarı kurak bölgelerdeki meraların kalitesi ve miktarı için önemlidir. Meralarımız yanlış yönetim nedeniyle hızla bozulmuştur ve bu familyadaki lezzetli, uzun ömürlü ve kaliteli bitki türlerinden yeni çeşitler geliştirilmelidir. Bu nedenle, yeni çeşitler geliştirmek amacıyla bir koyun yumağı ıslah çalışması başlatılmıştır. 2017 yılında, Anadolu mera alanlarından on bir koyun yumağı popülasyonu, Türkiye, Ankara Tarla Bitkileri Merkez Araştırma Enstitüsünün Gölbaşı ilçesindeki araştırma istasyonunda gözlem bahçesinde ridu kontrol çeşidi ile birlikte ekilmiştir. Bu ıslah araştırmasının ilk aşamasında (2018 ve 2019'da), hem morfolojik (bitki boyu, sap kalınlığı, boğumlar arası uzunluk, boğum sayısı, bayrak yaprak uzunluğu ve genişliği) hem de agronomik özellikleri (yeşil ot ve kuru ot verimi) tespit ettik ve değerlendirdik. Tüm genotipler arasında, G-735 ve G-736 en yüksek bitki boyuna, ayrıca G-728 ve G-729 da en yüksek yeşil ve kuru ot verimine sahip olmuşlardır. Buna ek olarak, G-731 ve G-735 boğumlar arası mesafe en uzun olurken G-729 da en kısa mesafeye sahip olmuştur. G-728 ve G-729 genotipleri, kontrol çeşidinden daha yüksek yeşil ve kuru ot verimi üretmişlerdir. Gelecekte, bu genetik materyaller yeni çeşitler oluşturmak amacıyla ıslahta kullanılabilir. Ayrıca, Kümeleme Analizi, tüm genotiplerin yeşil ot ve kuru ot verimlerine göre A ve B olmak üzere iki gruba ayrıldığını göstermiştir. Temel Bileşen Analizi benzer özellikleri ve bunların benzerlik düzeylerini ortaya koymuştur. Ayrıca bu analiz, G-728 ve G-729'un en yüksek ot verimini verdiğini ve G-735'in de en yüksek bitki boyu ve boğum arası mesafesine sahip olduğunu göstermiştir.
Anahtar Kelimeler: Koyun yumağı, morfolojik özellikler, agronomik özellikler, kümeleme analizi, temel bileşen analizi

OBSERVATION ON MORPHOLOGICAL AND AGRONOMIC TRAITS OF SHEEP FESCUE GENOTYPES (*Festuca ovina*) IN SEMI-ARID CONDITIONS

Abstract
Plants in the grass family are important for the quality and quantity of rangelands in semiarid regions. Our rangelands have rapidly deteriorated due to mismanagement, and new varieties should be developed from the delicious, long-lasting and high-quality plant species in this family. Therefore, a sheep fescue breeding study was initiated in order to develop new cultivars. In 2017, eleven sheep fescue populations from Anatolian rangeland areas were sown with a ridu control cultivar in a nursery plot at the research station in Gölbaşı district of Field Crops Central Research Institute, Ankara in Türkiye. During the initial stage (in 2018 and 2019) of this breeding research, we identified and evaluated both morphological (plant height, stem diameter, distance between nodes, node number, flag long and flag wide) and agronomic traits (fresh forage and dry forage yields). Of all genotypes, the G-735 and G-736 had the highest plant height, moreover, the G-728 and G-729 had the highest yields of fresh and dry forage. In addition, the G-731 and G-735 had the longest distance between nodes while G-729 had the shortest that. The G-728 and G-729 genotypes produced higher fresh and dry forage yields than the control cultivar. In the future, these genetic materials can be used for breeding experiments in order to create new varieties. Furthermore, Cluster Analysis showed that all genotypes were divided into two groups, A and B, based on fresh forage and dry forage yields. Principal Component Analysis came out with similar traits and their levels of similarity. This analysis also showed that G-728 and G-729 gave the highest forage yield and G-735 had the highest plant height and internode distance.
Keywords: Sheep fescue, morphological traits, agronomic traits, cluster analysis, principal component analysis

MİKROBİYAL GÜBRE UYGULAMASININ ORGANİK MAYDANOZ YETİŞTİRİCİLİĞİNDE VERİM VE KALİTEYE ETKİSİ

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Özet
Maydanoz üretiminde aşırı miktarda kullanılan kimyasal gübreler insan sağlığını olumsuz etkilemekte çevre ve toprak yapısını bozmaktadır. Bu nedenle fungal izolatlardan elde edilen mikrobiyal gübreler bu olumsuz etkinin üstesinden gelmek için çevre ve insan sağlığına dost çözümler sunmaktadır. Ancak bu biyogübrelerin bitkisel üretim üzerindeki etkilerinin belirlenmesi, kimyasal gübrelerin yerine kullanılabilmesi için çok önemli bir adımdır. Bu nedenle, 2022 sonbahar sezonunda Ondokuz Mayıs Üniversitesi Ziraat Fakültesi Araştırma ve Uygulama arazisinde serada yetiştirilen maydanoz (*D'Giant Italiana*) çeşidinde fungal izolatlardan elde edilen ticari formülasyona sahip *Aspergillus Oryzae* ve kimyasal gübre (15-15-15 NPK) uygulamalarının verim ve kalite parametreleri üzerine etkileri araştırılmıştır. Yapılan araştırma sonuçlarına göre yetiştirilen maydanozlarda bitki boyu(23.2), yaprak sayısı(70), yaprak alanı(27.8cm^2) kompoze gübre uygulamasında ön plana çıkmıştır. En iyi dallanma sayısı(26 adet), ve hue(134.4) değeri ise mikroorganizma uygulanan maydanozlardan elde edilmiştir. Ortalama verim değeri en iyi kompoze gübre uygulamasından (1414 g) elde edilmekle beraber, kontrol (874g)bitkilerine göre mikroorganizma uygulamasının (1399g) maydanoz yetiştiriciliğinde verimi arttırdığı tespit edilmiştir.
Anahtar Kelimeler: *Aspergillus oryzae*, Gübre, Sera, Organik yetiştirme

EFFECT OF MICROBIAL FERTILIZER APPLICATION ON EFFICIENCY AND QUALITY IN ORGANIC PARSLEY GROWING

Abstract
Chemical fertilizers used in excessive amounts in parsley production negatively affect human health and disrupt the environment and soil structure. Therefore, microbial fertilizers obtained from fungal isolates offer environmentally and human health-friendly solutions to overcome this negative effect. However, determining the effects of these biofertilizers on crop production is a very important step to use them instead of chemical fertilizers. Therefore, the effects of Aspergillus Oryzae with commercial formulation obtained from fungal isolates and chemical fertilizer (1515-15 NPK) applications on the yield and quality parameters of parsley (D'Giant Italiana) variety grown in the greenhouse in the Research and Application land of Ondokuz Mayıs University Faculty of Agriculture in the autumn season of 2022. has been researched. According to the results of the research, plant height (23.2), number of leaves (70) and leaf area (27.8cm^2) in parsley grown came to the fore in the application of compound fertilizer. The best branching number (26) and hue (134.4) values were obtained from parsley treated with microorganisms. Although the average yield value was obtained from the best compound fertilizer application (1414 g), it was determined that the microorganism application (1399 g) increased the yield in parsley cultivation compared to the control (874 g) plants.
Keywords: *Aspergillus oryzae*, Fertilizer, Greenhouse, Organic growing

MARKETING PROMOTION OF RURAL COMPANIES IN THE DIGITAL ENVIRONMENT

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Abstract
The processes of digitalization lead to the transformation of business processes and the search for innovative models of interaction between companies and users. Producers of agricultural products must adapt to modern realities to ensure an appropriate level of competitiveness. Small businesses in rural areas have the opportunity to use modern digital marketing channels to find their target audience online. Achieving optimal results for rural companies involves the use of web analytics, which allows gathering information in a digital environment. Data processing makes it possible to identify optimal models of interaction between producers of agricultural products and potential customers. Science-based approaches enable local companies to achieve optimal economic results. Thanks to the use of modern digital marketing tools, agricultural companies have the opportunity to establish long-term communications with customers and maintain stable demand for their products. Interaction with the target audience involves the use of relevant content that makes it possible to promote agricultural products on the Internet. Visualized content allows to show potential users tasty dishes that are associated with the relevant local brand. It is important to emphasize the environmental friendliness of products since modern consumers are oriented towards a healthy lifestyle and a clean environment. Therefore, modern digital technologies in the field of marketing provide significant opportunities for rural companies. The integration of artificial intelligence into digital marketing leads to qualitative transformations and an increase in the level of loyalty of the target audience, which should be used by agricultural companies to maintain the interest of consumers in a highly competitive environment.
Keywords: Digital Environment, Marketing Promotion, Rural Company, Target Audience

FUNCTIONING OF RURAL COMPANIES IN THE ELECTRONIC TRADE MARKET

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Abstract
The development of the Internet is connected with the introduction of innovative information technologies, which prompts a significant number of the modern population to reorient to the digital environment. The Internet acts as a medium for the promotion of products by various companies and encourages the creation of new models of purchasing products by users. The e-commerce market is very promising for modern rural companies, which have the opportunity to sell their products on the appropriate digital resources. E-commerce market research allows agricultural companies to identify target audiences and form marketing strategies to promote products. Comprehensive analysis serves as an effective tool for identifying optimal marketing tools that allow to achievement of the maximum level of conversion. Thanks to constant monitoring, it is possible to identify changes in the demand for agricultural products and adapt to the features of e-commerce by the influence of external environmental factors. The e-commerce market requires rural companies to promote their products on relevant web resources. Through the use of Internet advertising and organic search, it is possible to create sales funnels with a high conversion rate. With proper targeting, customers who are interested in buying the relevant agricultural products are identified. E-commerce enables rural companies to expand the opportunities to sell their products both nationally and internationally. The promotion of products in the digital environment is an integral part of modern business processes, as globalization leads to increased competition and the need to find a target audience.
Keywords: E-Commerce, Internet, Rural Company, Users

DOCKING ASSESSMENT OF FLAVONOIDS ON ADIPONECTIN PROTEIN AND FAT MASS AND OBESITY ASSOCIATED (FTO) PROTEIN AS ANTI-OBESITY AGENTS: AN *IN-SILICO* INVESTIGATION

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Abstract
Fat Mass and Obesity Associated (FTO) Protein and Adiponectin play essential roles in obesity development and management respectively. In the adipose tissue, FTO is associated with the accumulation of body fat while adiponectin is involved in healthy energy expenditure. Thus, a need to investigate the inhibitory and enhancing effect of flavonoids on FTO and adiponectin proteins respectively, via molecular docking, to confer their anti-obesity function. HPLC analysis was used to isolate quercetin, p. coumarin, epigallocatechin, caffeic acid, sinapic acid, naphthoresorcinol, and gallic acid flavonoids in ethylacetate flavonoid-rich fraction of honey (EAFH) and methanol flavonoid-rich fraction of lime juice (MFLJ); and AutoDock Vina software was used for the molecular docking of these ligands and the standard drugs (Atorvastatin and Orlistat). The binding affinities of atorvastatin and orlistat to adiponectin were (-7.9 Kcal/mol and -7.4 Kcal/mol), and to FTO protein were (atorvastatin: -7.5 Kcal/mol and orlistat: -6.6 Kcal/mol). The amino acids essentially involved in hydrogen bond formation and interactions between ligands and the FTO protein were: Ser-229, Tyr-108, Asp-233, and Glu-234; and of adiponectin were: His-382, His-241, and Tyr-252. The (ΔG) value of binding affinity for all ligands revealed their capable potential as inhibitors of FTO protein. Quercetin (-8.2 Kcal/mol), epigallocatechin (-8.0 Kcal/mol), and p. Coumarin (-7.3 Kcal/mol) possessed the highest inhibitory effect on FTO protein than the standard drugs (atorvastatin: -7.5 Kcal/mol and orlistat: -6.6 Kcal/mol). The binding affinity (ΔG) value for quercetin (-8.4 Kcal/mol), p. coumarin (-8.0 Kcal/mol), and epigallocatechin ligands portrayed their proficiency as anti-obesity phytotherapy, with latent potential to enhance adiponectin protein function in lipid and glucose metabolism. It may be concluded that the higher (ΔG) value of quercetin, p. coumarin, and epigallocatechin suggest their inhibitory effect on FTO protein and potential as anti-obesity drug target on adiponectin to exert their antioxidant, glucose, and lipid metabolic effects on this protein and thus could improve its function in healthy energy expenditure.
Keywords: Adiponectin, Anti-obesity, Atorvastatin, Epigallocatechin, Flavonoids, FTO protein, Ligands, Orlistat, P. coumarin, Quercetin

EVALUATION OF NUTRITIONAL QUALITY OF NIGERIAN SOYBEAN (*Glycine Max*)

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Abstract
The current study evaluated both the nutrient contents and biological quality of Nigerian soybean, using standard procedures of food compositional analysis and rat feeding trial. Dried whole soybean was treated into powder form (SBF) for nutrients composition evaluation. SBF was modified into dried, rectangular-shaped diet (SBD) for a fourteen-day feeding trial on a group of healthy male Sprague Dawley rats. The group comprising four rats was placed on *ad libitum* feeding and drinking alongside each of a group of four rats placed on protein-free diet, and standardized laboratory chow. During the last four days of the trial, daily body weight, amount of feed intake was recorded, and total faeces were collected from each diet-fed group to assess the biological quality. The nutrient contents of SBF showed a higher energy percent for protein (38.24), lipid (40.20), but lower energy percent for carbohydrate (21.56) compared with the recommended range. The findings showed that moisture, ash, fibre content, and the density of iron, zinc and calcium were within the recommended range. The biological quality was also considerable for net protein ration, NPR, (2.19), true digestibility, TD, (85.25%), but lower for protein efficiency ratio (PER) and protein digestibility corrected amino acid score (PDCAAS). Sulphur amino acid (SAA) was the limiting amino acid, and about 30% lower compared with the reference value. The current study demonstrated that soybean is a source of high-quality protein, and such makes a protein-rich source food for complementing poor plant-based food in the formulation of adequate complementary foods. The quantitative data thus obtained from the study could be used to establish and/or update Nigeria food composition table and dietary guidelines for achieving the Sustainable Development Goals (SDGs) in infants and young child feeding.
Keywords: Soybean, protein energy percent, calcium, iron, zinc, protein energy ratio, net protein ration, true digestibility, protein digestibility corrected amino acid score, Nigeria

FEDERATED LEARNING-BASED INTRUSION DETECTION SYSTEM FOR IOT

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Abstract
The rapid growth of Internet of Things (IoT) devices in wireless networks has increased the need for effective intrusion detection systems to protect sensitive data and ensure network security. However, traditional centralized approaches for intrusion detection face challenges such as data privacy concerns and scalability limitations. Federated learning has emerged as a promising technique to address these issues by enabling collaborative and privacy-preserving intrusion detection in IoT wireless networks. In this paper, we propose a federated learning-based intrusion detection system for IoT wireless networks. The system leverages the distributed nature of IoT devices to train a shared intrusion detection model without compromising data privacy. Each IoT device performs local training using its own network traffic data, ensuring that sensitive information remains within the device. The model updates from each device are then aggregated in a privacy-preserving manner, allowing the global model to benefit from the collective intelligence of the devices.
Keywords: IoT devices, wireless networks

LONG NON CODING RNAs (lncRNAs) IN NEURODEGENERATIVE DISEASES-DIAGNOSIS AND THERAPEUTICS

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Abstract
RNA molecules longer than 200 nucleotides, known as long-non-coding rnas (lncrnas), are involved in a multitude of biological processes and an increasing number of diseases. They regulate gene transcription, pre-mrna processing, the transport of mature mrnas to distinct cellular compartments, mrna stability, and protein translation and turnover. Neurodegenerative diseases (ndds) are progressive and eventually lethal conditions that include Alzheimer's disease (AD), Parkinson's disease (PD), and Huntington's disease (HD). Environmental signals and heredity are two elements that affect the start of NDD. New research reveals the critical roles lncrnas play in the development of neurological disorders, such as ndds.In the future, an enhanced comprehension of the diagnosis methods for diseases.
Keywords: Non coding RNA, Mrna stability, Parkinson disease, neurological disorder, alzheimer’s diseases, hungtington’s diseases

Aronıa Melanocarpa (MICHX.) ELLIOTT MEYVE VE YAPRAK ÖZÜTLERİNİN BİYOLOJİK AKTİVİTELERİNİN BELİRLENMESİ

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Özet
Aronia melanocarpa (Michaux) Elliot, *Rosaceae* familyasının bir üyesi olup, çok yıllık bir çalı formunda ve üzümsü meyveleri olan bir bitkidir. Kuzey Amerika ve Kanada'nın doğusu orjinli olan aronya, 2012 yılından itibaren Türkiye'de de yetiştirilmektedir. İçeriğinde yüksek oranda polifenoller bulundurması ve üzümsü meyveler içerisinde en yüksek antosiyanin miktarına sahip olması birçok araştırmacının dikkatini çekmiştir. Aronya bitkisinin farklı kısımları ile yapılan çeşitli çalışmalar sonucunda bu bitkinin sindirim sistemi hastalıkları, kardiyovasküler hastalıklar ve çeşitli kanser türleri üzerinde koruyucu etkisinin olduğu gösterilmiştir. Bu çalışmanın amacı, Ankara-Gölbaşı'nda yetiştirilen aronya bitkisinin meyve ve yaprak kısımlarının metanol özütlerinin antimikrobiyal, antioksidan ve sitotoksik aktivitelerinin tespit edilmesidir. Bu amaçla bitkinin yaş ve kuru meyveleri ile yapraklarından metanol özütleri elde edilmiş, bu özütlerin farklı patojen mikroorganizmalar üzerindeki antimikrobiyal aktiviteleri mikrodilüsyon yöntemi ile; antioksidan kapasiteleri ise DPPH serbest radikalini süpürme testi ile belirlenmiştir. Ayrıca özütlerin sağlıklı L929 fibroblast hücreleri üzerindeki sitotoksik etkisi MTT testi ile tespit edilmiştir. En yüksek antimikrobiyal etkinin, kuru meyve özütünün *Staphylococcus aureus* ATCC 25923 üzerine (Minimum inhibitör konsantrasyon değeri: 12,5 mg/mL) olduğu, özütlerin tümünün yüksek DPPH süpürücü etkiye sahip olduğu ve en yüksek

antioksidan aktiviteyi ise yaş meyve özütünün gösterdiği (IC50: 0,71 ± 0,12 µg/mL) tespit edilmiştir. Özütler çalışılan dozlarda sağlıklı hücrelerin canlılığını yüksek oranda etkilememiş; özellikle düşük dozlarda ISO standartlarının kabul sınırları dahilinde olan %70 ve üzeri canlılık gözlemlenmiştir. Araştırmamızın sonucunda, aronya bitkisinin metanol özütlerinin literatür verileriyle uyumlu olarak antimikrobiyal ve antioksidan aktivite göstermesi ve bununla birlikte sağlıklı hücreler üzerinde toksik etkisinin olmadığının belirlenmesi, bitkinin sağlık alanında kullanılabilecek potansiyel bir terapötik ajan olabileceği yönündeki verileri desteklemektedir.
Anahtar Kelimeler: *Aronia melanocarpa* (Michaux) Elliot, antimikrobiyal aktivite, antioksidan aktivite, sitotoksisite, biyolojik aktivite

DETERMINATION OF THE BIOLOGICAL PROPERTIES OF ARONIA MELANOCARPA (MICHX.) ELLIOTT FRUIT AND LEAF EXTRACTS

Abstract
Aronia melanocarpa (Michaux) Elliot is a member of the Rosaceae family, a perennial shrub with berries. Originating from North America and eastern Canada, Aronia has been cultivated in Turkey since 2012. The fact that it contains high amounts of polyphenols and has the highest amount of anthocyanins among berries has attracted the attention of many researchers. As a result of various studies conducted with different parts of the Aronia plant, it has been shown that this plant has a protective effect on digestive system diseases, cardiovascular diseases, and various types of cancer. The aim of this study was to determine the antimicrobial, antioxidant, and cytotoxic activities of methanol extracts of fruit and leaf parts of Aronia plant grown in Ankara-Gölbaşı. For this purpose, methanol extracts were obtained from the fresh and dry fruits and leaves of the plant, and the antimicrobial activities of these extracts on different pathogenic microorganisms were determined by the microdilution method, and their antioxidant capacities were determined by DPPH free radical scavenging test. In addition, the cytotoxic effect of the extracts on healthy L929 fibroblast cells was determined by MTT assay. The dried fruit extract had the highest antimicrobial effect on Staphylococcus aureus ATCC 25923 (Minimum inhibitory concentration value: 12.5 mg/mL), all of the extracts had a high DPPH scavenging effect, and the highest antioxidant activity was shown by the fresh fruit extract (IC50: 0, 71 ± 0.12 µg/mL) was detected. The extracts did not highly affect the viability of healthy cells at the doses studied; especially at low doses, 70% and above viability was observed, which is within the acceptance limits of ISO standards. As a result of our research, methanol extracts of Aronia plant showed antimicrobial and antioxidant activity in accordance with the literature data, and the determination that it has no toxic effect on healthy cells supports the data that the plant may be a potential therapeutic agent that can be used in the field of health.
Keywords: *Aronia melanocarpa* (Michaux) Elliot, antimicrobial activity, antioxidant activity, cytotoxicity, biological activity

THE RELATIONSHIP BETWEEN VECTOR TRANSMISSION OF PLANT VIRUSES AND GENOME ORGANIZATION

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Abstract
Plant viruses cause significant economic and yield losses in terms of quality and quantity in many plant species (cereals, garden plants, ornamental plants, etc.). In the emergence of these losses, the transmission of the virus from plant to plant and the way it is transmitted are of great importance. One of the reasons why effective control methods against viruses have not been developed is due to the lack of sufficient information about the transmission of viruses from one host to another. Plant viruses must go through two phases during the infection cycle. First, viruses take control of cellular systems and multiply themselves within the host cell (replication); In order to colonize at the points where infection begins in plants, it has to pass to neighboring cells (short-distance transport) and pass through the vascular system to other tissues and organs (long-distance transport). Second, viruses must spread to new hosts and to do so must cross cellular barriers upon entry into cells. The process of crossing the cellular barriers required for many viruses to pass to new hosts is managed by vector organisms. The spread of plant viruses from plant to plant is carried out by inoculum, seeds and tubers, or by vectors such as arthropods, nematodes, fungi and plasmodiophorids. There are many findings regarding the viral factors that determine transport, but there is still limited information on the viral determinants required for vector specification of transport. Non-structural proteins, including the coat protein (CP) or its derivatives (Readthrough CP and auxiliary CP) and the auxiliary component (HC) and transport factor, are essential determinants for the specialization of transport.
Keywords: Plant virus, Vector transmission, Genome organization

ADDED VALUE OF COCONUT SAP TO BE COCONUT SUGAR

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Abstract
Life to be healthier, consumers often wish to substitute refined sugar with alternative sweeteners, such as coconut sugar. Coconut sugar made of coconut sap. Coconut sap is a clear liquid with a sweet taste produced from coconut flower bunches. Therefore, coconut sugar maker processes the sap to increase added value become coconut sugar. This study aimed to determine how much-added value and profit is generated in the coconut sugar agro-industry. This was case study located in Pangandaran West Java Indonesia in 2022. The data was analyzed by Hayami method. The results showed that the coconut sugar agro-industry provided an added value of IDR 1,323 per kg of sap with an added value ratio of 69.02% which is included in a high added value ratio. The profit earned is IDR 1,073 per kg with a conversion factor 0.17. If sold in raw matter, coconut sap has a price of IDR 350.00/kg, while if it is processed into coconut sugar products, it has a price of Rp. 12,000/Kg in producer.
Keywords: Coconut sugar; healthier; sap

ASSESSMENT OF FARMERS' ACCESS AND USE OF AGRICULTURAL CREDIT FACILITIES IN ENUGU WEST SENATORIAL ZONE OF ENUGU STATE, NIGERIA

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Abstract
Access and utilization of credit are key to agricultural growth and development. The study investigated farmers' access and use of agricultural credit facilities in Enugu west senatorial zone of Enugu state, Nigeria. Multi-stage and purposive sampling techniques were used in sampling seventy-two farmers for the study. The data were collected using structured interview schedule and analysed using frequency, percentage, mean and standard deviation. The result showed that friends/family (83.3%), and cooperative society (65.3%) were the major available sources of credit to farmers. They were also the main accessible sources; friend and family (M=2.24), and cooperative society (M=1.78). The accessed credits were essentially used for planting operations such as planting, weeding, spraying (97.2%), purchase of farm inputs like seeds and seedling (97.2%), hiring of labour (94.4%), land preparation (clearing, stumping) (93.1%), and purchase of farm chemicals like insecticide and fertilizer (80.6%). In conclusion, farmers lacked access to more formal credit sources, and for credit to be meaningful for agricultural development, it has to be available in reasonable amounts, and farmers must be able to readily access and utilize them at will. Hence, government should avail farmers access to institutional credit sources with more capital base.
Keywords: agricultural growth, Nigeria, farmers

A NEW BIOMASS-BASED ACTIVATED CARBON FOR THE REMOVAL OF CATIONIC DYES FROM THE AQUEOUS ENVIRONMENTS: CHARACTERIZATION, KINETICS, ISOTHERM, THERMODYNAMICS

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Abstract
Adsorption of organic pollutants onto activated carbons, especially based on plant waste, has a good interest by scientists due to its low cost and less energy consumption. This study deals with the development of activated carbon based on FCP powder by phosphoric acid (H3PO4) activation, named AC-FCP, and their application as adsorbents of methylene blue dye. Due to their high toxicity, the dye content in wastewater must be within tolerable limits before their discharge into the aquatic environment. With a small quantity, these dyes can diffuse over a large surface of an aquatic environment causing inhibition of photosynthesis by depriving light penetration into the water. The activated carbon obtained was characterized by physicochemical methods like Brunauer-Emmett-Teller (BET) theory, morphological studies (SEM), Energy dispersive X-ray (EDX), X-ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR), complementary analyses and thermodynamics. The effects of various parameters on removal efficiency and adsorption capacity of methylene blue onto AC-FCP were studied by testing the effect of the mass, initial concentration, contact time, pH, and temperature. The characterization of AC-FCP shows that our activated carbon has a high surface area charged negatively, a microporous and mesoporous structure, and an amorphous structure. The removal efficiency is at 99,28 % with an adsorption capacity of 72.58 mg.g-1 in a contact time of 110 min. the adsorption mechanism is favorable, and reversible, forming a monolayer with a chemosorption mechanism which is defined by The Langmuir isotherm and Pseudo-second-order kinetic. Our activated carbon AC-FCP has the best characteristics for the high removal of toxic dyes like methylene blue in aqueous environments with low cost and less energy.
Keywords: FCP, Adsorption, kinetics, methylene blue

ELECTROCHEMICAL POTENTIAL-BASED DIAGNOSTICS OF STEEL REBAR CORROSION IN CONCRETE

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Abstract
Corrosion in reinforced bars is a major cause of structural deterioration in concrete structures, leading to reduced structural integrity and increased maintenance costs. Corrosion in concrete structures become a very serious issues as buildings age. In Nigeria and most developing African countries were majority of building structures are more than 40 years old, this constitutes a major issue as building collapse has been on the increase. This paper will focus on the use of potential corrosion techniques to diagnose concrete structures in the bid to identify areas under corrosion threat thereby stalling the total failure of these structures. In this paper, full-scale reinforced concrete beams were corrosion analysed. Corrosion was stimulated by the Modied Immersion Accelerated Corrosion - CAIM method, at three levels of mass loss: 10, 15 and 20%. The diagnostic technique through the corrosion potential was applied, in which it was observed that there is uncertainty in the corrosion evaluation for the mass loss levels of 15 and 20%, resulting in a corrosion uncertainty interval, but at 15%, the potential technique proved to be satisfactory.
Keywords: Corrosion, reinforcement, diagnostic technique, corrosion potential

POTENSI PERKEMBANGAN PEREKONOMIAN KOTA PEMALANG

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Abstract
Pemalang City has great potential to develop in the economic field. The city has a strategic location, abundant natural resources, and a friendly community. Pemalang is located on the pantura route, which is the main trade route in Indonesia. The city also has easy access to various major cities in Central Java, such as Semarang, Yogyakarta, and Jakarta. Pemalang has abundant natural resources, including vast and fertile agricultural land, mining potential, and tourism potential. Pemalang people are known as friendly and hardworking people. This will be an important capital to develop the city's economy. The research method used is using descriptive qualitative method. This research can be done by collecting data from interviews, data from observations, and data from literature review. These data are then analyzed to understand the factors that influence the economic development of Pemalang City, as well as to formulate the city's economic development strategy. The results of the research on the economic development potential of Pemalang City show that Pemalang City has great potential for development. The city has a strategic location, abundant natural resources, and a friendly community. The economic potential of Pemalang City can be developed in various sectors, namely First, the agricultural sector, Pemalang has extensive and fertile agricultural land. Food crops cultivated in Pemalang include rice, corn, and soybeans. Second, the industrial sector, Pemalang has several large industries, including the textile industry, food industry, and handicraft industry. Third, the trade sector of Pemalang is one of the trade centers on the pantura route. Fourth, the tourism sector of Pemalang has various natural, cultural, and historical attractions. Potential efforts for the economic development of Pemalang City that can be done by the government and the community are the Government: Building the Pemalang-Batang toll road to improve access to Jakarta and Semarang. Build an industrial area to attract investment. Provide skills training for the community. Community: Increase agricultural productivity by using modern agricultural technology, Develop typical Pemalang handicraft products, Build small and medium enterprises (SMEs).With the support of the government and the community, Pemalang City will have great potential to develop and become a developed and prosperous city.
Keywords: Pemalang, economy, potential, strategy, development

STUDY OF MECHANICAL PROPERTIES OF PARTICLE FILLED WASTE BAST FIBER AND EPOXY RESIN COMPOSITE

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Abstract
These days, composites reinforced with fibers generated by natural or synthetic materials are becoming more and more important due to the market's growing need for strong, lightweight materials for certain uses. In addition to having a high strength to weight ratio, fiber-reinforced composites made from polymers have remarkable qualities such great durability, stiffness, damping property, flexural strength, and resistance to wear, corrosion, impact, and fire. Composite materials are used in numerous manufacturing industries, including mechanical, construction, automobiles, aerospace, biomedical, and marine. This is due to their vast range of various properties. Composite material performance is mostly determined by the components and production processes used. In this study, Polymer composites were prepared using hand-layup method using different fiber loading of waste bast fiber and epoxy resin to investigate its haw tensile strength, young modulus, flexural strength, modulus of elasticity, impact and hardness change with fiber loading. The results showed a reduction in tensile strength, young modulus and flexural strength and increased in modulus of elasticity with fiber loading up to 0.5%, while impact and hardness showed increased by about 100% and 300% respectively. This suggests that the composites can be used in the production of materials with better impact, hardness and modulus of elasticity.
Keywords: Polymer Composites, Natural fiber, Bast fiber, Epoxy resin, Mechanical test.

A REVIEW OF THE ROLE OF PHENOLIC COMPOUNDS IN PLANTS UNDER ENVIRONMENTAL STRESSES

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Abstract
Flavonoids, anthocyanins, tannins, hydroxycinnamic acids, and lignins are phenolic compounds that are part of the secondary metabolites of the phenylpropanoid pathway, which are abundantly found in plant tissues. The phenylalanine ammonia-lyase (PAL) enzyme is the initiator of the phenylpropanoid pathway, which converts L-phenylalanine to trans-cinnamic acid by deamination. This path is the main path of biosynthesis of secondary metabolites in the cell. Phenolic compounds are synthesized in the cell under normal conditions, but environmental stresses change their amount in the cell. A change in the activity of biosynthesizing enzymes of these compounds affects the amount of these compounds in the cell. Flavonoids are a large group of secondary metabolites that are widespread among plants and have multiple roles. These roles include protection against UV radiation, creating color in flowers, seeds and pollen grains, helping pollination, germination and pollen tube growth, and auxin transport. The main enzymes involved in the biosynthesis of flavonoids are phenylalanine ammonialyase and chalcone synthetase. So far, about 12 groups of flavonoids have been identified, the three most important of which are flavones, flavonols, and anthocyanins. In addition to the mentioned roles, phenolic compounds also act as antioxidants in the cell. By reducing or inhibiting auto-oxidation of lipids, scavenging oxygen free radicals, quenching singlet oxygen, or dissociating peroxides, phenolic compounds act as a necessary antioxidant to protect against the progression of the oxidation chain and defend against reactive oxygen species (ROS). The antioxidant characteristic of phenolic compounds is related to their chemical structure, which can act as electron or H^+ donors. Polyphenols can act as chelators of transition metals such as iron and as a result prevent reactions such as Fenton or Haber-Weiss reactions. Numerous studies in plants show that environmental stresses such as salinity, drought, heavy metals, etc. affect the increase in the amount of non-enzymatic antioxidants, including the increase in the amount of phenolic compounds, glutathione, ascorbate, carotenoids, and also increase the activity of the enzyme phenylalanine ammonialyase. Accumulation of these compounds has been reported in various environmental stresses.
Keywords: Phenolic compounds, Flavonoids, Phenylalanine ammonia-lyase enzyme, phenylpropanoid pathway, Secondary metabolites, Environmental stresses

THE EFFECT OF GRADED LEVEL OF DIETARY SUPPLEMENTATION OF CITRIC ACID ON PERFORMANCE AND SERUM LIPIDS OF BROILER CHICKENS

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Abstract
This study was conducted to evaluate the effects of graded levels of organic acid as growth growth-promoting agent on growth performance and serum lipid profile of broiler chickens. In a 6-week feeding trial experiment, a total of 240 unsexed day-old arbor acres broiler chicks were randomly allocated to four treatments; Treatment 1(T_1) - basal diet (control), Treatment 2 (T_2)- basal diet + 1% citric acid, Treatment 3 (T_3)- basal diet + 2% citric acid, Treatment 4 (T_4)- basal diet + 3% citric acid. Each treatment consisted of six replicates with ten birds each. Feed intake, Weight gain, feed conversion ratio (FCR) and serum lipids were determined. Data obtained were analysed at $p<0.05$ level of significance using one-way ANOVA procedures of Statistical Analysis System (SAS 9.4) software. Means were compared using Duncan multiple range tests and polynomial regression was used to determine the optimum level of the graded levels of citric acid. The feed intake of broiler chickens fed T_2 (2191.33g), T_3 (2194.83g), and T_4 (2195.83g) respectively were significantly ($p<0.05$) higher than that of birds fed the control diet (2022.17g). The weight gain and FCR were significantly ($p<0.05$) affected. The broiler chickens in T_2 had the highest weight gain of 1290.16g while its counterpart in T_1 had the least weight gain of 782.48g. Broilers on diets with graded levels of citric acid had decreased FCR (1.71, 1.91, 1.92 values for T_2, T_3, and T_4 respectively) compared with those on control diet T_1(2.59). Varying levels of citric acid in the diets also exerted a significant ($p< 0.05$) effect on the serum lipids. The triglyceride, total cholesterol, LDL and VLDL values of broilers fed varying levels of citric acid (T_2, T_3 and T_4) were similar but significantly ($p< 0.05$) lowered compared to birds on the control diet (T_1). Conversely, the HDL value of broilers on T_1 (21.26mg/dl) was significantly lower than T_2 (25.83mg/dl), T_3 (25.16mg/dl) and T_4 (25.00mg/dl). From this study, it could be inferred that the inclusion of 1% citric acid in the diets of broilers could lower the blood cholesterol of broiler chickens, serve as a growth-promoting agent and enhance broiler chickens' performance.
Keywords: Organic acids, growth promoter, broiler performance, serum lipids, supplemental feed additives.

THE IMPACT OF VILLAGE SAVING LOAN ASSOCIATION ON SMALL HOLDER FARMERS IN TAIAMA, KORI CHIEFDOM, MOYAMBA DISTRICT

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Abstract
Governments and nongovernmental organizations have made poverty reduction a top priority. This has resulted in the implementation of programs and projects aimed at reducing poverty levels. To supplement the government's efforts to com- bat poverty among smallholder farmers, farmer's groups are adopting the Village Savings and Loans Association (VSLA) model, which is aimed at promoting access to agricultural activities and money to the rural poor as a means of reducing poverty. This study was conducted in Taiama, Kori Chiefdom, Moyamba District to examine the effects of village saving loan associations on smallholder farmers. This was accomplished through questionnaire interviews with 100 VLSA participants. According to the study's findings, women are more active in the saving category. Seventy-five percent of respondents are married, and those between the ages of 41 and 45 are more engaged in VSLA. The study also showed that there was an increase in agricultural operations, which increased the availability of nutrient-rich food and an increase in the chance for family members to pursue higher education through loans or profit-sharing from the VSLA. It can be concluded that VSLA can be utilized as a method to significantly reduce poverty among smallholder farmers in Taiama and to replicate the concept in other farming areas.
Keywords Village saving loan association · Smallholder farmers · Poverty reduction · Agriculture
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IMPROVEMENT OF MECHANICAL PROPERTIES OF POLYMERIC WASTES COMPOSITES USING CHARCOAL PRODUCED FROM DOUM PALM (Hyphane thebaica L.) FRUIT AS REINFORCEMENT

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Abstract
The growing concern over environmental sustainability and the need for innovative waste management solutions have spurred interest in the utilization of waste resources. This study investigates the potential of utilizing charcoal produced from Doum Palm (*Hyphane thebaica L.*) fruit as filler to improve the mechanical properties of polymeric waste materials. The composite materials were formed by incorporating varying proportions of charcoal into the polymeric matrices through a melt-blending technique. The resulting composites were then subjected to a certain characterization processes, including FTIR, SEM and mechanical testing. The mechanical testing investigates changes in tensile strength and flexural strength. The tensile strength of the samples have fairly increased with increased of the filler concentrations except for polypropylene which starts to decline at 10%wt filler concentration. There was a consistent increase in flexural properties, the optimum values were 41.15, 48.09 and 76.01MPa for polypropylene (PP), polyethylene (PE) and polystyrene (PS) respectively. The findings of this study can contribute to the development of sustainable materials with improved properties from waste polymers in the following areas: construction, automotive, and electronics industries. Hence, this can contributes to the improvements of the socio-economic status of the people and reducing environmental impacts associated with polymer waste disposal.
Keywords: Characterization, Filler, Mechanical properties, Polymer wastes, and Recycling.

YENİ KETEN (*Lınum Usıtatıssımum* L.) GENOTİPLERİNİN GELİŞİTİRİLMESİNDE HIZLI ISLAH TEKNİĞİNİN KULLANIMI

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Özet

Keten (*Linum usitatissimum* L.), buğday ve arpa ile birlikte ilk kültüre alınan bitkilerdendir. Liflik keten ve yağlık keten olarak iki çeşidi bulunmaktadır. Liflik ketenlerden elde edilen lifler, keten bezi başta olmak üzere sicim, halat ve urgan yapımında da kullanılmaktadır. Yağlık ketenler tohumları için yetiştirilir. Yağlık ketenlerin tohumları, yüksek oranda Omega-3 yağ asidi, lif ve protein içerir. Keten tohumu, kalp sağlığını desteklemek, kolesterolü düşürmek, sindirimi düzenlemek ve sağlıklı kilo vermeye yardımcı olmak gibi birçok faydaya sahiptir. Ketenin aynı zamanda farklı iklim koşullarında adaptasyon yeteneği yüksek olup, sürdürülebilir tarım sistemlerine katkı sağlamaktadır. Keten ıslahı kullanım amacına göre farklılık göstermektedir. Hem yağlık hem liflik keten bitkisinin verimini, kalitesini ve dayanıklılığını artırmak ıslah amaçları arasındadır. Keten ıslah çalışmalarında geleneksel ıslah yöntemlerinin yanı sıra, modern yöntemlerin de kullanımı vazgeçilmezdir. Bu çalışmada; yeni keten hatlarının geliştirilmesinde klasik ıslah metodlarına yardımcı olarak ıslah süresini kısaltıcı yöntemlerin kullanılması amaçlanmıştır. Bu kapsamda son yıllarda birçok bitki türünde başarıyla uygulanan hızlı ıslah tekniği keten bitkisi için de optimize edilmiştir. Keten tohumlarının ekimi Ankara, Tarla Bitkileri Merkez Araştırma Enstitüsü Müdürlüğü, Biyoteknoloji Araştırma Merkezinde bulunan iklim odalarında gerçekleştirilmiştir. Gerekli bakım işlemleri (sulama, gübreleme, ilaçlama vb.) yapıldıktan sonra hasat olgunluğuna gelmemiş kapsüllerde bulunan tohumlar hasat edilerek etüvde 32˚C'de ışıksız ortamda 5 gün süreyle tutulmuştur. Tohumlardaki dormansiyi kırmak ve tohumların aynı anda çimlenmesini teşvik etmek amacıyla 0,5-1 ppm giberellik asit uygulaması yapılarak buzdolabında +4 ˚C'de ışıksız ortamda 4 gün bekletilmiştir. Giberellik asitte bekleyen tohumlar, çimlenme gözleninceye kadar 4 gün oda sıcaklığında tutulmuştur. Çimlenen tohumlar torf ve perlit içeren viyollere aktarılmıştır. Viyoller 24 ˚C gündüz/18 ˚C gece sıcaklığında 22 saat ışık/2 saat karanlık fotoperiyot olacak şekilde 190.000 lüx [(bitkinin üzerine düşen ışık bitki boyuna göre değişmekle beraber 7000 lüx (650 milimol)] ışık şiddetindeki iklim odasına alınmıştır. Gerekli

bakım işlemleri yapıldıktan sonra hasat olgunluğuna gelmemiş tohumlar tekrar hasat edilmiştir. Seçilen kapsüllerden elde edilen tohumlara generasyon atlatma teknikleri uygulanarak 1 yılda 4 generasyon ilerleme sağlanmıştır. Tohumdan tohuma geçen süre 75-80 gün olarak kaydedilmiştir.

Anahtar kelimeler: Keten ıslahı, generasyon atlatma, modern ıslah yöntemleri

USING OF SPEED BREEDING TECHNIQUE TO DEVELOP NEW FLAX (Linum usitatissimum L.) GENOTYPES

Abstract
Flax (*Linum usitatissimum* L.) is one of the first cultivated plant, along with wheat and barley. It has two types as fiber flax and oil flax. The fibers obtained from fiber flax are used in the production of linen cloth, twine, rope, and tether. Oil flax is grown for its seeds. Oil flax seeds contain high levels of Omega-3 fatty acids, fiber, and protein. Flaxseed has many benefits such as supporting heart health, lowering cholesterol, regulating digestion, and helping healthy weight loss. Flax also has a high adaptability in different climatic conditions and contributes to sustainable agricultural systems. Flax breeding varies depending on the purpose of use. Increasing the yield, quality and durability of both oil and fiber flax plants is among the breeding objectives. In addition to classical breeding methods, the use of modern methods is indispensable in flax breeding studies. In this study; it was aimed to use methods that shorten the breeding time as an aid to classical breeding methods in the development of new flax lines. In this context, the speed breeding technique, which has been successfully applied to many plant species in recent years, was optimized for flax. Flax seeds were sown in the growth chambers at the Biotechnology Research Center of the Central Research Institute of Field Crops (CRIFC), Ankara, Türkiye. After the necessary maintenance procedures (irrigation, fertilization, pest management, etc.) were carried out, the seeds in the capsules that did not reach harvest maturity were harvested and kept in an oven at 32˚C without light for 5 days. In order to break the dormancy in the seeds and to encourage the seeds to germinate at the same time, 0.5-1 ppm GA_3 was applied and kept in the refrigerator at +4˚C for 4 days without light. The seeds were kept at room temperature for 4 days until germination was observed. The germinated seeds were transferred to the viols containing peat and perlite. The viols were placed in a growth chamber at 24˚C day/18˚C night temperature and 22 hours light/2 hours dark photoperiod with a light intensity of 190.000 lux [(the light falling on the plant varies according to the plant height, but 7000 lux (650 millimoles)]. After the necessary maintenance procedures were carried out, the seeds that did not reach harvest maturity were harvested again. Generation skipping techniques were applied to the seeds obtained from the selected capsules and 4 generations were progress in 1 year. The time from seed to seed was recorded as 75-80 days.
Keywords: Flax breeding, generation skipping, modern breeding methods

FARKLI ASPİR (*Carthamus tinctorius* L.) GENOTİPLERİNE AİT MELEZ KOMBİNASYONLARINDAN ANTER KÜLTÜRÜ METODUYLA HAPLOİD BİTKİ ELDESİ

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Özet

Aspir (*Carthamus tinctorius* L.,) kurağa dayanıklı yazlık ve kışlık yetişitirilme tabiatına sahip yağlı tohumlu tek yıllık bir bitkidir. Yağ oranı dikenli ve dikensiz çeşitlerine göre değişmekte olup dikensizlerde %25-28, dikenlilerde ise %30-40 arasındadır. Aspir bitkisinin yağ tipi oleik ve linoleiktir. İnsan gıdası olarak yağlık amaçlı kullanılmasının yanı sıra kozmetik sanayisinde de kullanılmaktadır. Renkli çiçekleri nedeniyle gıda ve kumaş boyası amacıyla değerlendirilmektedir. Aspir ıslah çalışmaları yüksek tohum ve yağ verimi, yağ kalitesi ve biyotik-abiyotik stres şartlarına dayanıklı çeşitler geliştirmek amacıyla yürütülmektedir. Ancak geleneksel ıslah metotları kullanılarak yapılan çalışmalar uzun zaman almaktadır. Bu nedenle ıslah sürecini kısaltacak biyoteknolojik çalışmalar büyük önem kazanmaktadır. Biyoteknolojk yöntemlerle ıslah süresinin kısaltılarak talep edilen çeşitlere daha kısa sürede ulaşılabilmesi mümkün olabilmektedir. Bu çalışmada; aspir bitkisinde anter kültürü yöntemi kullanılarak verimli, kurağa ve soğuğa dayanıklı ve yağ açısından kaliteli yeni çeşitlerin daha kısa sürede geliştirilmesi amaçlanmaktadır. Ülkemizde Orta Anadolu koşullarında yürütülen klasik ıslah çalışmalarında aspir bitkisinde bir yılda bir generasyon ilerleme sağlanabilmektedir. Farklı bitki gruplarında anter kültürü metodunun kullanılmasıyla kısa süre içerisinde saf hatlara ulaşmak mümkün olmaktadır. Bu çalışmada kullanılan donör bitkiler, Ankara, Tarla Bitkileri Merkez Araştırma Enstitüsü Müdürlüğü, Yenimahalle yerleşkesinde bulunan melez bahçesinde yetiştirilmiştir. 4 farklı aspir genotipine ait kombinasyonlar ile melezlenme çalışmaları yürütülmüştür. Melezleme çalışmaları sonucunda elde edilen F1 ve F2 kademesinde bulunan genotiplerin tablalarındaki anterlerin gelişimleri incelenmiştir. Anter alımı için uygun aşama belirlenmiştir. Uygun anter gelişim evresinde alınan ana tablalar

folyoya sarılı olarak 4 gün +4˚C'de soğuk ön muamele işlemine tabi tutulmuştur. Ön muamele süresi dolan tablalara %20'lik çamaşır suyuyla 20 dakika sterilizasyon işlemi uygulanmıştır. Tablalardan izole edilen anterler başlangıç ortamı olarak BAP, NAA, 2,4-D'nin farklı konsantrasyonları ile 1 mg $AgNO_3$ içeren besiyerlerine aktarılmıştır. 25˚C'de karanlıkta inkübatörde bekletilen petrilerdeki anterlerde 28. günden sonra kallus oluşumu gözlenmeye başlamıştır. Kalluslardan sürgün elde edilebilmesi için BAP, NAA ve TDZ'nin farklı konsantrasyonlarını içeren rejenerasyon ortamlarına kalluslar aktarılmıştır ve 25˚C ve 16 saat ışık 8 saat karanlık fotoperiyotlu iklim dolaplarına alınmıştır. Sürgünler 30 gün sonra gözlenmeye başlamıştır. Farklı gelişimleri gözlenen sürgünlerin köklenmesi için IAA, IBA ve NAA hormon kombinasyonları denenmektedir.

Anahtar Kelimeler: Aspir, biyoteknoloji, homozigot

PRODUCTION OF HAPLOID PLANTS FROM HYBRID COMBINATIONS OF DIFFERENT SAFFLOWER (*Carthamus tinctorius L.*) GENOTYPES BY ANTHER CULTURE METHOD

Abstract
Safflower (*Carthamus tinctorius* L.) is an annual oilseed plant that is resistant to drought and suitable for summer and winter cultivation. The oil content varies according to thorny and thornless varieties and is between 25-28% in thornless and 30-40% in thorny varieties. The oil types of the safflower plant are oleic and linoleic. In addition to being used as human food for cooking oil, it is also used in the cosmetics industry. In addition to being used as human food for oil, it is also used in the cosmetics industry. Due to its colorful flowers, it is valued for food and fabric dyeing. Safflower breeding studies are carried out to develop varieties with high seed and oil yield, oil quality, and resistance to biotic and abiotic stress conditions. However, studies using traditional breeding methods take a long time. Therefore, biotechnological studies that will shorten the breeding process gain great importance. By shortening the breeding period with biotechnological methods, it is possible to reach the demanded varieties in a shorter time. In this study; it is aimed to develop new varieties that are drought and cold resistant, high-yielding and high oil quality in a shorter time by using anther culture method in safflower plant. In classical breeding studies carried out in Central Anatolian conditions in our country, one generation progress can be achieved in safflower plant in one year. With the use of anther culture method in different plant groups, it is possible to reach pure lines in a short time. The donor plants used in this study were grown in the crossing garden located in Yenimahalle campus of the Central Research Institute of Field Crops (CRIFC), Ankara. Crossbreeding studies were carried out with combinations of 4 different safflower genotypes. The development of the anthers in the main head (capitulum) of the genotypes in the F1 and F2 generations obtained as a result of hybridization studies were examined. The appropriate generations for anther removal was determined. The main head taken at the appropriate anther development stage were wrapped in aluminium foil and subjected to cold pretreatment at +4˚C for 4 days. After the pretreatment period, the capitulums were sterilized with 20% sodium hypochlorite during 20 minutes. Anthers isolated from the capitulum were transferred to medium containing different concentrations of BAP, NAA, 2,4-D, and 1 mg $AgNO_3$ as starter medium. After the 28th day, callus formation was observed in the anthers in the petri dishes kept in the incubator at 25˚C in the dark. In order to obtain shoots from the calluses, the calluses were transferred to regeneration media containing different concentrations of BAP, NAA and TDZ, and placed in climate cabinets with a photoperiod of 25˚C and 16h light 8h dark. Shoots were observed after 30 days. Hormone combinations of IAA, IBA, and NAA are tried for rooting of shoots with different development.
Keywords: Safflower, biotechnology, homozygous

NUTRITION & DIETETICS

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Abstract
Registered dietitians (RDs) and dietetic technicians, registered (DTRs) can implement environmentally responsible practices in their workplace and personal lives. RDs and DTRs who conserve natural resources while minimizing environmental degradation will help maintain sustainability of the food system, which requires knowledge of the external costs of operational and personal decisions. These external costs include energy to produce, transport, and process food; water for food production, preparation, and sanitation; removal of air pollutants; and waste management. RDs and DTRs are uniquely positioned to meet the growing needs of those seeking guidance on food choices as they relate to ecological sustainability. In an effort to promote ecologically sustainable diets, it is important to consider natural resources as they relate to food production, transformation, distribution, access, and consumption. It is essential that the dietetics community takes a more active leadership role in support of ecological sustainability and social responsibility. RDs and DTRs can influence policy at the institutional, community, local, state, and national levels by presenting results of operational practices and science-based natural resource information. RDs and DTRs are encouraged to become educated and active in implementing sustainable practices and shaping policy in an effort to promote healthier individuals, communities, and the nation as a whole.
Keywords: Ecological sustainability, ecologically sustainable diets, sanitation

THE IMPACT OF HUMAN RESOURCE MANAGEMENT ON THE DEVELOPMENT OF INNOVATIVE BUSINESSES

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Abstract
This work was carried out in order to inform more about the impact of innovation technology on the development of entrepreneurship. This paper begins with the explanation about the enterprises, starting with their concept, their development over the years, where it elaborates a theory of time about the reasons why the enterprises are opened and exist, continuing with the discussion of who the entrepreneurs are, and what are the tasks theirs, and also gives us a clear picture of how businesses cannot function without business law. This research continues with the most important subject of the time, the history of the development of innovation, showing us different theories about innovation, how it has developed and how it has changed over time, continuing to the division of innovation. Part of the innovation is also the innovation in marketing, where different theories will be examined, including Ansuff's Matrix. Throughout this paper, we have also penetrated the information system, starting from the definition of the terminology of the system, to the types and development of the information system. Then the advantages and disadvantages of virtualization and office automation will be elaborated.
Keywords: IT, E-business, Information systems, Innovation, etc.

OPTIMIZING CROP SELECTION AND ALLOCATION FOR MAXIMUM YIELD: A QUBO APPROACH

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Abstract
Crop selection and allocation play crucial roles in maximizing agricultural yield and profitability. In this study, we propose a novel approach using a Quadratic Unconstrained Binary Optimization (QUBO) model to optimize crop selection and allocation in agricultural systems. The objective is to determine the optimal combination of crops that maximizes yield or profit while considering the interactions and costs associated with different crops. The QUBO model incorporates negative impacts or costs associated with selecting each crop and positive effects or synergies between different crop combinations. By formulating the problem as a QUBO model, we enable the use of quantum annealing or classical optimization techniques to find the optimal solution. The model's effectiveness is demonstrated through numerical experiments and case studies. Results show that the QUBO-based approach provides significant improvements in crop selection and allocation decisions compared to traditional methods. It takes into account the complex interactions between crops and considers the trade-offs between costs and synergies, resulting in more efficient and profitable agricultural systems. The proposed model offers a flexible and adaptable framework that can accommodate various crop types, growth requirements, market conditions, and constraints. It provides decision-makers in the agricultural sector with a powerful tool to optimize crop selection and allocation, ultimately increasing agricultural yield and profitability while promoting resource sustainability.
Keywords: crop selection, crop allocation, agricultural optimization, QUBO model, yield maximization

EFFECT OF ENVIRONMENT AND GENOTYPE ON DURUM WHEAT: RESPONSES OF GENOTYPES, YIELD, AND QUALITY PARAMETERS

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Abstract
Drought is a major constraint on agricultural production. It is therefore important to optimize the water supply according to the real needs of the crop, taking into account environmental conditions. The objective of this study is to assess the effect of water stress on germination, early seeding growth, and agronomic and physiological parameters of sixteen durum wheat genotypes *(triticum durum)* at the flowering stage. For this purpose, two water stress levels were considered to be provided by the 66% and 33% irrigation water regimes of the field capacity during the controlled early flowering phase. Two experiments were conducted in the experimental field of the National Institute of Agricultural Research at Douyet Fès (34°2 N, 5°W, 416 m) under rainfall conditions over two growing seasons (2019/20, 2020/21). The assessment involved several morphological, physiological, biochemical and agronomic traits. The results obtained show that the various water regime treatments had an effect on the

majority of the parameters studied. As a result, the water deficit caused a small decrease in seedling growth (decrease in plant height and relative water content). Similarly, there has been a decrease in photosynthetic yield and in the number of seeds per plant, particularly under severe stress. The existence of positive correlations between the reduction of photosynthetic activity and the decrease in chlorophyll content and number of seeds, on the other hand, indicates that the reduction in the number of seeds under the effect of water stress would be a consequence of the reduction in photosynthetic activity, explained by a decrease in leaf area and chlorophyll content. Moreover, for most of the parameters studied, the 16 varieties reacted differently to water stress.
Keywords: Drought, durum wheat, water stress, tolerance, germination, proline.

FAUNA OF PLANT PARASITIC NEMATODES IN WORLD HAZELNUT SOILS

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Abstract
Hazelnut, *Corylus avellana* L., is one of the most economically important nut crops worldwide. Among the producer countries, Turkey ranks first, producing almost half of the world's total hazelnut production. Turkey is followed by countries such as Italy, Azerbaijan, the United States, China, Georgia, Iran, France, Chile, and Spain. There are many pests that negatively affect hazelnut yield directly and indirectly. Plant parasitic nematodes are one of them. A limited number of research have conducted on the nematode fauna in hazelnuts. Only a few authors pointedout the nematode pest status of hazelnut in some countries: Italy (Mancini et al., 1975), Georgia (Gorgadze et al., 2020), Greece (Kyrou, 1976), Spain (Pinochet et al., 1992), California, US (Norton et al., 1984) and Türkiye (Kepenekci, 2002; Akyazi et al.,2014). The nematodes detected in hazelnut production orchards are root-knot (*Meloidogyne* spp.), cyst (*Heterodera* spp.), root-lesion (*Pratylenchus* spp.,), pin (*Paratylenchus* spp., *Gracilacus* spp.), dagger (*Xiphinema* spp.), ring (*Criconema* spp., *Criconemella* spp.), spiral (*Helicotylenchus* spp.), reniform (*Rotylenchus* spp.) and stunt nematodes (*Tylenchorhynchus* spp.), which are the most economically important and most common worldwide.
Keywords: Hazelnut, nematod fauna, plant parasitic nematodes

HAYVAN BESLEMEDE ALTERNATİF BİR YEM BİTKİSİ; TEF *(Eragrostis tef [Zucc.] Trotter)*

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Özet
Ülke hayvancılığının en önemli sorunlardan biri kaliteli, ucuz ve bol yem ihtiyacının düzenli olarak karşılanmasıdır. Buna yönelik olarak, kaliteli yem açığının kapatılması hedeflenmelidir. Bu hedefe ulaşabilmek için, dünyadaki küresel ısınma ve kuraklık tehdidi de düşünülerek, üretimini ve kalitesini arttırabileceğimiz alternatif yem kaynaklarının kullanım olanakları araştırılmalıdır. Kuru ot, yeşil yemler ve silaj gibi maliyetleri düşük kaba yemler ile kesif yemlerin dengeli bir şekilde hayvanlara verilmesi halinde, hayvancılık işletmelerinin verimleri ve karlılığı arttırılabilmektedir. Bu gibi yem materyallerinin üretilmesine katkı sağlayacak alternatif yem bitkilerinin hayvancılık sektörüne kazandırılması gerekmektedir. Ülkemizde çok çeşitli yem kaynakları olmasına rağmen, kaliteli yem kaynağı olabilecek yem maddeleri sınırlı düzeydedir. Genellikle alışılmış yemler hayvan tüketimine sunulmaktadır. Oysaki gelişmiş ülkelerde alternatif yem kaynaklarından da yararlanılmaktadır. Hayvancılığı gelişmiş ülkelerde alternatif bir yem bitkisi olarak kullanılan bitkilerden biri de Tef *(Eragrostis tef [Zucc.] Trotter*)'dir. Anavatanı Etiyopya olan bitki ülkede hem insan hem de hayvan gıdası olarak kullanılmaktadır. Buğdaygiller familyasından olan Tef bitkisi kuraklığa oldukça dayanıklı, uyum yeteneği yüksek, hızlı gelişen, tek yıllık ve yılda 2-3 kez biçim veren, lezzetli, yüksek tane ve ot verimiyle ön plana çıkmaktadır. Tef bitkisi hayvan besleme açısından, yeşil ve kuru ot, silaj yemi, danesi ve otlatma yapılarak mera bitkisi olarak kullanılabilmektedir. Bu çalışmanın amacı, ülkemizde de yetiştirilebilme olanağı bulunan ve hayvan beslenmesinde alternatif yem kaynağı olarak kullanılabilecek Tef bitkisinin tanıtılması ve tüm yönleriyle kullanım olanaklarının ortaya konulmasıdır.
Anahtar Kelimeler: Hayvan besleme, Alternatif yem, Tef

ALTERNATIVE FORAGE PLANT IN ANIMAL NUTRITION; TEFF (*Eragrostis tef [Zucc.] Trotter*)

Abstract
One of the most important problems of the country's livestock farming is to meet the need for quality, cheap and abundant feed on a regular basis. To this end, it should be aimed to close the quality feed gap. In order to achieve this goal, the use of alternative feed resources that can increase the production and quality should be investigated, taking into account the threat of global warming and drought in the World. If low-cost forages such as hay, fodder and silage and concentrated feeds are fed to animals in a balanced manner, the efficiency and profitability of livestock enterprises can be increased. Alternative forages that will contribute to the production of such feed materials need to be introduced to the livestock. Although there are a wide variety of feed resources in our country, feed materials that can be a quality feed source are limited. Generally, conventional feeds are offered for animal consumption. However, alternative feed sources are also used in developed countries. One of the plants used as an alternative forage in countries with developed animal husbandry is Teff (*Eragrostis tef [Zucc.] Trotter*). The plant, whose homeland is Ethiopia, is used as both human and animal food in the country. Teff, which is from the wheataceae family, stands out with its drought resistance, high adaptability, fast growing, annual and mowing 2-3 times a year, delicious, and high grain and herb yield. Teff can be used as green and dry grass, silage, grain and pasture plant for grazing in terms of animal nutrition. The aim of this study is to introduce the Teff, which can be grown in our country and can be used as an alternative feed source in animal nutrition, and to reveal its usage possibilities in all its aspects.
Keywords: Animal nutrition, Alternative forage, Teff

GAMMA IRRADIATION EFFECTS ON FORTUNA STRAWBERRY CULTIVAR: A COMPREHENSIVE STUDY OF GROWTH, MORPHOLOGY, AND GENETIC IMPLICATIONS

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Abstract
A comprehensive study was undertaken to investigate the response of the Fortuna cultivar to varying levels of gamma irradiation. The research revealed that the LD50 (lethal dose) for calluses of this cultivar was determined to be 70 Gy. The findings demonstrated that as the irradiation doses increased, several key vegetative growth parameters experienced reductions. Furthermore, we conducted an evaluation of the effects of three different irradiation doses (5 Gy, 10 Gy, and 10 Gy) on Fortuna variety plants. Our results highlighted the significant impact of these irradiation doses on plant growth, morphology, and fruit characteristics. It's worth noting that the influence of cultivation conditions had a limited effect on specific parameters. Particularly noteworthy was the substantial interaction observed between irradiation doses and the growth environments, whether in a greenhouse or an open field setting, which proved crucial for most of the variables studied. Moreover, it was observed that plant vigor declined with increasing irradiation dose, regardless of the cultivation environment. While irradiation doses had a significant impact on all variables examined, the influence of cultivation conditions was only significant for certain parameters. Notably, the interaction between irradiation doses and cultivation conditions was a significant factor across most of the variables under investigation. These results hold promise for the strawberry genetic improvement program in Morocco and provide valuable insights for future research and cultivation practices.
Keywords: Cultivar Fortuna; Gamma ray; LD50, Genetic improvement.

APPLICATION OF NANOCOATING MADE FROM CHITOSAN AND ZnO NANOPARTICLES TO EXTEND THE SHELF LIFE OF MEATBALL

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Abstract
The meatball is perishable and it has a very short shelf life, usually less than 1 day when stored at room temperature. One of the solutions to extend the shelf life of meatballs is by using preservatives. However, there are many cases of using illegal preservatives such as borax (natrium tetraborate) or formalin on the meatball. Therefore, we need a way to extend the shelf life of meatballs without the use of illegal preservatives. This study aims to produce nanocoating based on chitosan and ZnO nanoparticles to prolong the shelf-life of meatball. The coating solution was prepared with ZnO nanoparticles at the concentration of 0%, 1%, 2% (w/w) followed by antimicrobial activity testing. The results of the antimicrobial activity test against *E. Coli*, *B. Cereus*, and *S.aureus* done by using well diffusion method showed that the addition of ZnO nanoparticles increased the inhibitory zones. Nanocoating solution from chitosan with the addition of 1% ZnO nanoparticle was selected to be applied as an edible coating on meatballs and stored at room temperature for 2 days. The parameters measured were physical, chemical, microbiological, and organoleptic. The meatballs stored at room temperature increased the water activity (a_w) value, total microbe, and color (brightness) during storage, whereas the pH value and texture decreased. The result of total plate count (TPC) test showed that the meatball without nanocoating stored for 12 hours had the total amount of microbes already exceeded the maximum limit set by Indonesian National Standard (SNI), i.e. 5.85 log CFU / g. While meatballs with chitosan and chitosan + ZnO coating still met the standards with the total number of microbes were 3.77 log CFU/g and 3.91 log CFU/g, respectively. The application of nanocoating on the meatballs could increase the shelf life of meatballs for 36 hours compared to the control that is only 12 hours. Organoleptic testing showed that there is no difference of panelist acceptance scores between meatballs with and without nanocoating.
Keywords: meatball, nanocoating, ZnO nanoparticle, Chitosan

GCMS PROFILING AND IN SILICO INVESTIGATION OF BIOACTIVE COMPOUNDS OF HEXANE EXTRACT OF *SESAMUM INDICUM* SEEDS TO IDENTIFY FERTILITY AGENT: POTENT INHIBITORS OF ANGIOTENSIN CONVERTING ENZYMES AND PHOSPHODIESTERASE 1A RECEPTORS

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Abstract
Back ground: Infertility is a disease of the reproductive system which affects both men and women. The Angiotensin converting enzymes (ACE) and phosposdiesterase 1A (PDE1A) receptors affect human reproductive function in humans by reducing sperm count and motility. The binding of the bioactive compounds of *Sesamum indicum* seeds (SIS) to these receptors can inhibit their activities thereby maintaining sperm quality. Sesame seed is commonly used in the North central of Nigerian by traditional healers and have been been reported to improve sperm quality thus it may be as result of the bioactive constituents present in them. Herein, we investigated the bioactive compounds of hexane extract of SIS as potent inhibitors of ACE and PDE1A receptors and a promising drug candidate for effective therapy against male infertility. Methods: The Bioactive compounds of hexane extract of SIS were identified using gas chromatography mass spectrophotometer (GCMS). The compounds were screened with SwissADME to determine high GIT availability and drug-likeness features and the molecular docking of the screened compounds with high GIT bioavailability were performed using BIOVIA Discovery Studio Visualizer and Autodock Vina. Results: GCMS analysis showed the presence of 21 bioactive compounds. 5-Hydroxy-4-methyl-3-heptanone was identified as the most abundant and Octasiloxane, 1,1,3,3,5,5,7,7,9,9, 11,11,13,13,15,15-hexadecamethyl was identified as the least abundant compound. Fourteen compounds were found to have high GIT bioavailability. The free binding energies generated from molecular docking of the compounds against two targets enzymes; Angiotensin converting enzymes (ACE) and Phosphosdiesterase1A (PDE1A) showed that 4-Thiazolidinone,3-ethyl-5-[(phenylamino)myethlene]-2-thioxo(4TET) exhibited high binding energy (-6.9Kcal/mol) against ACE while glyceric acid(GA) exhibited a high binding energy(-6.2Kcal/mol) against PDE1A compared to other compounds . 4TET and GA also adhered to lipsinki's rule of five, demonstrating its drug-like potential after drug-likeness analysis with SwissADME Conclusion: The findings of this study contribute valuable insight into fertility potential of 4TET and GA in SIS, providing a promising candidate for further exploration in the quest for

effective therapy against male infertility and the mechanism by which SIS improves sperm quality and maintains fertility preservation.

Keywords: Angiotensin converting enzymes, gas chromatography mass spectrophotometer

DIABETES MELLITUS: PANDEMIC IN INDIA

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Abstract
India has a high prevalence of diabetes mellitus and the numbers are increasing at an alarming rate. In India alone, diabetes is expected to increase from 40.6 million in 2006 to 79.4 million by 2030. Studies have shown that the prevalence of diabetes in urban Indian adults is about 12.1%, the onset of which is about a decade earlier than their western counterparts and the prevalence of Type 2 diabetes is 4–6 times higher in urban than in rural areas. The risk factors peculiar for developing diabetes among Indians include high familial aggregation, central obesity, insulin resistance and life style changes due to urbanization. Screening for gestational diabetes and impaired glucose tolerance among pregnant women provides a scope for primary prevention of the disease in mothers as well as in their children. The problems of obesity and impaired glucose tolerance (IGT) are not confined to adults alone but children are also increasingly getting affected. Our nation will face a severe health care crisis due to the increased prevalence of diabetes Timely effective measures and screening tests for complications at the time of diagnosis becomes important not only for early detection, but also to prevent progression to end stage disease. Screening for gestational diabetes among pregnant women would also go a long way in primary prevention of the disease. Life style changes/interventions and drugs like rosiglitazone are the current strategies that can prevent and/or delay the onset of diabetes. Simple interventional strategies like “Eat less, Eat on time and Walk more” can go a long way in preventing these chronic disorders among present as well as in the future generations.
Keywords: Type 2 diabetes, Central obesity, Insulin resistance, Gestational diabetes, Familial aggregation

SABİT SERMAYE YATIRIMLARININ GENEL VE KIRSAL İSTİHDAM YÖNÜNDEN İNCELENMESİ: YOZGAT İLİ ÖRNEĞİ

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Özet
Sabit sermaye yatırımlarının ekonomik kalkınmadaki rolü oldukça önemlidir. Sabit sermaye yatırımları ekonomik kalkınmanın itici gücü olmakla birlikte, yeni istihdam alanlarının yaratılması bakımından da değerlidir. Bir firma açısından sektörel sabit yatırım en temel zorunluluktur. Sektörel yatırım, firmanın karlılığı ve değeri üzerinde doğrudan etkili olup, firmanın devamlılığının da bir belirleyicisidir. Yozgat ili kalkınmada birinci derecede öncelikli yöreler arasındadır. Bu nedenle, yatırımlarda hem kamunun ve hem de özel sektörün payı artırılmalıdır. İlde, pek çok ekonomik sektör yatırımları gerçekleştirilmiş olsa da, tarım ve kırsal potansiyelin yüksek olması nedeniyle, tarım ve gıda sektörlerine daha fazla yatırım yapılmalıdır. Bu çalışmada, Yozgat ilinde sabit sermaye yatırımlarının sektörlere göre dağılımları incelenerek, istihdam katkısının ortaya konulması amaçlanmaktadır. Çalışmada, tarım ve gıda sektörünün istihdam katkısı ayrıntılı olarak ele alınmaktadır. Bu çalışmanın ana materyalini, Yozgat Sanayi ve Teknoloji İl Müdürlüğü ile Yozgat Ticaret İl Müdürlüğünden elde edilen veriler oluşturmaktadır. Araştırma bulgularına göre, Yozgat il nüfusunun %33.91'i kırsal nüfustan oluşmakta ve aktif nüfusun %29.31'i tarım sektöründe çalışmaktadır. İlde toplam 49 924 tarım işletmesi faaliyet göstermektedir. İlde toplam 607 sanayi ve gıda işletmesi mevcut olup, toplam 7 292 kişi çalışmaktadır. Tarım sektörüne yapılan yatırımlarda 720 kişi, gıda ve içecek sektörüne yapılan yatırımlarda ise 1 918 kişi istihdam edilmiştir. Gıda ve içecek sektörü dışındaki diğer sektörlerde ise 5 374 kişi çalışmakta ve çalışanların çoğunu kırsal insanlar oluşturmaktadır. İlde 9 adet küçük sanayi sitesindeki 1 571 firmanın toplam 5 227 çalışanı bulunmaktadır. Tekstil imalatı sektöründeki 4 firmada 124 kişi çalışırken, giyim imalatı sektöründeki 9 firmada ise 1 589 kişi çalışmaktadır. İlin sermaye yapısında tarımın ağırlığı oldukça önemli olduğundan, tarım ve gıda sektörüne yönelik yatırımlara öncelik verilmesi ve bu yatırımların teşviklerden aldığı payın daha da arttırılması gerekmektedir.
Anahtar Kelimeler: Ekonomik Gelişme, Gıda Sektörü, İstihdam, Sabit Sermaye

INVESTIGATION OF INVESTMENTS IN FIXED CAPITAL IN TERMS OF GENERAL AND RURAL EMPLOYMENT: YOZGAT PROVINCE EXAMPLE

Abstract
Today, the role of investments in fixed capital in economic development is very important. While fixed capital investments are the driving force of economic development, they are also valuable in terms of creating new employment areas. Sectoral fixed investment is an absolute necessity for a firm. Sectoral investment has a direct impact on the profitability and value of the firm and is a determinant of the continuity of the firm. Yozgat province is from the locations with first-degree priority in development. Therefore, the share of both the public and private sectors in investments should be increased. Although investment has been made in many economic sectors in the province, due to the high agricultural and rural potential, more investments should be made in the agricultural and food sectors. In this study, it is aimed to reveal the employment contribution by examining the distribution of fixed capital investments according to sectors in Yozgat province. The employment contribution of the agriculture and food sectors is discussed in detail in the study. The main material of this study consists of data obtained from the Yozgat Provincial Directorate of Industry and Technology and the Yozgat Provincial Directorate of Commerce. According to the research findings, 33.91% of the population of the Yozgat consists of the rural population and 29.31% of the active population works in the agricultural sector. A total of 49 924 agricultural holding is active in the province. There are a total of 607 industrial and food firms in the province, and firms employ a total of 7 292 workers. 720 people have been employed in the investments made in the agricultural sector, and 1 918 people have been employed in the investments made in the food and beverage sector. Sectors other than the food and beverage sector employ 5 374 workers, most of whom are from rural. 1 571 firms in 9 small industrial sites have a total of 5 227 employees. While 4 firms in the textile manufacturing sector employ 124 workers, 9 firms in the clothing manufacturing sector employ 1 589 workers. Since the weight of agriculture in the capital structure of the province is very important, investments in the agriculture and food sector should be prioritized and the share of these investments in incentives should be further increased.
Keywords: Economic Development, Food Sector, Employment, Fixed Capital

"THE AUTHORITY, DUTIES, AND FUNCTIONS OF THE NATIONAL HUMAN RIGHTS COMMISSION (KOMNAS HAM) IN UPHOLDING HUMAN RIGHTS IN INDONESIAN"

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Abstract
The enforcement of human rights in Indonesia has a long history, dating back as far as the existence of the Indonesian state itself. In fact, human rights have been inherent and recognized in the realm of human civilization since the early days of the first human civilizations. This can be observed in several classical literary works that describe this concept. Human rights are one of the key subjects of legal study, both in the context of national law and international law. On the international stage, human rights became an intriguing and widely discussed topic long before they gained significant attention from the global community, especially in more advanced nations. In its development, human rights were initially recognized and defined by the Western and European world. This was mainly due to the stronger emphasis on the regulation of human rights in the Western world, driven by the implications of war crimes and the victims of war that occurred in the Western world. Essentially, human rights emerged because of conflicts of interest in the Western world regarding the outcomes of wars that they had themselves conducted. This eventually evolved into Western hegemony, where, in the name of human rights, they created their own conflicts and political constellations that were imposed on other parts of the world under the guise of global human rights guarantees, without taking into consideration the values and norms that had previously existed in those countries. In

response to the global political demands for the establishment and regulation of human rights worldwide, Indonesia, as an independent nation, also participated in efforts to uphold human rights. However, it should be noted that the conceptualization of human rights in Indonesia was adjusted to align with its sociological and normative conditions, as well as the values inherent in the Indonesian nation that had already existed within its society. The extension of recognition of human rights naturally extends further within a country's jurisdiction, and this process has been ongoing since the inception of the nation. Indonesia has experienced three different government regimes: ORLA, ORBA, and the Reform Era, each of which has made efforts to establish regulations regarding human rights through their respective political policies. In the end, it was during the ORBA era that several human rights instruments were established, including the National Human Rights Commission (Komnas HAM) in 1993. Subsequently, during the Reform Era, additional regulations were introduced for the entire human rights framework, and the authority of Komnas HAM was expanded to further promote the enforcement of human rights in Indonesia. The scientific paper titled "The Authority, Duties, and Functions of the National Human Rights Commission (Komnas HAM) in Upholding Human Rights in Indonesia" is based on the desire to further elaborate on how and to what extent the efforts to enforce human rights in Indonesia have been undertaken. It also aims to outline the role of Komnas HAM in the assurance and enforcement of human rights in Indonesia. In the research effort concerning Komnas HAM, a normative juridical approach is employed. This is a research methodology that primarily focuses on legal aspects as its foundation, but it also seeks to examine the legal principles and rules that are applicable within society. The research in this study falls under the category of descriptive-analytical research. This means that it involves describing the existing legal regulations and connecting them with legal theories and the practice of positive law related to the issues at hand. The data collection techniques in this research primarily focus on gathering secondary data, specifically primary legal materials, using a qualitative normative analysis method. Therefore, the expected outcome of this research is to provide clear answers and insights regarding the efforts to enforce human rights in Indonesia.

Keyword: Enforcement, HAM, Komnas HAM, and Indonesian

TOXICOLOGICAL EFFECTS OF *Heliotropium indicum* LEAF EXTRACTS ON ALBINO RAT TISSUES

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Abstract
Toxicological effects of *Heliotropium indicum* Linn leaf extracts was examined on wistar albino (*Rattus norvegicus*) rat tissues by investigating the activities of biomarker enzymes in the liver and kidney. Commercially available reagent kits were used to perform the biochemical investigations. The parameters measured were serum creatinine level (Scr), uric acid level, and blood urea nitrogen level (URN) for renal function; while alanine aminotransferase (ALT), aspartate aminotransferase (AST) and alkaline phosphatase (ALP) enzyme levels were measured to determine liver functions. Serum ALT level of the control was 39.6±3.23 IU/L, while groups 2,3 and 4 had ALT levels of 47.07±3.89, 31.99±0.75, and 36.00±0.51, respectively. Also, the serum AST levels of the control was 93.55±1.77, while groups 2,3 and 4 had serum AST levels of 112.17±0.99, 107.57±0.57, and 101.48±0.69 IU/L, respectively. In a similar vein, the serum ALP levels of the control was 31.66±0.16 IU/L, while groups 2,3 and 4 had ALP levels of 34.13±0.45 IU/L, 23.34±0.75 IU/L, and 35.15±0.11. The standard range of ALT, AST and ALP are 10-40 IU/L, 30-150 IU/L, and 30-130 IU/L, respectively. The serum ALT, AST, and ALP levels did not show any statistical significant difference between the extract groups and the control at (p<0.05) level of significance. The results showed that administration of leaf extracts of *H.indicum* did not significantly (p< 0.05) increase the AST,

ALT, and ALP levels over the control, though group 2 administered with hexane extract had a raised level of ALT above the control.On the other hand, group 3 administered with leaf ethyl acetate extract of *H.indicum* had a slight decreased level of ALP when compared with the control.For the renal function test, the serum creatinine levels range from 0.4393±0.01 mg/dL to 0.4377±0.00 mg/dL, while the Uric acid levels range from 0.1190±0.00 mmol/L to 0.1443±0.00 mmol/L and the BUN Urea levels range from 0.2310±0.00 mmo/L to 0.2307 ±0.00 mmol/L, respectively. The reference standard range for serum creatinine, uric acid, and urea are 0.7-1.3 mg/dL, 0.24-0.51 mmol/L, and 1.8-7.1 mmol urea/L. This study showed that the serum creatinine, uric acid, and urea levels of the kidney post-treatment also showed no statistical significance difference ($P < 0.05$) with the control. The three serum enzymes are found mainly in the liver, kidney, red blood cells (RBC), pancreas, biliary ducts of the liver and heart. The levels of ALT and AST in the serum are used to diagnose body tissues, especially to know whether the liver and kidney are injured or not. Research has suggested that, when body tissues are damaged, additional ALT and AST are released into the bloodstream and raise the serum enzyme level. As a result, the amount of ALT and AST in the blood is directly associated with the amount of tissue damage.The liver and kidney were assayed for histopathology analysis. The result showed that there was no noticeable alteration in the architectural integrity of the investigated tissues, except for minor lesions around the liver cells.
Keywords: *Heliotopioum indicum* L, Biochemical, Histopathological, Toxicity

MAGNETIC NANOPARTICLES FOR BIOMEDICAL APPLICATIONS

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Abstract
The synthesis of graphullerene 2*D* nanomaterial with unexpected properties represents a groundbreaking achievement in the realm of carbon-based materials, holding promising prospects for the development of a novel category of two-dimensional 2*D* materials. Herein, we investigated the thermodynamic features and magnetocaloric effect of graphullerene-like structure through Monte Carlo simulations based on standard Metropolis algorithm. In this paper, we detailed the impact of the Hamiltonian parameters on the thermodynamic properties and magnetocaloric quantities of the system. Distinct characteristic behaviors were observed, including first- and second-order phase transitions, *Q*-type behavior and square hysteresis loops. Furthermore, it has been found that altering the magnetic field not only enables critical temperature regulation, but also significantly affects the magnetocaloric characteristics, including the magnetic entropy change and the relative cooling capacity. Our findings strongly suggest that the graphullerene-like 2*D* nanomaterial is a promising candidate for biomedical applications.
Keywords: Monte Carlo, thermodynamic features, magnetic nanoparticles

WASTE MATERIAL OF WILD CARROT (*Daucus carota* L.) SEEDS AS A SOURCE OF NATURAL ANTIINFLAMMATORY AGENTS

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Abstract
The wild carrot, *Daucus carota* L., belongs to the family Apiaceae (Umbelliferae) and is sometimes referred to as the subspecies carota. Its flower umbels are edible and usually French-fried, and its seed oil, which is commercially available, is used to flavor beverages and food products. Available literature on the therapeutic effects of wild carrot showed that the plant possessed antilithic, diuretic, antibacterial, and antifungal activities. Wild carrot seeds show antinociceptive, anti-inflammatory, antioxidative, and anticancer effects. Extracts of wild carrot umbels exhibited anti-inflammatory, anti-ulcer, anti-cancer, and antioxidant activities. The aim of this study was to determine the antiinflammatory activity of extracts from waste material after fatty oil isolation from wild carrot seeds grown in Southeastern Serbia (SWCE) and Greece (GWCE). The fatty oil was isolated by Soxhlet extraction using hexane as extragens. The solvomodule was 1:10 m/V. After isolating the fatty oil, the plant material was dried and extracted with 50% v/v ethanol, by the maceration method using solvomodule 1:10 m/V for 48 h. *In vitro* anti-inflammatory activity of the seed waste material was determined by Bovine Serum Albumin-BSA assay. Both extracts exhibited a significant *in vitro* antiinflammatory effect, where the higher percentage was detected by SWCE extract (81.89%) in comparation with GWCE extract (80.11%). The value of BSA denaturation inhibition for diclofenac sodium (standard anti-inflammatory drug) was 95.6%. The obtained results indicate the possible application of both extracts in the food and pharmaceutical industries as a safer alternative to synthetic additive, as well as the utilization of waste material after the isolation of fatty oil from wild carrot seeds.
Keywords: wild carrot seed, waste, *Daucus carota* L.
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Katarina Stanojević is a student of the Faculty of Medicine, University of Niš.

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ANTI-INFLAMMATORY ACTIVITY OF WILD CARROT (*Daucus carota* L.) SEED HYDROLATE

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Abstract
Wild carrot, *Daucus carota* L. belongs to the family Apiaceae (Umbelliferae) and sometimes referred to as the subspecies *carota*. Unlike the cultivated carrot, wild carrot has a small, white, fleshy taproot. The white flowers are densely clustered in terminal umbels, some containing a central purple flower which is regarded in herbal lore as an indicator of medicinal quality. Wild carrot essential oil showed antimicrobial and anti-inflammatory activity, has a beneficial effect in the treatment of liver dysfunction and stimulates the excretion of urea and toxins from the body. It is used for anti-aging skin preparations, as an antioxidant in the fight against free radicals. In this work, the antiinflammatory activity of the wild carrot seeds hydrolate after hydrodistillation of essential oil was investigated. The plant material was wild grown in the village of Badince, Leskovac, Serbia. The oil was obtained by Clevenger-type hydrodistillation with hydromodule 1:10 m/V. After the hydrodistillation, the plant material was separated from the aqueous phase of the suspension from the round-bottom flask (hydrolate) by filtering with a weak vacuum (filtration on a Büchner funnel). *In vitro* antiinflammatory activity of the seed hydrolate was determined by Bovine Serum Albumin-BSA assay. The hydrolate exhibited a *in vitro* antiinflammatory effect of 83.80%. The value of BSA denaturation inhibition for diclofenac sodium (standard anti-inflammatory drug) was 95.6%. These findings suggest that the seed hydrolate possesses significant potential as an anti-inflammatory agent. The obtained results indicate the possible application of wild carrot hydrolate as natural and alternative therapeutic option with potential benefits and fewer side effects compared to synthetic pharmaceuticals.
Keywords: wild carrot, anti-inflammatory activity, hydrolate

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ISIRGAN OTU VE AKÇAKESME ETANOLİK EKSTRAKTLARININ ARTEMIA ZENGİNLEŞTİRİLMESİNDE KULLANILABİLECEK GÜVENLİ DOZ ARALIĞI

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Özet
Bu araştırma akçakesme (*Phillyrea latifolia*) ve ısırgan otu (*Urtica dioica*) %96'lık etanolik özütlerinin antimikrobiyal etkilerinden faydalanmak üzere artemia (*Artemia sp.)* zenginleştirmesinde kullanılması amacıyla gerçekleştirilmiş bir ön çalışma niteliğindedir. Söz konusu ekstraktların güvenli dozunun belirlenebilmesi için artemia yumurtaları açıldıktan sonraki ilk 24 saat süreyle faklı konsantrasyonlarda suya ilave edilmiştir. 1. denemede 1000-20000 µg/100 mL konsantrasyonlarında akçakesme ve ısırgan özütlerine maruz bırakılan artemialarda hiçbir ölüm gözlenmemiş ancak 10000 µg/100 mL konsantrasyondan itibaren artemiaların hareketlerinde yavaşlama meydana gelmiştir. 2. denemede ise 50000-150000 µg/100 mL konsantrasyonları denenmiş ve lethal konsantrasyonun (LC 50) 50000 µg/100 mL olduğu tespit edilmiştir. Bu verilerden yola çıkarak güvenli doz 5000 µg/100 mL olarak tespit edilmiştir.
Anahtar Kelimeler: Akçakesme, ısırgan, artemia, LC50

SAFE DOSE RANGE THAT CAN BE USED IN NETTLE AND GREEN OLIVE TREE ETHANOLIC EXTRACTS IN ARTEMIA ENRICHMENT

Abstract
This research is a preliminary study to use 96% ethanolic extracts of green olive tree (*Phillyrea latifolia*) and stinging nettle (*Urtica dioica*) in artemia (*Artemia* sp.) enrichment to benefit from their antimicrobial effects. In order to determine the safe dose of the extracts in question, artemia eggs were added to water at different concentrations for the first 24 hours after hatching. In the 1st trial, no death was observed in artemia exposed to green olive tree and nettle extracts at concentrations of 1000-20000 µg/100 mL, but a slowdown in the movements of artemia occurred starting from the concentration of 10000 µg/100 mL. In the second trial, concentrations of 50000-150000 µg/100 mL were tested and the lethal concentration (LC 50) was determined to be 50000 µg/100 mL. Based on these data, the safe dose was determined as 5000 µg/100 mL.
Keywords: Green olive tree, stinging nettle, artemia, LC50

PESTİSİTLERİN *DAPHNIA MAGNA* ÜZERİNDEKİ EKO-GENOTOKSİK ETKİLERİNİN İNCELENMESİ

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Özet
Pestisitler yıllardır zararlı canlılara karşı sanayide, tarımda ve evlerde sıklıkla kullanılmaktadır. Pestisitler su kanallarında yaşayan canlılara doğrudan uygulama, yağmur sırasında veya sonrasında tarlalardan yüzey akışı veya sızma, uygulama sırasında aşırı spreyleme sonucu sürüklenme veya kanalizasyona pestisit bulaşması yoluyla sucul ortamlara ulaşabilmektedir. Bu nedenle, hedef olmayan akuatik canlılar pestisitler nedeniyle genotoksik hasar gibi istenmeyen etkilere maruz kalabilmektedir. Besin zincirinde önemli bir yere sahip olması, kültürünün kolay olması, yaşam döngüsünün kısa olması, temiz su indikatörü olması ve çevresel kirleticilere karşı duyarlılığının diğer canlılara göre nispeten yüksek olması nedeniyle en yaygın kullanılan model organizmalardan biri *Daphnia magna*'dır (Crustacea, Cladocera). Ayrıca canlı organizmalar, toksik maddelerin vücutlarında metabolize olmasını sağladıkları ve DNA onarım mekanizmalarının çalışmasından dolayı toksik maddelere karşı oldukça duyarlı sonuçlar verebilmekte, bu nedenle genotoksisite testlerinde sıklıkla kullanılmaktadır. Özellikle hassas ve güvenilir bir genotoksisite testi olan komet (Tek hücre jel elektroforezi) testinin son yıllarda *Daphnia magna'*ya uyarlanması, eko-genotoksik etkilerin değerlendirilmesinde *Daphnia magna*'nın sıklıkla kullanılmasına yol açmıştır. Bu derlemenin amacı pestisitlerin *Daphnia magna* üzerindeki eko-genotoksik etkilerini incelemektir.
Anahtar Kelimeler: *Daphnia magna,* pestisitler, genotoksisite, ekotoksisite, komet

THE EXAMINATION OF THE ECO-GENOTOXIC EFFECTS OF PESTICIDES ON *DAPHNIA MAGNA*

Abstract
Pesticides have been extensively employed in industry, agriculture, and households to combat pests over an extended period. Pesticides can reach aquatic environments through direct application to organisms living in water channels, surface runoff or seepage from fields during or after rain, drift due to overspray during application, or pesticide contamination into sewers. *Daphnia magna* (Crustacea, Cladocera) is one of the most widely used model organisms because it has an important place in the food chain, is easy to culture, has a short life cycle, is a clean water indicator and has a relatively high sensitivity to environmental pollutants compared to other organisms. Therefore, non-target aquatic organisms may be exposed to undesirable effects such as genotoxic damage due to pesticides. In addition, the living organisms can give highly sensitive results against toxic substances due to the metabolism of toxic substances in their bodies and the functioning of DNA repair mechanisms, so it is frequently used in genotoxicity tests. The recent adaptation of the comet (single cell gel electrophoresis) test, a particularly sensitive and reliable genotoxicity test, to *Daphnia magna* has led to the frequent use of *Daphnia magna* in the assessment of eco-genotoxic effects. The aim of this review is to examine the eco-genotoxic effects of pesticides on *Daphnia magna.*
Keywords *Daphnia magna*, pesticides, genotoxicity, ecotoxicity, comet

DÜZCE İLİ MEYVECİLİĞİ

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Özet
Düzce ili nemli ve fazla sert olmayan Karadeniz Bölgesi'nin kıyı kesimlerinde görülen iklimin etkisindedir. İl doğal bitki örtüsü açısından oldukça zengindir. Kıyı kesimi maki ve yalancı makiler, kıyı ardındaki dağlar ise gürgen, kayın, kestane ve meşe ormanları ile kaplıdır. Düzce ilinde 75.408 ha işlenen tarım alanının %84,16'sında (634.590 da) meyve üretimi yapılmakta ve 85.562 ton ürün elde edilmektedir. İlin en önemli tarımsal ürünü fındıktır. Düzce ili 634.541 da alandan 83.052 t ürün ton ile ülke üretimin %11'ini karşılamaktadır. Alan bakımından fındıktan sonra ceviz, elma, armut ve kestane öne çıkan türlerdir. Üretim bakımından ise fındıktan sonra kestane 710 t, elma 305 t, ceviz 316 t, Trabzon hurması 205 t ve armut 150 t ile ilk sıralarda yer almaktadır. İlk genelinde çilek, kivi, ahududu, böğürtlen, maviyemiş gibi üzümsü meyvelerin üretimi de gün geçtikçe artmaktadır.
Anahtar Kelimeler: Düzce, Meyve, Üretim.

FRUIT CULTURE IN DUZCE PROVINCE

Abstract
Düzce province is under the influence of the climate seen in the coastal areas of the Black Sea Region, which is humid and not too harsh. The province is very rich in terms of natural vegetation. The coastal area is covered with maquis and false maquis, and the mountains behind the coast are covered with hornbeam, beech, chestnut and oak forests. In Düzce province, fruit production is carried out in 84.16% (634.590 da) of the 75.408 ha cultivated agricultural area and 85.562 tons of product is obtained. The most important agricultural product of the province is hazelnut. Düzce province covers 11% of the country's production with 83.052 tons of product from an area of 634.541 decares. In terms of area, after hazelnuts, walnuts, apples, pears and chestnuts are the prominent species. In terms of production, after hazelnuts, it rank first chestnuts 710 t, apples 305 t, walnuts 316 t, persimmons 205 t and pears 150 t. The production of berries such as strawberries, kiwis, raspberries, blackberries and blueberries is increasing day by day. The production of berry fruits such as strawberry, kiwi, raspberry, blackberry and blueberry is increasing day by day.
Keywords: Duzce, Fruit, Production.

OPTIMIZATION OF BIOGAS PRODUCTION AND COMPRESSION FROM CO-DIGESTION OF ANIMAL DUNGS

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Abstract
Biogas has been generally accepted as an alternative energy source but its commercial use has never been realized due to challenges in its storage and transportation. This research presents the study on the production, scrubbing, compression, and storage of biogas. It was found that scrubbing of biogas to remove major impurities i.e. carbon dioxide, hydrogen sulfide, and water must be carried out before compression and storage of biogas to improve its versatility. Chemical scrubbing of carbon dioxide was done with sodium hydroxide (NaOH). Hydrogen sulfide was scrubbed using iron fillings while water vapour was scrubbed using silica gel crystals. The result shows that after biogas production from co-digestion of cow dung and camel dung, methane content has improved from 62 % before scrubbing to 92 % after scrubbing, while carbon IV oxide has reduced from 37 % to 6 % after scrubbing. H_2S shows no traces after purification. Compression of biogas (CBG) was carried out by a 3hp two-stage air compressor and bottled into a 12.5kg LNG cylinder. The compressed biogas had an average volume of 0.233 m^3, a total mass of 0.10 kg, and a mean density of 2.216 kg/m^3. While 0.40 MJ was utilized for compression, the CBG in the cylinder has an energy content of 5.25 MJ. The compressor produces 2.52 MJ of heat energy and 1.63 MJ of electrical energy. Raw biogas was compressed to an absolute pressure of 6 bar during the course of an average compression duration of 2.57 minutes. Using the water boiling test and the food cooking test, it was also

discovered that the CBG's methane content was higher than that of raw biogas.
Keywords: Biogas, scrubbing, compression, cylinder

ANTI-INFLAMMATORY, ANTIOXIDANT AND ANTIBACTERIAL EFFECTS OF THE MEDICINAL PLANT SCABIOSA STELLATA L.

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Abstract
This study is devoted to the estimation of total bioactive contents and the evaluation of acute toxicity and in vivo anti- inflammatory effects and the assessment of in vitro antioxidant and antibacterial effects of the species *Scabiosa stellata.* the acute oral toxicity and the anti-inflammarory activity using the model of carrageenan-induced paw edema were tested on male Wistar rats.The antioxidant activity was evaluated by four different methods. Furthermore, the antibacterial activity was estimated by agar disk diffusion assay against ten bacterial strains. According to the results, the phytochemical screening of the extracts revealed the presence of several types of secondary metabolites. The ethyl acetate extract recorded the highest content of polyphenols, flavonoids and tannins. All the crude extracts (PE, EtAOc and *n*-BuOH) had antioxidant activities in various assays and showed antibacterial activity against most tested strains, with zones of inhibition ranging from 9 to 20 mm. . The oral administration of the ethyl acetate extract at various concentrations (500, 1000 and 2000 mg/kg), does not induce any toxic symptoms or mortalities in all the treated animals. No significant changes in biochemical and hematological parameters compared to the control group were observed. Thus, the approximate acute lethal dose 50 of this extract was higher than 2000 mg/kg. In addition, the administration of ethyl acetate extract at doses of 50 and 75 mg/kg prevents a significant acute paw edema and present a higher anti-inflammatory activity than Diclofenac as a positive control. It could be concluded that *S. stellata* can be an important source of therapeutic agents against pathological damage due to free radicals inducing inflammatory and infectious diseases.
Keywords: Acute toxicity , Anti-inflammatory, Antioxidant, Antibacterial, *Scabiosa stellata*

SYNTHESIS OF A NEW POLYBENZOXAZINE-BASED ARYLIDENE MOIETY

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Abstract
Polybenzoxazine (PBz) is a fantastic and highly intriguing resin with various sophisticated uses. Because of their peculiar properties, benzoxazines have piqued the curiosity of academics worldwide. Nonetheless, most benzoxazine resin manufacture and processing, notably bisphenol A-based benzoxazine, rely on petroleum resources. This research aimed to synthesize new benzoxazine monomers by utilizing bio-based starting materials, primarily due of the environmental implications involved. The primary objective of this study is to create a new benzoxazine compound (CHPE) using an arylidene base. Subsequently, the chemical was used as a modifier for the cellulose acetate (CA) matrix to produce film samples. The main goal is to assess the efficacy of these film samples in inhibiting fouling. The CHPE compound was synthesized from a bis(arylidene) cyclohexanone diol and studied using Fourier transform infrared (FTIR) and nuclear magnetic resonance (NMR) spectroscopy methods, respectively. The films were prepared by mixing different weight ratios of 0%, 20%, 40%, 60%, and 80% w/w. The CHPE/CA films were analyzed using FTIR analysis to determine their composition, and their morphology was observed using scanning electron microscopy (SEM). Thermal gravimetric analysis (TGA) was employed to investigate the thermal stability of the films.



NITRIC ACID ACTIVATION FOR TUNING THE PORE STRUCTURE OF SEWAGE SLUDGE DIGESTATE BIOCHAR ADSORBENT: IMPLICATIONS ON METHYLENE BLUE ADSORPTION

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Abstract
This study has been focused on both the ecologic and the economic gains resulting from the sewage sludge treatment. Accordingly, anaerobic digestion and adsorption were combined to solve these problems, resulting in synergistic effects to improve productivity. In the first, a considerable amount of methane (energy source) was produced by anaerobic digestion of sewage sludge (SS) under mesophilic conditions (38°C), resulting in a biologically activated digestate. Secondly, the residue of anaerobic digestion (digestate) was then utilized as a raw material to design a low-cost adsorbent for dye removal. The present work aims to evaluate the adsorption capacity of designed activated biochar with different concentration of nitric acid (HNO_3) to eliminate from aqueous solutions, methylene blue (MB) as targeted pollutant. The results showed that the BC-HNO_3 lead to maximum dye adsorption capacity of 83.09 mg/g. Further, the adsorption process was found to be best modelled by Langmuir and pseudo-second order kinetic models for the prepared activated biochar. In addition, the BC-HNO3 exhibited good stability and regenerative ability indicating that this absorbent is suitable for frequent uses.
Keywords: Sewage sludge, Anaerobic digestion, Activated Biochar, Adsorption, Dyes

ANALYSIS OF THE SOIL COMPOSITION OF THE SUBSTANCE AND IMPROVEMENT OF ITS QUALITY USING NEW DATA PROCESSING APPROACHES

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Özet
Today, the rapid development of rural industry opens up new ways for researchers to increase yields, the quality of seed products and the opportunity to defeat such a global problem of humanity as hunger. To solve this problem, scientists are taking various steps related to increasing its fertility, the withdrawal of new plant varieties to improve the welfare of the population. Chemical analysis of the soil can show the main disadvantages faced by agriculture in a particular area of our globe. Undoubtedly, clay soil adversely affects the growth of agricultural products, hinders its development. The same effect is exerted by excessive moisture, which is observed in swampy, tropical areas, as well as in regions with frequent rains and showers. Which way can we go? On the one hand, it is possible to dilute fertile soil containing chernozem with clay, thereby ensuring an average yield level in several territories at the same time. On the other hand, you can try to synthesize the required composition of the substance in accordance with some reference sample, evaluate its composition and the components that need to be added. In addition, there are situations in which soil with the same composition of matter in two different areas yields different yields. Detailed noise spectroscopy of the substance composition can help to analyze such phenomena.
Keywords: agriculture, data processing, industrial production.

AN OVER REVIEW OF PHARMACOLOGICAL ASPECTS OF DIABETES MELLITUS OF INDIAN MEDICINAL PLANTS

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Özet
Diabetes mellitus is a global epidemic with far-reaching health, economic, and social implications. The management of this complex metabolic disorder remains a subject of extensive research and clinical intervention. In this context, the traditional healing systems of India, with a rich history of herbal remedies, have gained significant attention for their potential in treating and managing diabetes. This review offers a comprehensive analysis of the pharmacological aspects of diabetes mellitus, focusing on the role of Indian medicinal plants and their antidiabetic properties. Indian traditional medicine systems, such as Ayurveda and Siddha, have long recognized the therapeutic potential of numerous plant species. These traditional systems have identified plants like bitter melon (Momordica charantia), fenugreek (Trigonella foenum-graecum), and holy basil (Ocimum sanctum) for their ability to modulate blood glucose levels and alleviate the symptoms associated with diabetes. The mechanisms underlying the antidiabetic effects of these plants involve a range of actions, from enhancing insulin sensitivity to inhibiting glucose absorption. Scientific investigations and clinical studies have provided valuable insights into the efficacy of these natural products in diabetes management. As the world grapples with the increasing burden of diabetes, integrating traditional Indian medicinal knowledge with modern pharmacological approaches holds promise. This review underscores the importance of bridging the gap between ancient wisdom and contemporary scientific understanding to harness the full potential of Indian medicinal plants in the fight against diabetes. By elucidating the mechanisms of action and consolidating the existing evidence, this review contributes to a deeper comprehension of the pharmacological aspects of diabetes mellitus and the role of Indian medicinal plants in its management.
Keywords: Diabetes Mellitus, Indian Medicinal Plants, Antidiabetic Activity, Pharmacological Aspects, Traditional Medicine, Herbal Remedies, Natural Products, Medicinal Plant Compounds, Glycemic Control, Traditional Knowledge.

MAISIR IN THE DIGITAL AGE: AN ANALYSIS OF THE PHENOMENON OF CRYPTOCURRENTCY GAMBLING AND ITS IMPLICATIONS

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Abstract
The purpose of this study is to analyze the phenomenon of crytocurrentcy gambling in the digital era and analyze the implications or consequences that arise from these cryptocurrentcy gambling activities. This type of research uses a qualitative approach. The results of this research use literature studies, which are sourced from books and journals related to the phenomenon of cryptocurrency gambling and its implications. The results of this research conclude that maysir and cryptocurrency have a close relationship, Cryptocurrency contains elements of maysir because of the intention to gain profits from highly speculative price speculation where this activity is considered a form of gambling. Cryptocurrency has several types, one of the most famous types of Cryptocurrency is bitcoin, the value of bitcoin is quite large compared to other cryptocurrencies. Not only does it contain elements of maysir, Cryptocurrency also contains elements of Gharar because of its fluctuating prices, inadequate security, a form of digital currency that is unclear and cannot be seen physically and allows fraud to occur. If left unchecked, the magnitude of harm in cryptocurrency will certainly not have a good impact on social and environmental aspects. This requires a challenge to avoid it, namely by prioritizing a cautious attitude to avoid elements of maysir or gambling that occur. Like using bitcoin as a transaction tool or commodity, then weighing it in terms of the risks obtained, whether it is greater than the benefits generated, if the profits are large but the risk of losses is greater, then it must be considered further. Gambling or maysir in Islamic law is

strictly prohibited. Cryptocurrency is not only prohibited by Islam, it also has consequences that can arise from cryptocurrency activities which are very detrimental to its users. The fluctuating value of cryptocurrency, cryptocurrency gambling activities can cause gambling players to pay attention to drastic price changes because it can result in financial losses. Crime and fraud, in the digital world such as cryptocurrency, there is great potential for committing crimes and fraud such as identity theft, investment scams, and cyber attacks, and there are many other possible consequences that could occur. This research comprehensively analyzes the relationship between cryptocurrentcy gambling in the digital era and the elements of Maisir contained.
Keywords: Cryptocurrency, Bitcoin, Gharar, dan Maisir

RECYCLING WASTE POLYTHENE MATERIALS TO USEFUL PRODUCTS VIA PYROLYSIS

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Abstract
Plastic materials have been crucial to the development of science, technology, and almost all aspects of modern progress since the mid-twentieth century. However, the increasingly unsustainable culture of plastic consumption and the accumulation of plastics in landfills, oceans, and broader ecosystems has also made negative, potentially irreversible environmental impacts. In recent decades, scientists and engineers have spent significant time and resources searching for more effective plastic waste management techniques based on thermochemical routes like pyrolysis. Indeed, plastic to fuel conversion has the potential to severely limit plastic pollution and to contribute to the circular economy, but industrial scale plastic pyrolysis has not been achieved. Therefore, this paper presents a bibliometric analysis and systematic literature review of pyrolysis-related articles in the Web of Science database published between 2001–2020. The resulting articles (n = 670) show that Spain is the most productive country in terms of total output and that there are an increasing number of researchers focused on this topic worldwide. The results also highlight the current landscape and future directions of plastic pyrolysis research based on the following hot topics: i) kinetic triplets as a vital component of plastic pyrolysis and scaling up processes, ii) catalysts syntheses and performance, iii) co-pyrolysis of plastic/biomass mixtures, and iv) reactor design and reaction parameters. In conclusion, the study offers a comprehensive overview of plastic pyrolysis progress, which will remain a major area of research for chemists and engineers in the coming decade and a powerful tool for environmental management. Plastics are cheap, pliable, and moldable materials. Since the 1940s, communities worldwide have developed a “plastic culture”. The material has improved quality of life for many, but also changed global consumption patterns, increased demand for resources and production, and generated almost incalculable tons of waste and pollution. From food packaging to aerospace to medical instruments, our lives are metaphorically, and sometimes literally, wrapped in plastic. In fact, plastic consumption has increased twentyfold since the 1950s, and it is expected to reach to 720 million tons in the next 20 years . To address this issue, in 2018 the European Commission the EU Strategy for Plastics in the Circular Economy, which establish the main goals for plastic design, manufacture, use, re-use, and end-of-life management by 2030 . Despite the significant development of various technologies to handle homogeneous and relatively clean plastic waste in primary and secondary recycling, converting plastic waste into building block molecules, fuels, and energy remains a significant challenge . Part of the challenge is separating plastic waste from other solid waste components; without this step, it is not possible to process used plastic and obtain high-quality outputs. Several tertiary recycling methods and technologies have attracted

attention and have the potential to be useful on the commercial stage. These include depolymerization (chemical feedstock recovery), as well as plasma arc gasification, and pyrolysis . Among the available processes for converting plastics into fuel or any other value-added product, pyrolysis has drawn the most scientific attention between early-stage and mature technologies. Recently, Solis and Silveira provided an extensive TRL assessment on eight technologies available for plastic recycling and reviews recent technological developments in pyrolysis, catalytic cracking, and gasification for TRL 8-9. Nevertheless, the full potentials of these technologies and their impact on the circular economy of plastics is still unclear and requires more full-scale projects to be subjected to critical examinations. Meanwhile, another review by Qureshi et al.argues that pyrolysis can be an effective management tool that will complement mechanical recycling. Some of the primary challenges with elevating plastic to fuel pyrolysis to the industrial scale are feedstock quality, segregation of materials, reactor operations, and stability and standardization of the end products. Finally, Spreafico et al.recently reviewed the innovations and the evolution of different technologies for plastic pyrolysis. Their analysis of patents and articles further indicates that pyrolysis technologies are changing from macro to micro, especially with the use of laser or microwave pyrolysis systems. Efforts to optimize raw material and energy input are advancing quickly. Therefore, the present review aims to offer further insights into how the state-of-the-art has and will develop.

Keywords: Plastic pyrolysisWaste managementCircular economyThermochemical conversionPlastic-to-fuel.

IRON DEFICIENCY ANAEMIA IN PREGNANCY: REEXAMINING THE NATURE AND MAGNITUDE OF THIS PUBLIC HEATH CONCERN

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Abstract
Iron deficiency anemia (IDA) is the most common nutritional deficiency worldwide with immerse public health consequences. Iron deficiency anaemia is a condition in which the number of red blood cells and consequently their oxygen-carrying capacity is insufficient to meet the body's physiologic needs. Pregnant women are recognized as one of the groups most vulnerable to iron deficiency anaemia because of increased iron requirements during pregnancy. Approximately 800 mg of iron are required in pregnancy, which is far higher than the "230 mg of iron that non-pregnant women need. Iron supplies oxygen and nutrients to the foetus, supports placental functions and manufactures red blood cells and is an important micro-nutrient for the development of the foetal brain and cognitive abilities of the new born. Maternal iron deficiency and particularly iron deficiency anaemia has been associated with detrimental effects on maternal and infant function. Maternal iron deficiency is associated with increased risk for cesarean delivery, transfusion, perinatal bleeding, preeclampsia, placental abruption, poor maternal thyroid status, poor wound healing, cardiac failure, and even death. Adverse perinatal outcomes include intrauterine growth retardation, prematurity, low birth weight, all with significant mortality risks. Post-partum cognitive impairment and behavioral difficulties are also reported. Notably, more human studies are essential to generate the best evidence to advance strategies to reduce the incidence of iron deficiency during pregnancy to improve maternal, neonatal and infant health.
Keywords: Iron deficiency anemia, pregnancy

IMPLEMENTATION AND TESTING OF A SOLAR DECLINATOR WITH WATER PREHEATING

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Abstract
The primary aim of this study was to develop a novel approach for obtaining drinking water in arid regions that are severely affected by droughts, by utilising brackish water sourced from pre-existing wells. The study focused on developing an active solar desalination unit, which aimed to preheat water using a flat solar collector, and subsequently perform boiling desalination through an evaporation and condensation chamber. A prototype active solar desalination unit was constructed, utilising Ferro-cement and masonry collector to desalinate brackish water. The unit composed of a flat solar collector, which is used to preheat water, and an evaporation and condensation chamber, which perform the boiling desalination process. Upon conducting several tests, it was observed that the unit produced an average of 3.3 litres of desalinated water per square metre on a daily basis.
Keywords: drinking water, solar desalination

ISLAMIC MACRO CONCEPTS: TW0 SECTOR ECONOMY

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Abstract
The aim of this research is to look in more depth and prove that the level of economic activity depends on the level of aggregate expenditure carried out by all groups of society and to discuss determining the level of economic activity in a two-sector economy or a simple economy, knowing the balance of national income in the sectors, to knowing the multiplier number (Multipler Effect), to find out the balance with the zakat and infaq variables. The results of this research discuss how aggregate expenditure will determine the level of economic activity or is called an analysis of the balance level of the country's economy or an analysis of determining the level of national income. This research uses a qualitative method, namely in the form of data collection.
Keywords: Macroeconomics, 2 factor economics, simple economics.

THE ROLE OF ZAKAT IN ISLAMIC ECONOMIC AXIOLOGY

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Abstract
Zakat has a very important role in the axiology of Islamic economics in the branch of philosophy that considers values and ethics, and zakat is one of the main principles of Islamic economics which deals with the provision of mandatory donations to help those in need. Therefore zakat is important in reflecting Islamic economic values and ethics such as social justice, community empowerment, poverty alleviation, social solidarity, and improving the quality of life. This research aims to explore, analyze, and examine the role and impact of zakat in the context of Islamic economics. This research is a literature study with a qualitative approach. The data sources in this research are obtained through the study of various references such as books, journal articles, the internet, and other sources relevant to the research topic. The data analysis in this research uses content analysis techniques from existing reference sources. The results of this study show that zakat not only has religious value, but zakat also has significant economic value.
Keywords: Zakat, Axiology, Economy, Islam

MORPHO-ANATOMICAL MODIFICATION IN WITHANIA SOMNIFERA (L.) DUNAL FROM PUNJAB, PAKISTAN: INSIGHT INTO ADAPTATION

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Abstract
The Solanaceae family, commonly known as the deadly nightshade or potato family, encompasses a wide range of important food plants and medicinal species. Among these is Withania somnifera (L.), also known as Ashwagandha or Winter cherry, an evergreen shrub native to India, the Middle East, and certain regions of Africa. This study focused on the collection of plant material from twelve different ecotypes in the Punjab region, including Shadan Lund, Layyah, Kot Adu, Jam Pur, Vodor, DG canal, Kala, Chah Jeand Wala, Faisalabad, DG Khan, Jang, and Multan, to investigate morphological and anatomical variations. The collected samples were preserved in a 70% alcohol solution, and freehand sectioning and double staining methods were employed. Microscopic examination using a digital ocular camera facilitated the analysis of various anatomical structures in the roots, stems, and leaves. Morphological and anatomical features were carefully observed and documented. Results indicated that the Jam Pur ecotype exhibited the maximum root epidermal thickness, while the Faisalabad ecotype displayed the largest root radius. Stem characteristics varied significantly among the ecotypes, with the Vodor ecotype exhibiting the highest cortical cell area, Jam Pur ecotype displaying the greatest epidermis thickness, and the Shahdan Lund ecotype showing the thickest sclerenchyma layer. The Vodor and Jang ecotypes had the highest abaxial stomatal area and number of trichomes. Statistical analysis, utilizing Analysis of Variance (ANOVA) at a 5% probability level, confirmed the significance of the observed results in terms of morphology and anatomy.
Keyword: withania somnifera, Morpho-Anatomical modification

STABILITAS PEREKONOMIAN DI DESA MULYOREJO

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Abstract
Economic stability in Mulyorejo village is an interesting phenomenon to study. This village is located in a rural area that has abundant natural potential, but still faces challenges in achieving sustainable economic stability. This research aims to analyze the factors that influence economic stability in Mulyorejo village. The research method used is a case study with a qualitative approach. Data was obtained through in-depth interviews with village stakeholders, direct observation, and analysis of related documents. The research results show that economic stability in Mulyorejo village is influenced by several key factors. First, geographical factors and natural resources are the main economic basis of this village. Mulyorejo Village has great agricultural potential, especially in the production of rice, vegetables and fruit. However, challenges such as climate change and limited market access affect the stability of the village economy. Second, social and cultural factors also play an important role in the stability of the village economy. The active involvement of the community in economic activities, such as cooperatives and farmer groups, makes a positive contribution to economic growth and village stability. However, the existence of social inequality and differences in asset ownership are also obstacles that need to be overcome. Third, government policy factors and institutional support also influence the stability of the village economy. The existence of development programs such as skills training, infrastructure provision and business capital assistance can help increase village economic stability. Economic stability in Mulyorejo village is influenced by geographical, socio-cultural factors and government policy. To ensure sustainable economic stability, collaborative efforts are needed between the government, society and related institutions. In the long term. Developing local economic potential and increasing market access are important factors in achieving sustainable economic stability in Mulyorejo village
Keywords: stability, balance and prosperity.

EFFECT OF VARIED TEMPERATURES ON SEED GERMINATION AND SEEDLING EMERGENCE IN CHERIMOYA (*ANNONA CHERIMOLA* MILL.)

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Abstract
The cherimoya tree (*Annona cherimola* Mill.), commonly known as Cherimoya, belongs to the Annonaceae family and produces a fruit known as cherimole, renowned for its exceptional flavor and aroma, rendering it a fruit of significant agronomic potential. Cherimoya has been shown to possess antioxidant properties, reduce the risk of certain forms of cancer, and lower the risk of certain heart-related conditions and high blood pressure. Nevertheless, there is limited knowledge regarding its seed propagation. According to the scientific literature, the germination of cherimoya seeds is substantially influenced by external conditions rather than internal factors. In this study, the germination of the *Concha Lisa* variety was examined under constant temperatures of 25°C, 30°C, 40°C, and at room temperature (fluctuating between 20°C-25°C), combined with complete darkness. The seeds were sown in Petri dishes (0.8% water agar) and incubated for 25 days. Germination kinetics were assessed based on five closely associated parameters: final germination percentage (FGP), mean germination time (MGT), germination rate coefficient (CVG), time to 50% germination (T50), and seedling length (SL). The results revealed that a temperature of 30°C was optimal, resulting in a 70.8% FGP, 17.5 days MGT, and a 3.91 cm SL, while the room temperature of 20-25°C modestly improved germination with only a 25% FGP. Furthermore, a significant reduction in FGP and SL was observed at 25°C and 40°C compared to 30°C. The analysis also indicated that the germination of cherimoya seeds during days 10-15 after sowing was suitable for final counts. An overview of cherimoya seedling emergence over a 12-week period in pots is also illustrated in this study.
Keywords: Cherimoya, Seed germination, Temperature effects, Annonaceae, Agriculture.

AI-2 QS SIGNALLING AND INHIBITION IN DENTAL UNIT WATER LINE BIOFILM ISOLATES

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Abstract
Dental unit water line (DUWL) contamination by opportunistic pathogens has its significance in nosocomial infection of patients, health care workers and life-threatening infections to immunocompromized persons. The quorum sensing (QS) system of DUWL isolates has been found to affect their biofilm-forming ability, making it an attractive target for antimicrobial therapy. However, detailed information about the anti-biofilm effect of these compounds is still lacking. In the present study, the effect of two quorum-sensing inhibitory compounds (patulin; PAT, penicillic acid; PA) and EDTA on *in-vitro* biofilm formation, planktonic growth and AI-2 signaling of *Pseudomonas aeruginosa*, *Achromobacter xylosoxidans* and *Achromobacter* sp. was monitored. Crystal violet staining method for biofilm formation as well as inhibition, while *Vibrio harveyi* BB170 bioassay was used to detect the AI-2 signaling in DUWL isolates. All strains were found to form biofilms within 72 h of incubation. The QSIs/ EDTA combination have isolate-specific effects on biofilm formation and in some cases it stimulated biofilm formation as often as it was inhibited. The *V. harveyi* BB170 bioassay failed to induce bioluminescence in *A. xylosoxidans* and *Achromobacter* sp. while *P. aeruginosa* showed false positive results for AI-2 activity suggesting the need of some pretreatments prior to bioassay.
Keywords: AI-2 like activity; *P. aeruginosa*; biofilm formation; QSI; biocide

BIOSYNTHESIS AND CHARACTERIZATION OF ZINC OXIDE NANOPARTICLES USING *NIGELLA SATIVA* AGAINST COCCIDIOSIS IN COMMERCIAL POULTRY

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Abstract
Coccidiosis causes huge economic losses worldwide. Our study evaluated the effect of biosynthesized Zinc oxide nanoparticles (ZnONPs) using *Nigella sativa,* on *Eimeria tenella* infected broilers. Scanning electron microscopy showed spherical ZnONPs with 50-100nm diameter, Fourier transforms infrared spectroscopy revealed the functional groups involved in the reduction of zinc acetate dihydrate to ZnONPs, UV-vis spectroscopy showed a peak at 354nm, and Zeta potential showed stability at -30mV. A total of 150, day-old broiler chicks were divided into 5 equal groups. Control negative: uninfected and untreated; Control positive: Infected and untreated; 3rd, 4th and 5th group were infected orally with 5×10^4 sporulated oocysts of *Eimeria tenella* and treated with 60mg/kg ZnONPs, 1% *Nigella sativa* seeds and amprolium 125ppm respectively. ZnONPs significantly (p<0.05) improved the growth performance in the

infected birds and decreased the oocyst shedding and anti-coccidial index. A significant (p<0.05) decrease in the level of aspartate transferase, and alanine transferase, and a significantly higher amount of antioxidants like catalase, and superoxide dismutase in ZnONPs treated group was observed. Pro-inflammatory cytokines like IL-2 and TNF-α were significantly decreased by ZnONPs (p<0.05). In conclusion, biogenic ZnONPs with *Nigella sativa* might have enhanced anticoccidial, antioxidant, and anti-inflammatory effects with improved growth performance.
Keywords: Coccidiosis, green synthesis, zinc oxide nanoparticles, growth performance, antioxidants, pro-inflammatory cytokines, broilers

3D VISIBILITY NETWORK USING FOR ANALYZING COMPLEXITY OF MICROSTRUCTURE OF ROBOT LASER HARDENED SPECIMENS

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Abstract
In computational geometry, the visibility graph problem has long been researched and used in a variety of contexts. Many 3D geometric issues can be solved with 3D visibility graphs. In this work, the microstructure of robot laser hardened specimens has been analyzed using the visibility network in 3D space, which provides more information than the visibility graph. The creation of fractal geometry by Mandelbrot was one of statistical physics' most significant findings. On all length scales, fractal formations have the same appearance. New types of topological fractality have been seen in complex networks where the links indicate interactions between individuals, while these intriguing patterns were originally geometric, i.e., applying to structures in physical space. Networks have been geometrized, allowing us to view computer phenomena the methods of graph theory and topology have made a significant impact in a variety of fields, including physics, materials science, biomedical image processing, and social networking. In this research I present application network theory and fractal geometry in material science, namely in researching complexity of microstructure during process of robot laser hardening. Robot laser hardening (RLH) is a process to improve the wear behavior of components. With laser hardening, the energy of the laser beam is applied directly to the component surface. The edge layer is heated to the hardening temperature in a reduced area within a very short time. In laser hardening, the laser beam and its adjustable focal point are guided over the surfaces to be hardened by a robot. For this process you need a robot controller with the quality in terms of TCP path accuracy and speed. The material hardens as a result of the production of a martensitic structure, which occurs as the laser moves over the surface. As the laser moves across the surface, it instantly heats the surface and a desired case above the austenizing temperature. Laser hardening has several benefits over conventional hardening techniques, including improved precision and accuracy, a wider range of material acceptability, and a decreased danger of warping and cracking. Almost any carbon-containing steel or cast iron can be hardened using a laser. The work-piece can be very straightforward or extremely complex. The laser beam is set to move across the surface of the work-piece following a preprogrammed route, causing the area under the beam to instantly attain the desired temperature. The hardened case depth is determined by the laser energy per unit area, which is dictated by the laser power and surface speed.
Keywords: Robot laser hardening, 3D visibility network

AN IN-DEPTH ANALYSIS OF MULTIFARIOUS DETERMINANTS IMPACTING ENGLISH SPEAKING PROFICIENCY ATTAINMENT AMONG RURAL STUDENTS IN INDIA

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Abstract
This comprehensive review explores factors shaping English speaking skills acquisition among rural students in India. As English proficiency gains significance for education and employment, understanding rural learners' unique challenges is vital for effective language education. Drawing from extensive literature, this review synthesizes existing knowledge, pinpointing determinants influencing rural India's English-speaking skills development. Factors like socioeconomic constraints, cultural norms, teacher quality, psychological barriers, and linguistic influences are probed. These challenges hinder rural students' path to proficient English speaking. Insights on strategies like teacher training, community engagement, tech integration, culturally relevant content, and multilingualism promotion are provided. These empower rural students to overcome linguistic barriers, boost confidence in English speaking, and enhance personal and socio-economic prospects. In summary, this review deepens our grasp of English language acquisition dynamics in rural India. It underscores the need for targeted interventions to bridge the language gap, equipping rural students with skills to thrive globally.
Keywords: English speaking skills, rural students, India, language education, language proficiency.

IMPACT OF FISCAL POLICY ON INDIA'S ECONOMIC GROWTH

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Abstract
This study investigated the effect of fiscal policy on economic growth in India. The aim of the study is to determine the effect of fiscal policy on the growth of Indian economic. The researcher employed expost facto design, the sample size was chosen through purposive sample method to be 21 years. The data used were purely secondary and was collected from CBI annual reports and accounts. The statistical tool applied was ordinary least square multiple regression analysis. The findings at 0.05 level of significance, revealed that capital expenditure has no positive and significant effect on gross domestic product in India, recurrent expenditure has no positive and significant effect on gross domestic product in India, value added tax has a negative and significant effect on gross domestic product in India and custom and excise duty has no positive and significant effect on economic growth in India. Based on the findings, it was recommended that government should ensure that the funds spent as recurrent expenditure is actually channeled and applied so as to grow and develop the economy, Government should seriously monitor organ saddled with responsibility of collecting value added tax and ensure they remit them to the government coffers so to catalyze economic growth in India etc.
Keywords: Fiscal Policy, Economic growth, VAT, multiple regression analysis

PROPOSING THE STATE OF THE ART DATA MINING METHODOLOGIES FOR PERFORMING ENERGY AUDIT AND MANAGEMENT

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Abstract
This paper is a survey report on the Data Mining methodologies for performing Energy Audit and Management. Data Mining is a field of Computer Science and Engineering that is going to be used for the purpose of making an audit on the Energy of various aspects and then make a management of the Energies that could be used for several purposes. Data mining is a field that exploits the human beings capability to make interpretation of patterns presented in the form of graphs, charts etc. We will use the Data Mining technology for the purpose of Energy Audit and Management. At last we propose the usage of Data Mining for the purpose of Energy Auditing and Management.
Keywords: Data Mining, Energy, Audit, Management, Computer.

PROPOSING THE STATE OF THE ART METHODOLOGIES FOR CONSERVATION OF ENERGIES

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Abstract
This paper is a survey report on the various sources of Energy. The paper describes the various flavours of Energy. The paper also describes the sources from where the aforementioned energy sources are coming. Next the paper describes the major issues or what we can say challenges in the field of Energy. The paper looks into the Energy paradigm at a Global level and tries to provide measures that should be implemented at global level to face the challenges that we are facing right now in a more emphasized way. The paper focuses a lot on the Computer and Electronic Industry for the Energy issues. We in the last section have a forum that make a prolonged and detailed discussion on the Energy crisis around the world and how to counter the crisis. In the paper the authors make a brief and not a detailed discussion on the country India which is a developing country and has to focus on this issue in a serious way to get to the destination it is having in its target.
Keywords: Computer, Energy, Conservation, Renewable, Non-renewable.

PROPOSING THE STATE OF THE ART MACHINE LEARNING ALGORITHMS FOR THE NOTION OF CLEAN AND SUSTAINABLE ENERGY

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Abstract
Energy is the term on which the whole infrastructure and economy of the country depends on. This paper looks into the ways of the various Energy Generation forms that does not make emission of Greenhouse gases. We in the paper will visit the several systems running around the globe on a daily basis producing a lot of emissions of various types we will first see a segregation process of the Systems that may cause Greenhouse gas emission and will provide remedial measures to cope up with the problem. In the paper we will observe the various limitations that we have from Global perspectives in terms of Energy production. At last we will observe a Machine Learning approach to tackle the problem and provide measures to eradicate the problem addressed.
Keywords: Artificial Intelligence, Energy, Clean and Sustainable, Machine Learning, Emission.

EFFECT OF BACILLUS CEREUS ON GROWTH OF TOMATO (*Solanum lycopersicum* L.) IRRIGATED WITH TEXTILE WASTE WATER

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Abstract
Textile wastewater is utilized by farmers for irrigation of crops in many developing countries. The presence of many toxic pollutants, high level of salts, detergent, dyes, total dissolved solids, etc. make it unfit for drinking and irrigation purpose. However, in spite of water toxicity, resource deficient countries where water is limited and treatment methods are costly, use it for irrigation to agricultural fields without treatment. The main objective of present work to investigate the role of bacteria (*Bacillus cereus*) as bio-fertilizer applied to tomato (*Solanum lycopersicum L.*) irrigated with textile industry waste water in three concentrations (50%, 75%,100%). A pot experiment was performed with three replications. Water and soil were analyzed for physio chemical properties such as pH, EC, carbonates, bicarbonates, sodium, and potassium contents, before and after irrigation with polluted water and bacterial application. Results showed that the toxicity of textile waste water increased with increasing concentration of polluted water. Soil having bacterial inoculum showed resistance in pH fluctuation than stress treatments. However, sever reduction in morphological and quality parameters observed in plants grown under maximum stress level. Significant results of growth parameters (shoot length, root length, shoot fresh and dry weight and root fresh and dry weight), chlorophyll content, protein and carbohydrate contents were obtained in samples taken after *Bacillus cereus* application. Bacteria mainly act on root and modified tomato (*Solanum lycopersicum L.*) root architecture a lot. Roots of plant at 75% concertation of textile industry polluted water in combination with *Bacillus cereus* are more fibrous. Overall, results demonstrate that *Bacillus cereus* as biofertilizer is promising biological agent to improve plant growth under textile industry waste water stress condition.
Keywords: Bacillus cereus, Tomato (*Solanum lycopersicum* L.), Textile industry waste water, Bio-fertilizer, Growth parameters, Root architecture.

E-COMMERCE AND CONSUMER BUYING BEHAVIOR FOR AGRICULTURAL PRODUCTS IN DEVELOPING COUNTRIES: A CASE OF PAKISTAN.

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Abstract
With the success of e-commerce, agricultural products e-commerce has become a hot topic in the development of e-commerce in the agriculture sector. Although, certain development has achieved by the agricultural products, still there is a large room for growth exists when compare with the internet users and economic scale of e-commerce. This study analyzed the perception of the consumers and influencing factors of buying agricultural products. Primary data were collected by using the well- structured questionnaire from the consumers in Multan, the main and fifth largest city of Pakistan. The findings of this study indicated several key insights into the dynamics of consumer behavior in the online agricultural products market. Factors such as trustworthiness, product information, pricing, convenience, and product quality emerge as significant determinants in shaping consumer perceptions and choices in this growing e-commerce sector. Additionally, the study underscores the importance of customer reviews, reliable delivery, and robust customer support as pivotal components of the consumer experience.
Keywords: e-commerce, agricultural products

POTENTIAL ANTICANCER AND ANTIOXIDANT LAURIC ACID BASED HYDRAZONES SYNTHESIS AND COMPUTATIONAL SLANT TOWARDS THE ELECTRONIC PROPERTIES

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Abstract
Natural products modification is a key area of synthetic organic chemistry for the accomplishment of valuable chemical building blocks with prized medicinal significance. Herein, lauric acid based hydrazones: (E)-N'-(2-nitrobenzylidene) dodecanehydrazide (NBDH), (E)-N'-(naphthalen-1-ylmethylene) dodecanehydrazide (NMDH), and (E)-N'-(4-fluorobenzylidene) dodecanehydrazide (FBDH)" were synthesized and characterized using spectroscopic techniques. The newly synthesized lauric acid based hydrazones were screened for their anticancer and antioxidant potential. Antioxidants showed activity by inhibiting the oxidative chain reactions that produce reactive oxygen species. The antioxidant activity showed that NBDH exhibited the maximum DPPH inhibitory activity when compared with that of NMDH and FBDH. In contrast, the anticancer activity showed that FBDH exhibited maximum percent viability when compared to that of NBDH and NMDH. The reactivity and biological needs of the synthesized compound NBDH, NMDH, and FBDH were met by performing geometrical, FT-IR vibrational, UV-visible, global reactivity parameters (GRP), MEP, FMO, NBO, ELF, LOL and nonlinear optical (NLO) analysis at DFT/B3LYP/6-311+G(d,p) level. NBO analysis confirmed the existence of extended conjugation and intramolecular charge transfer among NBDH, NMDH, and FBDH are from the lowest gap $\pi \rightarrow \pi^*$ which are in line with FMO results where successful charge transfer occurred from HOMO→LUMO. GRP analysis confirmed the potential of NBDH, NMDH, and FBDH for biological, electronic and NLO applications. It is clear from the comparative analysis of the urea molecule that NBDH, NMDH, and FBDH are all components of fine NLO properties.
Keywords: Lauric acid based Hydrazones; Anticancer; Antioxedant; DFT Study; Spectroscopic Analysis

ANTIBACTERIAL ACTIVITIES OF ENDOPHYTIC BACTERIA ISOLATED FROM *Adenosma bracteosum* Bonati AGAINST *Vibrio parahaemolyticus*

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Abstract
Currently, the dependent and unbalanced use of antibiotics has caused antibiotic-resistant bacteria. Therefore, many studies focus on using medicinal plants to treat diseases without causing drug resistance. However, most research on medicinal plants focuses on essential oils or plant extracts, while research on endogenous bacteria in medicinal plants has not received adequate attention. Several studies have shown these bacteria to possess potent antibacterial properties, making their isolation from *Adenosma bracteosum* Bonati, collected from Lo Go National Park in Tay Ninh province, Vietnam, a crucial step in searching for antibiotics from microorganisms. This study aimed to evaluate the antibacterial efficacy of endophytic bacteria isolated from the medicinal plant *Adenosma bracteosum* Bonati. A total of 48 endophytic bacterial isolates were isolated and tested for their ability to inhibit the pathogen *Vibrio parahaemolyticus* using the agar disk diffusion method. Results showed that 10 out of the 48 isolates exhibited antibacterial activity against *Vibrio parahaemolyticus*, with isolate 1R13.2 having the highest inhibition zone diameter of 12 mm. 16S rRNA gene sequencing identified 1R13.2 as being 100% similar to the *Bacillus velezensis* LEF MYM 5 isolate. This research confirms that the medicinal plant *Adenosma bracteosum* Bonati harbors endophytic bacteria with potent antibacterial properties against *Vibrio parahaemolyticus*, providing potential avenues for future studies on natural antibacterial solutions.
Keywords: *Adenosma bracteosum*, antibacterial activity, endogenous bacteria, isolate, *Vibrio parahaemolyticus*.

HUMAN NATURE, ETHICS OF FREEDOM AND SOCIO-ECONOMIC RESPONSIBILITY

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Abstract
This paper aims to explain human nature, ethics of freedom and socio-economic responsibility by formulating the following questions: first, what is meant by human nature? Second, what is the definition of ethics and the function of ethics? Third, how is ethics a consideration for science? Fourth, what is meant by humans as ethical creatures? Fifth, what is meant by moral science ethics? Sixth, what is meant by social ethics, economic ethics and religious ethics?. This paper uses a qualitative approach, because data sources and research results in library research, inductive data analysis, grounded theory (towards the direction of theory building based on data). Findings First, The essence of humans is basically the Caliph of Allah SWT or can be said to be a servant of Allah. This human nature is inherent in (1) Human Specialties (2) The glory and primacy of reason (3) Comparison of reason with knowledge (4) Reason for intelligent people. Second, definition and function of ethics. Ethics is a science that talks about human practices or discussing the meaning of good and bad, right and wrong, then humans use reason and conscience to achieve good and correct life goals in accordance with the desired goals. The main function of ethics is as an assessor, and determiner of an action carried out by a human being. Third, Ethics as a value judgment, that is, as the function of ethics is as an assessment, ethics is used as a measure in assessing human behavior. Fourth, humans as ethical creatures, where humans are creatures who are able to understand moral and religious rules and use them as guidelines for speaking, acting and behaving well. Fifth, Ethics, Moral Science, a science that tries to understand human behavior and then determines whether this behavior is despicable or begins to be in accordance with moral values. Finally, regarding three ethics, (1) social ethics (2) economic ethics and (3) religious ethics. This paper provides a comprehensive description of the relationship between philosophy as human nature and ethics as the benchmark for human judgment.
Keywords: Philosophy, Ethics, Reason

ANALYSIS OF THE BENEFITS OF PURWACENG AS A MEDICINAL PLANT

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Özet
Purwaceng is a commercial herbaceous l plant whose roots are medicinal as an aphrodisiac, diuretic, and tonic. The plant is native to Indonesia that lives endemic to mountainous areas such as the Dieng plateau in Central Java, Mount Pangrango in West Java, and mountainous areas in East Java. The purwaceng population is already rare because it has undergone massive genetic erosion, currently the plant is only found in the Dieng plateau. Based on several studies from the purwaceng plant, purwaceng content was found such as coumarin derivatives, sterols, saponins, and alkaloids. Data from the Research Center for Medicinal and Aromatic Plants shows that other purwaceng content is lomonene compounds, kafaet acid, skualena, dianethole, isoorientin, anisketone, and hydrokinone. Based on the content in it, purwaceng is also believed to be one of the aphrodisiacs. Purwaceng is included in herbal plants that can provide various health benefits, including: increasing male virility, increasing female sexual desire, overcoming fungal infections, improving blood circulation, pain and fever relief, preventing cancer and tumors, maintaining muscle health, increasing stamina, and anti-cold medicine. To get noticeable efficacy, Purwaceng should be taken regularly for 7-15 days. In addition, this plant is also efficacious in warming the body, nerves and muscles, eliminating colds and soreness, promoting urination, analgetic drugs (relieving pain), lowering heat, deworming, antibacterial and anti-cancer. The original Purwaceng has a distinctive taste, which is spicy, which is produced by its roots and seeds.
Keywords: medicinal plant, aromatic, purwaceng

ECOLOGICAL FACTORS SHAPING THE EVOLUTION AND BEHAVIOR OF SPOONBILLS: INSIGHTS FOR CONSERVATION AND MANAGEMENT

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Abstract
The ecological factors that shape the evolution and behavior of spoonbills, a group of large wading birds, have been the subject of considerable scientific interest. This Abstractprovides a comprehensive overview of the research conducted in this field and highlights the key findings and implications. Spoonbills are highly specialized birds that inhabit wetlands and coastal environments across various regions of the world. Their unique physical and behavioral characteristics, such as their long bills and feeding strategies, have evolved in response to specific ecological factors. The availability of suitable foraging habitats, prey availability, and competition for resources have played significant roles in shaping the morphology and behavior of spoonbills. The evolution of the spoonbill's characteristic spoon-shaped bill can be attributed to its feeding habits. Spoonbills primarily feed on small aquatic organisms, such as fish, crustaceans, and insects, which are abundant in shallow waters. The elongated bill allows spoonbills to sweep through water and mud, capturing prey with remarkable accuracy. Studies have shown that variations in bill size and shape among spoonbill species are associated with differences in prey preference and feeding techniques. Furthermore, the breeding behavior of spoonbills is strongly influenced by ecological factors. These birds typically nest in large colonies situated in areas with optimal nesting conditions, including suitable vegetation cover and protection from predators. The availability of nesting sites and the proximity to foraging grounds are crucial determinants of breeding success and population dynamics. The conservation implications of understanding the ecological factors shaping spoonbill evolution and behavior are significant. Wetland degradation, habitat loss, and changes in prey availability due to human activities pose threats to spoonbill populations worldwide. By identifying and understanding the specific ecological requirements of spoonbills, conservation efforts can be targeted toward preserving and restoring their habitats. In conclusion, ecological factors have played a pivotal role in shaping the evolution and behavior of spoonbills. The unique morphology and feeding strategies of spoonbills have evolved in response to the availability of suitable foraging habitats and prey resources. Understanding these ecological relationships is vital for the effective conservation and management of spoonbill populations in the face of ongoing environmental changes.
Keywords: Spoonbills, wading birds, ecological factors, evolution, behavior, feeding habits, bill morphology

LENS AND CULINARY BRILLIANCE: A VISUAL JOURNEY INTO FOOD PHOTOGRAPHY'S INFLUENCE ON GASTRONOMY AND DIETETICS

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Abstract
In the realm of culinary arts and nutritional science, the visual portrayal of food has evolved into an influential force, significantly impacting gastronomy and dietetics. This study embarks on a visual journey, aiming to comprehensively examine the profound influence of food photography on both gastronomic experiences and dietary choices. The primary purpose of this research is to elucidate the symbiotic relationship between food imagery and the realms of taste perception, nutritional awareness, and health-conscious eating. The theoretical framework guiding this study draws from consumer behavior theory, emphasizing the visual language of food photography and its impact on human perception and behavior. The methodology adopted encompasses both qualitative and quantitative approaches, including content analysis of food imagery in various media, and surveys to gauge public responses to visually presented dishes. The preliminary results of this study reveal the compelling role of food photography in influencing the aesthetic appreciation of food, triggering emotional responses, and affecting dietary preferences. The discussion that ensues from these findings underscores the importance of strategically using food photography to promote healthy eating habits and nutritional literacy. In conclusion, this research highlights the pivotal role of visual art, particularly food photography, in shaping gastronomy and dietetics. It underscores the need for a conscious and informed approach to the visual representation of food, encouraging healthier dietary choices and increased patronage. The recommendations emanating from this study advocate for the integration of visual literacy and mindful food photography practices in culinary education and dietary counseling. By exposing gastronomy, nutrition and dietetics scholars to a local content photography course in visual art as an elective course to further amplify their understanding of culinary arts.
Keywords: Aesthetics, Dietetics, Food Photography, Gastronomy, Nutrition, Visual Perception.

JOINT FAMILY SYSTEM

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Abstract
The joint family system is a traditional family structure in which extended family members live together in the same household. This family structure has been prevalent in many cultures around the world for centuries, and it continues to be a common practice in many parts of the world. This survey aims to explore the effects of the joint family system on people's behavior and identify the advantages and disadvantages of this family structure. The survey is conducted online. The method of survey is closed questions total fourteen. The survey ask participants about their experiences growing up in a joint family. Our research suggests that joint family system has influenced people's behavior, and have a significant impact on people's behavior, including their socialization, communication, and decision-making.
Keywords: Joint family system, traditional family structure, extended family members, prevalent, cultures, centuries, common practice, effects, behavior, advantages, disadvantages, online survey, closed questions, experiences, socialization, communication, decision-making.

BEAUTY FROM WITHIN: AN INTERPLAY BETWEEN GUT AND SKIN HEALTH

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Abstract
Dermatology an exciting and developing frontier is the close relationship between gut health and skin disorders, which has attracted increased attention in recent years. The goal of this study article is to shed light on prospective therapeutic strategies and preventive measures by exploring the complex interaction between gut microbiota and skin health. the complex pathways connecting the skin and the gut through an extensive analysis of recent literature. The gut-skin axis, which includes immunological responses, metabolic pathways, and gut microbiota, is essential for preserving homeostasis and controlling inflammatory skin diseases. An increasing amount of research demonstrates how variations in the makeup of the gut microbiota can affect several dermatological disorders, such as rosacea, psoriasis, acne, and eczema. This study looks at how nutrition, probiotics, and prebiotics affect gut health and how that may affect skin health. In addition, the influence of lifestyle factors on gut-skin interactions is examined, highlighting the significance of a comprehensive approach in dermatological therapy. The complex interplay between gut health and skin health is a potential field for further study and therapeutic application. Dermatologists and other healthcare professionals can create more potent treatments and preventive measures by identifying and addressing the gut-skin axis, which will ultimately improve the quality of life for people with a variety of skin disorders. This work opens the door for a more comprehensive approach by encouraging medical professionals and students to think about the wider implications of gut health in the field of dermatology.
Keywords: Gut health, Gut microbiota, gut-skin axis, skin health, inflammatory skin diseases.

ISLAMIC ECONOMICS: BROADENING HORIZONS JUSTICE AND HUMANITY

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Abstract
This research aims to analyze the principles of Islamic economics based on the teachings of the Quran and Hadith. The research method used is a literature study that involves analysing religious texts and Islamic economic literature. The results show that Islamic economics emphasizes fairness, social justice, and humanity in all aspects of life, including economics. These principles include wealth redistribution, economic equality, the avoidance of usury, and the implementation of zakat. In addition, Islamic economics encourages the responsible use of resources and environmental sustainability. This study concludes that by applying the principles of Islamic economics, it can overcome economic inequality and social injustice that exist in the world. In addition, the principle of prohibition of waste and environmental protection in Islamic economics encourages the wise utilization of natural resources wisely, reducing negative impacts on the environment, and maintaining the sustainability of ecosystems. Caring for the sustainability of the ecosystem. By integrating economic and environmental aspects, this approach has the potential to create an economic framework that not only focuses on growth, but also maintains the balance of nature, encourages sustainable resource utilization, and provides long-term benefits for future generations. Long-term benefits for future generations. By expanding the horizons of justice and humanity, Islamic economics can be a solution to be a solution in overcoming economic injustice and social disparities that still occur in the world. That still occur in the world. Through the implementation of its principles, Islamic economics is able to make a positive contribution in creating an economic system that is more equitable and prioritizes humanity. A more equitable economic system and prioritize humanity. with principles of Islamic economics that are centered on Islamic values, it is hoped that a more just, sustainable and beneficial economy will be created. Will create an economy that is more just, sustainable, and beneficial for all parties.
Keywords: Ekonomics, Islamic, Humanity

HEAVY METALS ASSESSMENT OF FARMLAND SOIL IN BAGEGA MINING COMMUNITY, ZAMFARA STATE, NORTHWESTERN NIGERIA

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Abstract
The present study was conducted to examine the level of heavy metals pollution of farmland soil at Bagega community, anka Zamfara State as a result of artisanal and illegal mining activities going on in the community. Soil samples were collected from farmland soil at the depth of 15cm, acid digestion was carried out and the solution was subjected to Atomic Absorption Spectrophotometer model Varian AA240FS for the metal analysis. The level of soil contamination were assessed by Geo-accumulation Index (Igeo) and Pollution Load Index (PLI). The Geo-accumulation studies show that the soil was moderately polluted by Pb(1.21mg/kg), Fe(0.9mg/kg), Zn(0.91mg/kg) and Cu(1.46mg/kg). The Pollution Load Index result shows that farmland soil was polluted, with PLI value of 2.1. Also, the geochemical distribution of the metals in the soil samples was revealed by sequential extraction procedures which show that 90% of the metal concentrations were found in the residual fractions. This signified high level of heavy metals contamination of the farmland soil is associated with the anthropogenic activities such as the mining activities going on in the community.
Keywords: Bagega, Geo-accumulation Index (Igeo), Pollution Load Index (PLI), Residual fractions and Zamfara State.

MEDICINAL PLANTS UTILIZED IN CONVENTIONAL DIABETES TREATMENT IN RIF ISSAGUEN DISTRICT, NORTHERN MOROCCO

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Abstract
Medicinal plants (MPs) have been used extensively and as the foundation for medical treatments since ancient times; according to the World Health Organization (WHO), 80 percent of the world's population uses traditional medicine based on plants and their products for primary healthcare. In the Rif Issaguen district, as in all other regions of developing countries, medicinal plants, due to the presence of phytochemical constituents, play a very important role in traditional medicine. They are widely used for their livelihoods and to address health problems. Diabetes is a significant illness that affects a lot of individuals worldwide and from various socioeconomic backgrounds. Approximately two million Moroccans aged 18 and older have diabetes at this time, and 50% of those patients are unaware they have it (Moroccan Ministry of Health). This review focuses on Moroccan herbal medicines and plants endemic that are used to treat diabetes, particularly in Rif, such as: Arbutus unedo L , Ammi visnaga (L.) Lam., Pistacia lentiscus L, Thymus vulgaris, Artemisia herba-alba, Nerium oleander L, Chamaerops humilis L., etc. It also serves as a starting point for future research on the bioactive anti-diabetic chemicals found in plants.
Keywords: Medicinal plants, Diabetes, Ethnobotanical survey, Phytotherapy, Issaguen district.

WOMEN ROLE IN SUSTAINABLE RURAL DEVELOPMENT IN PAKISTAN: A SYSTEMATIC REVIEW

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Abstract
Like in other developing nations, Pakistan's rural women contribute significantly to the economy through their necessary responsibilities in reproduction and production. In many different ways, rural women are resourceful economic agent who support the growth of communities and the income of families. They engage in an uneven amount of unpaid labour at home in addition to working as self-employed individuals, entrepreneurs, farm and non-farm labourers, family business and employees of others. But in order to fully realise their potential, they must overcome ongoing prejudice, gender norms, and unequal access to resources, which limit female involvement. The sustainable development of their communities is greatly impacted by their active involvement in income-generating activities, agriculture, and livestock management, as well as healthcare and education, yet their contributions are rarely adequately acknowledged. They do, however, confront a number of difficulties, such as restricted access to resources, opportunities for education, cultural norms, and discrimination based on gender. They are only offered programmes pertaining to child health, nutrition, and other relevant topics and have been left out of the many training and rural development initiatives that typically involve males. It proves how most women are invisible, working on the family farm for free. Traditionally, women have handled livestock care and vegetable farming; however, with the increasing modernization of dairy work, women are losing control over management and financial gains. It has been discovered that women's education in animal husbandry is completely ignored. Furthermore, there has been virtually little advancement in domestic technology, particularly in underdeveloped areas where most women still use antiquated instruments. Also, there isn't a good working atmosphere available when at work. While control over resources was shown to be unimportant, the research revealed that self-esteem, decision-making ability, and freedom of mobility were statistically significant factors having a beneficial impact on rural development. It has been proposed that a tanning scheme, a respectable salary, appropriate working conditions, and sufficient education might all be extremely important in empowering women in rural areas. Additionally, having access to media especially mobile phones can greatly empower women, which benefits rural development.
Keywords: Pakistan, women, rural development

FORMULATION AND EVALUATION OF ANTIMICROBIAL CREAM FROM TRIBULAS TERRESTRIS ETHANOLIC EXTRACT

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Abstract
Phyotoconstituent that beget antimicrobial exertion of ethanolic excerpt of these factory. These factories have colorful phytoconstituent like flavonoids rutin quercitine tannins alkaloids. these factory has numerous factory Tribulas terrestris is herbal factory now today's period there's a extensively compass in sauces because these drug has lower side effect than the allopathic medicines 'in the present study we tried to find out the part like leaves brume flavoure root fruits with different effect. These factory have colorful pharmacological exertion like diuretics testrogen supporteranti-inflammatory antifungal antimicrobial. these factory is extensively available in India on road side that's why we prepared these factory for study. In these experiment firstly done the extraction in that ethanolic extract is mainly used after that thin layer chromatography perform than we goes for thin layer chromatography for detecting the affinity of compound after that column chromatography done than we should proceed for the gcms after that antimicrobial activity was tested on the microbes e-coli than move for the formulation. The phytoconstituents present in leaves which promotes natural healing process. The study reveals the phytoconstituents like alkaloid, glycoside, Tannins, flavonoid, present in the leaves of ethanolic extract of plant show the Antimicrobial activity. Microbial infection is cure from these creams.
Keywords: Tribilusus terrestris, Rutin, quercitine, Anti-microbial activity, Cream.

MICROPLASTICS IN AQUATIC FOOD: A HIDDEN THREAT TO HUMAN HEALTH

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Abstract
Microplastics are small pieces of plastic that have been detected in various aquatic environments, including freshwater, marine, and estuarine ecosystems. Microplastics can originate from different sources, such as cosmetic products, industrial discharge, or fragmentation of larger plastic debris. Microplastics can pose a threat to aquatic organisms, as they can be ingested, accumulate in tissues, and cause physical and chemical effects. Moreover, microplastics can also affect human health, as they can be transferred through the food chain and contaminate seafood products. This essay aims to review the current state of knowledge on the presence, identity, and quantity of microplastics in aquatic food, and to discuss the potential impacts of microplastics on human health. The essay will also identify the knowledge gaps and research needs in this emerging field of study. The main topics covered in the essay are: (1) the sources, pathways, and fate of microplastics in aquatic environments; (2) the methods and challenges of detecting and quantifying microplastics in aquatic food; (3) the bioaccumulation and translocation of microplastics in aquatic organisms and human tissues; (4) the physical and chemical toxicity of microplastics and associated contaminants; and (5) the mitigation and adaptation strategies to reduce microplastic pollution and exposure. The essay will conclude with a summary of the main findings and recommendations for future research.
Keywords: microplastics, aquatic food, human health, plastic pollution, bioaccumulation, toxicity, sea food, mitigation

THE IMPORTANCE OF UNDERSTANDING MAQASHID SHARIA AS THE MAIN GOAL OF ISLAMIC LAW

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Abstract
This paper aims to explain maqashid sharia as the main goal of Islamic law by formulating the following questions: First, what is the definition of maqashid sharia? Second, how is the distribution of sharia maqashid based on their level of importance? Third, what is the purpose of maqashid sharia?. This paper uses a qualitative approach, because the data sources and research results are in library research, inductive data analysis, grounded theory (towards the direction of constructing theories based on data). Findings First, etymologically, maqashid sharia consists of two words, namely maqashid and sharia. Maqashid is the plural form of maqshad which means purpose, or intention. Sharia means the path to the spring, or you could say the path to the source of life. In the Koran, these two words are used to mean religion as a straight path ordained by Allah SWT for humans to follow in order to obtain salvation. Second, maqashid sharia is divided according to its level of importance in human life, consisting of three levels, namely: (1) Dharuriyah is the upholding of the benefits of religion from the world (2) Hajiyah is interpreted as fulfillment secondary needs or as a complement and support human life (3) Tahsiniyah is carrying out good habits and avoiding the bad according to what is known by reason healthy. Third, from the explanation above, it can be understood that basically the purpose of Allah SWT in enacting His laws is for the benefit of humans by maintaining the basic elements of life as mentioned above, namely: (1) Hifz al-Din or Maintaining Religion (2) Hifz al-Nafz or Guarding the Soul (3) Hifz al-'Aql or Maintaining Reason (4) Hifz al-Nasl or Protecting the Offspring (5) Hifz al-mal or Safeguarding Assets.
Keywords: Maqashid Sharia, Islamic Law, Islamic Economics

RESEARCH ARTICLE: ANALYTICAL METHOD DEVELOPMENT AND VALIDATION OF THIAZOLIDENEDIONES DERIVATIVE BY RP-HPLC

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Abstract
One of the compounds of the thiazolidenedione class has hypoglycemic properties. In order to manage type 2 diabetes mellitus, this is taken in addition to diet, exercise, and other antidiabetic drugs. By agonism at the Peroxisome Proliferator-activated receptor-gamma (PPARy), it exerts its pharmacological action. For the purpose of validating a derivative of thiazolidenedione, a straightforward, quick, precise, and accurate Reverse Phase High Performance Liquid Chromatographic Method has been set up. An Agilate column C18 (150 mm × 4.6) with a 5 micron filter, 0.7 ml/min flow rate, and 20 microns/ml injection was used for the separation. The UV detection was detected at 266 nm, and the constant temperature of the column was ambient. The following specifications are included in this - method: 0.1% OPA (68:32) of methanol, optimized based on observations. Included are Plates (5985) and RT (3.63). Following the development of the procedure, it was validated in accordance with ICH Q2 requirements. Validation yielded a linear result at 30.987 × -10.309, SD – 0.86, % RSD – <2, LOD – 0.091, LOQ – 0.278. The method was developed and validated hence the conclusion of this method is that it is more economical, exact, accurate, and time-saving.
Keywords: Thiazolidenediones, RP-HPLC, Validation, PPAR.

REVIEW ON: NEUROCOSMETICS: THE SKIN-BRAIN CONNECTION

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Abstract
The "modern" cosmetology sedulity emphasizes on studies on fresh neurocosmetics features that could boost the interactions between the nervous system and the skin. Several cosmetic organizations have started to create neurocosmetics that modify the skin's neuromediators in attempts to maintain influence over the cutaneous nerve system. Through several modes of operation. With an emphasis on the nonsupervisory side, this review seeks to elucidate the definition of neurocosmetics and outline the characteristics of a few useful components and items that are available upon request. This review has focused on the concept of neurocosmetics, demonstrating the significance of the ancient natural and medical interaction between skin and brain. An overview of the neuroscience impact focus on how they interact to the attractiveness of ornamental products.
Keywords: Neurocosmetics, Anti-Aging, Skin Care, Cosmetics.

HARNESSING DEXTRIN DERIVATIVES FOR TARGETED DRUG DELIVERY WITH NANOFIBERS

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Abstract
Due to the increasing prevalence of type 2 diabetes worldwide, there is an urgent need for effective and safe medications to treat the condition. Recently, a new medication called imeglimin was approved in Japan for treating type 2 diabetes patients. Imeglimin has shown promising abilities to lower glucose levels by improving insulin sensitivity in peripheral tissues and enhancing the activity of pancreatic beta cells. However, it has certain limitations, including gastrointestinal discomfort and poor absorption when taken orally. To overcome these limitations and provide a more convenient method of administration, a new formulation of imeglimin has been developed using fractionalized dextrin derivatives. This formulation was loaded onto electrospun nanofibers and intended to be administered through the buccal canal (inside the cheek). Various properties of the nanofibers were measured, including their diameter, drug-loading capacity, disintegration time, and release patterns. The results showed that the imeglimin nanofibers had an average diameter of 361 ± 54 nm and a drug-loading capacity of 23.5 ± 0.2 µg/mg of fibers. X-ray diffraction data confirmed that the solid dispersion of imeglimin in the nanofibers improved the drug's solubility and release, leading to increased bioavailability. The disintegration time of the drug-loaded nanofibers was measured at 2 ± 1 seconds, indicating that this dosage form is suitable for buccal administration and that the medication will be completely released within 30 minutes. Based on the findings of the study, it can be concluded that the produced imeglimin nanofibers can be administered buccally, offering improved patient compliance and potentially leading to better therapeutic outcomes.
Keywords: Drug, nanofibers, safe medications

A REVIEW ON MOUTH DISSOLVING TABLET

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Abstract
Scientists have long been drawn to the creation of elaborate oral medicament delivery systems as a strategy to increase patient compliance. Mouth dissolving medicament delivery systems (MDDDS) have grown to be one of them. Standing in the demand by resolving earlier supervisory issues And helping to extend the life of the patent. The distinctive character of MDDDS is that they Dissolve and release the medicine as soon as they come into contact with spit, closing out the need for water during administration. As a result, these lozenge forms have attracted a particular patient demographic to the demand, including dysphagic, bedridden, interior, older, and paediatric cases. Newly, a number of approaches have been created to enhance the fragile Lozenge forms capacity to disintegrate without losing their integrity. The available technologies And advancements are the main matters of this composition. Made therefore far in the subject of making Tablets that dissolve in the mouth. In addition to the traditional fabrication ways, this review discusses in depth a number of new patented technologies, including Zydis, Lyoc, Quicksolv, Orasolv, Durasolv, Flashtab, Oraquick, Wowtab, and Ziplet, along with its benefits And downsides.
Keywords: Mouth dissolving tablet (MDTs), super disintegrants, taste masking, Lyophillization, direct compression.

THE APPLICATION OF HERBAL EXTRACT-LOADED NANO-FORMULATIONS FOR PEST CONTROL IN AGRICULTURE: A REVIEW

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Abstract
The worldwide growth in population and the consequent need for food have compelled the optimisation of agricultural practises to avoid losses in the field. The intended outcome can be achieved by employing insecticides and pesticides. However, the extended use of these substances has generated notable environmental concerns over the emergence of resistance to insecticides and pesticides in plants, as well as the destruction of the ecosystem. As a result, a wide range of extremely harmful pesticides have been banned. However, the resolution of this matter might be efficiently tackled through the progression of various biological pest control agents. In recent times, there has been a notable surge in the adoption of nanotechnology in various sectors and areas of study, with a special emphasis on environmental and agricultural systems. Herbal extracts that demonstrate a wide range of efficacy against mosquitoes, including characteristics such as ovicidal, larvicidal, pupicidal, adulticidal, and repellent effects, offer promising alternatives to synthetic counterparts. However, the practical efficacy of these compounds is currently under examination due to their volatility and relatively lower efficiency in comparison to synthetic equivalents. In recent years, researchers have made efforts to tackle these concerns through the development of nano-formulations of botanical extracts. The usage of nanoparticles including herbal extracts has attracted considerable interest among scholars who seek to investigate and assess their potential toxicity against various insects and pests. The utilisation of various inorganic and organic nanoparticles loaded with herbal extract have proven to be an effective approach in the targeted control of various harmful arthropods, agricultural pests, and vectors. This is primarily due to their cost-effectiveness, widespread accessibility, and ease of production.
Keywords: Nanoparticle; Herbals; Pest Management; Nano-formulation; Agriculture

CHARACTERIZATION OF LACUNARY $\mathcal{I}$-CONVERGENT SEQUENCES IN CREDIBILITY SPACE

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Abstract
This research paper aims to introduce the concept of lacunary ideal Cauchy sequences of fuzzy variables in a credibility space. We establish the interrelationships between this notion with lacunary ideal convergent sequences in the same structure from several aspects of credibility. Also, we investigate the ideas of strongly lacunary Cauchy, strongly $\mathcal{I}$-lacunary Cauchy and strongly $\mathcal{I}$-lacunary Cauchy sequences of fuzzy variables in credibility and look into the relationship among them.
Keywords: $\mathcal{I}$-lacunary Cauchy, credibility space, characterization

OPTIMAL PREPARATION OF LOW-COST PHONGITIC CLAY MICROFILTRATION (MF) MEMBRANE FOR REAL-WASTEWATER TREATMENT FROM CLOTHES WASHING

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Abstract
The challenge of the scientific community is to synthesize innovative, low-cost, and environmentally friendly membrane materials for the treatment of industrial wastewater. The objective of this work is the elaboration and characterization of a new flat ceramic membrane

based on a natural Moroccan phengite clay by the paste casting method for microfiltration applications. The ceramic membrane was sintered from 850 °C to 1150 °C for 2 hours. The optimal membrane sintered at 1050 °C has a porosity of 34.5 %, an average pore diameter of 3.9 µm, water permeability of 43.50 L/h.m^2.bar, mechanical strength of 26.7 MPa, and excellent chemical corrosion resistance in acidic and basic media. The performance of the optimal membrane was evaluated by frontal microfiltration of the pre-treated real wastewater (RWW3) from a local clothes washing. The obtained results show that the removal percentage of electrical conductivity, total dissolved solids, and suspended matter is 66.2 %, 71.8 %, and 100 % respectively. The cost of preparing the ceramic membrane was estimated at 3.5 \$/m^2, which is cheaper compared to those commercially available. The high regeneration efficiency showed that demineralized water was able to adequately clean the fouled microfiltration membrane by 82 %. The obtained filtration results are very promising and could allow the use of the membrane prepared from a locally available material as an alternative process in the treatment of various sources of industrial wastewater.

Keywords: Cost estimation; Microfiltration membrane; Phengite clay; Real-wastewater; Regeneration.

ANTICANCER AGENT FROM MARINE SOURCE

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Abstract
Natural medicines have long been utilized to treat a wide range of medical issues. Many plant extracts are used in Ayurvedic therapy to cure cancer, according to the ancient medicinal philosophy. The marine environment is rich in biologically active substances that can be used to treat human ailments such as cancer. To thrive in their particular surroundings, marine organisms have developed pathways that differ from those of their terrestrial counterparts. This has enabled them to create a wide range of complicated molecules. In marine populations, new bioactive metabolites with a wide range of chemical configurations are stored. Terpenes, alkaloids, nucleosides, macrolides, polyketides, peptides, Beta-lactone, polysaccharide, polyphenolic, phenolic, and other chemical families are just a few examples of the many chemical families represented by marine-derived medications. These medications may inhibit the growth of human tumour cells both in vivo and in vitro, implying therapeutic usefulness. The marine environment provides a rich potential source of new cancer treatments. Marine compounds have been found to have antibacterial, anti-diabetic, anti-viral, anti-inflammatory, and even anticancer properties. The impact of marine animals is examined in detail, with a focus on marine plants, algae, mollucs, actinomycetes, fungi, sponges, and soft corals, as well as unique chemical structures and chemical property space. Finally, we discuss the treatment techniques' future directions and limitations, as well as the existing use of marine-derived components.
Keywords: Anticancer; Mollusk; Fungi; Nucleoside; Peptides; Antibacterial.

APPLICATION OF PID CONTROL IN GREENHOUSE TEMPERATURE REGULATION FOR CROP GROWTH OPTIMIZATION

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Abstract
This paper explores the application of PID (Proportional-Integral-Derivative) control systems in the context of greenhouse agriculture, focusing on the precise regulation of temperature to optimize crop growth and resource utilization. Greenhouse agriculture has become a cornerstone of modern crop cultivation, offering a controlled environment to safeguard and enhance plant development. Maintaining an optimal temperature within greenhouses is paramount, as temperature fluctuations can significantly impact crop growth. The paper highlights the role of PID control in achieving the precision required for effective greenhouse temperature management. PID control works in concert to minimize deviations from the desired temperature setpoints, ensuring stable and efficient climate control. This controller is designed to modulate heating system in response to temperature variations, ultimately maintaining the target temperature. The study reports the effectiveness of PID control in providing consistent and precise temperature regulation. This precise control benefits crop growth and reduces energy consumption, leading to more sustainable and efficient greenhouse operations. The paper also emphasizes the significance of fine-tuning the PID controller parameters, specifically the proportional, integral, and derivative gains. These adjustments are essential to adapt the system to different crops and varying environmental conditions, requiring ongoing monitoring and calibration. In conclusion, the study underscores the critical role of PID control systems in greenhouse agriculture for precise temperature regulation. This technology contributes to the advancement of controlled environment crop cultivation, improving crop quality and resource efficiency while offering economic viability and sustainability.
Keywords: PID, greenhouse, crop growth optimization

ANTICIPATING RISK MAPPING FOR LAND MOVEMENTS IN MOROCCO'S MIDDLE RIF REGION

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Abstract
The history of landslides in Morocco, particularly in the Central Rif region (between Al Jebha and Al Hoceïma), has witnessed serious incidents, including temporary road closures, such as the Regional Road N° 610 near the city of Kassita for several days during the Al-Hoceima earthquake of 2003, as well as during winter episodes marked by extreme rainfall, including a daily record of approximately 136 mm near National Route N° 16, close to the town of El Jebha. Given the high potential for ground movement in this area and in line with the Moroccan government's desire to promote the development of the Al Hoceima and El Jebha region through the establishment of new port, road, and railway transport infrastructures, as well as urbanization infrastructure like electrical and potable water networks, it is prudent to select, during the preliminary phase of technical studies, locations that are shielded from the risk of landslides. This approach aims to optimize the costly maintenance of these infrastructures throughout their operational lifespan. With this objective in mind, this article aims to create landslide risk maps in this study area. To do this, we conducted an inventory of the predominant surface soils and rocks, with their spatial representation in the form of geotechnical maps, which did not exist before this work. Furthermore, we combined these geotechnical maps with topographic contour lines to identify areas where soils with weak geotechnical characteristics intersect with steep topographic gradients. The aim of this work, as mentioned, is to delineate high-risk landslide areas.
Keywords: Slope instability, risk map, geotechnical design, Middle Rif Morocco

IDENTIFICATION OF *PASSALURUS AMBIGUUS* IN DOMESTIC RABBITS (*Oryctolagus cuniculus*) IN KARBALA PROVINCE, IRAQ

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Abstract
Commercial rabbit farming is primarily focused on the production of rabbit meat, although the presence of gastrointestinal disorders can impede their productivity. Endoparasites significantly contribute to the development of several diseases in rabbits, leading to higher rates of illness and death. *Passalurus ambiguus* is a widely distributed nematode that commonly infects the intestines of rabbits and hares. Parasitic disease can have a substantial economic impact on the industry by reducing the commercial value of rabbit meat and skins, impeding growth and development, and leading to mortality. This study aims to examine the frequency of gastrointestinal parasites in domestic rabbits that are bred in Karbala province, Iraq. Throughout the trial, fecal samples were collected from a randomly selected group of 48 live rabbits. The feces are collected directly from the anus of each living animal. The samples were tested and the presence of eggs and nematodes was detected in the infected samples. Upon testing, it was found that 16 out of 48 fecal samples, accounting for a prevalence of 33.33%, were infected with at least one nematode. Chi-square ($\chi 2$) statistics Age and genders are not statistically significant at P values ≥ 0.05. This study identified the presence of Passalurus ambiguus in rabbits of varying ages residing in Karbala region, Iraq, including both male and female domestic rabbits. Determining the age and gender of rabbits affected by passalurosis would enable the management of the infection level in these animals. Regular use of a consistent and dependable diagnostic method is essential in industrial rabbit farms to detect and monitor gastrointestinal parasite illnesses.
Keywords: *Passalurus ambiguous*, Pin worm, Rabbit, Iraq

IMPACT OF RURAL FINANCE INSTITUTION BUILDING PROGRAMME ON SOCIO-ECONOMIC LIFE OF BENEFICIARIES IN ANAMBRA STATE, NIGERIA

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Abstract
Rural Finance Institution Building Programme (RUFIN) was initiated to improve the socio-economic conditions of poor rural households. The study evaluated the impact of RUFIN on the socio-economic condition of the beneficiaries in Anambra State, Nigeria. Multi-stage, purposive and snowball sampling techniques were used to select 60 RUFIN beneficiaries (RB) and 60 Non-RUFIN beneficiaries (NRB) for the study. Data were collected using structured interview schedule. The average amount of loan obtained by RB was ₦67, 266.70, at an average payback period of one year. On the average, RB obtained loan once since programme inception. Sex and years of farming experience significantly ($p \leq 0.05$) influenced the amount of loan obtained while age, significantly ($p \leq 0.05$) influenced the numbers obtained. Beneficiaries were better-off than NRB; though not significantly ($p > 0.05$). Non-beneficiaries were significantly ($p \leq 0.05$) better than RB in the number of poultry owned and total annual income from farm. The study revealed relevant information on programme impact which could be of help to programme evaluators, policy makers and programme executors on more innovative and creative ways to pilot programmes in such that expected programme goals are birthed rightly
Keywords: Anambra State, Impact evaluation, rural farmers, rural finance, socioeconomic life.

DEVELOPMENT OF VALIDATED RP-HPLC METHOD FOR QUANTITATIVE ESTIMATION OF PIOGLITAZONE HCL IN BULK AND FORMULATION BY USING QUALITY BY DESIGN APPROACH

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Abstract
The current study attempts to quantify pioglitazone using a chromatographic approach with assistance from quality by design (QbD). Analytical QbD was instigated with the assignment of an analytical target profile (ATP) and critical analytical attributes (CAAS). Risk assessment studies and factor screening studies facilitate to identification the critical method parameters (CMPS). Optimization was performed by employing Box Behnken design using identified CMPS i.e., Mobile phase composition (X1), flow rate (X2) and wavelength (X3) at three different levels and evaluating selected CAA i.e., retention time (Y1), peak area (Y2), tailing factor(Y3) and Plate count(Y4). The individual and interactive influence of CMPS on CAAS was tested by statistical data and response surface plots. Analysis of variance (ANOVA) confirmed that method parameters are significant ($P < 0.05$).The chromatographic separation was achieved on the C_{18} column using mobile phase consisting of mixture of 0.02m potassium dihydrogen phosphate buffer and Acetonitrile in ratio of 25:75 The detection was carried out at 269nm with flow rate of 1ml/min. The retention time for pioglitazone hydrochloride 3.9 was found minutes respectively. The calibration curve was found linear ($r^2 = 0.991$) for RP- HPLC method. The proposed method successfully demonstrated QbD based approach for the development of highly sensitive, reliable, and suitable for routine analysis, and clinical applications.
Keyword: Analytical method, quality by design, DoE, Box-Behnken, ATP, pioglitazone hydrochloride

UNVEILING THE IMPACT OF MAD41 OVEREXPRESSION ON MYCORRHIZAL SYMBIOSIS IN COMMON BEAN

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Abstract
The MADS-box family encompasses transcription factors that play crucial roles in various facets of plant growth, including vegetative growth, root maturation, floral organogenesis, and responsiveness to environmental stimuli. However, the specific involvement of MADS-box genes in legume-mycorrhizal symbiosis remains elusive. Our prior RNA-seq analyses have unveiled the upregulation of the MICK-type MAD41 gene specifically during mycorrhizal symbiosis. In this investigation, we acquired the complete coding sequences (CDs) of MAD41 from *Phaseolus vulgaris* (common bean) root cDNA and conducted overexpression by inserting it into the binary vector pH7WG2D. The resultant construct, designated as *PvMAD41*-OE, was subsequently introduced into *Agrobacterium rhizogenes* K599 to generate transgenic hairy roots. An empty vector was utilized as the control. Transgenic roots were identified and selected using a fluorescent stereomicroscope based on the YFP marker. The roots overexpressing *PvMAD41* displayed heightened lateral root density and an increased count of tertiary roots in comparison to the control. In mycorrhizal conditions, the *PvMAD41*-OE roots exhibited significantly elevated infection units and a greater proportion of mycorrhizal colonization. Additionally, there was a conspicuous surge in vesicle numbers in the overexpressed roots relative to the controls. The overexpression of *MAD41* led to a substantial augmentation in lateral root volume and enhanced mycorrhizal colonization, signifying that MAD41 augments fungal symbiosis in the cultivated legume, *P. vulgaris*. We express our gratitude to PAPIIT-UNAM for partially funding this research through grant no. IN216321 to K.N and IN213221 to M.K.A.
Keywords: MICK-MADS Box, Phaseolus vulgaris, mycorrhizal symbiosis

LONG NON CODING RNAs (lncRNAs) IN NEURODEGENERATIVE DISEASES-DIAGNOSIS AND THERAPEUTICS

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Abstract
RNA molecules longer than 200 nucleotides, known as long-non-coding rnas (lncrnas), are involved in a multitude of biological processes and an increasing number of diseases. They regulate gene transcription, pre-mrna processing, the transport of mature mrnas to distinct cellular compartments, mrna stability, and protein translation and turnover. Neurodegenerative diseases (ndds) are progressive and eventually lethal conditions that include Alzheimer's disease (AD), Parkinson's disease (PD), and Huntington's disease (HD). Environmental signals and heredity are two elements that affect the start of NDD. New research reveals the critical roles lncrnas play in the development of neurological disorders, such as ndds. In the future, an enhanced comprehension of the diagnosis methods for diseases.
Keywords: Non coding RNA, Mrna stability, Parkinson disease, neurological disorder, alzheimer’s diseases, hungtington’s diseases

microRNAs – BIOGENESIS, MECHANISM OF ACTION AND ROLE IN BREAST CANCER – OVERVIEW

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Abstract
In eukaryotes, microRNAs [microRNAs] are non-coding single-stranded RNAs that play a role in controlling the post-transcriptional expression of particular genes. When microRNA assembles into RISC, the complex is activated to target the messenger RNA [mRNA] that the microRNA has designated. Numerous models for RISC assembly have been put forth, and studies on the process of RISC loading and activation are still ongoing. Virtually operating at the post-transcriptional level, microRNAs attach to their target messenger RNA's 3′ UTR to inhibit expression. Research has indicated that miRNAs are significant regulators of various physiological processes, including cell division, proliferation, and embryonic development. Clinical data suggests that some miRNAs, whose expression in cancer is markedly elevated or decreased, can be employed as prognostic and diagnostic biomarkers for breast cancer.
Keywords: microRNAs, post- transcriptional, RISC, embryonic development, biomarkers, breast cancer

BIRD DIVERSITY AND FEED GUILD IN THE WAY KAMBAS NATIONAL PARK BUFFER ZONE (CASE STUDY OF LABUHAN RATU VII VILLAGE)

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Abstract
Buffer zone is interpreted as a supporting area that has the main function to protect the national park area from various forms of pressure and disturbance both from within or outside the area. The buffer zone function also supports the national park in maintaining biodiversity, one of which is bird diversity. The purpose of this study was to analyze the level of bird species diversity in Labuhan Ratu VII Village based on the Shannon-Wienner species diversity index (*Diversity Index*), the evenness index, and the dominance index. Sampling was done by dividing the observation points based on three habitats, namely gardens, yards and rice fields. The method in this study is point count with one observation point in each habitat. Observations were made in the morning at 06.00-09.30 WIB and in the afternoon at 14.30-18.00 WIB, then analyzed with the Shannon-Wienner species diversity index (Diversity Index), the evenness index, and the dominance index. The results showed there were a total of 42 bird species with a total of 462 individuals. H' in the garden habitat type was 2.23, yard 2.42, and rice field 2.89. J in the garden habitat type was 0.8, yard 0.9, and rice field 0.8. Meanwhile, D in the garden habitat type is 0.2, 0.1 in the yard, and 0.1 in the rice field. Bird feeding guilds based on field findings were grouped into 7 types dominated by insectivore (31%). piscivore (19%), granivore (17%), omnivore (14%), frugivore (7%), carnivore (7%), and nectarivore (5%). This research on bird diversity and food groups can support bird conservation in labuhan ratu VII village as a buffer zone.
Keywords: birds, habitat, feed guild, buffer zone, Labuhan Ratu VII.

BIOSORPTION OF NI^{2+} AND PB^{2+} FROM WASTE WATER USING DOUM PALM NUT SHELL ACTIVATED CARBON

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Abstract
The search for cheaper and environmentally friendly methods of waste treatment using natural products has taken a central stage in the recent past. Doum palm nutshell activated carbon (DPSAC) was investigated with a view of using it as a low cost biosorbent for the removal of toxic heavy metals from wastewater. The activated carbon was prepared from raw doum palm nutshell which was used for the adsorption of Ni^{2+} and Pb^{2+}. The effect of contact time, adsorbent dosage and pH of solution were studied by batch adsorption experiment, in which maximum removal of Ni^{2+} was recorded at 50min and maximum removal of Pb^{2+} was recorded at 30min of contact time. Contact of Ni^{2+} with 0.5g of DPSAC adsorbent, there is 99.87% maximum adsorption capacity while Pb^{2+} with 0.6g of DPSAC adsorbent, there is 99.81% maximum adsorption capacity. The amount of metal ion adsorbed was optimum at solution pH of 9 of both the two metal ions.
Keywords: biosorption, waste water, nutshell, and activated carbon

REVIEW ON: TO STUDY THE PHARMACOGNOSTIC AND PHARMACOLOGICAL ACTIVITIES OF *DATURA STRAMONIUM LINN.*

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Abstract
To study the Pharmacognostic and pharmacological activities of datura (Datura stramonium).The world Health Organization estimates that 4 billion people 80% of the world Population presently use herbal medicine for some aspect of primary health care. Datura, a genus of medicinal herb from the Solanaceae Family, is credited with toxic as well as medicinal properties. The different plant part of Datura species, mainly D. Stramonium L. Datura stramonium contain biologically Active Substance like, Atropine, sropolamine, tannin, carbohydrate and protein. The plant show various types of activities such as Antiperspirant activity, Antiasthmatic activity, Antimicrobial Activity, Antidiabetic effect. The preliminary phytochemical investigation was performed on methanolic and hydroalcoholic extract of Datura fastuosa dried seeds revealed the presence of alkaloids, tannins, cardiac glycosides, flavonoids, Carbohydrates, amino acids and phenolic compounds. Datura spp. has also been used against animal bites such as snake bites, which helps relieve pain.
Keywords: Datura stramonium, L.datura, Pharmacological property, Natural products etc.

REVIEW ON: PHARMACOLOGICAL ACTIVITY OF *Selaginella bryopteris L.*

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Abstract
In the form of Ayurveda, India has a long history of herbal treatment and traditional wisdom. *Selaginella bryopteris* is a used in Ayurvedic system of India. *Selaginella bryopteris L*. is also known as “Sanjeevani booti” is a plant with a literal definition of “something that offers life” (jeeva =life) it is renowned for its extraordinary capacity for renaissance. According to the classic Hindu epic Ramayana, medications made from this herb are even thought to be able to bring the dead back to life. According to the traditional Chinese medicine, the liver, stomach and lung meridians are connected to selaginella. In that to study the different chemical constitunts like alkaloids, steroids, phenol, tannin, saponin, etc. These properties can be effectively exploited to prepare novel drugs with antibacterial, anticancer, antifungal and antiviral activities also used in cosmetic industries. It also work as antioxidant and antiinflammatory agents. It shows some pharmacological Actions in that antihyperglycaemic activity, growth promoting activity, antistress cell death, antiprotozoal activity, antibacterial activity, etc. In that to follow the plants collection and extract preparation material and Method.
Keywords: Selaginella bryopteris L, Selaginellaceae, Sanjeevani, Lycopodium bryopteris L.

KNOWLEDGE OF FARMERS ON PESTICIDE SAFETY PRACTICES IN NSUKKA LOCAL GOVERNMENT AREA, ENUGU STATE, NIGERIA

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Abstract
The study assessed knowledge of farmers on pesticide safety practices in Nsukka local government area, Enugu State, Nigeria. Multistage sampling procedure was used to select four town communities, eight villages, and eighty farmers for the study. Data was collected using structured interview schedule, analyzed with SPSS and presented in percentage and mean score. Result revealed that majority (90%) of the respondents applies pesticides in the morning and 80% use knapsack sprayer for pesticide application. Also, findings indicated that the perceived health effects of the pesticides on farmers were: skin damage ($\bar{x} = 2.79$), irritation on the skin ($\bar{x} = 2.78$) and eye irritation ($\bar{x} = 2.71$). Furthermore, finding showed that majority (90%) of the respondent had high knowledge of pesticide safety practices. Moreover, result indicated that constraints faced by the farmers in adhering to pesticides safety precaution were: lack of money to buy material ($\bar{x} = 3.44$), high cost purchasing personal protective equipment ($\bar{x} = 3.36$) among others. Finally, result revealed that possible strategies that can be employed to improve farmers' safety practices on pesticide use were: free provision of protective materials ($\bar{x} = 3.49$), subsidization of price of protective equipments ($\bar{x} = 3.48$) among others. The study concluded that farmers had good knowledge of pesticides safety application practices on their farm but poverty hindered them from getting necessary protective materials. Thus, government should provide the farmers with personal protective equipments or subsidize prices of the protective materials to enable the farmers procure and use them while applying pesticides.
Keywords: Pesticide, safety practices, irritation, protective equipment

THE FUTURE OF AGRICULTURE: UNLEASHING THE POTENTIAL OF DIGITAL TECHNOLOGIES

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Abstract
There will be 9.7 billion people on the earth by 2050, resulting in an exponential increase in the need for food. Agriculture, despite its importance, confronts a number of challenges. Farmers must address growing environmental issues while also determining how to produce more food with fewer resources. Fortunately, digital technologies are revolutionizing agriculture. From big data analytics and artificial intelligence to precision farming and smart irrigation systems, these technologies have immense potential to transform the industry. This review will address the application of digital technology in agriculture to increase crop yields, reduce resource consumption, reduce environmental impact, and improve food security.
Keywords: Introduction, Role of digital technologies, Precision agriculture, The rise of smart farming, AI and MI in agriculture, use of drones and robotics in farming operations, Data analytics and predictive modelling, overcoming challenges and barriers in digital adoption, conclusion.

GROUNDWATER QUALITY ASSESSMENT IN RURAL AREA OF RANCHI: A CASE STUDY

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Abstract
The continuous deterioration in the quality of drinking water sources has raised serious concern over human health. The precariousness of the rural population in Ranchi district is often symbolized by the lack of safe drinking water. The study investigates the physico-chemical and bacteriological characteristics of water samples collected from the boreholes of different rural area of Ranchi district. The different methods/instruments are used to analyze the physical parameters whereas IS: 3025 methods of sampling use to analyze the chemical parameters for different water samples. The water quality index (WQI) tools are used to assess the overall water quality with different water samples in rural area of Ranchi. Furthermore, to obtain the potential control over groundwater reservoir compare the obtained results with BIS permissible limit and found some of the physical, chemical, heavy metal and micro bacteriological parameter exists within the international standard ranges and some are extended from the ranges. The results are shows that a potential control over in groundwater reservoir by inefficiently exploiting by the selective withdrawal structures.
Keywords: Water Quality Index, Rural Area, Groundwater, Physico-Chemical, Assessment

NEW AGRICULTURE TECHNOLOGY IN MODERN FARMING - A REVIEW

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Abstract
In contemporary agriculture, innovation is more crucial than ever. Massive obstacles confront the industry as a whole, ranging from shifting consumer preferences for sustainability and transparency to increased labor costs and supply-side constraints. Corporations involved in agriculture are beginning to realize that these problems require quick fixes. Agtech, or agricultural technology, is another name for it.This novel idea pertains to the application of technology in contemporary farming and agricultural methods to boost yield, sustainability, and efficiency in food production. It encompasses a wide range of technological fields, including automation, biotechnology, smart irrigation, and precision agriculture. Significant technological advances have also been made in fields like blockchain, artificial intelligence, indoor vertical farming, livestock technology, and contemporary greenhouse practices. And the most valuable are the contemporary farming technologies.
Keywords: agtech ,modern farming, smart irrigation,blockchain, agriculture technology

FORMULATION AND EVALUATION OF ANTI AGEING CREAM USING *Tınospora cordıfolıa* (GILOY)

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Abstract
The skin care preparations has grown phenomenally over the years. People utilize a range of skin care preparations, from mouth wash, from lipsticks to complexion creams to foot powders and so on, in the hope of developing a charming personality, protecting their bodies and avoiding bad smell. Skin care preparations are described as substances that are intended to be rubbed, poured, sprinkled and sprayed on or, introduced into or otherwise applied to human body or any part of body, for cleansing, beautifying, promoting attractiveness or altering the appearance of skin. In this study cream was formulated based on the anti-aging potential of herbal extracts and its evaluation. Tinospora cordifolia stem were shade, dried, grind using mechanical grinder and extracted by using soxhlet method with different solvents such as methanol and acetone. The cream was formulated with neem leaves extract, giloy extract and rose oil with different concentrations namely F1 to F3. The cream was found to be stable during stability studies accordingly ICH guidelines 30± 2°C / 50±5% RH and 40±2°C / 75±5% RH for 2 months. The real time for stability was 12 months. It can be concluded that herbal creams without side effects having anti-aging property can be used as provision of a barrier to protect the skin and avoid aging of the skin. The cream was evaluated for various evaluation parameters such as color, odour, consistency, pH, viscosity, homogeneity, irritancy and spreadability. The giloy extract was subjected to qualitative phytochemical screening for detecting the presence of various phytochemicals. The formulated cream gave satisfactory and good results for all evaluation parameters. As this formulation contains various herbal ingredients it does not produce any harmful action on skin, it is non-irritant and is reliable.
Keywords: *Tınospora Cordıfolıa*, skin, anti ageing cream

ISLAMIC ECONOMIC PRINCIPLES AND THEIR IMPLEMENTATION IN EVERYDAY LIFE

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Abstract
This paper aims to explain the principles of Islamic economics by formulating the following questions: First, What are the principles of Islamic economics? Second, How is the application of the principles of Islamic economics in everyday life?. This paper uses a qualitative approach, because data sources and research results in library research, inductive data analysis, grounded theory (towards the direction of theory building based on data). Findings First, the principles of Islamic economics include: (1) Control of individual property (2) Income distribution is done inclusively (3) Prohibition of usury (4) Prohibition of maysir or gambling (5) Infaq, sadaqah, and waqf (6) Multi-type ownership (7) Freedom of action or business (8) Social justice. Second, the implementation of Islamic economic principles in everyday life, namely: (1) Control of individual property is by keeping individual property from being used excessively or uselessly. An example of its application is avoiding waste and considering needs before buying goods. (2) Income distribution is carried out inclusively, namely keeping income distributed fairly and evenly. An example of its application is giving zakat and alms to people in need. (3) Prohibition of usury, namely usury or interest is forbidden in Islamic economics. An example of its application is avoiding loans with interest and choosing financial products that comply with sharia principles. (4) Prohibition of maysir or gambling: Gambling activities are forbidden in Islamic economics. An example of its application is avoiding gambling and choosing investments that are in accordance with sharia principles. (5) Infaq, sadaqah, and waqf: Providing donations to people in need and strengthening the economy of the ummah. An example of its application is giving infaq, sadaqah, and waqf to institutions or people in need.
Keywords: Principles, Islamic Economics, Implementation of Islamic economic principles.

A REVIEW OF THE IMPORTANCE OF HYDROPONIC CULTIVATION IN PLANTS

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Abstract
With the rapid increase in world population and the reduction of arable land due to urbanization, people are turning to new technologies such as hydroponics or soilless agriculture. This method of growing without soil uses nutrient solutions to feed plants in water and in the absence of soil. Hydroponics has the potential to sustain a large portion of the world's population and allow third world countries to feed their people, even in places where soil is less fertile and water is limited. This technology can also be used as a valuable source for food production in places where space is scarce. In hydroponics, non-soil culture medium can be used for mechanical support of the roots, which supports the weight of the plant and keeps it vertical. All over the world, the trend of population growth is increasing significantly. Since half of the world's population lives in urban and semi-urban areas, consumption patterns for food have changed. Due to the limitations of water resources and the lowering of soil quality, the production of agricultural products and food resources for supply the needs of the growing population of the world requires the use of new and efficient methods and solutions to produce more and with better quality. Therefore, different countries are trying to provide the basic needs of their society (food) by growing, developing and reaching maximum technology, industry and agriculture, while being self-sufficient. One of the effective methods in this field is the production and cultivation of plants by hydroponic method. It is probably one of the best ways to grow crops today because it allows for the optimal use of nutrient solution, water and space, as well as better control of climate factors and plant protection. Hydroponic technology can be an efficient way to produce food from extreme environmental ecosystems such as deserts, mountainous areas or even polar communities. In addition, hydroponic production increases the quality of products and its productivity, which leads to higher competitiveness and economic income. Various types hydroponic systems can be used to grow crops.
Keywords: Hydroponic method, Soilless agriculture, Nutrient solutions, Non-soil culture medium, Modern crop farming

NOVEL MUTATIONS IN LDTB, PONA1, AND PONA2 IN PYRAZINAMIDE RESISTANCE CLINICAL ISOLATES OF *MYCOBACTERIUM TUBERCULOSIS*

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Abstract
Peptidoglycan (PG) is a complex and critical bacterial cell wall component. The PG synthesis in the human pathogen Mycobacterium tuberculosis (Mtb) is mainly carried by major PG synthetic enzymes LdtB, PonA1, and PonA2. These are essential genes required for Mtb growth and are also involved in drug resistance. The current study aims to screen mutations in *ponA1*, *ponA2*, and *ldtB* using whole genome sequencing (WGS). TB suspect samples were cultured, followed by PZA drug susceptibility testing. Five PZA-resistance Mtb isolates were subjected to WGS to screen mutations in PncA and their associations with LdtB, PonA1, and PonA2. Similarly, 289 drug-resistance WGS were also re-trieved from NCBI for screening mutations in LdtB, PonA1, and PonA2. Among five PZA-resistance WGS, three were completely sequenced. The WGS data were submitted to NCBI under BioProject Accession No: PRJNA629298, PRJNA629388. Nine different mutations, including two novel inser-tions, have been detected in all three samples in PonA1 and PonA2. Among 289, 32 novel mutations have been seen in PonA1, PonA2, and, LdtB proteins. Seven mutations, including two synonymous, have been detected in PonA1. Sixteen mutations were present in PonA2, including five synonymous and seven non-synonymous in LdtB. All seven novel mutations in LdtB were clustered at amino acid positions 48 to 65 except A257S. A48E was detected in three different genomic isolates, and D68E was present in two different isolates. None of the PZA-resistance PonA1, PonA2, and LdtB mutations were seen in 289 WGS retrieved from the NCBI. All the PZA-resistance mutations were unique except Pro631Ser, reported in the earlier study. Two novel insertions, CCGCCT and CGT, have been detected at positions 55543 and 55553 and in two samples (Ba-4, Ba-9). The frequency and novelty of mutations in PZA resistance isolates were high compared to the other genomic isolates. To our knowledge, this is the first comprehensive investigation to screen mutations in major PG synthetic enzymes, PonA1, PonA2, and LdtB. Mutation impacts these proteins, affecting their flexibility and

stability, showing a drug-resistance mechanism that may impact innovative drug development. Therefore, before devel-oping novel drugs against these essential enzymes, mutational data may be considered for potential antimicrobials. The current study provides useful information for better understanding the PZA-resistance and mutations in other essential targets of Mtb isolates in high-burden countries, including China and Pakistan.
Keywords: *Mycobacterium Tuberculosis*, Pakistan, PZA-resistance

SYNTHESIS AND ANTISEIZURE POTENTIAL OF 1,3,4-OXADIAZOLE BASED DERIVATIVES

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Abstract
In present work, a series of novel structural hybrids of 1,3,4-oxadiazole and carbamothioate was designed by chemical modification of 2-(4-isobutylphenyl)propanoic acid. Target compounds (**7a-f**) were synthesized in significant yields (84–88 %) by coupling compound (**4**) with different electrophiles under different reaction conditions. The structures of oxadiazole based carbamothionate derivatives were confirmed by spectroscopic (FTIR, 1H NMR, 13C NMR) and physiochemical methods. During *in-vivo* experimentation, all synthesized compounds were tested through 6 Hz (32 mA) and PTZ (80 mg/kg) mouse seizure models. The **7b** and **7c** showed significant outcomes ($P < 0.05$) in terms of seizure severity, protection and mortality. The behavioural outcomes of PTZ tests were further strengthened with video-electroencephalogram (vEEG) findings in which EEGs were analyzed for epileptic spikes to understand the impact of **7b** and **7c** treatment on these ictal activities. The **7b** was found most efficient in reducing the seizure spiking activity in brains of PTZ-treated mice while both **7b** and **7c** significantly reduced overall PTZ-induced seizure severity. The molecular docking studies also predicted the BBB permeability, reduced binding energies and good compound interaction with GABAA receptors and SV2A protein. Therefore, the observed pharmacological outcomes might be attributed to the GABAA agonistic and SV2A modulating potential of these oxadiazole-carbamothioate hybrid compounds
Keywords: Epilepsy, 1,3,4-oxadiazole, Electroencephalogram, Seizure

COMPARISON OF THE VOLATILE COMPOUNDS OF ESSENTIAL OIL EXTRACTED FROM PISTACIA LENTISCUS STEMS VIA HYDRODISTILLATION, AND MICROWAVE AND THEIR EFFECTS ON ITS ANTIOXIDANT, AND ANTIFUNGAL ACTIVITY

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Abstract
The essential oil of Pistacia Lentiscus, which is an aromatic and medicinal plant, has been used traditionally to improve varicose veins and heavy legs, congestion, and venous stasis, as well as external and internal hemorrhoids. Due to their physicochemical properties that are very interesting, the knowledge of the extraction method allows to have a high yield, to extract the maximum possible volatile compounds, to be fast, easy, economical, easy to maintain, and that does not have a dangerous on the environment is something that must be taken into consideration. To improve the effectiveness of the extraction method, we evaluate the effect of Hydrodistillation (HD) as an ancient method, and Microwaves assisted extraction (MAE) as a novel process of extraction on the chemical composition, antioxidant, and antifungal activity of essential oil extracted from Pistacia Lentiscus stems.
Keywords: Pistacia Lentiscus; volatile compounds; antioxidant activity; antibacterial activity.

OPTIMIZATION OF QUICKLIME PRODUCTION FROM EGGSHELLS USING RESPONSE SURFACE METHODOLOGY

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Abstract
This study developed empirical response surface models for optimizing the quicklime characteristics. The calcination process parameters evaluated were calcination temperature, calcination time, and eggshell particle size. Two process models were successfully developed and validated for RSM models. The modelling validation runs were within the 95% prediction interval of the developed models and their residual errors compared to the predicted values were less than 5%. Results from this study shows that the significant parameters that influenced the quicklime yield and reactivity are calcination temperature, calcination time and eggshell particle size. The RSM approach shows that a compromised setting of calcination temperature of 945.91^{o}C and calcination time of 180.82 min will produce quicklime of optimal yield of 99.6608 % and optimum level of calcination time of 210 min and calcination temperature of 895.03^{o}C produced optimum quicklime reactivity of 0.467835^{o}C/s. The RSM models developed in this study can be used in the quicklime production industries to find the settings of the calcination process that will maximize quicklime quantity and quality. This will reduce the downtime encountered by industries having problems caused by variation in the quality of purchased quicklime.
Keywords: eggshell, RSM approach, quantity

DETERMINATION OF TOTAL PHENOLIC, TOTAL FLAVONOID CONTENT, AND ANTIOXIDANT ACTIVITY IN BASIL EXTRACTS (OCIMUM BASILICUM L).

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Abstract
Antioxidants play a crucial role in preserving the quality of vegetable oils by preventing lipid oxidation. Basil (Ocimum basilicum) is an aromatic plant rich in bioactive compounds, some of which have shown promising antioxidant properties. This study focuses on evaluating the potential of basil extracts as natural antioxidants. Dried basil leaves were subjected to extraction using various solvents to isolate the active compounds. The obtained extracts were then assessed for their antiradical and antioxidant capacity using the DPPH (2,2-diphenyl-1-picrylhydrazyl) method and the malondialdehyde (MDA) assays. The crude extract with the highest antioxidant activity was chosen for the analysis of its flavonoid and polyphenol composition. Our results demonstrate that the crude basil extract exhibits strong antiradical activity. In conclusion, basil extract could be considered as a valuable source of natural antioxidants for stabilizing edible fats.
Keywords: Basil; Ocimum basilicum L.; Antioxidant activity; Oxidative stabilization; Soya oil.

EFFECTS OF HORMOPRIMING WITH CYTOKININS ON THE GERMINATION OF *Solanum lycopersicum* CV. IDEAL

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Özet
Although the New World crop *Solanum lycopersicum* L is grown by the Bulgarian farmers for about couple of centuries it gradually became the most consumed vegetable by the Bulgarians. And in XX-th century Bulgaria got among top world producers of this crop. Because of such importance the tomatoes became object to breeding efforts to improve local adaptation and traits. Among the results of these efforts is the cv. Ideal, which is one of the most widespread varieties in cultivation in the country. The cultivar has remarkable balance of good yield combined with great nutritive values and memorable deliciousness and aroma of the fruits which won the appreciation of the notoriously demanding local consumers and growers of this crop. Because of this locally it is grown under diverse environmental conditions and scenarios, which sometimes aren't very optimal for the plant. From research with other crops it is known that priming with some plant growth regulators can have positive effects on the plant development under normal and stressful conditions. Therefore as aim of the present study was set to explore the effects of some plant growth regulators with cytokinin action, on the early stages of the development and some important for the growers and farmers parameters, since the early stages of the plant ontogenesis are one of most crucial ones for the long term survival, growth and yield for the crop. The results revealed that there is significant improvement of the germination start compared with the non-treated controls with all tested plant growth regulators. However, the results from the other parameters may have different trends depending on the application scenario of the used plant growth regulators.
Keywords: *Solanum lycopersicum,* cv. Ideal, cytokinin, hormopriming, hormone

EXPLORING THE INTUITIVE IMPACT OF OPTIMIZATION TECHNIQUES ON THE CONTROL OF FOOD SECURITY AND AGRICULTURAL PROFIT MARGINS

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Abstract
This research aims to investigate the intuitive impact of optimization techniques on the control of food security and agricultural profit margins. In a world facing the challenges of increasing population, climate change, and resource scarcity, the agricultural sector plays a pivotal role in ensuring food security and sustainable profit margins. Optimization techniques, including precision agriculture, supply chain management, and data analytics, have the potential to enhance productivity and efficiency within the agricultural sector. This study seeks to evaluate how these optimization techniques influence food security by ensuring a stable food supply and profitability by maximizing agricultural profit margins. Through a comprehensive analysis of relevant literature, case studies, and expert interviews, this research will provide insights into the intuitive impact of optimization techniques on the agriculture industry and how they can contribute to global food security and economic sustainability. The suggested model was implemented on two rice farms located in the North Central region of Nigeria. In both regions, the optimal production strategy resulted in higher gross returns, reduced fertilizer usage, and decreased irrigation water consumption compared to the current production approach.
Keywords: optimization techniques, food security, agricultural profit margins, precision agriculture, supply chain management, data analytics, sustainability, productivity, agricultural sector, climate change.

MEDIA LITERACY AND AGRICULTURAL SUSTAINABILITY: EMPOWERING RURAL COMMUNITIES THROUGH COMMUNICATION EDUCATION

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Abstract
Media literacy is essential in today's information-rich world to close the information gap between rural and urban communities. Gaining media literacy skills for rural communities is essential to ensure informed involvement in decision-making processes and the viability of sustainable agricultural practices, especially when the agriculture and rural development sectors confront many obstacles. This study's main goal is to evaluate how media literacy initiatives affect rural communities' capacity for productive dialogue in the context of agriculture. It aims to comprehend how communication education gives rural people the abilities to obtain, assess, and make use of media information for their own advantage. This research is guided by a theoretical framework based on media literacy models and communication theory, which highlights the contribution of media education to improving communication competence and decision-making in rural areas. The use of focus groups, in-depth interviews, and content analysis of media literacy courses has been made. According to research, teaching media literacy improves rural populations' access to and comprehension of information, which encourages them to take an active role in agricultural decision-making and embrace sustainable practices. The results of this study highlight the value of media literacy as a strategy for rural empowerment, making sure that information and knowledge about agriculture are available, understandable, and efficiently utilized by rural populations. The discussion part explores media literacy's effects on information sharing, rural development, and its ability to help solve issues like sustainable agriculture and food security. This study concludes by recommending the inclusion of media literacy initiatives in rural education and development projects. It suggests working together with stakeholders and legislators to incorporate media literacy into rural education programs so that rural populations have access to the communication skills required for rural development and sustainable agriculture.
Keywords: Agricultural Sustainability, Communication Education, Empowerment, Media Literacy, Rural Communities, Sustainable Agriculture.

WILD EDIBLE MUSHROOMS AND THEIR BIOACTIVE COMPOUND PRODUCTION POSSESS ANTIBACTERIAL ACTIVITY

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Abstract
A vast range of bioactive chemicals, including polysaccharides, peptides, glycoproteins, triterpenoids, lipids, and their derivatives, are produced by wild edible mushrooms, which have a high nutritional value and have been consumed by people from all over the world. There is a critical need to find alternative approaches to combating multidrug-resistant diseases because of the dramatically rising number of these pathogens in the world. Free radicals, oxidative stress, and a number of diseases are also caused by eating unhealthily, being exposed to UV light, and other environmental factors. As a result, the wild edible mushroom may be a novel source of antibacterial potential and has antioxidant qualities that are important for avoiding a variety of ailments. The antibacterial and antioxidant capabilities of wild edible mushrooms and the generation of their bioactive compounds are the main topics of this book chapter.
Keywords: Mushroom, Antibacterial, Environmental factors, Peptides, Multidrug-resistant diseases

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STUDIES ON THE PERFORMANCE OF ORGANIC AND INORGANIC FERTILIZER ON THE GROWTH AND YIELD OF CUCUMBER (*Cucumis Sativus*)

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Abstract
Cucumis sativus is a widely and popularly cultivated plant in the gourd (Cumbitaceae) family. It is a creeping vine that bears cucumiform fruits, commonly used as vegetables in the household meals and restaurants. This study assessed the effect of organic and inorganic fertilizers in the growth and yields of cucumber (Cucumis Sativus). The research study was conducted in the school farm of Lagos State University of Education Department of Agriculture, Otto/Ijanikin, Nigeria. The seeds of Cucumis Sativus were locally sourced and planted directly on prepared seed beds for the study. The planting was laid out in a randomized complete block design (PCBC), replicated three times in split plot arrangement. Four days after planting 600g/m^2, 800g/m^2, 1000g/m^2 poultry manure was applied. Similarly, 100g/m^2, 150g/m^2, 200g/m^2 of NPK was also applied and a control experiment was set. After four weeks of germination, parameters of plant height, number of leaves, stem girth, plant yields and vigour were studied and vigor were studied and analysed. Using Analysis Of Variance (ANOVA). The result of the analyses indicated significance difference among the treatment. According to the parameter studied ($P< 0.05$), Highest plant height of 33cm was recorded with 1000g/m^2 for treatment and control 11.5cm; highest number of leaves recorded 500g/m^2, control 1000g/m^2; stem girth, 1.8cm recorded with 800g/m^2 and control 0.58; excellent vigour was produced by the 600g/m^2, the lowest vigour at 100g/m^2. The best plant yield was recorded with 1000g/m^2 compared to control which had the least performance. 1000g/m^2 NPK had the highest plant height of 20.5cm; lowest plant height 13cm recorded with 200g/m^2 while the control had 11.5cm. the study revealed that application of poultry manure in the propagation of Cucumis Sativus remarkably influenced the growth and yield of cucumber.
Keywords: Cucumber, Poultry Manure, NPK Fertilizer, Yields

FULL TEXT

ANALYSING THE RANGE OF SCHOOL UNIFORMS FOR OVERWEIGHT PRIMARY SCHOOL CHILDREN

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Abstract
The purpose of this paper is to analyse the range of school uniforms for overweight primary school children to identify problems in this area. School uniforms are clothes in which children spend 8-10 hours a day, they grow, actively move and develop most of the time spent in school uniforms, based on this fact, the need for comfortable and proportionate school uniforms to preserve the health of children is obvious. As a result of the analysis of the assortment offered by domestic and foreign representatives, a diverse offer of school uniforms of children's clothing brands with a size range from 134 to 146 was revealed. In the course of the study of size tables published by manufacturers, it can be concluded that children's sizes, determined by height, have very strict limits in the definition of waist and chest circumferences - fullness group. The choice for children with other fullness groups is limited, and for children with excessive body weight is not represented at all under well-known Russian brands, clothes for children with metabolic syndrome can be found only on the Internet, which complicates the choice of school uniforms.The obtained data revealed a number of problems arising in the selection of school uniforms for children with excessive body weight, associated with the lack of size diversity in the mass production of children's clothes: partial mismatch of clothes to the size and shape of the child's figure leads to slow growth of the child, violation of the functions of internal organs and blood circulation, thermal balance of the body, in addition to health problems there is a threat of rapid maturation, as children are forced to buy clothes of larger size for an older age group.
Keywords: school uniforms, primary school children, overweight, disproportionality.

INTRODUCTION

The purpose of this work is to analyze the assortment of school uniforms for girls of primary school age with overweight and identify problems in this area. School uniform is a uniform set of clothing items in style, design, combination of colors and types of fabrics, unified according to significant external features, intended for wearing by students of state educational organizations. Significant external features of the school uniform include in the aggregate: design and color, the type of fabric of the top of the school uniform, decorative and distinguishing elements of installed colors and samples, installed fittings.

School uniforms are necessary for a number of different reasons. Reducing the rate of increase in the incidence of children and preventing diseases caused by wearing low-quality clothes are among the most important. The immune system is fully formed by the age of 6-7, just at this age children go to the first grade. School is a new environment to which a child needs to adapt both physically and psychologically, the process does not always go unnoticed, this is a difficult period, during which the load on immunity increases.

Children, especially young preschool children, need to get used to the format of school education in a short time in order not to miss important information, so chronic diseases or low immunity can greatly harm the learning process.

Minimizing signs of social stratification, preventing interethnic and interfaith conflicts, an equally important reason for the need for school uniforms. It cannot eliminate the problem of social inequality completely, but it is able to reduce the frequency and severity of conflicts. School uniforms eliminate a significant part of external attributes that indicate family affluence, help children and adolescents overcome poverty-related complexes, and even, as teachers testify, contribute to cohesion in school teams.

The elimination of a significant part of external attributes optimizes the learning process due to the fact that it significantly increases the focus of students. Teenage children try to show their uniqueness, sense of style and awareness in the field of fashion, bright decor on clothes or accessories prevent them from focusing not only on others, but also on a child who wears images incompatible with business style, he fixates on his appearance and does not pay due attention to the fundamental goals of going to school.

In connection with the above arguments, it can be concluded that the form contributes to improving the educational process and creating favorable conditions for the educational process. School uniforms are clothes in which children spend 8-10 hours a day, they grow, actively move and develop most of the time, spending in school uniforms, based on this fact, the need for a convenient-sized school uniform to preserve the health of children is obvious.

At the moment, there are studies proving that the indicators of dimensional typology do not correspond to the harmonious physical development of this age group. For children with overweight on the market, a large selection of school uniforms is not provided at all. The currently used set of dimensional features contained in the regulatory documentation does not take into account the degree of development of subcutaneous fat, as well as known dimensional features are not able to assess the features of the physique and the location of anthropometric points necessary to identify design points. The current regulatory documents do not take into account the peculiarities of the physical morphofunctional development of the body of children with metabolic syndrome.

As a result of the analysis of the assortment offered by domestic and foreign representatives, a diverse offer of school uniforms for primary school children of brands of children's clothing with a size range from 134 to 146 was revealed. In a study of dimensional tables published by manufacturers, it can be concluded that children's sizes, determined by height, have very rigid frames in the definition of waist and chest girth. For example, the size table of the Russian brand of children's clothing "O'STIN kids" displays that one height value has one waist girth and one chest girth. However, in regulatory documents, in GOST 17916-86 "Figures of girls are typical. Dimensional features for clothing design. "For height 134cm, which corresponds to children 7-8 years old - primary school age, there are eight indicators of chest girth and ten indicators of waist girth.

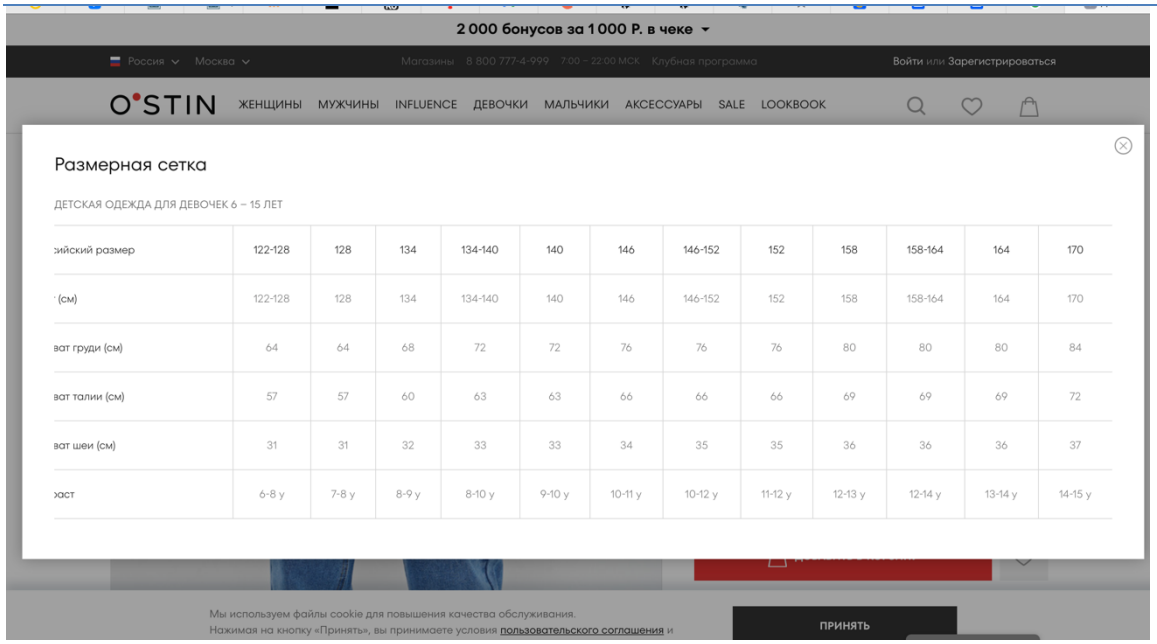


Fig.1 - Size grid of brand "O'stin"

If the child is 134cm tall, but the waist girth is different from the usual one for the 134th size - 60 centimeters and matters more, then the consumer is forced to buy a larger product intended for the child of greater height. In this regard, the location of anthropometric points and values important for building a model design changes. For the child population, preserving health and development is most important. Even a partial mismatch of clothing with the size and shape of a child's figure leads to a slowdown in growth, a violation of the functions of internal organs and blood circulation, and the thermal equilibrium of the body.

Обмеры изделия | Общие значения

Размер / рост	Возраст	Обхват талии (СМ)	Обхват бёдер (СМ)
116	6–7	55	65,5
122	7–8	56,5	68,5
128	8–9	58	71,5
134	9–10	59	74,5
140	10–11	60,5	77,5
146	11–12	62	81
152	12–13	63	84,5
158	13–14	64,5	86,5
164	14–15	65,5	90

Fig. 2 - Size grid of the Russian brand "Sela"

Apart from the issue of disparity, when choosing larger clothes for the older age group to get the full group needed, the problem of growing up quickly appears. Models for adolescents 14-15 years old are very different from models created for primary school children 7-10 years old.

The choice for children with small differences in figure from size is limited, and for children with overweight and not at all presented under the known Russian brands, clothes for children with metabolic syndrome can only be found on the Internet, which complicates the choice of school uniforms, since it is more difficult to try on. In this regard, it is more difficult for parents to choose a school uniform that fully corresponds to the size.

According to the data obtained, a number of problems were identified when choosing school uniforms for overweight children, associated with a lack of size diversity in the mass production of children's clothing.

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MITIGATING EFFECT OF CHRYSIN ON SALT STRESS IN CUCUMBER (*CUCUMIS SATIVUS* L.) SEEDLING

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ABSTRACT
Salt stress is one of the most important problems faced by plants. Cucumber is a sensitive vegetable crop to salt stress, which causes significant damage to the plant. In this study, the mitigative effect of exogenous chriysin applications on the damage caused by salt stress on cucumber was examined. For this purpose, different doses (0, 0.1, 0.5 and 1.0 mM) of chrysin were applied to plants under salt stress (100 mM NaCl) and their effects on the plant were studied based on morphological, physiological and biochemical properties. In the study, salinity caused a decrease in plant fresh weight, root fresh weight, plant dry weight, root dry weight, plant height, stem diameter, leaf number, leaf area and leaf relative water content (LRWC). In addition, plant tissue electrical conductivity (TEC), melondialdehyde (MDA) and proxidase enzyme activity (POD) increased with salt stress. However, positive effects occurred with exogenous chrysin application on cucumber plants under salt stress, and the severity of damage was lower. The negative effect of salt stress on the mineral and hormone content of cucumber plants was significantly reduced by chrysin applications. As a result, it can be concluded that salt stress can be alleviated by applying chrysin exogenously to the plant, this effect may vary depending on the dose.

Keywords: Salinity, Stress, Cucumber, Plant Growth

INTRODUCTION

It is important that agricultural production is sustainable to meet the food needs of the increasing world population. Reasons such as intensive production and global climate factors have caused various problems in agricultural production. Abiotic stresses faced by plants have been one of the issues that have been emphasized in recent years and serious measures need to be taken. Salinity, one of the most important abiotic stresses, negatively affects plant growth, development and efficiency in agricultural production. Soil salinity negatively affects approximately 20% of the world's irrigated agricultural lands (Carillo et al., 2011; Zhao et al., 2021). Salt stress causes ionic stress and osmotic stress in the plant. With salt stress, high concentrations of sodium ion (Na^+) accumulate in plant cells, reaching toxic levels and causing disruption of ion homeostasis. Salt stress causes osmotic stress through ion imbalance and water deficiency in the plant cell. In this case, cell turgor pressure decreases, the plasma membrane shrinks and a change occurs in the cell wall (Liang et al., 2018; Zhao et al., 2021). Salinity inhibits plant growth by disrupting photosynthesis, decreasing turgor and osmoregulation, downregulating root sensing and shoot growth through signaling, and disrupting mineral transport to shoots (Dajic, 2006).

Flavonoids are low molecular weight polyphenolic secondary metabolic compounds in cell (Samanta et al., 2011). Flavonoids, a group of natural polyphenol substances, are found in vegetables, fruits, grains and tea, and as plant secondary metabolites, they play a role in many biological processes in plants and responses to environmental factors (Shen et al., 2022). Flavonoids perform various biological activities in living things; flavonoids, synthesized in certain regions in plants, have functions in many stages such as flower, fruit, seed, plant growth and development. Flavonoids protect plants from various biotic and abiotic stresses and may play a functional role in the tolerance of plants to stress (Samanta et al., 2011). Flavone of chrysin (5,7-dihydroxyflavone) is a natural flavonoid found in many plant extracts, blue passion flower, honey and propolis etc. (Satyanarayana et al., 2015). The effects of flavonoids against abiotic stresses have been studied in some plants (Di Ferdinando et al., 2012; Shah and Smith, 2020; Yildiztugay et al., 2020), but there is almost no research on the effects of chrysin, a flavonoid, on plants under salt stress.

Cucumber is a plant moderate sensitive to salinity (Dajic, 2006). Salt stress has a negative effect on growth and mineral uptake in cucumber plants (Yildirim et al., 2008). In addition, high

salinity affects plant growth in cucumber by closing stomata, decreasing photosynthesis rate, as well as reducing leaf water potential, osmotic potential, turgor potential, leaf expansion rate and leaf size (Chartzoulakis, 1994). In previous studies on cucumber have been reported that it is effective in alleviating the damage of salt stress with applications such as salicylic acid (Yildirim et al., 2008), melatonin (Zhang et al., 2020), glycine betaine (Estaji et al., 2019), nitric oxide (Fan et al., 2013). However, no study has been found effect of exogenous chrysin on cucumber grown under salt stress. Therefore, in this study, the effect of exogenous chrysin application on alleviating salt stress in cucumber plants was examined.

MATERIALS AND METHODS

This study was carried out in a glass greenhouse as pot experiment. Cucumber (*Cucumis sativus* L.) seedlings grown in a peat: perlite medium in a multi-cell seedling tray were planted in 2.5 L pots containing a soil: peat: sand (3: 1: 1, v:) mixture when they had true leaves (30 days after seed sowing). Pots were randomly placed on the benches according to the completely randomized design with three replicates and 6 plants for each replicate. Greenhouse temperature and humidity were controlled at average temperature of 25/18 ±2 °C during the day/night and 55±5 %. Chrysin solutions containing 0.02% Tween-20 as a surfactant prepared in 0, 0.1, 0.5 and 1.0 mM doses and applied by spraying to the leaves, the applications were repeated three times with one-week intervals. The NaCl solution was prepared using tap water and two concentrations (0 mM and 100 mM), and applied as irrigation. Salinity treatments were continued until harvest and the plants were harvested at 40 days after the onset of stress treatments. In order to determine the effect of the treatments on cucumber under salt stress, plant fresh weight, root fresh weight, plant dry weight, root dry weight, plant height, stem diameter, leaf number and leaf area were determined. In addition, analyzes were made regarding LRWC, TEC, MDA, POD activity, hormone content (IAA, ABA, GA, SA, cytokine, zeatin and jasmonic acid) and mineral element content. The differences between the applications were analyzed statistically according to the Duncan Multiple comparison test using the SPSS program.

RESULTS AND DISCUSSION

In the study, the effects of salt stress and chrysin applications on cucumber are given in Figure 1, Figure 2, Figure 3, Table 1 and Table 2. Salinity had negative effects on morphological, biochemical and physiological characteristics of cucumber seedlings.

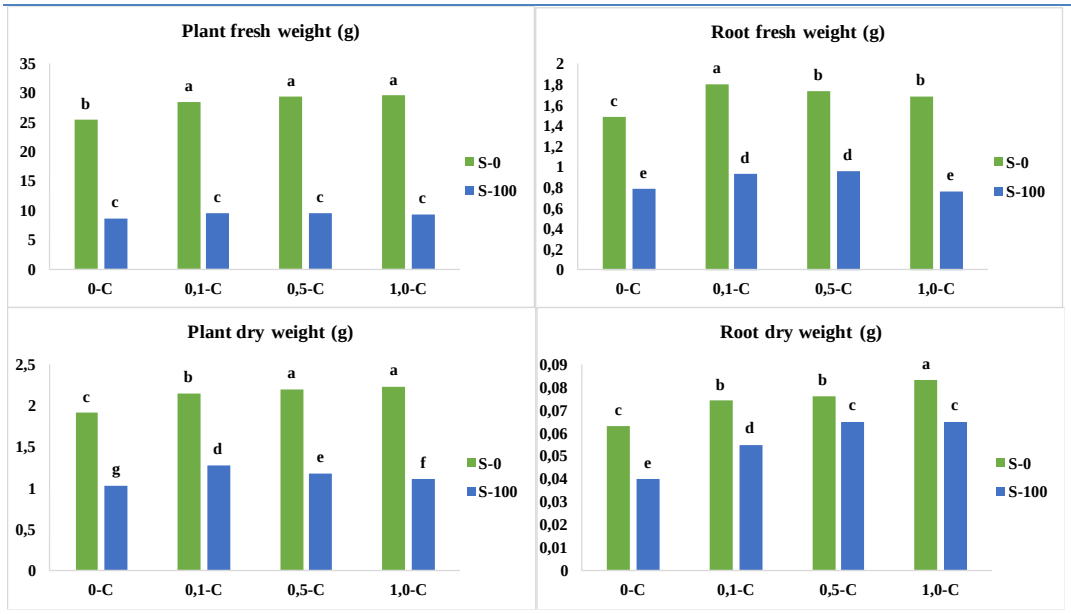


Figure 1. Effect of chrysin on plant fresh weight, root fresh weight, plant dry weight and root dry weight of cucumber seedling under salinity. There is no statistical difference between the mean shown with the same letter on bars (p<0,001).

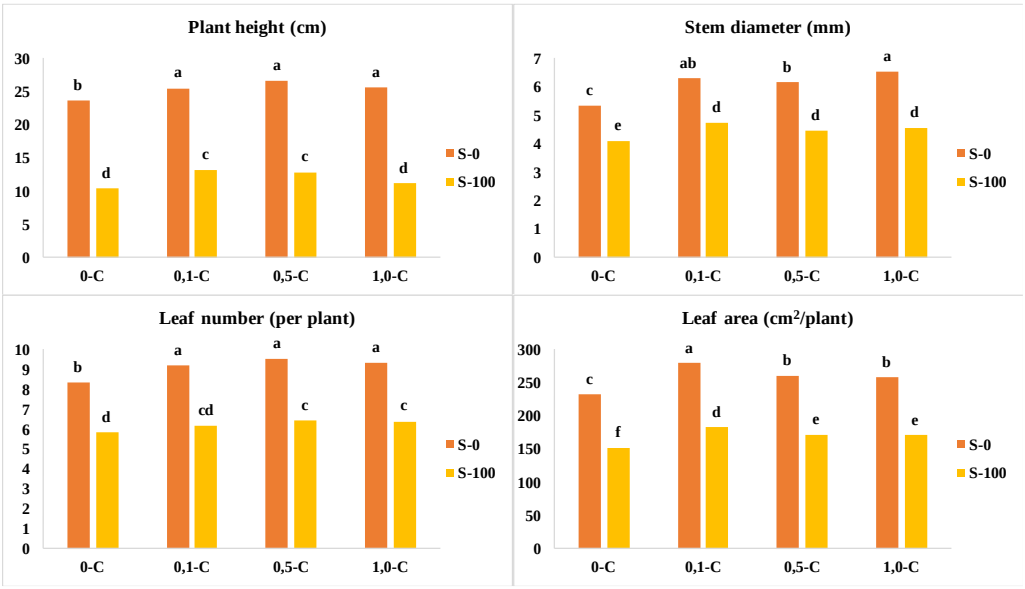


Figure 2. Effect of chrysin on plant height, stem diameter, leaf number and leaf area of cucumber seedling under salinity. There is no statistical difference between the mean shown with the same letter on bars (p<0,001).

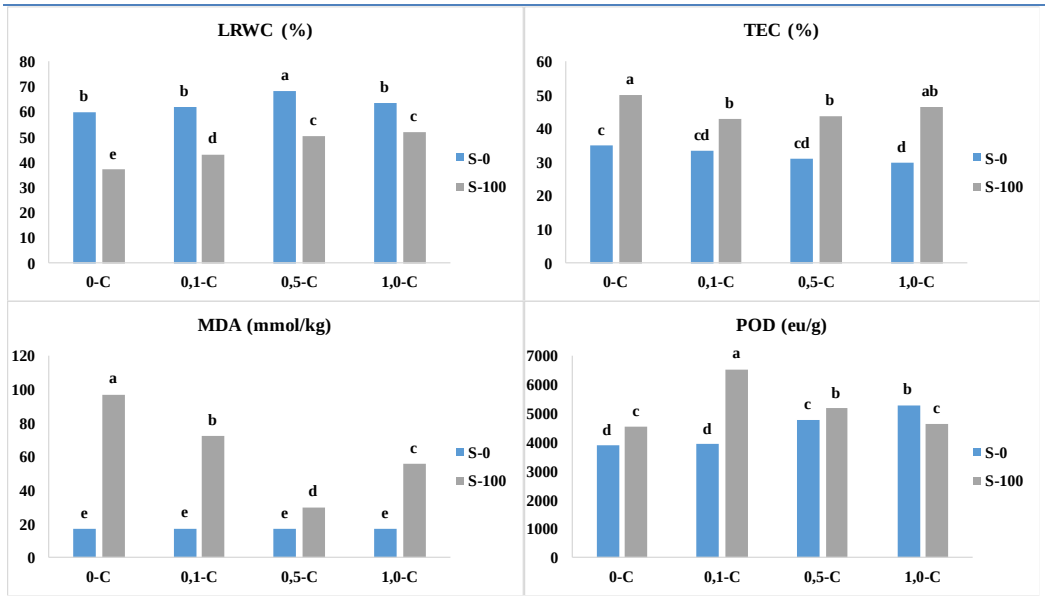


Figure 3. Effect of chrysin on LRWC, TEC, MDA and POD of cucumber seedling under salinity. There is no statistical difference between the mean shown with the same letter on bars ($p<0,001$).

Table 1. Effect of chrysin on mineral content of cucumber seedling under salinity

Salt	Treatment	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	S (%)
S-0	0-C	1,98 de	0,22 c	1,34 c	1,34 b	0,19 c	0,19 a
	0,1-C	2,26 cd	0,27 b	1,99 b	1,56 a	0,30 b	0,17 b
	0,5-C	2,88 b	0,34 a	2,17 a	1,56 a	0,39 a	0,17 b
	1,0-C	3,45 a	0,22 c	1,37 c	1,13 c	0,32 b	0,20 a
S-100	0-C	1,64 e	0,11 f	0,52 f	0,70 e	0,04 f	0,03 e
	0,1-C	1,79 e	0,17 e	0,67 e	0,82 d	0,17 d	0,11 c
	0,5-C	1,97 de	0,20 d	1,16 d	1,54 a	0,09 e	0,07 d
	1,0-C	2,37 c	0,23 c	1,25 cd	1,46 a	0,08 e	0,10 c
Salt	**Treatment**	**Mn (mg/kg)**	**Fe (mg/kg)**	**Zn (mg/kg)**	**Cu (mg/kg)**	**Na (mg/kg)**	**Cl (mg/kg)**
S-0	0-C	36,67 bc	16,91 b	2,17 b	1,50 bc	2,73 ef	13,91 e
	0,1-C	43,66 a	21,63 a	3,39 a	3,02 a	5,20 e	16,80 e
	0,5-C	41,03 ab	17,43 b	3,14 a	1,90 b	1,99 f	7,72 f
	1,0-C	44,65 a	14,99 c	3,30 a	3,20 a	3,13 ef	4,69 f
S-100	0-C	26,43 d	13,34 cd	2,05 b	1,48 c	61,08 a	95,24 a
	0,1-C	28,51 d	12,97 d	2,29 b	1,62 bc	52,00 b	70,95 c
	0,5-C	34,60 c	10,48 e	2,39 b	1,78 bc	41,22 c	76,80 b
	1,0-C	45,67 a	23,47 a	3,54 a	3,14 a	32,24 d	61,22 d

There is no statistical difference between the mean shown with the same letter in the same column ($p<0,001$).

Table 2. Effect of chrysin on hormone content of cucumber seedling under salinity

NaCl	Salt	IAA (ng/mg tissiu)	ABA (ng/g DW)	GA (ng/g DW)	SA (ng/g DW)	Cytokinin (ng/g DW)	Zeatin (ng/g DW)	Jasmonic (acid ng/g DW)
S-0	0-C	0,66 de	136,39 b	1,09 f	0,26 f	2,48 f	1,30 e	0,19 c
	0,1-C	1,69 c	122,36 b	4,45 c	0,99 c	11,09 c	4,52 c	0,90 b
	0,5-C	3,45 b	130,14 b	9,97 b	2,71 b	25,85 b	9,92 b	2,32 a
	1,0-C	4,85 a	133,52 b	16,03 a	4,21 a	48,29 a	20,62 a	0,83 b
S-100	0-C	0,03 f	327,40 a	0,16 g	0,03 g	0,30 g	0,19 f	0,01 d
	0,1-C	0,57 e	98,47 c	0,57 g	0,04 g	1,28 fg	0,17 f	0,14 cd
	0,5-C	0,96 de	130,98 b	1,91 e	0,37 e	5,21 e	2,64 d	0,17 c
	1,0-C	1,16 d	121,64 b	3,19 d	0,46 d	6,80 d	2,65 d	0,18 c

There is no statistical difference between the mean shown with the same letter in the same column ($p<0,001$).

With salinity, plant fresh, root fresh, plant dry and root dry weight decreased by 66%, 47%, 46% and 37%, respectively, compared to the control. Chrysin applications caused significant increases in these parameters in both salt-free and salt stressed plants. Especially in salt stress, plant fresh and plant dry weights were better with 0,1-C application, while 0,5-C application was important in root fresh weight. Also, there was an increase in root dry weight with 0,5-C and 1.0-C applications under salinity. Plant height, stem diameter, leaf number and leaf area of cucumber seedling were decreased with salinity. This decrease is 56%, 23%, 30% and 34%, respectively, compared to the control. Chrysin applications alleviated the reducing effect of salt stress on these parameters, the least decrease in plant height, stem diameter and leaf area was in the 0.1-C application (reduction %43, %11 and %21, respectively), while the number of leaves was in the 0.5-C application (%23). Studies have shown that salt stress causes decreases in plant growth, shoot growth, plant height, root growth, leaf size, etc. in many different plants (Shahid et al., 2011; Yildirim et al., 2015; Zhang et al., 2016; Shams et al., 2019; Ekinci et al., 2021). The first reason for this is that salt stress inhibits plant growth by reducing plant water absorption and causing osmotic stress. Then, plant growth is affected by ion toxicity, which occurs when excessively salty ions enter the plant transpiration stream, inhibiting photosynthesis, disrupting ion homeostasis, and damaging plant cells by peroxidizing membrane lipids (Hao et al., 2021).

As a plant metabolic strategy, increased accumulation of flavonoids in plant special cells, in areas such as cell walls and membranes, provides protection against oxidative damage that occurs as a result of abiotic stresses (Di Ferdinando et al., 2012). In this study, chrysin exhibited mitigating effects on plant morphological characteristics in cucumber seedlings under salt stress. In a study, leaf spraying of flavonoids in soybean under optimum growth conditions resulted in an increase in shoot fresh weight, shoot dry weight and leaf area, however, flavonoids did not affect plant growth under salt stress. Researchers determined that the application of flavonoids together with microbe-based material was more effective in reducing the negative effects of salinity stress and improved fresh weight, dry weight and leaf area of soybeans under salt stress conditions by 128%, 163% and 194%, respectively (Shah et al., 2022). Flavonoid application in salt-stressed tomatoes affected photosynthesis stimulation, increased CO2 fixation and thus promoted growth (Martinez-Alonso et al., 2022).

While salinity caused a decrease in LRWC (38%), it caused an increase in TEC, MDA and POD content. These increases are 44%, 475% and 17%, respectively, compared to the control. Chrysin applications did not cause much decrease in plant LRWC under salt stress, the least decrease was 13% in the 1.0-C application. 0.1-C applications are the prominent applications in terms of TEC and POD, and 0.5-C applications are the prominent applications in terms of MDA content. Excessive ROS production caused by salt stress causes major damage to the membrane. It increases membrane permeability, reduces its fluidity, affects the selectivity, flow rate and transport of ions, and causes osmotic stress by causing exosmosis of a large number of electrolytes (Ganie at al., 2019). One of the main effects of salt stress is an increase in MDA content. MDA is the main product of membrane lipid peroxidation and can disrupt its structure and function by inactivating proteins and enzymes on the membrane (Hao et al., 2021). Similarly, with salt stress, there was an increase in MDA content in many plants such as pepper (Sahms et al., 2019), cucumber (Turan et al., 2022) and eggplant (Ekinci et al., 2021).

Due to salt stress, the osmotic pressure of the soil solution is higher than the plant cells, thus preventing the plant from taking in enough water, cell turgor decreases, and stomata close to preserve water (Safdar et al., 2019). Salinity reduces the water conductivity of roots and affects the cellular relative water content, inhibiting the movement of water from the soil to the plants (Shahid et al., 2020). In different studies, it has been determined that leaf water potential

decreases with salinity (Yildirim et al., 2008; Shams et al., 2019; Ekinci et al., 2021: Ekinci et al., 2022). Plants try to protect themselves from salt stress damage through ROS. Enzymes such as superoxide dismutase, catalase (CAT) and peroxidase are used to clear ROS (Shahid et al., 2020). In this study, an increase in POD enzyme activity occurred with salt stress, and it was determined that salinity caused an increase in antioxidant enzyme activity in maize (Azooz et al., 2009), pepper (Ekinci et al., 2021) and tomato (Yildirim et al., 2023) plants.

In this study, it was determined that the application of chrysin, a flavonoid, may be effective in alleviating the damage of salt stress as a result of the increase in the relative water content of the leaves and the changes in MDA and POD enzyme activity in cucumber. Martinez-Alonso et al. (2022) reported that turgor in tomato plants was higher in those treated with flavonoids (CBL), indicating that the synthesis or accumulation of solutes as well as water transport through the cells increased with flavonoid treatment. With their antioxidant properties, flavonoids are effective in helping plants resist oxidative stress and protecting the plant from cellular peroxidation by suppressing free radicals. Mechanisms such as restriction of singlet oxygen, inhibition of ROS-producing enzymes, chelation of transition metal ions and recycling of other antioxidants are involved in the suppression of ROS production by flavonoids (Melidou et al., 2005; Mierziak et al., 2014; Shomali et al., 2022).

There was a decrease in mineral matter content with salinity (except Na and Cl). The decrease in N, P, K, Ca, Mg, S, Mn, Fe, Zn and Cu content compared to the control was 17%, 50%, 61%, 48%, 79%, 84%, 28%, 21%, 6% and 1% respectively. However, it was determined that chrysin applications had significant effects on salt stress in terms of mineral content in cucumber seedlings, and it was determined that it increased the mineral content. In salt condition, the prominent applications were 0.1-C application in terms of plant N, P, K, Mn, Fe, Zn and Cu content, 0.5-C application in terms of Ca content, and 0.1-C application in terms of Mg and S content. On the other hand, the increase in Na and Cl content due to salt stress was at a lower level with chrysin applications. There is an accumulation of Na^+ and Cl^- that occurs with salt stress and a deficiency of ions such as Ca2+ and K+. High concentrations of Na+ reduce the membrane potential and cause damage to cell metabolism and some enzymes (Hao et al., 2021). Salinity causes nutrient imbalances in the plant and causes a decrease in the concentrations of various elements in plant tissues (Safdar et al., 2019).

A higher number of stomata occurred in salt-stressed tomato plants treated with flavonoids due to higher CO_2 fixation, which also supported the increase in stomatal conductance and nutrient uptake (Martinez-Alonso et al., 2022). In this study, it was observed that chrysin increased plant nutrient uptake in both unstressed and stressed plants.

Apart from ABA, plant hormone content (IAA, GA, SA, cytokinin, zeatin and jasmonic acid) decreased with salinity. These decreases are 95%, 85%, 88%, 87%, 85% and 94%, respectively. There was a 140% increase in ABA content. In chrysin applications, hormone contents except ABA and Jasmonic acid increased in both salt-free and salt stress conditions. The application that increased the hormone content the most was 1.0-C application. Salt stress causes imbalances in plant hormonal homeostasis and changes in endogenous hormonal content, resulting in a decrease in the levels of plant hormones such as gibberellins, auxins and cytokinin, and an increase in the level of abscisic acid (Shahid et al., 2020). Similarly, in a study conducted on lettuce, it was determined that the GA and SA contents decreased and the ABA content increased in plants under salt stress (Yildirim et al., 2015). In our study, there was an increase in ABA and a decrease in other hormones with salt stress.

In this study, it is thought that chrysin is effective in increasing tolerance to salt stress as a result of the changes it makes in the hormonal content of the plant. As a matter of fact, it is known that flavonoid biosynthesis in plants is also affected by plant hormones that regulate growth and development (Yuan et al., 2012). Additionally, Jan et al., (2021) stated in their study that there is a connection between flavonoid and hormone signaling in response to the combination of salt and heat stress.

CONCLUSION

In this study, the mitigative effect of exogenous chrysin applications on the damage caused by salt stress on cucumber was examined. In the study, The negative effects of salt stress on the morphological, physiological and biochemical properties of cucumber seedlings could be alleviated by the application of chrysin. Although the effect of chrysin varies depending on the dose applied, it is useful to conduct the study on different plants or in later growth stages of the plant to obtain clearer results.

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INVESTIGATION OF THE EFFECTS OF HUMIC AND FULVIC ACID ON PLANT GROWTH OF CAULIFLOWER SEEDLINGS GROWN IN HERBICIDE-CONTAMINATED SOIL

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Abstract
Chemicals used in agriculture cause significant harm to the environment and humans. Herbicides used in large amounts in places where intensive agriculture is carried out damage the soil and the plants grown. In this study, the effects of humic acid (HA) and fulvic acid (FA) applications on cauliflower seedlings grown in herbicide-treated soil were examined. HA and FA applications were applied as 3% solutions to the leaves (L), soil (S) and both leaves and soil (L+S) three times with one-week intervals. In the study, the effects of the applications were examined in terms of plant fresh weight, root fresh weight, plant dry weight, root dry weight, plant height, chlorophyll reading value (SPAD), stem diameter and leaf area. There was a significant decrease in the parameters examined in cauliflower seedlings grown in herbicide-contaminated soil. However, it has been observed that this negative effect decreases with HA and FA applications. It has been determined that the effects of applications performed in the form of L+S gave much more positive response According to the results obtained from this study, the use of HA and FA has positive effects on plants grown in herbicide-treated soil.
Keywords: Seedling, Herbicide, Contaminate, Soil, Plant Growth

INTRODUCTION

Herbicides are widely used in agricultural systems as a practical and effective method for weed control. With the intensive use of herbicides, the risk of polluting the environment, especially groundwater and surface water, raises concerns. However, in addition to nutritional supplementation, the application of organic substances used to support the soil in agriculture also provides benefits such as reducing the mobility of herbicides (Takeshita et al., 2019). Adhesion of herbicides in the form of adsorption to soil particles is the main process that regulates their behavior in soil. The movement and degradation of herbicides affect herbicide spread processes in the environment (Zabolay et al., 2011). Humic substances from soil organic matter fractions are the primary adsorbents of herbicides (Cox et al., 2000). Humic substances have a separate effect on the behavior of herbicides according to their degree of humification (fulvic acid < humic acid < humin) (Takeshita et al., 2019).

Fulvic acids (FA), which constitute a significant part of the soil organic matter, contain nutritional elements and amino acids and have an effect on the transport and absorption of nutrients from the soil. Additionally, due to their low molecular weight, FAs act as natural chelators in penetrating the pores of membranes and transporting nutrients (Braziene et al., 2021). Humic acid (HA) is one of the humic substances with the highest molecular weight and has important effects on plant growth and development because it contains hormone-like substances (Aydin et al., 2021). HAs are organic macromolecules that can interact with herbicides and metallic cations (Dubas and Pimpan, 2008). While humic acid is taken up by the roots, insoluble molecules such as pesticides are also taken up, and it is stated that humic acids prevent the damage caused by pesticides to the plant cell due to their antitoxic, antimutagenic and antilastogenic activities (Aydin et al., 2021). In this study, the effects of HA and FA applications applied to cauliflower seedlings grown in herbicide-treated soil on plant development were examined. The first stage of the study is to examine the morphological properties, and in the next stage, changes in physiological and biochemical properties will be examined.

MATERIALS AND METHODS

Experiment was carried out in greenhouse condition (average temperature is 20±2°C and humidity is 55±5%) as pot experiment. Cauliflower (Brassica oleracea var. botrytis) seedlings grown in a peat: perlite medium in a multi-cell seedling tray were planted in 1.5 L pots containing a soil: peat: sand (3: 1: 1, v:) mixture when 30 days after seed sowing. Pots were

randomly placed on the benches according to the completely randomized design with three replicates and 6 plants for each replicate. The soil was treated with herbicide (Roundup) 3 days before the seedlings were planted in pots. After planting the seedlings, 3% fulvic acid (FA, Fulvagra) and 3% humic acid (HA, Pow Humus) were applied as spray to the plant leaves (L), as irrigation water to the soil (S) and applied to both leaves and soil (L+S). The applications were repeated 3 times at one-week intervals.

The study was terminated 30 days after planting the seedlings and morphological parameters such as plant fresh weight, plant dry weight, root fresh weight, root dry weight, plant height, stem diameter, chlorophyll reading value (SPAD) and leaf area were examined.

The mean of the data obtained as a result of the study was taken and statistical analysis was performed using the Duncan multiple comparison test in the SPSS program.

RESULTS and DISCUSSION

In this study, the effects of HA and FA applications applied to cauliflower seedlings grown in herbicide-treated soil on plant morphological properties were examined and results were given Figure 1 and Figure 2.

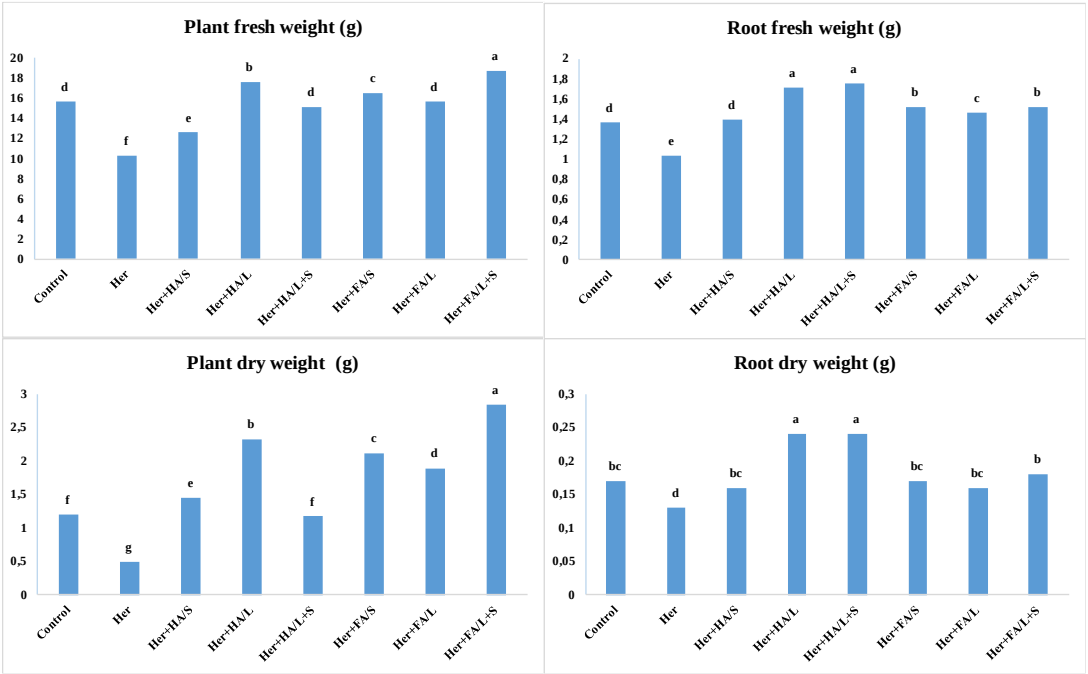


Figure 1. Effect of treatments on plant fresh weight, root fresh weight, plant dry weight and root dry weight of cauliflower seedling. There is no statistical difference between the mean shown with the same letter on bars ($p<0,001$).

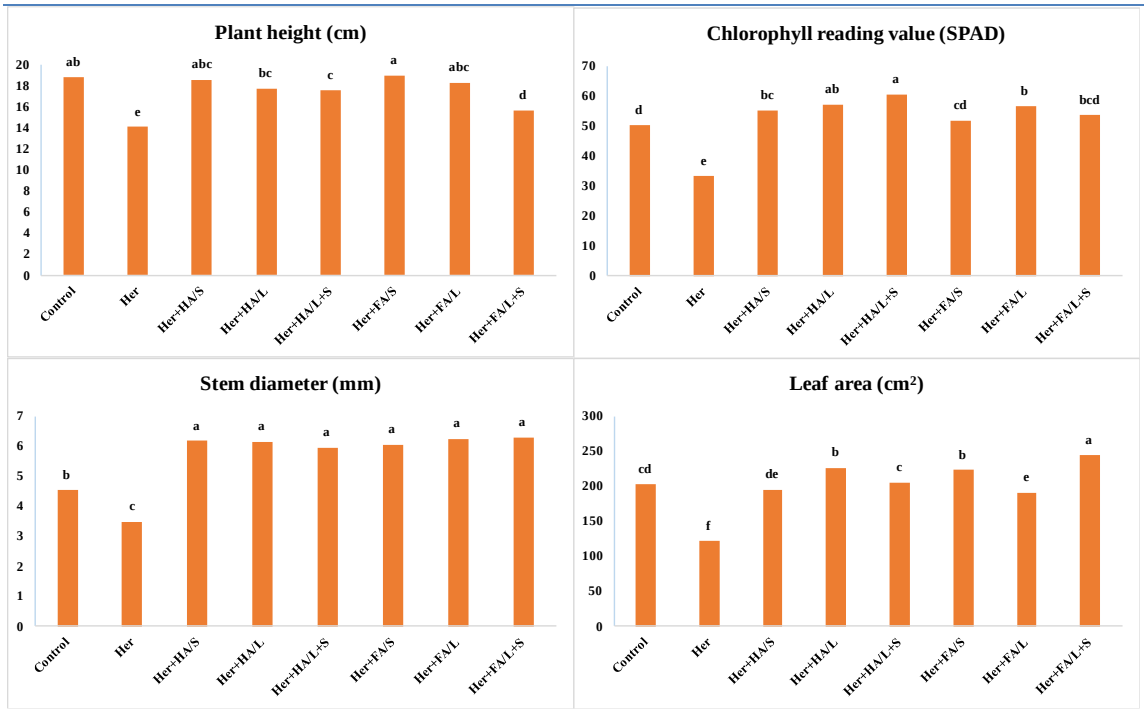


Figure 2. Effect of treatments on plant height, chlorophyll reading value, stem diameter and leaf area of cauliflower seedling. There is no statistical difference between the mean shown with the same letter on bars ($p<0,001$).

In the study, plant fresh weight, root fresh weight, plant dry weight, root dry weight, plant height, chlorophyll reading value, stem diameter and leaf area in plants grown in herbicide-treated soil were lower by 34%, 36%, 59%, 24%, 25%, 34%, 23% and 40% respectively, compared to control plants. While no significant damage to plant growth occurs with low dose herbicide applications (Cedergreen, 2008), high herbicide rates reduce plant growth promoting activity (Ahemad and Saghir Khan, 2011). In a study, it was determined that atrazine and metribuzin increased the number of shoots in sugar cane silty loam soil, while atrazine increased the total shoot weight. However, in the same study, it was determined that glyphosate, pendimethalin and terbasil herbicides caused phytotoxic effects against sugar cane, increased the severity of root rot and caused growth reductions. However, it has not been determined whether the decrease in growth is due to increased disease severity or direct herbicide damage (Dissanayake et al., 1998). Herbicide stress decreased shoot fresh weight, shoot length and root fresh weight in rapeseed, and these decreases increased in parallel with the increasing herbicide dose (Zhang et al., 2008).

Compared to plants grown in herbicide soil, the increases occurring with HA and FA applications are 23-83% in plant fresh weight, 35-70% in root fresh weight, 139-478% in plant

dry weight, 23-85% in root dry weight, 11-35% in plant height, 57-83% in chlorophyll reading value, 71-81% in stem diameter and 57-101% in leaf area. Additionally, there was a significant increase with the treatments compared to the control plants. Plant fresh weight FA/L+S application (23%), root fresh weight HA/L+S application (29%), plant dry weight FA/L+S application (136%) and root dry weight HA/S and HA /L+S applications (41%) caused the highest increase. Compared to control plants, plant height gave the highest increases in the FA/S application, chlorophyll reading value in the HA/L+S application, stem diameter in the FA/L+S application, and leaf area in the FA/L+S application. Similarly, application of humic preparation in winter wheat production was effective in reducing the toxic effect of sulfonylurea herbicide, improving soil mineral matter and plant nutrition, and increasing yield. Researchers stated that this effect may be related to the regulation of phosphorus mobilization by plants through root exudates due to the activation of the root microbiota of the humic substance (Bezuglova et al., 2019). Taşpınar et al. (2017) also determined that humic acids provide a protective effect when applied together with herbicides. Humic substances can degrade or neutralize the toxins left by pesticides in the soil, making the soil more suitable for plant growth (Cooper and Abi-ghanem, 2016). In this study, it was determined that both leaf and soil applications of HA and FA in cauliflower seedlings had significant effects on seedling development. These effects of humic and fulvic acids arise from the fact that they change the primary and secondary metabolism of the plant, and also cause structural and physiological changes in plant roots and shoots through changes in nutrient uptake, assimilation and distribution, and provide tolerance to various environmental stresses (Canellas et al., 2015).

CONCLUSION

In this study, the effects of HA and FA applications on plant development of cauliflower seedlings grown in herbicide-treated soil were examined. In the study, it was determined that plant growth was better in cauliflower seedlings grown in herbicide-contaminated soil with HA and FA applications made in the form of soil and leaf application. In the first stage of the study, morphological features were examined. However, in the next stage of the applications, the changes in the physiological and biochemical properties of both the soil and the plant will be examined. Based on the first results determined from the study, it is thought that humic substances can reduce herbicide-induced damages and provide a healing effect on soil and plants.

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SILENE COMPACTA' DA İKİ FARKLI BÜYÜME DÖNEMİNİN BİTKİ BÜYÜME ÖZELLİKLERİ ÜZERİNE ETKİSİNİN BELİRLENMESİ

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Özet

Dış mekân peyzaj tasarımında bitki materyalinin büyük bir bölümünü oluşturan ağaç, ağaççık ve çalılar; mevsimsel renk ve doku değişimleri sunarak mekan özellikleri üzerinde etkili olsalar da mevsimlik çiçekler kadar kısa zaman dilimlerine hitap edemez veya bu dilimlerde renksel değişkenlik fırsatları sunmazlar. Öte yandan boyutları, kullanım veya etkinlik olgunluğuna kısa sürede gelebilmeleri, mekan özelliklerini değiştirmek amacıyla yapılan uygulamaların kolaylığı bu tür bitkilerin en önemli avantajlarındandır. Türkiye'de bu amaçla peyzaj tasarımlarında kullanılabilecek mevsimlik çiçek tür sayısı oldukça fazla olmasına karşın, çoğunluğu yabancı orijinli olup dış mekan süs bitkilerinde en yüksek yabancı orijinli tür oranına bu alt grup sahiptir. Doğal mevsimlik çiçeklerin kültüre kazandırılması ve peyzaj tasarımlarında kullanılması ülke ekonomisine katkısı yanında, ekolojik, fonksiyonel, estetik, sosyal ve psikolojik anlamda birçok yarar sağlayacaktır. Peyzaj tasarımlarında mevsimlik çiçek olarak kullanım potansiyeli oldukça yüksek olan doğal türlerden biri olan *Silene compacta* Fischer, dikine büyüyen, çok sayıdaki oldukça gösterişli pembe çiçeklerini ilkbahar yaz aylarında açan iki yıllık veya çok yıllık otsu yapıdaki bir türdür. Bu çalışmanın amacı, Antalya ili Akseki ilçesi Cevizli köyünde doğal olarak yetişen, *S. compacta* türünün fidanlıkta satışa sunuluncaya kadarki dönemde sahip olduğu büyüme özelliklerinin belirlenmesidir. Çalışmada, sera koşullarında torf+perlit (1:1 hacimsel) karışımlı yetiştirme ortamı bulunan viyollere tek dönemde (Ekim ayında) ekilen *S. compacta* tohumlarından elde edilen fideler 4-5 yaprak oluşturduktan sonra Kasım ayı başında torf+perlit (2:1) karışımlı yetiştirme ortamları bulunan çapı 10,5 cm olan saksılara şaşırtılarak 2 farklı dönemde satışa sunuluncaya kadarki dönemi geçirmeleri sağlanmıştır. İlk dönem bitkileri 2,5 ay, 2. dönem bitkileri ise 4,5 ay boyunca saksılarda tutularak 2 haftada bir kompoze gübre verilmiştir. Iki haftada bir bitki bitki boyu (cm), bitki eni (cm), yaprak sayısı (adet), yandal sayısı (adet) ve yan dal uzunluğu (cm) olmak üzere büyüme özellikleri ölçülmüştür. Ayrıca iki farklı bitki büyüme dönemi sonunda, bitki bitki boyu (cm), bitki eni (cm), yaprak sayısı (adet), yandal sayısı (adet), yan dal uzunluğu (cm), bitki gövde kalınlığı (mm), yaprak eni (cm), yaprak boyu(cm), yaprak alanı (cm^2), kök sayısı (adet), kök uzunluğu (cm), kök ve gövde yaş ağırlığı (g), kök ve gövde kuru ağırlığı (g) ölçümleri yapılmıştır. Hem 2,5 ay hem de 4,5 ay sera koşullarında saksılarda büyütülen bitkilerde bitki büyüme özelliklerinde zamana göre düzenli artış olduğu belirlenmiştir.

Anahtar Kelimeler: *Silene compacta*, Mevsimlik Çiçek, Büyüme Özellikleri, Büyüme Dönemi

DETERMINATION OF THE EFFECT OF TWO DIFFERENT GROWTH PERIOD ON PLANT GROWTH CHARACTERISTICS IN *SILENE COMPACTA*

Abstract
Trees, small trees and shrubs constitute a large part of the plant material in outdoor landscape design; Although they have an impact on space characteristics by offering seasonal color and texture changes, they cannot address short time periods as seasonal flowers or do not offer opportunities for color variability in these periods. On the other hand, the most important advantages of such plants are their size, their ability to reach maturity for use or effectiveness in a short time, and the ease of applications to change the characteristics of the space. Although the number of seasonal flower species that can be used in landscape designs for this purpose in Turkey is quite high, most of them are of foreign origin and this subgroup has the highest rate of species of foreign origin among outdoor ornamental plants. Introducing natural seasonal flowers into culture and using them in landscape designs will provide many benefits in ecological, functional, aesthetic, social and psychological terms, as well as contributing to the country's economy. *Silene compacta* Fischer, one of the natural species with a high potential for use as a seasonal flower in landscape designs, is a biennial or perennial herbaceous species that grows vertically and opens its many showy pink flowers in spring and summer. The aim of this study is to determine the growth characteristics of the *S. compacta* species, which grows naturally in the Cevizli village of Akseki district of Antalya province, until it is offered for sale in the nursery. In the study, the seedlings obtained from *S. compacta* seeds sown in a single period (in October) in viols with peat+perlite (1:1 volumetric) mixed growing medium under greenhouse conditions were grown in peat+perlite (2:1) mixture at the beginning of November after forming 4-5 leaves. They were placed in pots with a diameter of 10.5 cm, containing growing media, and allowed to grow in two different periods until they were put on sale. First period plants were kept in pots for 2.5 months, 2nd period plants were kept in pots for 4.5 months and compound fertilizer was applied every 2 weeks. Plant growth characteristics, including plant height (cm), plant width (cm), number of leaves (number), number of side branches (number) and side branch length (cm) were measured every two weeks. Additionally, at the end of two different plant growth periods, plant height (cm), plant width (cm), number of leaves (number), number of side branches (number), side branch length (cm), plant stem thickness (mm), leaf width (mm). cm), leaf length (cm), leaf area (cm2), number of roots (pieces), root length (cm), root and stem fresh weight (g), root and stem dry weight (g) were measured. It was determined that there was a regular increase in plant growth characteristics over time in plants grown in pots under greenhouse conditions for both 2.5 months and 4.5 months.
Keywords: *Silene compacta*, Seasonal Flower, Growth Characteristics, Growth Period

GİRİŞ

Kırsal ve kentsel peyzaj tasarımlarında kullanılan bitkiler grubunu oluşturan dış mekan süs bitkileri Türkiye'de, süs bitkileri kapsamında değerlendirilen kesme çiçekler, iç mekan süs bitkileri, ve çiçek soğanları olan diğer gruplardan daha fazla üretim alanına ve miktarına sahiptir (Tuik, 2015). Türkiye doğal bitki türleri varlığı dolayısıyla süs bitkisi olarak kullanılabilecek bitki türleri varlığı açısından oldukça zengin bir ülke olmasına karşın özellikle dış mekanlarda yapılan bitkisel peyzaj tasarımlarında kullanılan türlerin büyük kısmını yabancı orijinli bitkiler oluşturmaktadır.

Akdeniz Bölgesi doğal bitki çeşitliliği açısından zengin bir bölgedir. Buna rağmen, bölgede süs bitkisi olarak kullanılan doğal tür sayısı oldukça sınırlıdır (Özkan ve ark., 1999). Oysa bir bölgede doğal türlerin kullanılması, gerek bitkinin temin edilmesi gerekse sulama, gübreleme, ilaçlama, budama gibi bakım unsurlarının gerçekleştirilmesinde maliyet ve işgücü açısından kolaylık sağlamaktadır (Karagüzel ve Taşçıoğlu, 2004). Doğal türlerin ıslah edilerek peyzaj tasarımında kullanılmaları ile bu bakım işlemlerinden kaynaklanan zararlı etkilerin doğal kaynaklar olan suya, havaya ve toprağa olan etkileri azaltılırken, suyun etkin kullanılması ile kuraklık ile mücadelede de yararı olmaktadır. Aynı zamanda doğal türlerin kültüre kazandırılması ve kullanılması dışa bağımlılıktan kurtulma ile ekonomik anlamda yarar sağlarken, biyolojik çeşitliliğin korunması ve sürdürülebilir kullanılmasını olanaklı kılmaktadır. Bunların yanında bir diğer önemli konu ise, doğal türlerin çoğaltılarak kullanılması gelecekteki diğer ıslah çalışmalarına da zemin hazırlıyor olmasıdır.

Dış mekan süs bitkilerinin bir alt grubunda yer alan mevsimlik çiçekler bakımından Türkiye'de bu amaçla peyzaj tasarımlarında kullanılabilecek tür sayısı oldukça fazla olmasına karşın, çoğunluğu yabancı orijinli olup dış mekan süs bitkilerinde en yüksek yabancı orijinli tür oranına bu alt grup sahiptir. Mevsimlik çiçeklerin anlam ve önemi mekanlara renk ve canlılık verme, tekdüzeliği giderme, yüzey etkisi yaratma, beğenilmeyen yerlerin kısa sürede kapanmasına olanak vermektir (Oral ve Açıkgöz, 1991). Mevsimlik çiçeklerin yazlık olanları, Haziran-Aralık ayları arasındaki dönemde, kışlık olanları ise Aralık-Haziran arasındaki dönemde çiçeklenirler. Yazlık mevsimlik çiçekler ve kışlık mevsimlik çiçekler olarak iki gruba ayrılmaktadırlar.

Türkiye'de Caryophyllaceae familyasındaki *Silene* cinsine ait 52'si endemik 129 tür, 29 alttür ve 9 varyeteden oluşan toplam 147 takson doğal olarak bulunmaktadır (Davis ve ark., 1988). *Silene compacta* ve *Silene armeria* süs bitkisi olarak kullanım için uygun bulunmuştur (Öztan ve Arslan, 1993; Karagüzel ve Taşcıoğlu, 2007; Yilmaz ve Yilmaz, 2009; Draghia ve ark., 2011; Draghia ve ark., 2013; Kösa ve Karagüzel, 2020). *S. compacta* türü çekici çiçekleri ve nispeten uzun çiçeklenme dönemi ile çatı ve kaya bahçelerinde bitki parteri tasarımında parter bitkisi veya yer örtücü olarak kullanım potansiyeli bulunmaktadır (Yılmaz ve Yılmaz, 2009; Kösa ve Karagüzel, 2020)

Silene compacta tamamen tüysüz, 120 cm'ye kadar dik gövdeli, başlarında çok sayıda pembe çiçekli ve Türkiye'nin Batı, Güney, Orta, Kuzey, Doğu ve Güneydoğu Anadolu Bölgesi'nde doğal olarak 0-2100m yüksekliklerde yayılış gösteren iki yıllık veya kısa ömürlü çok yıllık bir türdür (Coode ve Cullen, 1967; Kösa ve Karagüzel, 2020).

Son yıllarda ülkemizde doğal türlerin peyzaj tasarımlarında kullanım potansiyellerinin belirlenmesi ve fidanlıklarda üretiminin sağlanabilmesi için çoğaltma yöntemlerinin belirlenmesine yönelik çalışmalar oldukça artmıştır. Bir türün sektörel yapıda yer alması, diğer bir deyimle fidanlıklarda üretilmesi ve tasarımcı ve uygulayıcılar tarafından sağlanabilir olması için yalnızca çoğaltılabilir olması yeterli değildir (Jozwik, 1992). Etkin bir fidanlık yönetimi ve ekonomik bir üretim süreci için kullanılan türün yetiştirme ortamları ve gübreleme programlarına tepkileri ile belirli ekolojik koşullarda büyüme yeteneğine ilişkin temel bilgilerin var olmasına gerek vardır (Davidson ve ark., 1994). Doğal bitki türlerinin çoğaltma yöntemlerinin belirlenmesi ve fidanlıklarda üretimi sağlanarak sera koşullarında farklı büyüme dönemlerindeki bitki büyüme özelliklerinin tespit edilmesi bu türlerin bitkisel peyzaj düzenlemelerinde yıl içerisinde farklı zamanlarda açık alana dikilme dönemlerini ve performanlarını etkilemesi bakımından oldukça önemlidir. Peyzaj Mimarlığı ve süs bitkileri disiplinlerinin en önemli görevlerinden biri de bitkisel tasarım çalışmalarında kullanım alanına uygun bitki materyalini belirlemektir.

Bu çalışmanın amacı, Antalya ili Akseki ilçesi Cevizli köyünde doğal olarak yetişen, *S. compacta* türünün fidanlıkta satışa sunuluncaya kadarki dönemde sahip olduğu büyüme özelliklerinin belirlenmesidir.

MATERYAL ve YÖNTEM

Materyal

Çalışmanın materyalini, Antalya ili Akseki ilçesi Cevizli köyünde doğal olarak yetişen, *S. compacta* türünün tohumları ve bu tohumlardan elde edilen fideleri oluşturmaktadır.

Yöntem

Çalışmada, sera koşullarında torf+perlit (1:1 hacimsel) karışımlı yetiştirme ortamı bulunan viyollere tek dönemde olarak 7 Ekim 2022 tarihinde *S. compacta* tohumları edilmiştir. Tohumların çimlenmesi sonucunda elde edilen fideler 4-5 yaprak oluşturduktan sonra 4 Kasımda torf+perlit (2:1) karışımlı yetiştirme ortamları bulunan ağız çapı 10,5 cm olan saksılara şaşırtılmıştır. Şaşırtılan bu bitkilerin 2 farklı dönemde satışa sunuluncaya kadarki dönemi geçirmeleri sağlanmıştır. Bitkiler şaşırtıldıktan 2,5 ay sonra satışa sunulmaları ve şaşırtıldıktan 4,5 ay sonra satışa sunulmalarına göre 1. dönem bitkileri ve 2. dönem bitkileri olmak üzere 2 grupta tüm bakım işlemleri, ölçümleri ve elde edilen verilerin değerlendirmeleri gerçekleştirilmiştir. 1.dönem bitkilerine 2,5 ay, 2. dönem bitkilerine ise 4,5 ay boyunca 2 haftada bir her saksıya 10 ml olarak şekilde NPK (100-50-150 ppm) özellikli gübre verilmiştir. Tüm bitkilerde satışa sunuluncaya kadarki zaman boyunca iki haftada bir bitki bitki boyu (cm), bitki eni (cm), yaprak sayısı (adet), yandal sayısı (adet) ve yan dal uzunluğu (cm) olmak üzere büyüme özellikleri ölçülmüştür. Ayrıca iki farklı bitki büyüme dönemi(2,5 ay ve 4,5 ay) sonunda bitki bitki boyu (cm), bitki eni (cm), yaprak sayısı (adet), yandal sayısı (adet), yan dal uzunluğu (cm), bitki gövde kalınlığı (mm), yaprak eni (cm), yaprak boyu(cm), yaprak alanı (cm^2), kök sayısı (adet), kök uzunluğu (cm), kök ve gövde yaş ağırlığı (g), kök ve gövde kuru ağırlığı (g) ölçümleri yapılmıştır. Bu ölçümlerin gerçekleştirilebilmesi için uzunluk ve en ölçümlerinde cetvel ve kalınlık ölçümlerinde ise dijital kumpas aleti kullanılmıştır. Ağırlıkların ölçülmesinde 0,01 g düzeyinde hassasiyeti bulunan hassas terazi kullanılmıştır. Bitki kök ve gövdelerinin kuru ağırlıkların tartılması amacıyla bitkilerin bu kısımları sıcaklığı 50 C'ye ayarlanmış inkübatörde 5 ºC gün süreyle tutulmuştur.

BULGULAR ve TARTIŞMA

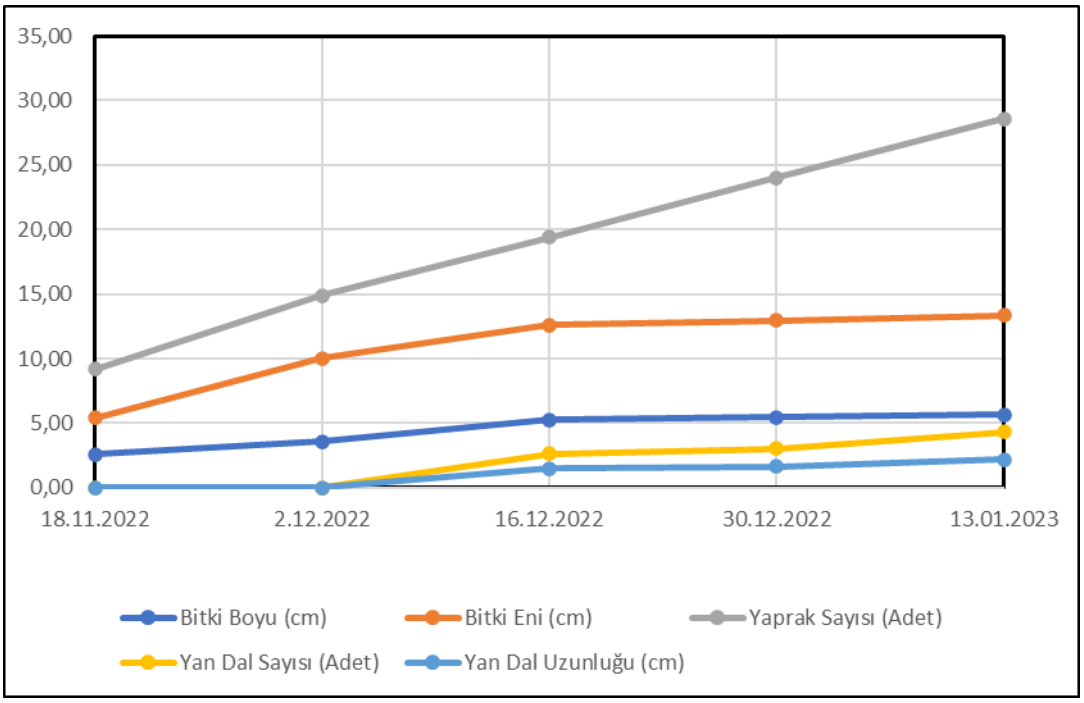
Bitki Büyüme Özelliklerinin Zamana Göre Değişimi

1.dönem bitkilerinde 2,5 ay boyunca 2 haftada bir gerçekleştirilen ölçümler neticesinde elde edilen büyüme özelliklerine ait bilgiler Çizelge 1'de, zamana göre değişim grafiği ise Şekil 1'de

sunulmuştur. 4 Kasım 2022 tarihinde saksılara şaşırtılan fidelerde 2 hafta sonra yapılan ilk ölçüm tarihi olan 18 Kasımda 2,56 cm olan bitki boyunun satışa sunulma tarihi olarak belirlenen 13 Ocakta 5,67 cm'e ulaştığı görülmektedir. Bununla birlikte, bitki eninin 5,43 cm'den 13,33 cm'e ve yaprak sayısının ise 9,2 adetten 28,58 adete ulaştığı belirlenmiştir. Yan dal oluşumu şaşırtılma zamanından 6 hafta sonra görülmeye başlanmıştır. Satışa sunulma tarihi olan 13 Ocakta yan dal sayısı 4,31 adet, yan dal uzunluğu ise 2,21 cm olarak belirlenmiştir (Çizelge 1).

Çizelge 1. Birinci dönem (2,5 ay) bitkilerinde bitki büyüme özellikleri

Bitki Büyüme Özellikleri	**Ölçüm Tarihleri**				
	18.11.2022	**2.12.2022**	**16.12.2022**	**30.12.2022**	**13.01.2023**
Bitki Boyu (cm)	2,56	3,59	5,28	5,47	5,67
Bitki Eni (cm)	5,43	10,05	12,62	12,97	13,33
Yaprak Sayısı (Adet)	9,20	14,89	19,42	24,01	28,58
Yan Dal Sayısı (Adet)	0,00	0,00	2,65	3,04	4,31
Yan Dal Uzunluğu (cm)	0,00	0,00	1,52	1,65	2,21



Şekil 1. Birinci dönem (2,5 ay) bitkilerinde bitki büyüme özelliklerinin zamana göre değişimi

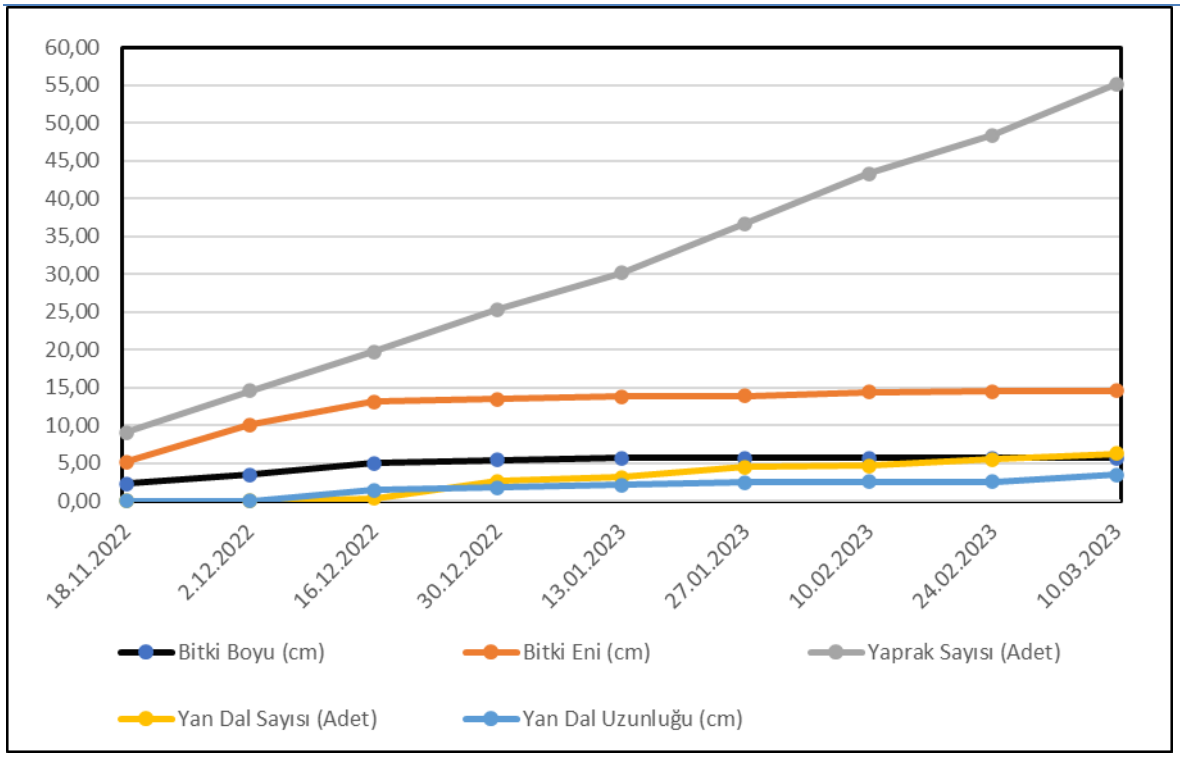
2. dönem bitkilerinde 4,5 ay boyunca 2 haftada bir gerçekleştirilen ölçümler neticesinde elde edilen büyüme özelliklerine ait bilgiler Çizelge 2'de, zamana göre değişim grafiği ise Şekil 2'de

verilmiştir. İlk ölçüm tarihi olan 18 Kasım 2022'de 2,30 cm olarak ölçülen bitki boyunun satışa sunulma tarihi olarak belirlenen 10 Mart tarihinde 5,73 cm olduğu görülmektedir. Bununla birlikte, bitki eninin 5,14 cm'den 14,56 cm'e ve yaprak sayısının ise 9,08 adetten 55,11 adete ulaştığı tespit edilmiştir. Yan dal oluşumu bu grup bitkilerde de şaşırtılma zamanından 6 hafta sonra görülmeye başlanmıştır. Satışa sunulma tarihi olan 10 Mart 2023 tarihinde yan dal sayısı 4,31 adet, yan dal uzunluğu ise 2,21 cm olarak saptanmıştır (Çizelge 2).

Çizelge 2. İkinci dönem (4,5 ay) bitkilerinde bitki büyüme özellikleri

Bitki Büyüme Özellikleri	**Ölçüm Tarihleri**								
	18.11.2022	**2.12.2022**	**16.12.2022**	**30.12.2022**	**13.01.2023**	**27.01.2023**	**10.02.2023**	**24.02.2023**	**10.03.2023**
Bitki Boyu (cm)	2,30	3,48	4,97	5,41	5,66	5,68	5,70	5,72	5,73
Bitki Eni (cm)	5,14	10,08	13,14	13,51	13,85	13,91	14,37	14,52	14,56
Yaprak Sayısı (Adet)	9,08	14,62	19,71	25,29	30,14	36,72	43,25	48,41	55,11
Yan Dal Sayısı (Adet)	0,00	0,00	0,32	2,62	3,16	4,46	4,70	5,49	6,27
Yan Dal Uzunluğu (cm)	0,00	0,00	1,44	1,79	2,12	2,48	2,52	2,57	3,50

İki farklı bitki büyüme döneminde elde edilen veriler karşılaştırıldığında, her iki dönemde de benzer değerlerde olmakla birlikte bitki boyu, bitki eni, yaprak sayısı, yan dal sayısı ve yan dal uzunluğunun ilk satış dönemi olan 13 Ocak tarihine kadar hızla artarak devam ettiği belirlenmiştir. Ancak bitki büyüme özelliklerindeki bu artış oranının, 2. dönem bitkilerinde 13 Ocaktan sonra ikinci satış dönemi olan 10 Marta kadar olan süreçte azaldığı görülmektedir (Çizelge 2).



Şekil 2. İkinci dönem (4,5 ay) bitkilerinde bitki büyüme özelliklerinin zamana göre değişimi

Fidanlık Dönemi Sonundaki Bitki Büyüme Özellikleri

Çalışmada, *S. compacta* fidelerinin saksılara şaşırtıldıkları tarih olan 4 Kasım 2022 tarihinden sonraki ilk satış dönemi olarak belirlenen 13 Ocak 2023 tarihine kadar olan 2,5 aylık süre sonundaki 1. dönem bitkilerinde ve 4 Kasım 2022 tarihinde ikinci satış dönemi olarak belirlenen 10 Mart 2023 tarihine kadar olan 4,5 aylık süre sonundaki 2. dönem bitkilerinde ölçülen bitki büyüme özelliklerine bilgiler Çizelge 3'te sunulmuştur. Bitki büyüme özellikleri 2,5 aylık süre sonunda ve 4,5 aylık süre sonundaki ölçümlere göre değerlendirildiğinde, 4,5 aylık süre sonunda tüm büyüme özelliklerinde artış olduğu tespit edilmiştir. Büyüme özelliklerindeki en fazla artışın yaprak sayısında olduğu görülmektedir.

S. compacta fidelerinin saksıya aktarıldıktan 2,5 ay sonra 5,67 cm bitki boyuna, 13,33 cm bitki enine, 5,22 mm gövde kalınlığına, 30 adet yaprağa, 6,93 cm^2 yaprak alanına, 7,48 cm yaprak boyuna, 1,91 cm yaprak enine, 4,31 adet yan dala, 2,21 cm yan dal uzunluğuna, 16,20 adet köke, 18,60 cm kök uzunluğuna, 1,29 g kök yağ ağırlığına, 0,24 g kök kuru ağırlığına, 8,87 g gövde yaş ağırlığına, 1,22 g gövde kuru ağırlığına sahip olduğu belirlenmiştir. *S. compacta* fidelerinin saksıya aktarıldıktan 4,5 ay sonra ise, 5,73 cm bitki boyuna, 14,56 cm bitki enine,

7,55 mm gövde kalınlığına, 55,11 adet yaprağa, 8,08 cm^2 yaprak alanına, 8,11 cm yaprak boyuna, 1,98 cm yaprak enine, 6,27 adet yan dala, 3,50 cm yan dal uzunluğuna, 18,55 adet köke, 20,28 cm kök uzunluğuna, 4,62 g kök yağ ağırlığına, 0,94 g kök kuru ağırlığına, 12,71 g gövde yaş ağırlığına, 2,79 g gövde kuru ağırlığına sahip olduğu tespit edilmiştir (Çizelge 3).

Çizelge 3. Fidanlık dönemi sonundaki bitki büyüme özellikleri

Bitki Büyüme Özellikleri	**Büyüme Dönemleri**	
	1.Dönem Bitkileri (2,5 Ay)	**2.Dönem Bitkileri (4,5 Ay)**
Bitki boyu (cm)	5,67	5,73
Bitki Eni (cm)	13,33	14,56
BitkiYaprak Sayısı (adet)	28,58	55,11
Yaprak Alanı(cm^2)	6,93	8,08
Yandal sayısı (adet)	4,31	6,27
Yandal Uzunluğu (cm)	2,21	3,50
Bitki gövde kalınlığı (mm)	5,22	7,55
Yaprak Eni (cm)	1,91	1,98
Yaprak Boyu (cm)	7,48	8,11
Kök sayısı (adet)	16,20	18,55
Kök uzunluğu (cm)	18,60	20,28
Kök yaş ağırlığı (g)	1,29	4,62
Gövde yaş ağırlığı (g)	8,87	12,71
Kök kuru ağırlığı (g)	0,24	0,94
Gövde kuru ağırlığı (g)	1,22	2,79

SONUÇ

Bu çalışmada, Antalya ili Akseki ilçesi Cevizli köyünde doğal olarak yetişen, *Silene compacta* türünün fidanlıkta satışa sunuluncaya kadarki dönemde sahip olduğu büyüme özellikleri belirlenmiştir. Çalışmada, Ekim ayında ekilen tohumların yaklaşık bir ay sonra Kasım ayında saksılara şaşırtılma durumuna ulaştığı tespit edilmiştir. Çalışmada kullanılan 10,5 cm'lik saksıların bu türün sera koşullarında satışa sunuluncaya kadarki süreci geçirmesi için yeterli bir boyuta sahip olduğu belirlenmiştir. Araştırmada, aynı tarihte ekilen tohumlardan elde edilen bitkilerin yine aynı tarihte aynı boyutta aynı yetiştirme ortamı doldurulan saksılara şaşırtılmalarından sonraki süreçte, iki farklı satışa sunulma tarihine kadar sulama ve gübreleme

olmak üzere bakımları benzer şekilde sağlanmıştır. Ilk satışa sunulma tarihi saksılara dikilmelerinden 2,5 sonra, ikinci satışa sunulma zamanı ise 4,5 ay sonra olacak şekilde kurgulanan bu çalışma sonucunda, her iki dönem bitkilerinde de ilk satış zamanına kadar olan süreçteki büyüme özellikleri hızla artmış, ancak ikinci satış dönemine kadarki olan süreçte büyüme hızı ve büyüme oranındaki artış azalmıştır. Bu sonuç, *S. compcata* türünün sera koşullarında saksılarda satışa sunuluncaya kadarki dönemin yaklaşık olarak tohumun ekiminden sonra 4 ay, bitkilerin saksılara şaşırtılmasında sonra ise 3 ay olması gerektiğini göstermektedir. Bu sonuca göre, *S. compacta* türünün fidelerinin satışa sunuluncaya kadar ortalama, 6 cm bitki boyuna, 14 cm bitki enine, 42 adet yaprak sayısına, 5 adet yan dala, 3 cm yan dal uzunluğuna, 7,5 cm^2 yaprak alanına, 6,5 mm gövde kalınlığına, 2 cm yaprak enine, 8 cm yaprak boyuna, 17 adet kök sayısına, 19 cm kök uzunluğuna, 3 g kök yaş ağırlığına, 11 g gövde yaş ağırlığına, 1 g kök kuru ağırlığına, 2 g gövde kuru ağırlığına sahip olduğu belirlenmiştir.

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PERCEPTION OF BUSINESS EDUCATION STUDENTS ON EFFECTIVENESS OF SIWES ADMINISTRATION IN FEDERAL COLLEGES OF EDUCATION IN THE SOUTH-SOUTH

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Abstract
The study ascertained perception of Business Education students on effectiveness of SIWES administration in Federal Colleges of Education in the South-South Nigeria. Three research questions guided the study and three null hypotheses were tested at 0.05 level of significance. The study adopted descriptive survey research design. The area of the study was South-South Nigeria. The population of the study consisted of all 300 level students in Business Education programme in the three Federal Colleges of Education in the South-South. The instrument for data collection was a structured questionnaire, validated by two experts. 25 questionnaire item was administered to the respondent by the researchers. Mean and standard deviation were used for data analysis while t-test was used to test the null hypotheses at 0.05 level of significance. Findings revealed that administrative effectiveness affects business education student's orientation process, placement process and payment of allowance process in SIWES programmes in Federal Colleges of Education in the South-South. Based on these findings, it was recommended among others that The FGN should strengthen the scheme through provision of adequate funding in order to enable the scheme to carry out its numerous activities effectively. Government and management of tertiary institutions should form a synergy with various organizations that are capable of accommodating students for SIWES programme in order to avoid a mis-match between field of students and where they are posted for their SIWES programme.
Keywords: Business Education, SIWES, Effectiveness, Administration.

INTRODUCTION

Over the years, industrial training has provided an avenue for the business education students to have the required practical knowledge to cope with the real-life situation in work places after completing their education. Industrial training is essential for business students because almost everything that is being studied in business education requires practical experience and exposure to internationalized

Business education is an aspect of education that is geared at equipping the learners (students) with business and education competencies (that is skills, knowledge and attitude) needed to effectively and efficiently function in the world of work either as an employer or an employee. In a similar view, Osuola (2004) in Olymese (2016) opined that business education is divided into two parts: office education which is vocational in nature for office careers and general business education which is a programme that provide information and competences needed for managing business. The primary objective of business education is to foster the acquisition of the necessary business competence needed to effectively function in the world of work either as an employee or an employer of labour. The need for ensuring that the theoretical knowledge acquired by students is matched with their practical knowledge gave room to the establishment of Student Industrial Work Experience Scheme (SIWES).

The SIWES center, units or department which is under the administrative head of the institutions, (in Colleges of Education is the Provost) is vested with the following functions and activities as enumerated in the industrial training policy document No1 of 1973. To develop, implement and regularly review guidelines for SIWES. Registration of eligible students for industrial training, timely collection, completion and submission of all ITF forms/documents, master list, placement list, direct e-payment form, ITF form and to the supervising ITF officers. Identify placement opportunities for students and assist in the placement of students on attachment with employers. Organized orientation programmes for all students going for IT in collaboration with ITF. Organize and coordinate supervision visits to students at IT sites. Capture students bank details at the point of registration for SIWES and effectively follow up.

Hortzell (2015) defined administration as basically an organization process, concerned with the implementation of objectives and plan with internal operator efficiently. It either connotes bureaucratic structure and behaviours with relatively routine decision making and maintenance of internal status. Also Okeke (2012) defined administration as that part of the management which is concerned with installation and carrying out procedures by which the program has laid

down, communicated and the progress of activities are regulated and checked against plans that is mobilization of the efforts of members and materials towards the attainment of stated objectives.

Hence, administrative effectiveness entails that SIWES unit or department of an institution should be capable of producing a desired result or output that is producing an intended or expected outcome. Thus the questions remain are the SIWES unit or department in the Federal College of Education in the South-South producing the desired output as concerned the responsibilities vested upon them by the ITF and their host institutions. Shuaibualiyu, Muazu and Muhammed (2020) states that, despite all the good intention of the scheme and efforts to ensure its implementation and goal actualization. Intending SIWES students are faced with challenges ranging from lack of standard orientation, inefficient supervisors, lack of proper monitoring by industry supervisors, poor placement, poor log book management and lack of ICT facilities. Ochiagh (2010) opined that for effective administration of SIWES units/department of an institution to be achieved, if requires constant internal and external supervision and evaluations from ITF.

Thus, it is pertinent for institutions of higher learning to ensure effectiveness and efficiency in the administration of the scheme which hopefully may create positive impact on the target students who constitute the potential labour force for the economy.

Statement of the Problem

SIWES requires effective and efficient administration to enable students receives proper work, training and experience which in the long run will enable them fit in properly in the work of life after graduation. Odika in Olumese and Ediabonya (2016) opined that, the attainment of the stated objectives depends largely on the effectiveness of the SIWES administration in the higher institution.

Although, there have been outcry about challenges of SIWES administration. Okolocha and Ibik (2014) stated that the major problems of SIWES unit administration are lack of proper implementation and commitment of staff and institutions. Chinedu (2022) also stated the following as some of the problem militating against effective SIWES administration in Nigeria Universities, lack of orientation, lack of supervision and care, laziness of workers and lack of support.

Shuaibualiyu, Muazu and Muhammed (2020), Olabiyi, Okafor and Aiyelabowo (2012) and Bupo (2018), all these studies revealed challenges of SIWES administration in Nigerian

University. None of the above studies or any other known studies by the researchers reveal the perception of business education students on the effectiveness of SIWES administration in Federal Colleges of Education in the South-South. Hence, this necessitated the study.

Objectives of the Study

The main objectives of this study are to examine the perception of business education students on the effectiveness of SIWES administration in Federal Colleges of Education in the South-South. Specifically, the study sought to determine

1. The administrative effectiveness of business education student's orientation process of SIWES program in Federal Colleges of Education in the South-South.
2. The administrative effectiveness of business education student's placement process of SIWES program in Federal Colleges of Education in the South-South.
3. The administrative effectiveness of business education student's payment of allowance process of SIWES program in Federal Colleges of Education in the South-South.

Research Questions

1. To what extent is the administrative effectiveness of business education student's orientation process of SIWES program in Federal Colleges of Education in the South-South?
2. To what extent is the administrative effectiveness of business education students placement process of SIWES program in Federal Colleges of Education in the South-South?
3. To what extent is the administrative effectiveness of business education students payment of allowance process of SIWES program in Federal Colleges of Education in the South-South?

Hypotheses

The following null hypotheses guided the study

1. There is no significant difference between male and female business education students in obtaining administrative effectiveness of SIWES orientation program in Federal Colleges of Education in the South-South.
2. There is no significant difference between male and female business education students in obtaining administrative effectiveness of SIWES placement program in Federal Colleges of Education in the South-South.

3. There is no significant difference between male and female business education students in obtaining administrative effectiveness of SIWES payment of allowance program in Federal Colleges of Education in the South-South.

METHOD

The design of the study was survey research design. The study was carried out in South-South geo-political zone of Nigeria. The population of the study consisted of all 149 students of 300 level students in the business education programme in the three (3) federal colleges of education in the South-South Nigeria (Federal College of Education Technical Asaba, Delta State, Federal College of Education Technical Omoku, River State and Federal College of Education Technical Obudu, Cross River State). The instrument for data collection in this study was a structured questionnaire. The questionnaire items were generated from the research questions which were divided into two sections. Section one of the questionnaires was to seek information on personal data of the respondents while sections two of the questionnaire were divided into clusters, covering the research questions. Also, three (3) hypothesis were drawn from the study. The reliability of the instrument was determined through test- retest techniques on business education students in Federal colleges of education (Technical) Umunze, Anambra State and Federal College of Education (Technical) Uyiamufu, Enugu State which is located outside the study area. The data that were obtained from the instrument was analyzed using Pearson Product Moment Correlation and the reliability coefficient of 0.05 was obtained at the end of the administration which determined the extent of reliability of the instrument. The research questions were analyzed using mean and standard deviation while t-test was used to test the null hypothesis at 0.05 level of significance. A mean score of 2.00 was used to determine the cut-off point, using an interval width of 0.05 so that upper limit is 2.50. Any items with a mean score of 2.50 and above were regarded as accepted, while a mean score below 2.50 were regarded as rejected. The hypothesis was tested using t-test at 0.05 level of significance. Where the P-value is greater than 0.05 the hypothesis will be accepted but where P-value is less than 0.05 the hypothesis will be rejected.

RESULTS

Research Questions1: To what extent is the administrative effectiveness of business education student's orientation process in SIWES program in Federal Colleges of Education in the South-South?

Table 1: Administrative Effectiveness of Business Education Student's Orientation Process in SIWES Program in Federal Colleges of Education

S/N	STATEMENT	$\bar{x}$	SD	Decision
1	Orientation exercises are organized within a specified time frame	3.88	1.19	High Extent
2	Issues of orientation exercise are not considered after the allotted time	3.70	0.89	High Extent
3	Each orientation exercise new idea and ways of handling SIWES programmes is always discussed	3.49	0.94	High Extent
4	Proper records of SIWES orientation process are achieved	3.74	0.93	High Extent
5	Computerization of SIWES orientation process is highly achieved	3.58	1.05	High Extent
6	Proper planning and organization of SIWES orientation exercise is achieved	3.26	0.97	High Extent
7	Material needed during SIWES orientation process is fully available	3.28	0.83	High Extent
8	Resources personal needed for SIWES orientation process are well experienced	3.44	0.81	High Extent
9	SIWES orientation is a proper guide on students	3.52	0.91	High Extent

The item by item analysis in table 1 shows that all items with the mean scores ranging from 3.26 to 3.88 are accepted by the respondents that to a high extent, administrative effectiveness affects business education student's orientation process in Federal Colleges of Education in the South-South. Also, the standard deviation ranges from 0.81-1.19 which indicated a close range in deviation among the responses of the respondents.

Research Question Two: To what extent does administrative effectiveness affects business education student's placement process in SIWES program Federal Colleges of Education in the South-South?

Table 2: Administrative Effectiveness of Business Education Student's Placement Process in SIWES Program in Federal Colleges of Education

S/N	STATEMENT	$\bar{x}$	SD	Decision
10	Is there a check on job specification from SIWES office	4.05	0.86	Very High Extent
11	SIWES provide credible alternative for job placement	3.41	1.02	High Extent
12	Credible monitoring on placement from SIWES office.	3.61	0.82	High Extent
13	Credible supervision on placement from SIWES office	3.53	0.76	High Extent
14	Adequate information from SIWES office on placement.	3.49	0.87	High Extent
15	Proper documentation of SIWES placement	3.55	0.82	High Extent
16	How supportive is SIWES office during student placement	3.70	0.78	High Extent
17	Compliance with rules and regulations as concern placement	3.36	0.87	High Extent
18	Work place complains are promptly handled by the SIWES office.	3.59	0.85	High Extent

The above table 2 reveals the mean range from 3.36-4.05. Hence, this implies that the respondents to a high extent accepted that administrative effectiveness affects business education student's placement process in SIWES program in Federal Colleges of Education in the South-South. The standard deviation reveals a range from 0.76-1.02 which indicates a close range in deviation among the responses of the respondents.

Research Question Three: To what extent does administrative effectiveness affects business education student's payment of allowance process in SIWES program in Federal Colleges of Education in the South-South?

Table 3: Administrative Effectiveness of Business Education Student's Payment of allowance Process in SIWES Program in Federal Colleges of Education

S/N	STATEMENTS	$\bar{x}$	SD	Decision
20	No amount of SIWES allowance can help students break even in financial expenditure while in school.	3.93	0.72	High Extent
21	SIWES allowance stimulates students interest i getting involved in the placement	2.96	1.09	Low Extent
22	There is no need to increase SIWES allowance as it adds nothing to students' expenditure.	2.38	1.12	Low Extent
23	SIWES is all about collecting stipend	3.53	0.79	High Extent
24	SIWES allowance are satisfactory	3.58	0.88	High Extent
25	Unnecessary delays are experience before payment of SIWES allowance.	3.16	1.02	High Extent
26	SIWES allowance are paid as at when due	3.46	0.99	High Extent
27	SIWES allowance serve as motivation	3.04	1.03	High Extent

The item by item analysis in table 3 shows that all items with mean scores ranging from 2.96 to 3.93 was accepted by the respondents that to a high extent, administrative effectiveness affects business education students payment of allowance process in SIWES program in Federal Colleges of Education in the South-South. The standard deviation reveals a range from 0.72 to 1.12 which indicates a close range in deviation among the responses of the respondents.

Hypothesis 1: There is no significant difference between male and female business education students in obtaining administrative effectiveness of SIWES orientation program in Federal Colleges of Education in the South-South.

Table 4: Summary of t-test analysis on mean ratings on male and female business education students in obtaining administrative effectiveness of SIWES orientation program in Federal Colleges of Education in the South-South.

Variables	N	Mean	Std. Dev.	t-cal.	Df	p-value	Decision
Male	149	20.95	7.20				
				4.825	78	.000	Sig.
Female	149	14.35	4.80				

The result in table 4 shows that the calculated t-test value is 4.825 and a p-value .000 with degree of freedom (df) 78 at alpha or probability level of 5% (.05). Since the calculated p-value .000 is less than the alpha level .05 (p .000 < α.05), the tested null hypothesis is rejected. Hence, there is a significant difference between the male and female business education students in obtaining administrative effectiveness of SIWES orientation program in Federal Colleges of Education in the South-South.

Hypothesis 2: There is no significant difference between male and female business education students in obtaining administrative effectiveness of SIWES placement program in Federal Colleges of Education in the South-South.

Table 5: Summary of t-test analysis on mean ratings on male and female business education students in obtaining administrative effectiveness of SIWES placement program in Federal Colleges of Education in the South-South.

Variables	N	Mean	Std. Dev.	t-cal.	Df	p-value	Decision
Male	149	17.93	6.16				
				12.313	78	.000	Sig.
Female	149	56.93	19.06				

The result in Table 5 indicates that the calculated t-test value is 12.313 and a p-value .000 with degree of freedom (df) 78 at alpha level 5% (.05). Since the calculated p-value .000 is less than the alpha level of .05 (p .000 < α.05), the tested null hypothesis is rejected. Hence, there is a significant difference between male and female business education students in obtaining administrative effectiveness of SIWES placement program in Federal Colleges of Education in the South-South.

Hypothesis 3: There is no significant difference between male and female business education students in obtaining administrative effectiveness of SIWES payment of allowance program in Federal Colleges of Education in the South-South.

Table 6: Summary of t-test analysis on mean ratings on male and female business education students in obtaining administrative effectiveness of SIWES payment of allowance program in Federal Colleges of Education in the South-South.

Variables	N	Mean	Std. Dev.	t-cal.	Df	p-value	Decision
Male	149	20.95	7.20				
				2.019	78	.047	Sig.
Female	149	17.93	6.16				

The result in Table 6 indicates that the calculated t-test value is 2.019 and a p-value .047 with degree of freedom (df) 78 at alpha or probability level of 5% (.05). Since the calculated p-value .047 is less than the alpha level .05 (p .047 < α.05), the tested null hypothesis is thus rejected. Hence, there is a significant difference between male and female business education students in obtaining administrative effectiveness of SIWES payment of allowance program in Federal Colleges of Education in the South-South.

DISCUSSION OF FINDINGS

The findings of the present study on research question one revealed that administrative effectiveness affects business education student's SIWES orientation process in federal colleges of education in the South-South. This finding agrees with the finding of Okolocha and Ibik (2014) who found that the major problems of SIWES in Nigeria are lack of proper implementation and lack of commitment by tertiary institutions, industries, government and the coordinating agencies. Ogbonnaya (2021) supported this assertion by stating that some of the significant challenges are the inability to secure placement in industries/organisations that are very relevant to their areas of disciplines, ineffective supervision from both industry and institution-based supervisors, poor orientation exercise and the lack of seriousness on the part of the students.

The findings of the study in respect to research question two revealed that administrative effectiveness affects business education student's placement process in SIWES program in Federal College in the South-South. The present findings however, is supported by Mofesola

(2012) who stated that the placement of students for industrial training through SIWES is relevant to the student course of study because it fulfills the number one objective of the federal government for establishing SIWES which is an avenue to make student acquire practical skills compared to classroom theoretical studies. Also this finding agree with the findings of Okolocha (2012) which showed that the student agreed generally that SIWES helped to make what was learnt in the classroom more meaningful by exposing and equipping them with practical experience. This finding was also supported by Awojobi (2002 reference) where the author stressed that many students for the SIWES programme could not find relevant placement that would enhance their course of study.

The findings from the analysis of research question three (3) reveals that administrative effectiveness affects business education student's payment of allowance process in SIWES program in Federal College of Education in the South-South. This aligns with the findings of Elijah (2017) who stated that the challenges students encounter during their SIWES programme ranges from delay in the payment of their allowances, unfriendly attitude of supervisor and lack of basic training tools and accommodation problems. The implication of the results shows that there were inadequate supervision by the school, difficulties of students in getting placement and undue delay in paying students' and supervisors' allowances.

The findings in hypothesis one of this study showed that there is a significant difference between the male and female business education students in obtaining administrative effectiveness of SIWES orientation program in Federal Colleges of Education in the South-South.

Similarly, findings in hypothesis two of this study further revealed that **there is a** significant difference between male and female business education students in obtaining administrative effectiveness of SIWES placement program in Federal Colleges of Education in the South-South.

Finally, the findings in hypothesis three found that **there is a** significant difference between male and female business education students in obtaining administrative effectiveness of SIWES payment of allowance program in Federal Colleges of Education in the South-South.

It is important to note that, after thorough search by the researchers there were no studies to support the findings of this study.

SUMMARY OF THE FINDINGS

Based on the data collected and analyzed, the following findings emerged;

1. That to a high extent, administrative effectiveness affects business education student's orientation process in SIWES program in Federal College of Education in the South-South.
2. That to a high extent, administrative effectiveness affects business education student's placement process in SIWES program in Federal College of Education in the South-South.
3. That to a high extent, administrative effectiveness affects business education student's payment of allowance process in SIWES program in Federal College of Education in the South-South.
4. **There is a** significant difference between the male and female business education student's in obtaining administrative effectiveness of SIWES orientation program in Federal Colleges of Education in the South-South.
5. **There is a** significant difference between male and female business education students in obtaining administrative effectiveness of SIWES placement program in Federal Colleges of Education in the South-South.

There is a significant difference between male and female business education students in obtaining administrative effectiveness of SIWES payment of allowance program in Federal Colleges of Education in the South-South.

CONCLUSION

This article has been able to look at the issues concerning SIWES which is a core scheme in ITF and which is saddled with the responsibility of strengthening the effective teaching and learning of skill based course such as Business Education. Based on the data collated and the subsequent analyses, this paper therefore concludes that SIWES is of great benefit to students of Business Education in Federal Colleges of Education in Delta States. SIWES programme usually helps business education students to acquire skills that will expose them to real work situation where they could make use of necessary tools. It therefore implies that the proper and effective administration of SIWES will go a long way in boosting and promoting the competencies of the workforce. It was also concluded that SIWES is confronted with series of challenges and this may have hindered the realization of the goals and objectives of the scheme and it therefore needs to be given attention by all concerned stakeholders.

RECOMMENDATIONS

This empirical investigation has revealed outstanding findings and based on that, the following recommendations are therefore advanced:

1. The FGN should strengthen the scheme through provision of adequate funding in order to enable the scheme to carry out its numerous activities effectively
2. Government and management of tertiary institutions should form a synergy with various organizations that are capable of accommodating students for SIWES programme in order to avoid a mis-match between field of students and where they are posted for their SIWES programme.
3. Business education students learning progress should be closely monitored and supervised by experienced staff
4. It is also recommended that institutions should release funds for the payment of stipend to trainees to ease off the problem of inadequate fund on students. Funds should also be released to institutions for effective supervision of students during SIWES training.
5. SIWES, Seminars and workshops programme should be strengthened in business education to educate undergraduates and lectures on institutions and industries collaboration.

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IĞDIRDA DOĞAL OLARAK YETİŞEN KUŞBURNU (*Rosa* spp.) GENOTİPLERİNİN ÖN SELEKSİYONU

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Özet
Bu çalışma Iğdır'ın Tuzluca ve Aralık ilçelerinde bulunan doğal kuşburnu popülasyonlarında ümitvar kuşburnu genotiplerinin belirlenmesi amacıyla 2023 yılında yürütülmüştür. Araştırma da 107 genotip, meyve ağırlığı, meyve eni, meyve boyu, meyve eti oranı, çekirdek ağırlığı, çekirdek sayısı, titre edilebilir asitlik, SÇKM, pH, meyve iç ve dış tüylülüğü, aroma ve meyve rengi gibi meyve özellikleri bakımından incelenmiştir. Genotiplerden meyve ağırlığı 1.5 g ve üzeri olan aynı zamanda %60 ve üzeri meyve eti oranına sahip 52 genotip değerlendirmeye alınmıştır. Seçilen ümitvar genotiplerin meyve ağırlığı 1.50-2.69 g; meyve eni 7.33-5.39 mm; meyve boyu 16.70-30.39 mm; meyve eti oranı %60.62-78.37; çekirdek ağırlığı 0.43-0.86 g; çekirdek sayısı 11.80-34.40 adet arasında; titre edilebilir asitlik değeri %1.50-11.66; SÇKM değeri %1.20-15.30; pH değeri 3.70-4.73 arasında değişmiştir. Genotiplerde meyve dış tüylülüğü 51'inde 'tüylü',1'inde tüysüz; meyve iç tüylüğü 39'unda 'az tüylü', 9 'unda 'orta tüylü', 3'ünde tüylü,1'inde tüysüz olarak değerlendirilmiştir. Genotiplerde tat durumu 13'ünde 'ekşi', 25'inde 'mayhoş'14'ünde tatlı olarak belirlenmiştir. 2024 yılı vejetasyon başlangıcında, özellikleri öne çıkmış olan genotiplerde fenolojik incelemeler yapılacak ve araştırma ikinci yılın sonunda üstün özellikli genotiplerin belirlenmesi suretiyle tamamlanmış olacaktır.
Anahtar Kelimeler: Kuşburnu, seleksiyon, genotip, Aralık, Tuzluca

PRE-SELECTION OF ROSE HIP (*Rosa* spp.) GENOTYPES GROWING NATURALLY IN IĞDIR

Abstract
This study was carried out to determine promising rosehip genotypes in natural rosehip populations in Tuzluca and Aralık districts of Igdir in 2023. In the research, 107 genotypes were examined in terms of fruit characteristics such as fruit weight, fruit width, fruit length, fruit flesh ratio, kernel weight, number of kernels, titratable acidity, soluble solid content, pH, fruit internal and external hairiness, aroma and fruit colour. Among the genotypes, 52 genotypes with a fruit weight of 1.5 g or more and a fruit flesh ratio of 60% or more were evaluated. Fruit weight of the selected promising genotypes varied between 1.50-2.69 g; fruit width 7.33-5.39 mm; fruit length 16.70-30.39 mm; fruit flesh ratio 60.62-78.37%; kernel weight 0.43-0.86 g; number of kernels 11.80-34.40; titratable acidity value 1.50-11.66%; SCC value 1.20-15.30%; pH value 3.70-4.73. In the genotypes, was evaluated as fruit outer hairiness ‘hairy' in 51, hairless in 1; the fruit inner hair ‘less hairy' in 39, 'medium hairy' in 9, hairy in 3 and hairless in 1. The taste status of the genotypes was determined as 'sour' in 13, 'sour' in 25 and sweet in 14. At the beginning of vegetation in 2024, phenological examinations will be carried out on genotypes with outstanding features, and the research will be completed by determining the genotypes with superior features at the end of the second year.
Keywords: Rose hips, selection, genotype, Aralık, Tuzluca

GİRİŞ

Türkiye'nin Anadolu bölgesi Rosa türlerinin başlıca genetik çeşitlilik merkezlerinden biridir (Nilsson 1972) ve bu bölgede yetişen kuşburnuların çoğu tohumdan elde edilmiştir. Anadolu'nun birçok yerinde kuşburnu meyveleri antik çağlardan beri dağınık yerlerden toplanmaktadır (Ercişli1995). Doğu ve Orta Anadolu bölgesi en büyük yerli kuşburnu popülasyonuna sahiptir (Ercişli 1996).

Binlerce yıldır devam eden tohumdan yayılım, çok çeşitli kuşburnu çalılarının ortaya çıkmasına neden olmuştur. Coğrafi ve iklimsel koşullardaki bariz farklılıklara rağmen, genetik olarak çeşitlilik gösteren bu kuşburnu bitkileri ülkenin dört bir yanına dağılmıştır (Ercişli 1996). Bu genetik değişkenlik çeşitliliği, yüksek verim, iyi meyve özellikleri ve hastalık ve zararlılara karşı tolerans isteyen kuşburnu ıslah programlarına katkıda bulunmak için kullanılabilecek zengin bir kaynaktır. Bu populasyonu kullanmak için, değişkenliği incelemek ve gen bankaları kurmak için ümitvar klonları seçmek üzere farklı kuşburnu üretim alanlarını araştırmak için çaba gösterilmelidir. Ayrıca, seçilen bu çalılar, daha iyi verim elde etmek ve çeşit tabanını genişletmek için tek tip çeşitlerin ekimlerinin vejetatif çoğaltımı için kullanılabilir.

Türkiye'de kuşburnu üzerine ilk seleksiyon çalışmaları 1990'lı yılların başında Orta ve Kuzeydoğu Anadolu'da başlatılmıştır. Bu çalışmalar sonucunda çeşitli meyve özellikleri bakımından ümit verici seleksiyonlar tanımlanmıştır (Ercişli 1996; Şen & Güneş 1996). Bununla birlikte ülkemizin farklı bölgelerinde yayılım gösteren kuşburnu türlerinin seleksiyonu üzerine de çok sayıda çalışma yapılmıştır (Balta ve Çam, 1966; Kazanlaya ve ark., 2001; Çelik, 2007; Ekincialp ve Kazankaya, 2012; Akkuş, 2015; Azgın,2017)

Ülkemiz kuşburnu genetik kaynakları açısından zengin olmasına rağmen halen standart ;kuşburnu çeşitleri mevcut değildir. Ercişli, 2005; Ercişli ve Güleryüz, 2006; Akkuş, 2015). Bundan dolayı ülkemizin dört bir yanına dağılmış olan zengin kuşburnu populasyonlarının araştırılması, verim ve kalite bakımından üstün genotiplerin seleksiyon kriterlerine uygun olarak seçilmesi ve tanımlanması ve ümitvar genotiplerde daha ileri düzeyde çalışmalar yaparak çeşit yada çeşitler geliiştirilmesi oldukça önemlidir

Bu araştırmada ülkemizin Doğu Anadolu bölgesinde yer alan Iğdır ili Tuzluca ve Aralık ilçelerinde doğal olarak yetişen kuşburnu genotiplerinin ıslah amaçları doğrultusunda incelenmesi ve pomolojik özelliklerinin belirlenmesi amaçlanmıştır.

MATERYAL ve YÖNTEM

Bu çalışma, kuşburnu bitkisinin doğal olarak yoğun bir şekilde yetiştiği Iğdır'ın Tuzluca ve Aralık ilçelerinde 2023 yılında yürütülmüştür. Yaklaşık 1500 adet bitkiye gidilerek seleksiyon kriterleri doğrultusunda işaretlenen toplam 107 farklı kuşburnu genotipinin bitkileri ve meyveleri bu çalışmanın materyalini oluşturmuştur. Kuşburnu genotiplerinden örnek alınırken özellikle çok küçük meyveli, bol çekirdekli, aşırı dikenli, hastalık ve zararlılarla bulaşık olan çalılardan meyve alınmamasına dikkat edilmiştir. Her bir genotipten 50 meyve örneği alınarak meyve ağırlığı (g), meyve boyu (mm), meyve eni (mm), meyve eti oranı (%), çekirdek ağırlığı(g), çekirdek sayısı (adet), şekil indeksi, SÇKM, pH ve titre edilebilir asitlik (%) değerleri tespit edilmiştir. İlk yıl yapılan ölçüm ve tartım sonuçlarına göre ön eleme yapılarak meyve ağırlığı 1.5 g ve üzeri olan aynı zamanda % 60 ve üzeri meyve eti oranına sahip 52 genotip seçilmiştir. Çalışmanın ikinci yılında bu genotiplerden tekrar meyve örneği alınacak, yapılacak ölçüm ve tartım sonuçlarına göre tartılı derecelendirme yapılarak ümitvar genotipler belirlenecektir.

BULGULAR VE TARTIŞMA

İlk yıl ortalama değerlere göre seçilen genotiplerde meyve ağırlığının 1.50 g ile 2.69 g; meyve eninin 7.33-15.39 mm; meyve boyunun 16.70-30.39 mm; meyve şekil indeksinin 1.36-2.69; meyve eti oranının % 60.62-78.37; çekirdek ağırlığının 0.43-0.86 g; çekirdek sayısının 11.80-34.40 adet/meyve; SÇKM değerinin % 1.20-15.30; pH değerinin 3.70-4.73; titre edilebilir asit miktarının % 1.50-11.66; arasında olduğu belirlenmiştir (Çizelge 1).

Ülkemizin çeşitli yörelerinde yapılan seleksiyon çalışmalarında meyve ağırlık değerleri Gevaş ve Edremit yöresinde 1.00-1.93 g (Kazankaya ve ark., 2002), Tatvan yöresinde 0.41-2.40 g (Türkoglu ve Muradoğlu, 2003), Bitlis, Hakkâri ve Van yörelerinde 2.04-6.10 g (Kazankaya ve ark., 2005), Erzincan yöresinde 0.91-2.53 g (Şavir, 2008), Muradiye (Van) yöresinde ümitvar genotiplerde 1.82-4.09 g (Yıldız ve Çelik, 2011), Bolu Merkez İlçede ümitvar genotiplerde 1.40-2.70 g (Özen, 2013); Hamur (Ağrı) yöresinde 1.44-4.69 g arasında bulnmuştur. Ülkemizin değişik yerlerinde yapılan araştırmalarda, meyve et oranları Kazankaya ve ark., (2005), % 46.8-79.9, Şavir, (2008), % 42.8-88.8, Yıldız ve Çelik, (2011), % 55.2-85.0, Ekincialp ve Kazankaya, (2012), % 59.3–76.6, Özen, (2013), % 64.9-82.8 Akkuş (2015) %60-79 arasında bildirilmiştir. Önceki çalışmalarda SÇKM içeriği Yıldız ve Çelik, (2011), % 15.0-26.2, Ekincialp ve Kazankaya, (2012), 14.2–27.5, Özen, (2013), % 24.5-30.5, Saeidi ve Beygi, (2009), % 13.3-17.1, Rosu ve ark., (2011), % 11.5-17.6, arasında bildirilmiştir. Yine önceki çalışmalarda titre

edilebilir asitlik miktarı Doğan ve Kazankaya, (2006), % 0.66-0.85, Dölek, (2008), % 1.09-2.50, Yıldız ve Çelik, (2011), % 1.38-3.50, Ekincialp ve Kazankaya, (2012), % 0.16–0.40, Özen, (2013), % 1.04-1.55, arasında rapor edilmiştir. Bu çalışmada elde edilen sonuçlar önceki çalışmalarla benzelik göstermektedir.

Çizelge 1. İlk yıl seçilen 52 genotipin bazı meyve özelliklerine ait ortalama değerler

Genotip No	Meyve Ağırlığı (g)	Meyve Eni (mm)	Meyve Boyu (mm)	Meyve eti oranı (%)	Meyve Şekil İndeksi	Çekirdek Ağırlığı (g)	Çekirdek Sayısı (adet/meyve)	SÇKM (%)	pH	Titre edilebilir Asitlik (%)
76 IGD-6	2.28	12.42	25.07	70.16	2.02	0.68	22.80	5.50	3.85	3.76
76 IGD-7	2.07	12.83	26.56	64.93	2.07	0.73	25.80	6.10	3.79	5.04
76 IGD-8	1.93	12.26	25.55	65.29	2.08	0.67	19.00	5.10	3.88	5.23
76 IGD-9	1.66	12.65	22.75	63.23	1.80	0.61	18.40	6.60	3.87	4.45
76 IGD-10	1.94	12.24	25.01	68.16	2.04	0.62	22.40	5.40	3.86	3.65
76 IGD-11	2.16	15.39	22.85	68.43	1.48	0.68	23.40	1.20	3.89	4.78
76 IGD-12	1.83	12.28	25.60	65.85	2.09	0.63	24.80	6.40	3.81	4.98
76 IGD-13	2.23	12.67	25.65	71.17	2.02	0.64	23.60	5.20	3.80	4.35
76 IGD-14	1.51	11.29	22.97	61.81	2.03	0.58	21.40	5.20	3.72	4.74
76 IGD-15	1.85	12.13	25.22	64.95	2.08	0.65	21.00	5.30	3.82	4.51
76 IGD-16	1.60	11.64	23.80	63.31	2.04	0.59	22.00	5.00	3.90	3.65
76 IGD-17	1.78	11.81	24.37	67.64	2.06	0.58	19.60	7.40	3.84	1.88
76 IGD-18	1.53	10.73	25.43	64.66	2.37	0.54	20.20	6.10	3.90	5.21
76 IGD-19	1.77	14.70	24.12	64.95	1.64	0.62	29.00	5.70	3.98	3.94
76 IGD-33	1.51	11.72	21.16	64.83	1.81	0.53	15.20	5.70	4.73	1.50
76 IGD-34	1.82	10.86	17.65	63.92	1.63	0.66	28.20	10.50	3.81	6.32
76 IGD-40	1.58	10.38	17.94	60.73	1.73	0.62	21.40	15.30	3.70	7.80
76 IGD-44	2.27	13.88	24.22	71.74	1.74	0.64	23.00	9.70	3.90	5.46
76 IGD-45	1.72	12.53	22.05	61.84	1.76	0.66	22.00	6.80	3.85	5.98
76 IGD-46	2.07	13.14	22.93	65.52	1.74	0.71	26.80	10.90	3.82	4.53
76 IGD-47	1.77	9.67	20.05	69.88	2.07	0.53	15.60	8.10	3.71	5.90
76 IGD-48	2.38	14.83	20.14	66.15	1.36	0.81	32.60	7.60	3.85	5.63
76 IGD-53	2.21	12.84	27.55	72.68	2.15	0.60	21.20	6.10	3.75	5.50
76 IGD-54	2.48	13.12	29.84	75.47	2.27	0.61	21.00	9.30	3.72	5.30
76 IGD-55	2.51	13.54	30.39	75.77	2.24	0.61	23.00	5.30	3.76	11.66
76 IGD-56	2.43	13.13	28.75	64.68	2.19	0.86	25.20	6.70	3.79	5.50
76 IGD-57	2.46	10.86	25.09	73.85	2.31	0.64	19.40	6.70	3.79	5.32
76 IGD-58	2.39	10.93	25.24	74.16	2.31	0.62	20.20	8.80	3.77	4.76
76 IGD-59	2.69	11.01	27.38	75.09	2.49	0.67	22.40	8.70	3.91	5.04
76 IGD-60	2.60	10.89	26.74	74.87	2.46	0.65	21.60	6.70	3.88	5.19
76 IGD-62	2.23	10.21	25.25	72.86	2.47	0.61	25.60	8.90	3.84	4.60
76 IGD-63	2.19	11.40	25.49	78.37	2.24	0.47	12.00	8.80	4.16	4.87
76 IGD-64	1.91	9.87	23.44	63.06	2.37	0.71	19.60	6.60	3.73	5.30
76 IGD-72	1.69	11.20	16.70	60.93	1.49	0.66	28.00	13.00	3.71	9.98
76 IGD-75	1.64	12.22	21.44	63.76	1.75	0.60	23.80	8.20	3.82	6.71
76 IGD-76	1.79	11.24	19.21	60.62	1.71	0.70	25.80	8.20	3.97	9.95
76 IGD-77	1.78	12.45	22.02	65.51	1.77	0.62	23.80	9.40	3.71	7.38
76 IGD-78	2.39	12.66	17.32	69.07	1.37	0.74	31.60	9.51	3.87	6.63
76 IGD-80	1.61	12.10	22.31	64.58	1.84	0.57	22.00	7.50	3.92	6.67
76 IGD-81	1.95	11.65	17.85	63.01	1.53	0.72	24.20	11.00	4.11	7.05

76 IGD-82	2.62	12.61	21.20	72.21	1.68	0.73	34.40	6.70	3.72	7.14
76 IGD-85	2.14	9.17	20.10	66.01	2.19	0.73	25.40	8.20	3.92	7.29
76 IGD-91	1.70	8.49	19.16	74.57	2.26	0.43	11.80	6.20	3.85	6.45
76 IGD-92	1.64	7.33	19.68	66.77	2.69	0.54	24.60	10.10	3.86	4.65
76 IGD-94	1.89	12.93	23.17	67.74	1.79	0.61	25.60	5.40	3.91	7.20
76 IGD-95	1.77	12.61	23.23	65.43	1.84	0.61	25.40	11.70	3.8	6.09
76 IGD-96	1.64	7.74	19.24	65.19	2.49	0.57	24.40	5.40	3.98	5.09
76 IGD-97	1.50	12.00	21.89	64.49	1.82	0.53	19.40	6.70	3.87	5.30
76 IGD-99	1.59	12.55	19.09	60.83	1.52	0.62	24.00	8.23	3.79	5.86
76 IGD-100	2.22	11.45	19.04	67.55	1.66	0.72	30.40	11.60	3.87	5.53
76 IGD-104	1.61	8.19	19.24	66.69	2.35	0.54	21.80	8.70	3.98	5.10
76 IGD-106	1.76	13.72	19.91	70.22	1.45	0.53	15.20	6.50	3.78	5.63

İlk yıl seçilen 52 kuşburnu genotipinde meyve dış tüylülük durumu 51'inde "tüylü", 1'inde "tüysüz", meyve iç tüylülük durumu 39'unda "az tüylü", 9'unda "orta tüylü", 3'ünde "tüylü",1'inde "tüysüz" aroma durumu 13'ünde "ekşi",25'inde "mayhoş, 14'ünde "tatlı"; meyve rengi 2'sinde "açık kırmızı", 13'ünde "kırmızı", 22'sibde "koyu kırmızı" ve 15'inde "turuncu" olarak değerlendirilmiştir (Çizelge 2).

Hamur (Ağrı) yöresinde yapılan bir çalışmada incelenen genotiplerin tamamında meyve dış tüylülüğü belirlenmezken, meyve iç tüylülüğü 3 genotip için 'az', 23 genotip için 'orta' ve 45 genotip için 'çok' olarak kaydedilmiştir (Akkuş,2015).Başka bir çalışmada Akıncılar (Sivas) yöresinde incelenen kuşburnu genotiplerinde meyve kabuk rengi 26'sında kırmızı, 22'sinde turuncu ve 7'sinde açık kırmızı olarak; aroma 41'inde orta, 7'sinde kötü ve 7'sinde iyi olarak; meyve dış tüylülüğü 2'sinde var olduğu, 53'ünde olmadığı; meyve içi tüylülüğünün 29'unda fazla, 21'inde orta ve 5'inde az olduğu; dikenlilik durumunun 5'inde az, 44'ünde orta, 6'sında çok olduğu belirlenmiştir (Karakuş ve Bostan, 2017). Bu çalışmada da benzer sonuçlar elde edilmiştir.

Çizelge 2. İlk yıl incelenen 52 genotipin meyve dış ve iç tüylülük durumları, aroma ve meyve rengi özellikleri

Genotip No	Meyve Dış Tüylülük Durumu	Meyve İç Tüylülük Durumu	Aroma	Meyve Rengi
76 IGD-6	Tüysüz	Az Tüylü	Tatlı	Kırmızı
76 IGD-7	Tüysüz	Az Tüylü	Tatlı	Koyu Kırmızı
76 IGD-8	Tüysüz	Az Tüylü	Mayhoş	Koyu Kırmızı
76 IGD-9	Tüysüz	Az Tüylü	Ekşi	Koyu Kırmızı
76 IGD-10	Tüysüz	Az Tüylü	Tatlı	Kırmızı
76 IGD-11	Tüysüz	Az Tüylü	Tatlı	Koyu Kırmızı
76 IGD-12	Tüysüz	Az Tüylü	Mayhoş	Koyu Kırmızı
76 IGD-13	Tüysüz	Az Tüylü	Mayhoş	Koyu Kırmızı
76 IGD-14	Tüysüz	Az Tüylü	Tatlı	Koyu Kırmızı
76 IGD-15	Tüysüz	Az Tüylü	Mayhoş	Koyu Kırmızı
76 IGD-16	Tüysüz	Az Tüylü	Ekşi	Koyu Kırmızı
76 IGD-17	Tüysüz	Az Tüylü	Tatlı	Koyu Kırmızı
76 IGD-18	Tüysüz	Az Tüylü	Ekşi	Koyu Kırmızı
76 IGD-19	Tüysüz	Tüylü	Ekşi	Koyu Kırmızı
76 IGD-33	Tüysüz	Orta Tüylü	Ekşi	Turuncu
76 IGD-34	Tüysüz	Az Tüylü	Mayhoş	Turuncu
76 IGD-40	Tüysüz	Orta Tüylü	Mayhoş	Koyu Kırmızı
76 IGD-44	Tüysüz	Az Tüylü	Mayhoş	Turuncu
76 IGD-45	Tüysüz	Az Tüylü	Mayhoş	Kırmızı
76 IGD-46	Tüysüz	Az Tüylü	Ekşi	Kırmızı
76 IGD-47	Tüysüz	Az Tüylü	Mayhoş	Turuncu
76 IGD-48	Tüysüz	Az Tüylü	Tatlı	Kırmızı
76 IGD-53	Tüysüz	Az Tüylü	Mayhoş	Koyu Kırmızı
76 IGD-54	Tüysüz	Az Tüylü	Mayhoş	Kırmızı
76 IGD-55	Tüysüz	Az Tüylü	Mayhoş	Kırmızı
76 IGD-56	Tüysüz	Orta Tüylü	Mayhoş	Koyu Kırmızı
76 IGD-57	Tüysüz	Az Tüylü	Mayhoş	Turuncu
76 IGD-58	Tüysüz	Tüylü	Tatlı	Kırmızı
76 IGD-59	Tüysüz	Orta Tüylü	Mayhoş	Koyu Kırmızı
76 IGD-60	Tüysüz	Az Tüylü	Mayhoş	Kırmızı
76 IGD-62	Tüysüz	Az Tüylü	Ekşi	Koyu Kırmızı
76 IGD-63	Tüysüz	Tüylü	Mayhoş	Kırmızı
76 IGD-64	Tüysüz	Orta Tüylü	Ekşi	Koyu Kırmızı
76 IGD-72	Tüysüz	Orta Tüylü	Ekşi	Koyu Kırmızı
76 IGD-75	Tüysüz	Az Tüylü	Tatlı	Koyu Kırmızı
76 IGD-76	Tüysüz	Az Tüylü	Tatlı	Turuncu
76 IGD-77	Tüysüz	Az Tüylü	Mayhoş	Kırmızı
76 IGD-78	Tüysüz	Az Tüylü	Mayhoş	Açık Kırmızı
76 IGD-80	Tüysüz	Az Tüylü	Tatlı	Turuncu
76 IGD-81	Tüysüz	Az Tüylü	Mayhoş	Turuncu
76 IGD-82	Tüysüz	Az Tüylü	Ekşi	Koyu Kırmızı

Çizelge 2. (devamı) İlk yıl incelenen 52 genotipin meyve dış ve iç tüylülük durumları, aroma ve meyve rengi özellikleri

Genotip No	Meyve Dış Tüylülük Durumu	Meyve İç Tüylülük Durumu	Aroma	Meyve Rengi
76 IGD-85	Tüysüz	Az Tüylü	Tatlı	Açık Kırmızı
76 IGD-91	Tüysüz	Orta Tüylü	Mayhoş	Koyu Kırmızı
76 IGD-92	Tüylü	Az Tüylü	Tatlı	Turuncu
76 IGD-94	Tüysüz	Orta Tüylü	Mayhoş	Turuncu
76 IGD-95	Tüysüz	Az Tüylü	Ekşi	Turuncu
76 IGD-96	Tüysüz	Az Tüylü	Mayhoş	Turuncu
76 IGD-97	Tüysüz	Az Tüylü	Mayhoş	Turuncu
76 IGD-99	Tüysüz	Az Tüylü	Mayhoş	Turuncu
76 IGD-100	Tüysüz	Az Tüylü	Ekşi	Kırmızı
76 IGD-104	Tüysüz	Orta Tüylü	Tatlı	Kırmızı
76 IGD-106	Tüysüz	Tüysüz	Ekşi	Turuncu

SONUÇ

2 yıllık yapılması planlanan kuşburnu seleksiyon çalışmamızda Iğdır'ın Tuzluca ve Aralık ilçelerinde doğal kuşburnu popülasyonunda yetişen toplam 107 kuşburnu genotipinden meyve örneği alınmış, yapılan ölçüm tartımlar neticesinde bir ön eleme yapılarak 52 genotip seçilmiştir. Türkiye'nin farklı yörelerinde yapılan az sayıdaki çalışmayla kıyaslandığında bu çalışmaya ait sonuçların genel olarak iyi durumda olduğu görülmüştür. Çalışmada incelenen genotiplerin meyve özellikleri, özellikle de kimyasal özellikleri bakımından farklılıklar gözlemlenmiş olup bu farklılıkların incelenen genotipin genetik yapısından, bölgenin iklim ve toprak özelliklerinden, meyvenin olgunluk durumundan ve ağacın bulunduğu rakım ve yöneyden kaynaklı olabileceği düşünülmektedir.

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STRUCTURAL ANALYSIS OF WUDIL CATTLE MARKET (KARA) WUDIL LOCAL GOVERNMENT OF KANO STATE-NIGERIA

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ABSTRACT
The study examined the structure of Wudil cattle market Wudil local government of Kano state-Nigeria. A multi stage sampling technique was employed for the study in which purposive sampling technique was used in the selection of the market, based on the concentration and intensity of the cattle marketing activities. The second stage involved random selection a total of one hundred thirty five (135) Buyers were selected using systematic sampling by truncation on weekly basis for period of 5 weeks. Descriptive statistics and ginni co-efficient was employed to analyze the collected data. The result shows that cattle buyers fall within the age range of 22-76 years and the majority 32.60% of the cattle buyers are within age group of 33-43 years, it was discovered 99% of the respondent were male. Ginni co-efficient model shown that the markets structure were competitive with low Ginni co-efficient of 0.413 which indicated homogeneous Market, freedom to enter or exit the market. The major constraints identified were price determination because value of an animal is determined by visual and tactile examination.
Keywords: Competitive, structure, Price, Cattle, Market and Analysis

INTRODUCTION

Market structure is simply a description of the number and nature of participants in a market. It relates to those characteristics of the organization of a market which strategically influence the nature of competition and pricing within the market. It also includes marketing channel and the relationship between them (Abbott and Makeham,1986). Olukosi *et a/.*,(2005) maintain that among the factors considered very important when determining market structure are the number and relative size of buyers and sellers, the degree of product differentiation, the ease of entry and exit of buyers and sellers into and out of the market, status of knowledge about costs, prices and market conditions among the participants in the market. They also gave a typology of market structures to include atomistic or pure competition, monopolistic / monopolistic competition, oligopolistic / oligopsonic competition and pure monopoly.

Despite it's largely peasant nature, Nigerian Agriculture remained one of the most important sectors of the nation's economy (Shuaibu, 1999). Apart from its contribution to Gross Domestic Product (GDP) and provisions of employment, Livestock sub sector is the major source of protein for human consumption (RIM, 1992). He further reported that cattle are the most important livestock in the country and they are the main source of animal protein such as milk, hides, bones, horns and blood which are all utilized. It is as well used as a means of transport in some part of the country. Therefore, increased knowledge and awareness of human requirement for healthy growth have focused on increasing attention as per the unique roles of livestock in developing economies. The basic biological role of cattle is no doubt in the provision of animal protein that sustains the human life .Livestock production is a source of employment and livelihood to many Nigerians. Cattle are the most predominant and highly valued livestock in Nigeria (Tewe,1997).

The study on cattle marketing in wudil local government, Kano State shade more light on some of these allegations. Marketing system is an allocating mechanism which exist to facilitate the rational allocation of resources in production and of the fact that the marketing activities increases the form and place utilities by processing and transporting agricultural commodities (Isitor 1990).

Market structure relates primarily to factors found in every market that are significant internal features of the market setting and that affect the conduct of firms. The characteristics mostly

emphasized as strategic aspects of market structure include the relative sizes and number of buyers and sellers, freedom of entry and exit, degree
of produce differentiation, market knowledge and the degree of seller or buyer concentration.

Marketing provides the mechanism whereby producers exchange their livestock and livestock's products for cash. The cash is used for acquiring goods and services which they do not produce themselves, in order to
satisfy a variety of needs ranging from food items, clothing, shelter, medication and schooling to the purchase of breeding stock and other production inputs and supplies (Solomon and Nagussie, 2002). Marketing is part and parcel of the production process. It supplements production in that it makes what is produced available to consumers and other users at the time, place and form required irrespective of the distance between them and the producers (Olukosi *et al.*, 2007).

there is numerous allegations of inefficiencies leveled against marketing system for agricultural products especially beef cattle in Nigeria. It is against this background that this research was undertaking with aim of examining the structure of Wudil cattle market of Kano state and find out the major constraints militating against sustainable
cattle production and marketing in the study area.

Kano as a centre of commerce, there are two main international cattle market such as Wudil and Dambatta in Kano state for marketing of cattle, as a result of this many people in the state engaged in marketing of cattle to earn their income for better life. Wudil local government area has a cattle market which gives an opportunity to the people of Wudil to engage in marketing of cattle to improve their standard of living. The study will aim to improve profitability of cattle marketing in Wudil local government of Kano state. In view of this, the research intends to answer the following questions:

i. What are the socio-economic characteristics of cattle consumers in the study area?

ii. What are the structures of cattle market in the study area?

iii.What are the major constraints affecting consumer in the study area?

METHODOLOGY

Study Area

This study was conducted at Wudil cattle market in wudil local government area, Kano state, Nigeria. Wudil local government is on the plain of Kano south zone. Wudil is located on latitude 12º11 and 12º11E and longitude 7º 38 and 8º38N (Nipost 2009).Its bordered by Warawa to the

north and west, Gaya to the east, Albasu and Garko to the south. In 2019 census projection put the population area at 719,140 with an estimated land of 362km^2 Wudil town is strategically located on river.

Method of Data Collection and Sampling Techniques

Primary data was used for the study. The data was collected with aid of semi structured questionnaire which administered randomly to selected respondent Wudil cattle market (Kara) was purposely selected as sample market based on high intensity and concentration cattle marketers and because it's the only market that sales cattle in Wudil local government. Twenty (20) cattle buyers were selected on weekly basis using systematic sampling by a truncation for a period of 7 weeks. Thus the study selected one hundred thirty five (135) cattle buyers.

Tools of Data Analysis

Descriptive statistics such as percentage, frequency and bar chart was used to analyze objectives socio-economic characteristics and constraints militating against marketing while inferential statistic such as Gini co-efficient was used to analysed market

Marketing Structure analysis

Gini coefficient was used to determine the market structure and concentration. It is a measure of statistical dispersion developed by the Italian statistician and sociologist Corrodo Gini. Gini coefficient is a measure of inequality of distribution, a value of 0 expressing total equality and a value of 1 expressing maximal inequality. It

has been applied in various disciplines such as sociology, economics, health science, ecology, chemistry,

engineering and agriculture (Sandras and Bongiavanni 2004).

GC = 1 - ΣXY ---------- (i)

Where

GC = Gini coefficient

X = the percentage of beef cattle sellers

RESULTS and DISCUSSION

Socio-economic characteristics of the cattle buyers

Socio-economic variables are important human attributes that enhance the efficiency of farmers, consumers and marketers of agricultural produce in their business (shu'aib, 2009)

Table 1: Quantitative Variables (Distribution of Age and Household Size of the Respondents)

Variable	Frequency	Percentage (%)
Age (years)		
22-32	15	11.10
33-43	44	32.60
44-54	28	20.70
55-65	27	20.00
66-76	21	15.60
Total	135	100.00
Household size		
1-5	23	17.00
6-10	55	40.70
11-15	33	24.40
16-20	12	8.90
21-25	8	5.90
26-above	4	3.00
Total	135	100

Source: field survey, 2023

Quantitative Variables (Distribution of Age and Household Size of the Respondents)

Age of the cattle buyers

The socio-economic characteristics of the respondents are presented in table 1 age is the years of the life of the respondents from birth to the time of survey. The result in Table 1 revealed that, adult people of ages 33-43 have the highest percentage (32.60%) followed by 44-54 years (20.70%) and the least percentage (11.10%) goes to young people of 22-32 years. Age and

dynamism considerably contribute too many of qualities associated with adult people as their active involvement in community development, higher social propensity, faster reaction time and proneness to innovation (Adesope, 2007).

Household size of the cattle buyers

This is the number of people living together under the same roof and sharing the same source of food. From the result obtained below in table 1, majority (47.6%) of the cattle buyers have household size between 1-5 while the (18.1%) of the respondents have household size between 11-15 person as their dependant, and 8.6% of the respondent have household size between 21-27 dependants and 26 to above have small percentage of (3.00%).

Table 2: Qualitative Variables (Distribution of the Respondents Based on Gender, Marital Status, Educational Level and Buyer Category of the Respondents)

Variable	Frequency	Percentage (%)
Gender		
Male	134	99.3
Female	1	0.7
Total	135	100
Marital Status		
Single	4	3.00
Married	129	95.60
Widowed	2	1.5
Total	135	100.00
Educational Level		
Qur'anic	40	29.60
Adult education	31	23.00

Primary	32	23.70
Secondary	19	14.10
Tertiary	13	9.60
Total	135	100.00
Buyer Category		
Small	34	25.20
Medium	69	51.10
Large	32	23.7
Total	135	100.

Source: field survey, 2023

Qualitative Variables (Distribution of the Respondents Based on Gender, Marital Status, Educational Level and Buyer Category of the Respondents)

Gender of the cattle buyers

Gender represent the sex of the respondent, weather a respondent is male or female. The area by nature of their culture and religious restriction found the purchase to be gender biased as it mostly done by the male. It was found from the survey that, most of the respondents (99.30%) were male, which means most of the cattle marketing were dominated by male. This could be attributed to the physical hardship involved in cattle marketing. This corroborates the finding of Adamu (2010) which states that, socio-cultural features of the study area restrict women from outdoor activities.

Marital Status of the Respondents

Marital status this is the weather the respondents is married, divorced, widowed or single. Table 2 below revealed that 95.60% were married, 3% were single and 1.50% was widowed. UN (1973) found that, different ethno-religious groups continue to attach prestige to marriage as an indicator of social responsibility, trust and achievement. This is a typical of northern community set up within which people marry early and this act shows responsibility and respect for religion. Marriage makes an individual more responsible and takes relatively technical decisions are

more accurately (Mustapha, 2010) the study area reverse the institution of marriage so much that the married people are viewed as more responsible and more gentlemanly.

Educational Level of the respondents

The analysis of level education in table 1 above shows that, religious (Islamic) education has the highest percentage (29.60%) followed by primary education with percentage of (23.70%) then adult education (23%) while tertiary has the least percentage of (9.60%). This is the indicator of the ability of the individual to read or write in a formal and the informal way. An individual level of education is usually enhancing his social and economic decisions favorably, as he has the capacity to judge and make decision objectively.

Buyer Category of the respondents

This explains level of the respondents in the business. Result from table 2 above revealed that, (51.10%) of the respondents were medium scale buyer followed by small scale buyer with (25.20%) was large scale buyers were the least (23.70%).

Table 3: Distribution of Cattle Buyers to Determine Market Structure in Wudil Market

Purchase Range	Frequency	Prop of buyers	Cumm. Frequency	Cumm. Prop of buyers	Total purchase	Prop of purchase	Cumm. prop	XY
70000-127000	23	0.170	23	0.170	2,315,000	0.10	0.10	0.017
127001-185000	60	0.444	83	0.614	9,351,000	0.40	0.50	0.222
185001-243000	44	0.326	127	0.940	9,188,000	0.39	0.89	0.290
243001-301000	4	0.030	131	0.970	1,051,000	0.05	0.94	0.028
301001-359000	4	0.030	135	1.000	1,395,000	0.06	1	0.030
Total	135	1			23,300,000	1		0.587

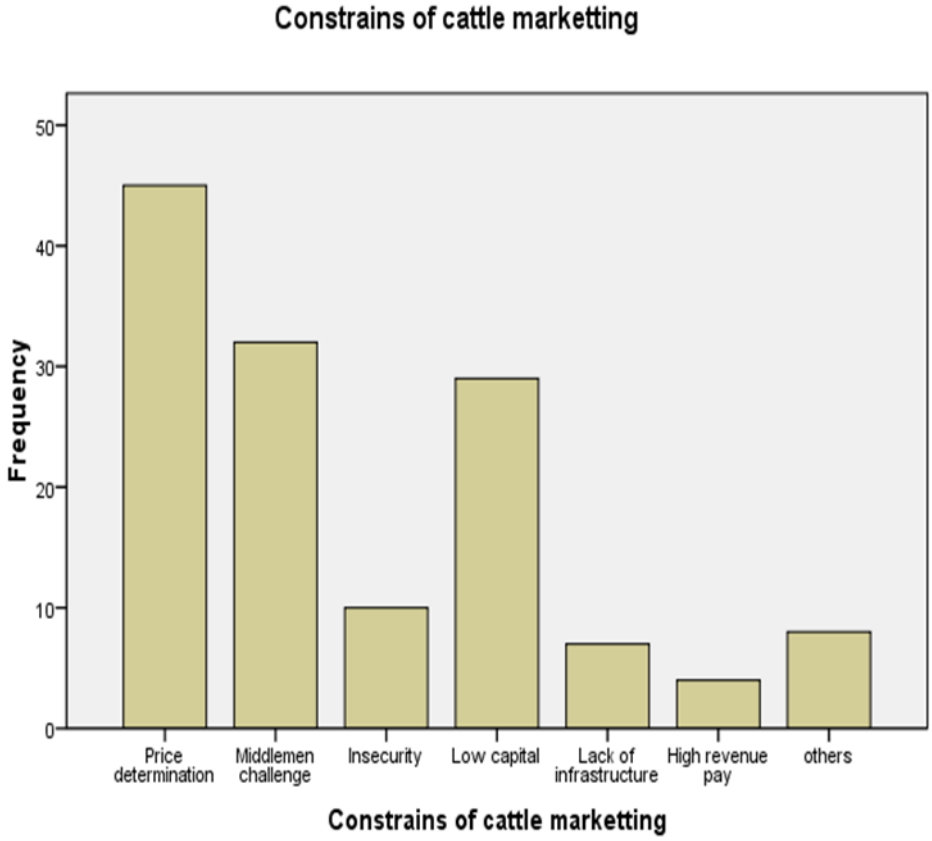
Source: field survey, 2023
Mean of the purchase= ₦ 1, 848, 60
Ginni Co-efficient= 1- ∑XY
Ginni Co-efficient = 1-0.587
G.C = 0.413

Distribution of Cattle Buyers to Determine Market Structure in Wudil Market

The result as presented in table 3 shows that, the estimated Ginni-cofficient for cattle buyers was 0.413 (41.3%). This figure suggested that, there is high level of inequality among the buyers. Therefore empirical result revealed that, the cattle market was competitive behavior in the market structure of the cattle market in the study area. This is in accordance with finding of Gebregziabher (2010) stated there is relative high level of inequality in the sale revenue of respondents and consequently high level of concentration and result is a reflection of the inefficiency in the market structure.

Figure 1: Distribution of Major Challenges Faced by Cattle Buyers in the Market

Fig. 1: Constraints Militating against Cattle Meketters



Source: field survey, 2023

Major Challenges Faced by Cattle Buyers in the Study Area

The marketing of agricultural products including livestock have various problems. Over the years agricultural marketing has not received the type of attention accorded in agricultural production. The result in table 6 indicated that major problems plaguing the buyers of cattle in

the study were price determination with (33.30%), followed by middlemen challenge (23.70%) in which they tend to exploit them by beating their hands down when it comes to bargaining the animal, while (21.50%) complained low capital to inject the business. Other problems were insecurity faced by buyers and sellers with (7.40%), lack of infrastructural facilities with (5.20%), high revenue pay with (3.00%) and others problems with (5.90%).

CONCLUSION

Based on the finding of this research it concluded that, cattle marketing in the study area were male oriented business and most of the men involved were young men indicating that there was less participation in the venture by elders. The structure of the market based on criteria laid was to be competitative. Constraint to the business includes middlemen challenges, insufficient capital, lack of social amenities within the market and lack of standard unit of measurement.

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DETERMINATION OF CHANGES IN SWEET CORN APPLIED DIFFERENT NITROGEN DOSES DURING STORAGE

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Abstract
The consumption of sweet corn as a fresh or processed product is increasing worldwide. The quality of sweet corn is highly affected by growing conditions, cultural practices and post-harvest methods. This study was carried out to determine the changes of nitrogen doses in sweet corn during storage. In the study, different nitrogen doses (150, 200 and 250 kg ha^{-1}) were applied to Composite sweet corn cultivars and harvested at milk maturity. The harvested sweet corn cobs were stored at -18°C and 90±5% relative humidity in a modified atmosphere package for 5 months. The study was carried out in the laboratories of Isparta University of Applied Sciences, Faculty of Agriculture, Department of Field Crops according to the randomized plots experimental design with 3 replications. In the study, weight loss, moisture content, total soluble sugar content, ash content, protein content and color parameters (L* and C*) of cobs were examined at 1 month intervals during storage. It was observed that the characteristics examined during fresh storage of sweet corn were significantly affected by nitrogen doses and storage time. In the study, moisture content, total soluble sugar content, ash content, protein content, color parameters (L* and C*) decreased and weight loss increased with increasing storage time. According to nitrogen doses, the highest weight loss, total soluble sugar content, ash content, protein content and color parameters (L* and C*) were determined in 250 kg ha^{-1} application. With increasing nitrogen doses, moisture content decreased, weight loss, total soluble sugar content, ash content, protein content and color parameters (L* and C*) increased. As a result, considering the characteristics examined, it was determined that sweet corn can be stored in modified atmosphere packaging for 3 months with 250 kg ha^{-1} nitrogen application.
Keywords: Sweet corn, Storage time, Nitrogen dose, Quality losses

1. INTRODUCTION

Şeker mısır (*Zea mays* L. var. *saccarata*), küresel olarak çeşitli iklimlerde yetiştirilen önemli bir tahıl cinsidir. Şeker mısır, diğer mısır türleri ile aynı botanik grupta yer almakta da fakat diğer mısır türlerinden temel olarak ayrımı tanesinin endosperminde daha yüksek polisakkarit içeriğine sahip olmasıdır (De Grazia et al., 2003). Şeker mısır tanesinde %5-6 şeker, %10-11 nişasta, %3 suda çözülebilir polisakkaritler, %70 su, %15 protein, %9 yağ, vitamin A ve potasyum, yüksek miktarda fosfor, magnezyum, demir ve çinko bulunmaktadır

Sweet corn (*Zea mays* L. var. *saccarata*) is an important genus of cereals grown in various climates globally. Sweet corn is in the same botanical group as other corn species, but its main distinction from other corn species is the higher polysaccharide content in the endosperm of the grain (De Grazia et al., 2003). Sweet corn grain contains 5-6% sugar, 10-11% starch, 3% water soluble polysaccharides, 70% water, 15% protein, 9% oil, vitamin A and potassium, high amounts of phosphorus, magnesium, iron and zinc (Keerthi et al., 2017; Sevov, 2017). Sweet corn is commonly consumed fresh, frozen or as a processed product (Siddiq and Pascali, 2018). In addition, sweet corn harvested at milk maturity has high levels of respiration after harvest due to its high moisture and sugar content. This causes serious nutrient loss, decreased freshness, softness, sweetness, hardening of grains and growth of pathogenic microorganisms (Wang et al., 2023). For these reasons, it is very important to develop strategies to reduce post-harvest quality losses and extend the storage period of sweet corn.

Plants require high amounts of nitrogen during vegetative growth, photosynthetic activity and for the development of leaves, stems and roots (Öktem et al., 2010). In addition, nitrogen is one of the most important macronutrients in corn agriculture and is the main plant nutrient that limits plant growth and affects the quality and mineral content of grains. Researchers have recommended different N application rates for sweet corn according to different climates, soils, plant varieties and planting times. When the studies are examined, it is seen that the highest yield of corn plant is reached at a dose of 150-300 kg N ha-1 (Can and Akman, 2014; Akgun et al., 2021). In our country, sweet corn production and consumption have been increasing in recent years and the need for chemical fertilizers is also increasing.

Depending on the agricultural practices applied in sweet corn, it is very important how they affect post-harvest. As a matter of fact, post-harvest management of sweet corn is critical in maintaining product quality and reducing wastage throughout the entire supply chain (Xiang et al., 2019). Sweet corn is among the perishable crops due to its high respiration rate, rapid sugar loss after harvest and quality deterioration (Dayı, 2011). In one day, it can lose approximately 60% of its sugar content at 30°C and 6% at 0°C. Sugar loss is very rapid at room temperature, and rapid cooling and storage at low temperatures after harvest can delay sugar loss (Dayı, 2011). In addition, producers and/or consumers often store fresh sweet corn cobs under unsuitable conditions, causing the product to deteriorate and lose its economic value. Accordingly, it is very important to determine the changes that occur in sweet corn during the storage period until it reaches the consumer and to develop strategies to reduce storage losses. This study was carried out to determine the changes in some quality characteristics of sweet corn cobs treated with different nitrogen doses during storage.

2.MATERIAL AND METHODS

The study was conducted in 2020 in the experimental fields of Isparta University of Applied Sciences, Faculty of Agriculture and Cereals and Edible Legumes laboratory. Kompozit Şeker, a sweet corn variety, was used as material in the study. In the experiment, 3 different nitrogen doses (150, 200, 250 kg ha^{-1}) were applied in the form of ammonium sulfate. The study was carried out according to the randomized block design with 3 replications and the area of each plot was designed as 14 m^2 (5 m x 4 rows, 70 cm between rows, 20 cm above rows). All plots were fertilized with 80 kg P_2O_5 ha-1 and different nitrogen levels (150, 200, 250 kg N ha^{-1}). All of the phosphorus and half of the nitrogen fertilizers (in the form of ammonium sulphate) were applied at planting and the other half was applied when the corn plants were 45-50 cm. All cultural practices such as hoeing, irrigation, weeding, spraying, etc. were carried out in accordance with traditional methods.

In the study, sweet corn cobs that reached the milk maturity period were harvested by hand and brought to the laboratory immediately. Sweet corn cobs of uniform size, without visual signs of disease and damage were selected to be used in the experiment. The cob leaves of the selected sweet corns were peeled and stored in a modified atmosphere package at -18°C and 90±5% relative humidity for 5 months. In the study, 3 replicates were established according to the

coincidence plots experimental design and 6 sweet corn cobs were included in each replicate. A total of 270 sweet corn cobs (3 nitrogen doses x 5 different storage periods x 3 replications) were used in the study. In the experiment, some of the following analyzes were performed on the sweet corn cobs removed from cold storage at 1 month intervals.

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Weight loss: Sweet corn cobs, which were weighed at the beginning of the experimental period and placed in storage, were taken from storage at each analysis period and weighed with a digital balance (Radwag AS 2020 R2 model) with a sensitivity of 0.01 g and weight loss (%) was determined by proportioning with the initial weight.

Moisture content: Sweet corn kernels were separated from the cob and their initial weights were recorded and then kept in an oven at 65oC until they reached constant weight. After reaching constant weight, the final weights of the samples were weighed again and the moisture content was determined by proportioning with the initial weight.

Total soluble sugar content: The method of Dubois et al. (1956) was used to determine the total soluble sugar content of sweet corn kernels. For extraction, 20 mL of 80% ethanol was added to 2 g of sample and crushed using a homogenizer. The samples were incubated overnight at -20 °C, centrifuged at 2000 x g for 5 minutes and the supernatant was removed. The supernatant was then read at 490 nm in a spectrophotometer and the results were expressed as mg g-1.

Ash content: Sweet corn kernels were ground in a mill with a sieve diameter of 1 mm and 3 g of the samples of sweet corn kernels, which were made ready for analysis, were subjected to incineration in a muffle furnace at 550°C for 5 hours and the value obtained was expressed as % (Yılmaz, 2005).

Protein ratio: In 1 mm sieve diameter ground grains, nitrogen content was determined by Kjeldahl method and the value found was multiplied by a coefficient of 6.25 to calculate the crude protein content of the grains as % (Bremner, 1965; Kacar & Inal, 2010).

Color parameters (L and C*): Fruits labeled for weight loss (6 in replicate) were used to determine the color changes in the fruit peel during storage. For this purpose, CIE L* and Croma

(C*) values were determined with a color device (CR 300 model Minolta) from the bottom of the labeled point on the fruit samples taken out of storage in each analysis period (Sincan et al., 2020).

The results obtained from the experiment were subjected to analysis of variance (Minitab v.17.2.1) according to the random plots experimental design. Tukey multiple comparison test was used to determine the differences between the means of the treatments ($P < 0.05$).

3. RESULTS AND DISCUSSION

Weight loss, which refers to the change in the weight of the product to be marketed during storage, is an important parameter affecting the commercial value of sweet corn after harvest. Especially at room temperature, transpiration and respiration of sweet corn are quite high, which increases the weight loss and causes a decrease in the quality and appearance of the product (Liu et al., 2021). In this study, nitrogen doses, storage duration and nitrogen dose x storage duration interaction significantly affected the weight loss of sweet corn during storage (Table 1). The weight loss (%) of sweet corn increased steadily with increasing nitrogen doses and storage time.

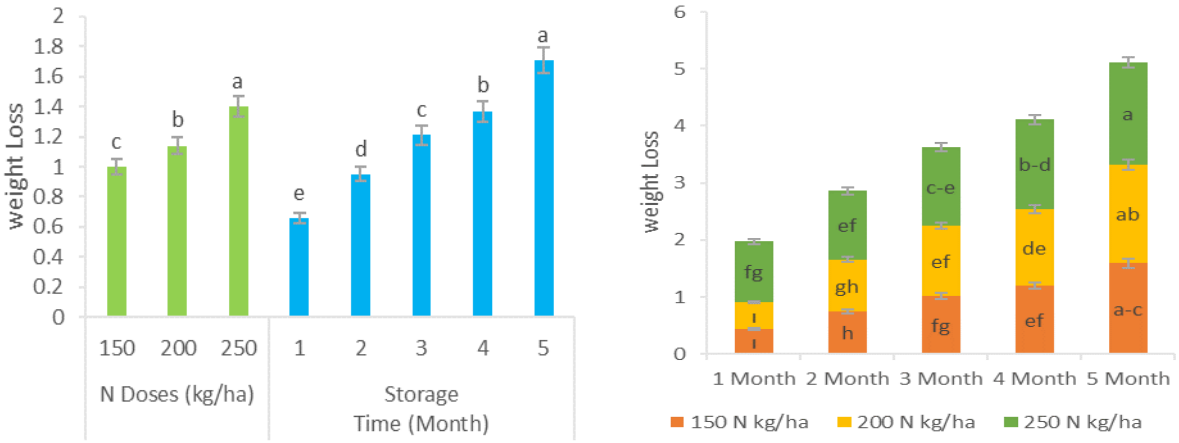
When the interaction of nitrogen doses and storage period was analyzed, it was determined that the weight loss of sweet corn increased as the nitrogen doses and storage period increased (Figure 1). Among the nitrogen doses, the highest weight loss was found at 250 kg ha^{-1} nitrogen dose, which was due to the high amount of nutrients such as starch, protein, etc. contained in the grain. Similarly, many researchers have determined in their studies that the protein ratio and starch content of sweet corn grain increased with the increase in nitrogen doses (Can and Akman, 2014; Öktem et al., 2010; Karaman et al., 2021; Saraçoğlu and Öktem, 2021). The increase in weight loss according to the storage period is due to the high humidity and respiration of the sweet corn cobs, and the weight loss of the grains increased in parallel. Similar to the findings of this study, many researchers reported that weight loss decreased steadily during storage (Halloran et al., 2000; Riad, 2004; Liu et al., 2021).

Tablo 1. Farklı azot dozu uygulanan şeker mısırda depolama süresince incelenen özelliklere ait varyans analiz sonuçları

Table 1. Analysis of variance results of the traits examined during storage in sweet corn with different nitrogen doses

Source of variation	df	MS						
		WL	MC	TSSC	AC	PC	L*	C*
N dose	2	0.64**	5.09**	0.21**	0.06**	1.01**	5.65**	18.53**
Storage time	4	1.44**	26.58**	1.13**	0.26**	2.44**	163.48**	56.07**
N x ST	8	0.03**	0.32^{ns}	0.01^{ns}	0.01**	0.18*	0.48^{ns}	0.44^{ns}
Error	28	0.01	0.64	0.01	0.00	0.06	0.44	0.54
CV (%)		6.43	1.13	1.05	0.95	2.16	0.99	1.43

MS: Mean squares, **: P ≤0.01, *: P ≤0.05, ns: not significant, WL: weight loss, MC: moisture content, TSSC: total soluble sugar content, AC: ash content, PC: protein content

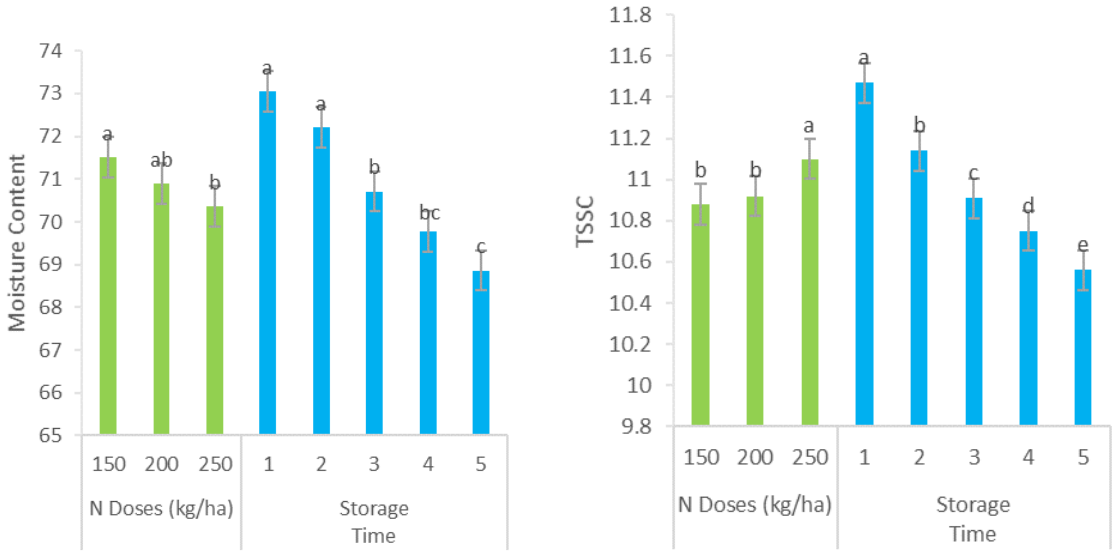


Şekil 1. Farklı azot dozu uygulanan şeker mısırda depolama süresince ağırlık kaybı üzerine etkileri

Figure 1. Effects of different nitrogen doses on weight loss of sweet corn during storage

Knowing the moisture content of products during storage allows the development of preservation techniques specific to that product. Sweet corn, which has high moisture content, loses moisture rapidly after harvest and during storage, which reduces the quality and storage time of the product (Hao et al., 2019). In this study, nitrogen doses and storage time caused significant changes in the moisture content of sweet corn during storage (Table 1). According

to nitrogen doses, the moisture content of sweet corn varied between 70.36-71.52%. The highest moisture content was determined at 150 kg ha^{-1} nitrogen dose and the lowest at 250 kg ha^{-1} nitrogen dose. On the other hand, the moisture content of sweet corns decreased with increasing storage period. The highest moisture content was determined in the first month (73.06%) followed by the second month (72.21%) and there was no statistical difference between them. The lowest moisture content was determined in the fifth month (68.86%) (Figure 2). The decrease in moisture content during storage was due to the high respiration of sweet corns after harvest. Shao and Li (2011) and Karaman and Türkay (2023) found that the moisture content of sweet corns decreased during storage. Again, many researchers have found that the moisture content of different plant species decreased during storage (Tu et al., 2000; Aqil, 2020).

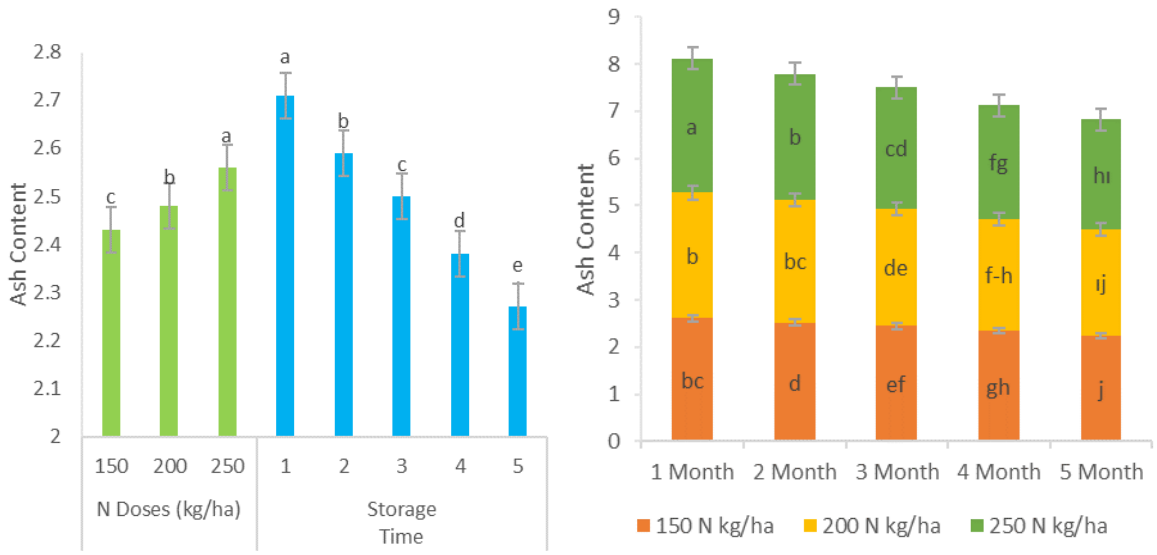


Şekil 2. Farklı azot dozu uygulanan şeker mısırda depolama süresince nem oranı ve toplam çözülebilir şeker içeriği üzerine etkileri

Figure 2. Effects of different nitrogen doses on moisture content and total soluble sugar content of sweet corn during storage

Total soluble sugar content is one of the most important post-harvest quality criteria of sweet corn. Sugar is a parameter that directly affects the sweetness of corn. In addition, since sweet corn has a high respiration rate, the sugar content decreases during storage due to the formation of sucrose and some organic compounds (Karande et al., 2014). In this study, the effect of nitrogen doses on total soluble sugar content of sweet corn was significant (Table 1) and total soluble sugar content increased as nitrogen doses increased (Figure 2). This may be due to the

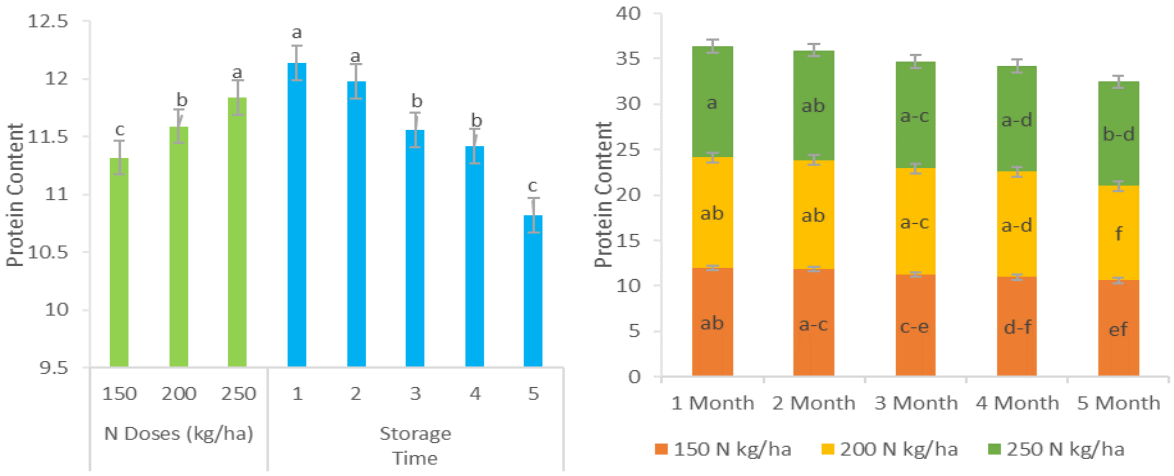
increased availability of nitrogen and its uptake and storage by different parts of the plant. Similar to the findings in this study, Khan et al. (2018) reported that the total soluble sugar content of sweet corn increased with increasing nitrogen doses. On the other hand, storage period significantly affected the total soluble sugar content of sweet corns (Table 1). During the storage period, total soluble sugar content varied between 10.56-11.47 mg g-1 and total soluble sugar content decreased with increasing storage period (Figure 2). This is due to the formation of sucrose and some organic compounds in the grain during storage of sweet corn, which decreases the sugar content (Karande et al., 2014), while the starch content increases (Dayı, 2011). Kara and Şahin (2012) found that the decrease in sugar content of sweet corn varieties at the end of the 12th day was 77.89-80.05% at room temperature and 37.02-35.90% at +4°C, respectively. Similar to the findings of this study, it was reported in different studies that the total soluble sugar content of sweet corn decreased significantly with the increase in storage time (Karaman and Türkay, 2021; Liu et al., 2021).



Şekil 3. Farklı azot dozu uygulanan şeker mısırda depolama süresince kül oranı üzerine etkileri
Figure 3. Effects of different nitrogen doses on ash content of sweet corn during storage

Ash consists of inorganic substances that remain after the burning of dry matter and do not burn. In addition, ash is found in the structure of nucleoproteins that play an important role in the cell and minerals that have functions in many events (Geren, 2000). In the study, nitrogen doses, storage time and nitrogen dose x storage time interaction significantly affected the ash content of sweet corn during storage (Table 1). According to nitrogen doses, ash content varied

between 2.43-2.56% and ash content increased with increasing nitrogen dose (Figure 3). This is due to the high dry matter production of crude ash in plants, which contributes directly or indirectly to the biosynthesis of minerals (Safdar, 1997). Similar to the findings in this study, Ayub et al. (2003) reported that ash content increased significantly with increasing nitrogen doses. During the storage period, the highest ash content was found in the first month (2.71%) and the lowest in the fifth month (2.72%). As the storage period increased, the ash content gradually decreased (Figure 3). Liu et al. (2013), who stored sweet corn for different periods (0, 3, 6 and 12 months), reported that ash content decreased with increasing storage time. Bello and Badejo (2017) and Karaman and Türkay (2021) found that the ash content of sweet corn decreased with increasing storage time. The findings of this study are in agreement with the previous studies.



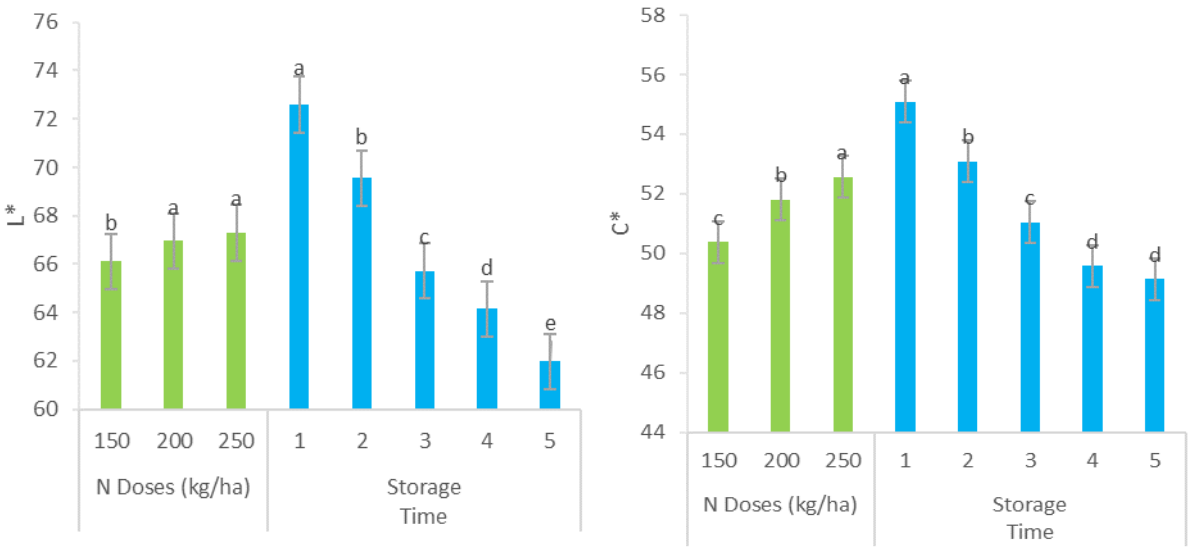
Şekil 4. Farklı azot dozu uygulanan şeker mısırda depolama süresince protein oranı üzerine etkileri

Figure 4. Effects of different nitrogen doses on protein content of sweet corn during storage

It is very important to preserve the protein content of sweet corn after harvest. Indeed, sweet corn is used as one of the main sources of protein and energy in the preparation of different foods in many parts of the world (Öktem et al., 2010). In this study, nitrogen doses, storage time and nitrogen dose x storage time interaction significantly affected the protein content of sweet corn during storage (Table 1). Protein content varied between 11.32-11.84% according to nitrogen doses and protein content increased with increasing nitrogen dose (Figure 4). This was due to the fact that nitrogen, the main component of protein, significantly increased the

protein content of the grain due to increased nitrogen uptake. Therefore, as reported by Kalibhavi et al. (2001), Kar et al. (2006) and Sunitha and Reddey (2012), adequate and balanced nitrogen availability in the soil increased the protein content of the grain due to better physiological and biochemical activity of sweet corn. On the other hand, protein content was highest in the first month (12.14%) and lowest in the fifth month (10.82%) of storage. Moreover, there was no statistically significant difference between the first and the second month of storage (Figure 4). As the storage period increased, the protein content decreased gradually. Similarly, Karaman and Türkay (2021) determined that the protein content of sweet corn decreased as the storage period increased and showed significant differences according to the varieties. Similar to the findings of this study, it was reported in different studies that the protein content of sweet corn decreased significantly with the increase in storage time (Xie et al. 2014; Xie et al., 2017).

Grain shell color, which is one of the important quality parameters of sweet corn, is very effective on the commercial value and storage period of the products. Consumers especially buy cobs with bright and full grain color of sweet corn and consume them with pleasure (Karaman and Türkay, 2023). In this study, L* (brightness) and C* (saturation) values of sweet corn were significantly affected by nitrogen doses and storage time (Table 1). In the study, L* and C* values increased with increasing nitrogen doses. According to the storage period, L* value varied between 61.97-72.60 and C* value varied between 49.13-55.09. L* and C* values decreased with increasing storage time (Figure 5). This is due to the increase in the rate of water loss and pigment breakdown of sweet corn kernels with the prolongation of storage time. Dayı (2011) found that L* and C* values of sweet corns decreased at the end of storage. Karaman and Türkay (2021) reported that L* and C* values of sweet corn grains decreased according to storage time. (2022) determined that L and C* values of pomegranates decreased with the increase in storage time and temperature and this decrease was due to the increase in water loss. The findings of this study are in accordance with the studies conducted in previous years.



Şekil 5. Farklı azot dozu uygulanan şeker mısırda depolama süresince L* ve C* değerleri üzerine etkileri

Figure 5. Effects of different nitrogen doses on L* and C* values of sweet corn during storage

4. RESULT

In this study, moisture content decreased, weight loss, total soluble sugar content, ash content, protein content and color parameters (L* and C*) increased with increasing nitrogen doses. According to nitrogen doses, the highest weight loss, total soluble sugar content, ash content, protein content and color parameters (L* and C*) were determined in 250 kg ha-1 application. Moisture content, total soluble sugar content, ash content, protein content, color parameters (L* and C*) decreased and weight loss increased with the extension of storage period. As a result, considering the quality characteristics examined, it was determined that sweet corn can be stored in modified atmosphere packaging for 3 months with 250 kg ha-1 nitrogen application. However, since the effects of such post-harvest applications may be affected by varieties, cultural practices, harvest time, storage time and conditions, further studies are needed in different varieties and species.

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DOĞAL BOR MADENI KULLANIMININ REZENE (*Foeniculum vulgare* Mill.)'DE UÇUCU YAĞ ORANI VE BILEŞIMI ÜZERINE ETKISI

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Özet
Bu çalışma, Kütahya-Gediz koşullarında farklı bor dozlarının (0, Saf ve 1/8 kg/da) Rezene (*Foeniculum vulgare* Mill.)'de bulunan uçucu yağ oranı ve kalitesi üzerine etkisini belirlemek amacıyla, 2017 yılında Dumlupınar Üniversitesi, Tıbbi ve Aromatik Bitkiler deneme tarlasında yürütülmüştür. 2017 yılında tarla denemeleri tesadüf blokları deneme desenine göre 3 tekerrürlü olarak kurulmuştur. Uçucu yağ bileşimi Gaz Kromatografi-Kütle Spektrometresi (GC-MS) ile belirlenmiştir. Uçucu yağ oranları sırasıyla borsuz doz %1.83, saf doz %3.43, 1/8 dozda %1.55 olarak bulunmuştur. Borsuz, saf dozda ve 1/8 dozda yetişen rezenelerin meyvelerinde yapılan 3 farklı dozun analiz sonucunda 7'şer bileşen tespit edilmiştir. Borsuz çalışmada elde edilen uçucu yağdaki ana bileşen sırasıyla; trans-anetol %85.82, limonen %5.94, p-allilanisol %4.26, fenkon %1.20'dir. Saf dozda elde edilen bileşenler ise; trans-anetol %94.52, anisol %3.54, limonen %1.09, fenkon %0.36 olarak bulunurken, 1/8 dozda trans-anetol %92.38, anisole %3.8, limonen %2.85, fenkon %0.35 olarak bulunmuştur.
Anahtar Kelimeler: Rezene; Bor; Uçucu yağ

THE EFFECT OF NATURAL BORON MINERAL USE ON ESSENTIAL OIL CONTENT AND COMPONENTS OF FENNEL (*Foeniculum vulgare* Mill.)

Abstract
This study was carried out in Dumlupınar University, Medical and Aromatic Plants Department's application field in 2017 in order to determine the effect of different boron doses (0, pure and 1/8 kg / da) on the rate and quality of volatile oil found in fennel (Foeniculum vulgare Mill.) in Kütahya-Gediz conditions. Field experiments were administered as 3 replicates according to randomized block design in 2017. The volatile oil composition was determined by Gas Chromatography-Mass Spectrometry (GC-MS). Essential oil ratios were found as 1.83%, 3.43% and 1.55%, for no boron dose, pure dose and 1/8 boron dose respectively. 7 components were found in each 3 analyzes made in fruits of the fennels which were grown with 3 different doses (no boron, pure dose and 1/8 dose). The main components in the volatile oil obtained without boron use are as follows; trans-anethole 85.82%, limonene 5.94%, p-allylanisole 4.26% and fenchone 1.20%. The components obtained in the pure dose were found as follows; trans-anethole 94.52%, anisole 3.54%, limonene 1.09%, fenchone 0.36%. And in 1/8 dose the rates are as follows; trans-anethole 92.38%, anisole 3.8%, limonene 2. 85%, fenchone 0.35%.
Keywords: Fennel; Boron; Essential Oil

GİRİŞ

Ülkemiz aynı zamanda birçok bitkininde anayurdudur (Yiğit ve ark., 2005). Rezene bitkisinde en fazla bulunan bileşen Anethol'dur. Bu bileşen keskin kokusuyla rezeneyi tatlandırır (Krug, 1991). Rezeneden elde edilen uçucu yağın antibakteriyel etkisinden dolayı bitkilerde bakteriyel hastalıkların tedavisinde doğal bakterisit olarak kullanılabileceğini, bunun da günümüzde yaygınlaşma sürecinde olan ekolojik tarım için önem arz ettiğini belirtmiştir (Cantore ve ark., 2004). Türkiye'nin farklı 8 bölgesinde toplanan rezenenin meyveleri analiz edilmiştir. Analiz sonucunda elde edilen bileşenler; trans-anethol %75.6-86.5, limonen %4.2-9.1, estragol %3.2-5.2, fenkhon %1-2.8, ϒ-terpinen %0.8-1.5 ve α-pinen %0,4-1,1 olarak bulunmuştur (Akgül, 1986). Rezene bitkisinin uçucu yağ oranı ve bileşimi yetiştiği bölgelere ve çeşide göre farklılık sergilemektedir. Acı rezene meyvesinin uçucu yağ bileşiminde; trans anetol (%50-75), fenkon (%12-33) ve estragol (%2-5) iken tatlı rezenenin meyvesinin uçucu yağının ana bileşenleri trans-anetole (%80-90), fenkon (%1-10) ve estragol (%3-10) arasında değişim göstermiştir (Gruenwald ve ark., 2004). Bu çalışma ülkemizde ekonomik öneme sahip olan rezene bitkisine verilen bor madeninin, uçucu yağ kompozisyonuna nasıl etkilediğine yöneliktir. Bor madeni kullanılarak *Foeniculum vulgare* Mill. türü üzerinde yapılmış bir çalışmaya rastlanılmamıştır. Araştırma bor madeni zenginliği olan Kütahya bölgesinde yapılmıştır. Çalışma ile bölge halkının ürün çeşitliliğini artırmak, ilaç ve gıda sektörüne katkı sağlamak hedeflenmiştir.

MATERYAL ve YÖNTEM

Deneme 2017 yılında Kütahya Dumlupınar Üniversitesi uygulama alanında yürütülmüştür. Tohumlar 2017 yılı Mart ayında ekilmiş çimlenme 15-20 günde gerçekleşmiştir. Deneme, tesadüf blokları deneme desenine göre 3 tekerrürlü olarak kurulmuştur. Bitki dikim aralığı 30 x 30 cm olarak, parseller 3 sıradan kurulmuştur. Her sıraya 24 bitki olmak üzere, bir parsele 24x3 =72 bitki ekilmiştir. Rezene bitkisine 3 farklı bor madeni (0, Saf ve 1/8 kg/da) dozları uygulanmıştır. Tüm parsellerde bitki 20 cm boyuna ulaştıktan sonra bor madeni verilmeye başlanmıştır. Bor madeni özütü hazırlandıktan sonra bitki başına 100 mL sıvı olarak verilmiş, bir ay sonra bitki başına 50 ml sıvı olarak verilmiştir. Denemede sulama hava koşullarına göre yapılmıştır. Yabancı otla mücadele çapayla yapılmıştır. Ölçüm ve gözlemler her parselde etiketlenen 9 adet bitkiden elde edilmiştir. Kütahya ili Gediz ilçesindeki lokasyonun toprak analizi potasyum ve fosfor bakımında zengin olmadığı görülüyor. Kireç oranı yüksek

bulunmuştur, organik madde bakımında fakir, toprak doygunluğu killi - tınlı olduğu analizler sonucunda belirlenmiştir (Anonim 2017).

Çizelge 1. Bor Madenine ait örnekte yapılan kimyasal analiz sonuçları

Ca	K	Mg	Na	Fe	Mn	Zn	Cu	Ni	Cd	Cr	Co
mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/kg	µg/kg	µg/kg	mg/kg	µg/kg
108,9	19,66	33,22	58,68	0,680	0,042	0,10	<10	<10	<10	0,034	<10

Tarla denemelerinde kullanılacak doğal bor madeninin kimyasal analizi yapılmıştır (Çizelge 1)'de. Yapılan analiz sonucuna göre doğal bor madeninde en çok Ca; 108.9 mg/kg bulunurken en az ise Cu;<10 µg/kg, Ni; <10 µg/kg, Cd; <10 µg/kg, Co; <10 µg/kg mineralleri bulunmuştur.

Özüt Hazırlanması

Çalışmamızda kullanılan özüt bor madeninden hazırlanmıştır. Söz konusu bor; Emet (Kütahya) bölgesinde temin edilmiştir. Bölgede alınan bor madeni toz haline getirilmiş. Daha sonra toz halindeki bor madeni 20 g tartılıp 100 mL saf suda çalkalanarak beş dakika süre ile homojenize edilmiştir. Homejenat olan bor beş dakika süre ile 3500 rpm de santrifüj edilmiştir. Süpernatant kısmı alınarak buzdolabında saklanmıştır. 100 mL karışımda 0.0260 g tortu oluşmuştur. Kullanılacak bu özüt ya saf olarak (seyreltme yapılmadan verilmiştir) ya da 1/8 oranında ki karışımda ise 100mL saf suya 20 mL saf özüt karıştırılarak uygulanmıştır (Kocaçalıskan, 2001; Karayel, 2006).

Uçucu Yağ Oranının Elde Edilmesi

Deneme uçucu yağ analizinin başlangıcında 20 g kuru materyal tartılarak 500 ml'lik balona alınmıştır. Üzerine 200 mL (örnek miktarına göre değişebilir, yaklaşık 10 kat) saf su eklenip çalkalanmıştır. İki saat süreyle hidrodistilasyon işlemine tabi tutularak uçucu yağ elde edilmiştir. Sistem soğuduktan sonra ve dereceli kısma toplanan uçucu yağ sulu fazdan ayrıldıktan sonra miktarı (mL) tespit edilmiştir. Tartımı alınan örnek miktarına (g) göre 100 g örnekteki uçucu yağ miktarı uçucu yağ oranı (%) olarak hesaplanmıştır (Skoula ve ark., 2000).

Uçucu Yağ Bileşenlerinin GC-MS ile Elde edilmesi

Örneklerin, uçucu yağ bileşen analizi GC-MS cihazı ile kapiler kolon kullanılarak gerçekleştirilmiştir. Örnekler analiz edilmek üzere 1:100 oranında hekzan ile seyreltilmiştir. Analizde taşıyıcı gaz olarak 0.8 ml/dk akış hızında helyum kullanılmış, örnekler cihaza 1 µl olarak 40:1split oranı ile enjekte edilmiştir. Enjektör sıcaklığı 250°C, kolon sıcaklık programı

60°C (10 dakika), 60°C'den 220°C'ye 4°C/dakika ve 220°C (10 dakika) olacak şekilde ayarlanmıştır. Bu sıcaklık programı doğrultusunda toplam analiz süresi 60 dakika sürmüştür. Kütle detektörü için tarama aralığı (m/z) 35-450 atomik kütle ünitesi ve elektron bombardımanı iyonizasyonu 70 eV kullanılmıştır. Uçucu yağın bileşenlerinin teşhisinde ise WILEY, NIST ve OIL ADAMS kütüphanelerinin verileri esas alınmıştır. Sonuçların bileşen yüzdeleri FID dedektör kullanılarak, bileşenlerin teşhisi ise MS dedektör kullanılarak yapılmıştır (Özek ve ark., 2010).

BULGULAR ve TARTIŞMA

Kütahya-Gediz koşullarında farklı bor dozlarının (0, Saf ve 1/8 kg/da) rezene (*Foeniculum vulgare* Mill.)'nin türünden elde edilen uçucu yağ oranı sırasıyla borsuz dozda %1.83, saf dozda %3.43, 1/8 dozda %1.55 olarak bulunmuştur. Elde edilen veriler, uçucu yağ verimi ve bileşenlerini artırmak için rezene kültüründe bor kullanımının gerekli olduğunu göstermektedir. En yüksek uçucu yağ oranı saf dozda elde edilmiştir. Doz seyreltildikçe uçucu yağ oranı azalıyor. Uçucu yağ bileşenlerinde bor dozu artıkça trans-anetol ana bileşenin oranında artış olmuştur. Ayrıca bor dozu uygulanan parsellerde farklı bileşenler elde edilmiştir.

Uçucu Yağ Oranı

Araştırmada farklı bor dozlarının (0, Saf ve 1/8 kg/da) uygulanması uçucu yağ oranı üzerindeki etkisi önemli bulunmuştur. Rezenede artan azot dozunda meyvenin uçucu yağ ve kompozisyonunda azot dozunun etkisinin olmadığını belirtmiştir (Yıldırım ve ark., 2006). Borda elde ettiğimiz bulgular benzerlik göstermemiştir. Aksine doz artması uçucu yağ oranında artış göstermiştir. Çalışmalarda elde edilen uçucu yağ oranları; % 2.74, (Şanlı ve ark., 2012), %1.93-2.28, (Özkan ve ark., 2000), % 3.09, (Uzun ve ark., 2011), % 0.79-1.06, (El-Awadi ve ark., 2010), % 1.58-1.60, (Arabacı ve ark., 2005), %1.87-1.92, (Tunçtürk ve ark., 2011) olarak elde etmişlerdir. Farklı lokasyonlarda yapılan çalışmalarda elde edilen sonuçlar saf bor dozundan düşük bulunmuştur.

Uçucu Yağ Bileşimi

Rezene bitkisinin uçucu yağ kompozisyonunun analiz sonuçları Çizelge 2'te verilmiştir. Rezene meyvesinde yapılan analizler sonucunda sırasıyla; borsuz, saf dozda, 1/8 dozda 7 şer bileşen tespit edilmiştir. Uçucu yağda elde edilen ana bileşenler doz sırasına göre borsuz dozda; trans-anetol %85.82, limonen %5.94, p-allilanisol %4.26, fenkon %1.20, saf dozda; trans-anetol %94.52, anisol %3.54, limonen %1.09, fenkon %0.36, 1/8 dozda; trans-anetol %92.38, anisol %3.8, limonen %2.85, fenkon %0.35 olarak değişim göstermiştir. Çalışmada elde edilen

tüm dozlarda ana bileşen trans-anetol olduğu belirlenmiştir. Bu konuda yapılan benzer çalışmalarda; rezene bitkisi üzerinde yapılan analizler sonucunda elde edilen uçucu yağın ana bileşenleri, *trans*-anetol (%85.27), fenkon (%6.22), p-allil anisol (% 4.31) ve limonen (% 1.93) olarak tespit edilmiştir (Şanlı ve ark., 2012). Uçucu yağ kompozisyonunda, en fazla trans-anethol (% 18.93-76.00), en az ise α-pinen, limonen, sineol, terpineon, sitronellol ve kafur olduğu belirlenmiştir (Şanlı ve ark., 2008).Uçucu yağ ana bileşeni olarak, anetol % 86.11-87.58 aralığında bulunmuştur (El-Awadi ve ark., 2010). Uçucu yağ içerisindeki ana bileşenin *trans*-anetol olduğu ve %79-86 aralığında değiştiği ve bu bileşeni limonenin takip etiğini belirtmiştir (Mahfouz ve ark., 2007). Borda elde edilen uçucu yağ bileşenleriyle ilgili literatürlere rastlanılmamıştır. Saf dozda elde ettiğimiz uçucu yağın ana bileşeni trans-anethole %94.52 olarak bulunmuş, yapılan diğer çalışmalarda elde edilen değerlerden yüksek bulunmuştur.

Çizelge 2. *Foeniculum vulgare* Mill. türünün uçucu yağ bileşenin bor doz oranına göre (%) değişimi

S.no	Bileşen adı	Borsuz doz	Saf doz	1/8 doz
1	limonen	5.94±0.014	1.09±0.021	2.85±0.0141
2	fenkon	1.20±0.021	0.36±0.0141	0.35±0.0212
3	fenil asetat	-	0.08±0.007	0.16±0.028
4	anisol	-	3.54±0.0141	3.8±0.141
5	*cis*-Anetol	-	0.26±0.028	0.22±0.007
6	*trans*-Anetol	85.82±0.0141	94.52±0.926	92.38±0.586
7	anisaldehit	-	0.15±0.007	0.24±0.021
8	cis-osimen	0.25±0.0141	-	-
9	p-allilanisol	4.26±0.0141	-	-
10	karvon	0.56±0.035	-	-
11	p-anisaldehit	0.91±0.014	-	-
	Toplam (%)	%98.94	%100	%100

SONUÇ

Bu çalışmada en az uçucu yağ oranı %1.55 ile 1/8 dozda, en fazla ise %3.43 ile saf bor dozu uygulanan parsellerden elde edilmiştir. Uçucu yağın ana bileşeni *trans*-Anetol olarak

belirlenmiştir. Bor dozu uygulanan parsellerde uçucu yağ kompozisyonunda farklı bileşen olarak; fenil asetat, anisol, *cis*-Anetol, anisaldehit elde edilmiştir. Ortak bileşen olarak; limonen, fenkon, *trans*-Anetol olarak bulunmuştur. Uçucu yağ oranı ve kompozisyonu için saf doz önerilebilir. Farklı rezene türleri üzerinde daha fazla çalışmaların yapılması yararlı olacaktır.

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APPLYING THE PRINCIPLES OF GREEN ECONOMY: FOCUSING ON CIRCULAR ECONOMY AND SUSTAINABLE DEVELOPMENT

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Abstract
Nowadays, reducing environmental risks and environmental scarcities represent the most powerful aims of any economy that prioritizes those activities that reflect friendliness to the environment, the desire to achieve sustainable development, and the high standards imposed by the Sustainable Development Goals (SDGs). What is more, the green economy applies the vital principles of ecological economics, which emphasize the necessity of being not only efficient and effective, but also fair and just, in order to stop the degradation of the environment and facilitate the smooth transition to the circular economy. Furthermore, by rigorously applying the key principles of the green economy, specialists acknowledge the success of the just transition to a new economic model characterized by low-carbon emissions, resource efficiency, and social inclusiveness. The paper focuses in the literature review (background) section on the analysis and characterization of valuable concepts, such as: green growth; green economics; green recovery; and circular economy. Also, the paper makes an in-depth analysis of the main sectors specific to the green economy, namely: renewable energy; green buildings; sustainable transport; water management; waste management; and land management. In addition, in terms of the practical approach, the study addresses the latest figures reflected by different ecological measurements, such as, the Green Score City Index and the Global Green Economy Index, in order to show the most recent global trends and to be able to make predictions regarding the evolution of the green economy and green economic growth. All in all, the current paper emphasizes, on the one hand, the importance of expending the economic opportunities of the Green Growth Strategies, and, on the other hand, the environmental pressure that accompanies every major decision taken by individuals, communities, country leaders, entities, and economic actors, in general, on the road of unlocking all the growth engines of the globalized world.
Keywords: Green Economic Growth, Green and Fair Economy, Well-Being, Planetary Boundaries, Efficiency and Sufficiency, Good Governance

INTRODUCTION

These days, specialists worldwide are showing tremendous concern regarding pivotal issues, such as, for example, the following ones: green economic growth; green and fair economy; well-being; planetary boundaries; efficiency and sufficiency; and good governance (Castanho, 2024). Besides all these aspects, researchers at a global level are displaying substantial worries with regard to the concrete possibilities that our Planet possesses in order to ensure a continuous support of the requirements that human beings have and that the industries request on a day-to-day basis (European Commission, 2015). Going even further with this current analysis, prominent leaders as well as powerful managers at an international level find themselves into delicate positions of having to make the best choices possible today in order to take into consideration the well-being, health, and continuity of the generations to come (European Commission, 2018).

Under these circumstances, applying the principles of the green economy seems to become a must, rather than an option – as it was seen, not too long ago, by individuals, communities, and organizations, while focusing on circular economy and sustainable development are becoming necessities, rather than alternatives to a lifestyle that will soon become impossible to support by the resources that the Planet still has to offer (Popescu, 2019).

According to this current research, reducing environmental risks and environmental scarcities represent the most powerful aims of any economy that prioritizes those activities that reflect friendliness to the environment, the desire to achieve sustainable development, and the high standards imposed by the Sustainable Development Goals (SDGs) (European Commission, 2023a). Hence, there are numerous environmental risks that accompany today's society and all these risks implicate, among other aspects, the fact that there are not enough resources to satisfy the necessities of the present generations and the ones that will come (Popescu & Popescu, 2019a). Besides these, the environmental risks may lead in their initial stages to natural disasters, hunger, flooding, diseases, and in other more advanced stages to social conflicts, wars, social inequalities, and economic and financial crisis (Azeez *et al.*, 2023; Green, 2022).

What is more, this current research brings to light the pivotal fact that green economy applies the vital principles of ecological economics, which emphasize the necessity of being not only efficient and effective, but also fair and just, in order to stop the degradation of the environment and facilitate the smooth transition to the circular economy. In this matter, specialists came to the conclusion that circular economy represents one possible solution to stop the environmental

degradation and damage, based on the fact that today's economic model does not have the capacity to consider the well-being of the individuals, communities, and environment on the long-term (Popescu, 2020a). Furthermore, this current research promotes the idea according to which by rigorously applying the key principles of the green economy, specialists acknowledge the success of the just transition to a new economic model characterized by low-carbon emissions, resource efficiency, and social inclusiveness.

The main research questions are the following ones: (RQ1) What does green economy represent and on principles is it based? – Which targets the presentation and characterization of the green economy concept together with the one of other associated notions, such as green growth, green economics, green recovery, and circular economy, and the analysis of the major principles that is reflected by green economy; (RQ2) What are the main sectors specific to the green economy and what implications do they have for the SDGs? – Which centers on displaying the main sectors specific to the green economy represented by renewable energy, green buildings, sustainable transport, water management, waste management, and land management, while having in mind the role and importance of circular economy; and (RQ3) What are the most recent global trends and which are the latest predictions regarding the evolution of the green economy and green economic growth? – Which offers the possibility to display the insights of the latest figures reflected by different ecological measurements, such as, the Green Score City Index and the Global Green Economy Index.

The general structure of the paper is as follows: (a) first of all, the paper focuses in the literature review (background) section on the analysis and characterization of valuable concepts, such as: green growth; green economics; green recovery; and circular economy; (b) second of all, the paper makes an in-depth analysis of the main sectors specific to the green economy, namely: renewable energy; green buildings; sustainable transport; water management; waste management; and land management; and (c) third of all, in terms of the practical approach, the study addresses the latest figures reflected by different ecological measurements, such as, the Green Score City Index and the Global Green Economy Index, in order to show the most recent global trends and to be able to make predictions regarding the evolution of the green economy and green economic growth. All in all, in essence, the current paper emphasizes, on the one hand, the importance of expending the economic opportunities of the Green Growth Strategies, and, on the other hand, the environmental pressure that accompanies every major decision taken

by individuals, communities, country leaders, entities, and economic actors, in general, on the road of unlocking all the growth engines of the globalized world.

Literature Review (Background)

This section is dedicated to the literature review (background) of the paper which targets the analysis and characterization of valuable concepts, such as: green growth; green economics; green recovery; and circular economy.

Based on researchers' most recently published results, the green economy and the green businesses represent the most recent and the viable alternative for development and growth that is capable to support individuals' and organizations' long-term vision to ensure prosperity worldwide as promoted in the United Nations documents targeting the SDGs (United Nations Secretary General, 2022). In continuation, green growth implicates enabling economic development and economic growth while focusing on the well-being of individuals and communities and the health of the environment (Popescu, 2020b). In this matter, green growth is the process according to which the natural assets and resources are used with great care. In the same time, while analyzing green growth it ought to be stated that the natural assets and resources should be responsibly preserved for the well-being of the individuals, communities, and environment (Management Association, 2019).

The most important principles of the green economy in the spirit of sustainable development are displayed in the lines below (see, in this matter, Table no. 1: Principles of Green Economy in the Spirit of Sustainable Development).

Table 1: Principles of Green Economy in the Spirit of Sustainable Development

Principles of Green Economy	Centering on Sustainable Development
The Efficiency and Sufficiency Principle	Promoting sustainable consumption and production represent important aspects on the agenda of green economy (European Commission, 2023b). Introducing the benefits of circular economy is crucial these days (Popescu, 2020d).
The Planetary Boundaries Principle	The focus should be on preserving biodiversity and ecosystems (Khandelwal *et al.*, 2023). The inclusive green economy must take into account protecting the environment, restoring the affected habitats, and enabling funds for the preservation of the environment (United Nations Department of Political Affairs, 2018).
The Well-Being Principle	The focus ought to be on individuals (United Nations (UN) University Centre for Policy Research, 2018). The Planet's wealth ought to be shared in a correct manner between individuals and communities, without accentuating inequalities and generating regional and international conflicts (United Nations (UN), 2022). The financial wealth ought to be shared among individuals, in order to build and support common actions for a better future for all (United Nations (UN), 2018).
The Justice Principle	The focus ought to be in promoting non-discriminatory policies and programs (United Nations Educational, Scientific and Cultural Organization (UNESCO), 2023). The benefits ought to be divided in an equal and correct manner, while finding solutions to decrease the gaps between people, empower women, and show solidarity towards minorities and indigenous people, hence respecting the human rights (Popescu & Popescu, 2019b).
The Good Governance Principle	The green economy tackles the following aspects: inclusive cross-disciplinary institutions and norms; decentralized decision-making management of natural resources; and economic and financial systems that promote safety, sustainability, and well-being, as addressed by the SDGs (Popescu *et al.*, 2015).

Source: The Author's Own Elaboration

The concepts of green recovery and circular economy are highly important when presenting the concepts of green economy and green economics. When characterizing the concept of green

recovery the aspects that ought to be thought of are the following ones: (a) the current economic system is believed to be inappropriate, according to most recent statistics, since it is no longer equipped with the capacity to support the social and environmental damage caused by the human activities (Popescu, 2020c); and (b) the people's activities are seen as extremely detrimental to the future of the Planet due to the repercussions encountered both at a social and at an environmental level, since today there are very serious problems regarding the greenhouse gases, global warming, and extraction of natural resources, such as water and oil, or the abusive use of soil, forests, and other rare resources (Ordóñez de Pablos & Zhang, 2023). Hence, green recovery has pivotal implications for the health of individuals, the happiness of the communities, and the preservation of the environment and should be considered together with the principles of green economy (displayed in the lines above, in Table no. 1: Principles of Green Economy in the Spirit of Sustainable Development) and with other concepts such as: green economists, green economics, green economic models, green marketing, and green businesses. The most important characteristics regarding green recovery and circular economy are displayed in the lines below (see, in this matter, Table no. 2: Green Recovery and Circular Economy on the Road to Achieving the SDGs).

Table 2: Green Recovery and Circular Economy on the Road to Achieving the SDGs

Characteristics of Green Recovery	Characteristics of Circular Economy
Interconnecting climate, social, economic, financial, and technological practices in order to positively balance the social and environmental goals (Yilanci, 2023);	Focusing on a new economic model that is non-linear and that considers the future of citizens, communities, businesses, and nature (Rokochinskiy *et al.*, 2023);
Prioritizing the reconstruction of natural habitats, biodiversity, and ecosystems for the success of the SDGs, while targeting the success of human well-being and social equity (Larsen, 2021);	Centering on a wide range of forms of capital – such as human, social, physical, and cultural capital – in order to develop the best strategies to allow people to flourish and businesses to prosper, while treating nature and natural resources sustainably (Akansel, 2020);
Knowledge and education should focus on developing more environmentally-friendly processes and production technologies, based on the fact that the infrastructure should become more sustainable (Akkucuk, 2015);	Collaborative approaches ought to be encouraged and fostered in order to make better decisions for a sustainable future for all (Nojiyeza, 2022);
New skills and training programs may be implemented in order to have a better and wider knowledge regarding green recovery, having in mind that green economy offers new opportunities for investment solutions and job creation (Larsen, 2020);	New techniques and technologies ought to be created and implemented, taking into account that circular economy should lead to an efficient use of resources, while reducing waste to minimum and using renewable energy sources such as solar, wind, hydrogen, and hydroelectric (Mourão & Martinho, 2021);
Rebalancing the consumer-producer model so that the consumer-driven models as well as the producer- driven models become more sustainable in terms of the usage of natural resources (Sharma & Sinha, 2019).	Tackles a long-term perspective that focuses on an adequate management of the processes that take place in the society in order to deliver value for the present and future generations, focusing on: efficiency and sufficiency of resources; resilience and well-being of individuals and communities; creating wealth, while respecting the Planet's ecological limitations; and being inclusive and non-discriminatory (Hamiduzzaman & Islam, 2022).

Source: The Author's Own Elaboration

In order to draw the conclusions specific to the literature review (background) section it ought to be highlighted that the focus is on the analysis and characterization of several valuable concepts, such as green growth, green economics, green recovery, and circular economy, based on the fact that these days the main concern of the worldwide leaders, managers, and researchers is to achieve the SDGs. The next sections of this current study focus on the material and method, the results and discussion, and the conclusions, while having in mind the following details: (a) in the next part of this scientific work an in-depth analysis of the main sectors specific to the green economy is made, namely: renewable energy; green buildings; sustainable transport; water management; waste management; and land management; and (b) also, in the remaining

of the paper, in terms of the practical approach, the study addresses the latest figures reflected by different ecological measurements, such as, the Green Score City Index and the Global Green Economy Index, in order to show the most recent global trends and to be able to make predictions regarding the evolution of the green economy and green economic growth. Under these given complex context it needs to be highlighted that the current research study intends to stress, on the one hand, the importance of expending the economic opportunities of the Green Growth Strategies, and to bring to light, on the other hand, the environmental pressure that accompanies every major decision taken by individuals, communities, country leaders, entities, and economic actors, in general, on the road of unlocking all the growth engines of the globalized world.

MATERIAL and METHOD

The methodology used in this paper is highly complex, due to the vital nature of the topic chosen for analysis. The theme chosen for the analysis revolves around applying the principles of the green economy, while focusing on the circular economy and the sustainable development.

In the first part of this paper the key concepts are presented and defined, which helps cover the main characteristics specific to key terms such as: socio-ecological analysis; health and human hazards; health access; health inequality; health system; economic conditional change; green economy; green economics; green economists; and collaborative efforts for a better future for all. This particular section uses the social, economic, and ecological approach to paint the current situation regarding the SDGs accomplishment as well as the necessity to determine people and organizations to act more responsible and more sustainable. First of all, the principles of the green economy – which are carefully displayed and thoroughly analyzed in the literature review (background) section – have multi-dimensional consequences, as follows: the linear model of economy become increasingly expensive to individuals and communities based on the fact that the "payment" is not necessarily reflected in the future of the current generations, but in the future of the next generations to come; the way in which citizens choose today to lead their lives according to the SDGs will become a model of good practices for the future generations or will, in fact, constitute the manner in which the people ought not to act if willing to be healthy and prosperous; and these days human and health hazards could become, in the near future, either situations with which humanity will not have to confront or, in the contrary, will represent constant challenges that will be very difficult to surpass. Second of all,

by applying the principles of the green economy there cannot be stated that there will be guarantees that the Planet will be better taken care of and that individuals will live better and more prosperous lives unless all the efforts done today will be continued in the future as well with the same dedication and enthusiasm.

In the next part of the paper the following aspects are highlighted: (a) first of all, in the next part of this scientific work an in-depth analysis of the main sectors specific to the green economy is made, namely: renewable energy; green buildings; sustainable transport; water management; waste management; and land management; and (b) second of all, in the remaining of the paper, in terms of the practical approach, the study addresses the latest figures reflected by different ecological measurements, such as, the Green Score City Index and the Global Green Economy Index, in order to show the most recent global trends and to be able to make predictions regarding the evolution of the green economy and green economic growth.

The main sectors specific to the green economy are the following ones: renewable energy; green buildings; sustainable transport; water management; waste management; and land management. The most important characteristics regarding these main sectors specific to the green economy – namely, renewable energy; green buildings; sustainable transport; water management; waste management; and land management – are displayed in the lines below (see, in this matter, Table no. 3: Green Recovery and Circular Economy on the Road to Achieving the SDGs).

Table 3: Main Sectors Specific to the Green Economy and the Implications of Sustainable Development and the SDGs

Characteristics of the Main Sectors Specific to the Green Economy	Implications of Sustainable Development and the SDGs for the Green Economy Sectors
Renewable Energy is the form of energy delivered from natural resources (Krstić & Pavlović, 2020).	These sources of energy are seen as plentiful and may be encountered all around (Akkucuk, 2019). These resources are believed to create far lower carbon emissions than burning fossil fuels (such as, for example, coal, gas, and oil) (Nayak *et al.*, 2023).
Green Buildings are known also as green constructions or sustainable buildings being built while having in mind environmentally responsible processes and offering to the owners resource-efficient solutions for living and/or working (Vasconcelos *et al.*, 2021).	The entire life-cycle of the building implicates the focus on green building technologies: architecture, design, planning, construction, operation, maintenance, renovation, and demolition (Ordóñez de Pablos *et al.*, 2022). The purpose is to provide people with healthy, confortable, and efficient use of space (Yang, 2020).
Sustainable Transport refers to models of transport which are characterized by low-emissions and zero-emissions, energy efficiency, and affordability (Dias & Luís, 2023).	These models of transport include electric and alternative-vehicles (Ordóñez de Pablos *et al.*, 2023). These models are intended to function with domestic fuels (Nogalski *et al.*, 2020). The most common forms of sustainable transport are electric/hybrid vehicles, car sharing, public transport, cycling and walking (Hasan & Hossain, 2022).
Water Management in terms of sustainability refers to protecting the shared water and marine ecosystems, resources, and environments from pollution and other factors that might affect the sustainable water management (Management Association, 2018).	The importance of clean water is crucial for the existence of every living creature on the Planet. The risks associated with floods ought to be considered (European Environment Agency, 2023). The beneficial use ought to be maximized with the aid of good water management, while minimizing damages to lives and properties (Management Association, 2020).
Land Management is defined as the process of carefully managing the use and development of all land resources which may be found in both rural and urban settings, so that these resources will be preserved in a sustainable manner (Management Association, 2017).	The land should be used in an appropriate manner in order to increase productivity and avoid inappropriate use or degradation (Shrestha *et al.*, 2021). Land resources are vital for the well-being and health of the Planet, which is why the accent ought to be placed on ecological activities, such as: organic agriculture, reforestation, and eco-tourism projects (El-Ayachi & El Mansouri, 2019).

Source: The Author's Own Elaboration

RESULTS and DISCUSSION

There are numerous previously published studies that come to support the outcomes and results displayed by this current paper. For instance, the importance of green economy was approached on numerous occasions by specialists who acknowledged the fact that it allows the reduction of carbon emissions and pollution (Popescu & Popescu, 2019a; Popescu & Popescu, 2019b). In the same time, the importance of green economy was emphasized in recent studies by international specialists stating that by implementing the principles of this form of economy the losses of the biodiversity and ecosystems will be prevented (Akkucuk, 2015; Dias & Luís, 2023). Also, there are numerous researches pointing out that green economy has the power to enhance energy and resource efficiency (Azeez *et al.*, 2023).

With reference to the latest figures reflected by different ecological measurements, such as, the Green Score City Index and the Global Green Economy Index the following aspects could be highlighted: (a) the Green Growth Index is a composite index that takes into consideration four key aspects, namely the efficient and sustainable use of resources, green economic opportunities, social inclusion, and natural capital protection; (b) based on recent statistics, in 2019 the top performing countries by region were Tanzania (in Africa), Mexico (in Americas), Japan (in Asia), Sweden (in Europe), and New Zeeland (in Oceania); and (c) according to the most recent results, Northern Africa recorded the highest green growth index as a result of higher values in terms of social inclusion and, in like manner, Northern Africa registered the best performance of green economic opportunities while compared to the other sub-regions that belong to Africa (Green Score City Index, 2023; Green Growth Index, 2023; United Nations Industrial Development Organizations, 2017).

CONCLUSIONS

There are several aspects that need to be taken into consideration while centering on the ways capable of applying the principles of green economy, having as a major priority the focus on circular economy and sustainable development.

Firstly, green economy represents a very powerful sustainable solution to these days polluting techniques and technologies. In this matter, learning how to care about the individuals, communities, and environment represents a crucial desire of leaders worldwide which is avidly supported by worrying results that have come to profess immense and irreversible damages to people and natural habitats. What is more, that world as it was known until present days is rapidly changing, while the challenges that occur are no longer taking place in moths or in

years, they are occurring at a much faster pace than it happened before. Furthermore, the society is no longer capable to support the alert rhythm, in which businesses are expending, while the environment is no longer able to move passed the damages of the eroding business process management which were not in accordance with the sustainable development norms, principles, regulations, and rules.

Secondly, this current study showed that it is highly needed to change the manner in which people act in order to support the efficient and sustainable use of resources. Likewise, the results of this current research paper come to display the immense need to preserve the natural capital, while having in mind the opportunities and principles of the green economy and circular economy. In line with the aforementioned aspects, this work has managed to successfully paint an image capable to display the importance of social inclusion in the spirit of the SDGs, given the fact that green investment opportunities are expected to change citizens' lives by offering new jobs and by showing a different and improved facet of the world.

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The Author declares that there are no conflicts of interest.

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AGRICULTURE, RURAL DEVELOPMENT, AND LAND REFORM: RECENT ADVANCES AND CONTRIBUTIONS TO ENVIRONMENTAL SUSTAINABILITY

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Abstract
These days, the Sustainable Development Goals (SDGs) are regarded by specialists worldwide as the most important global aims in the history of humanity. Moreover, these Global Goals are expected to ensure sustainable development at a large scale, while centering on major targets, namely: ending poverty; protecting the Planet; and ensuring that all individuals and communities will be able to enjoy peaceful times and great prosperity by the year 2030. Furthermore, agriculture, rural development, and land reform are seen as vital priorities for all regions and countries, given the fact that economic development, sustainable development, and environmental quality depend on finding the best solutions concerning a more equitable distribution of farmland. The paper sheds a new light in the literature review (background) section on the analysis and characterization of crucial concepts, such as: urban economy; environmental competitive advantages; land productivity; land reform strategies; rural poverty; poverty reduction; agricultural income; and small farms. Also, the paper makes an in-depth analysis of the main environmental policies that ought to support the smooth transition to the sustainable agriculture, placing a particular accent on the Common Agricultural Policy (CAP) specific to the European Union (EU) countries. In addition, in terms of the practical approach, the study addresses the latest figures published by the United Nations Food and Agriculture Organization (FAO) and by the United Nations (UN) in the attempt to emphasize the successes and failures in promoting sustainable agriculture and rural development. All in all, the current paper emphasizes, the most valuable trends and options for the future, based on the fact that the sustainable development agenda is multifaceted and concentrated mainly on biodiversity, biotechnology, and Green Revolution technologies.
Keywords: Agriculture Economies, Environmental Quality, Economic Development, Biodiversity, United Nations Food and Agriculture Organization (FAO), Green Revolution Technologies, Equitable Distribution of Farmland

INTRODUCTION

In this day and age, the agriculture, rural development, and land reform occupy a vital place when addressing the aspects related to economic development, sustainable growth, and household food security (United Nations Secretary General, 2022). In the same line with the agriculture, rural development, and land reform, the Sustainable Development Goals (SDGs) play a major role in the society these days, in particular, based on the fact that the responsibilities of individuals, communities, and entities are growing at a very fast rate in order to accomplish the desiderates expressed by the United Nations 2030 Agenda (United Nations Department of Political Affairs, 2018). What is more, the SDGs are regarded by specialists worldwide as the most important global aims in the history of humanity, especially in the context in which there is a broad vision globally displayed according to which by 2030 poverty must be eliminated and inequalities must be reduced drastically (Popescu *et al.*, 2024). Moreover, these Global Goals are expected to ensure sustainable development at a large scale, while centering on major targets, namely: facilitating sustainable rural development; developing agricultural value chains; providing measurable agricultural inputs; monitoring production and consumption in the agriculture sector, so that sustainability is obtained and maintained; protecting the Planet; and ensuring that all individuals and communities will be able to enjoy peaceful times and great prosperity by the year 2030 (Popescu, 2021; Manawadu *et al.*, 2021). Furthermore, agriculture, rural development, and land reform are seen as vital priorities for all regions and countries, given the fact that economic development, sustainable development, and environmental quality depend on finding the best solutions concerning a more equitable distribution of farmland (Management Association, 2022).

Besides all these, there are several key concepts that attract a lot of attention these days and which should be closely addressed, presented, and analyzed, as follows: agriculture economies, environmental quality, economic development, biodiversity, United Nations Food and Agriculture Organization (FAO), green revolution technologies, and equitable distribution of farmland (Chiliquinga *et al.*, 2023). These concepts are believed to promote an integrated and inclusive economy (Popescu *et al.*, 2023). In the same time, these vital terms envision the expansion of the agriculture activity in a sustainable manner, taking into consideration the fact that there is a tremendous need, on the one hand, for the implementation of an effective land

reform and, on the other hand, for an economic transformation and job creation in the agricultural sector (González *et al.*, 2023).

The current paper sheds a new light in the literature review (background) section on the analysis and characterization of critical concepts, such as: urban economy; environmental competitive advantages; land productivity; land reform strategies; rural poverty; poverty reduction; agricultural income; and small farms. Also, the paper makes an in-depth analysis of the main environmental policies that ought to support the smooth transition to the sustainable agriculture, placing a particular accent on the Common Agricultural Policy (CAP) specific to the European Union (EU) countries. In addition, in terms of the practical approach, the study addresses the latest figures published by the United Nations Food and Agriculture Organization (FAO) and by the United Nations (UN) in the attempt to emphasize the successes and failures in promoting sustainable agriculture and rural development. All in all, the findings of this current paper display the most valuable trends and options for the future, based on the fact that the sustainable development agenda is multifaceted and concentrated mainly on biodiversity, biotechnology, and Green Revolution technologies.

Under these circumstances, the main objective (the general objective) of this research paper is to tackle the agriculture, rural development, and land reform, while displaying the most recent advances and contributions to environmental sustainability. In terms of research questions, given the importance of the chosen topic there are several valuable matters that are covered. To begin with, the first research question (RQ1) is: What is the place of the agriculture, rural development, and land reform in achieving the SDGs? Moving on, the second research question (RQ2) is: What do the following pivotal notions represent: urban economy; environmental competitive advantages; land productivity; land reform strategies; rural poverty; poverty reduction; agricultural income; and small farms? In continuation, the third research question (RQ3) is: How can the smooth transition to the sustainable agriculture be made, placing a particular accent on the Common Agricultural Policy (CAP) specific to the European Union (EU) countries? In the end, the fourth research question (RQ4) is: What do the latest figures published by the United Nations Food and Agriculture Organization (FAO) and by the United Nations (UN) state and what do they express in terms of the successes and failures in promoting sustainable agriculture and rural development?

All in all, the originality of this paper is very high given the perspective addressed as well as the theme chosen. The nature and extent of this study show the fact that the society is expected

to become a valuable supported of the SDGs as well as a promoter of a healthy and sustainable lifestyle. In the same line with the aforementioned ideas, this current research paper is intended to paint a valuable image of the necessity to expend the agricultural activities but with a clear and well-defined focus on preserving the natural habitats, biodiversity, and ecosystems.

LITERATURE REVIEW (BACKGROUND)

This section is dedicated to the literature review (background) of the paper which targets the analysis and characterization of valuable concepts, such as: urban economy; environmental competitive advantages; land productivity; land reform strategies; rural poverty; poverty reduction; agricultural income; and small farms.

The place of agriculture, rural development, and land reform in achieving the SDGs is of great importance according to specialists worldwide. In this matter, according to the most recent studies creating a specific agricultural framework capable to ensure the development of the communities is a great matter and occupies a key position especially on the agenda of countries that are in the process of developing (United Nations Industrial Development Organizations, 2017). What is more, there is the need for comprehensive agricultural support programs which are expected to enable communities to be part of the extensive agricultural development processes which implicate aspects such as: the commercial farmers ought to receive funds in order to be able to become more productive in terms of grains production, horticulture production, and livestock production (Dharumarajan *et al.*, 2022); the agro-processing infrastructure ought to become more sustainable once it comes to develop further (Popescu, 2022); the agricultural colleagues and university programs ought to be revitalize with massive financial infusions of capital in order to become more attractive for the potential candidates (Luque González *et al.*, 2022b); and unemployment rates among the graduates of agricultural colleagues and university programs ought to be decreased by encouraging the placement of these people in commercial farms and by offering them support to further develop their skills and abilities on the long-term (United Nations Educational, Scientific and Cultural Organization (UNESCO), 2023).

These pivotal concepts are thoroughly analyzed in the lines below (see, in this matter, Table no. 1: Recent Advances and Contributions to Environmental Sustainability: Centering on Expending the Agricultural Activities while Fostering Sustainable Development).

Table 1: Recent Advances and Contributions to Environmental Sustainability: Centering on Expending the Agricultural Activities while Fostering Sustainable Development

Key Concepts for Environmental Sustainability	Targeting Sustainable Development
Urban Economy and Environmental Competitive Advantages	Promoting and inclusive rural economy implicates offering jobs in agriculture to individuals and helping them, in the same time, to use technologies that are ecological, hence supporting the sustainability principles (United Nations (UN) University Centre for Policy Research, 2018).
Land Productivity and Land Reform Strategies	Improving agricultural production implicates creating new reforms that are centered on sustainability (Popescu & Yu, 2024).
Rural Poverty and Poverty Reduction	Increasing food security is in line with the SDGs, which implicates that sustainable agriculture will target: the increase in the Gross Domestic Product; job creation; and opportunities to support the farmers with additional funds coming from projects (Management Association, 2018b).
Agricultural Income and Small Farms	Agriculture is an extremely vulnerable sector which implicates that numerous farmers find themselves at the level of subsistence (European Commission, 2018). Possible solutions could implicate: supporting small farmers with agricultural blended finance coming from programs and projects; the mechanization of farms; and the improvement and development of infrastructure in terms of increasing the grain, horticultural, and livestock production (Luque González *et al.*, 2022a).

Source: The Authors' Own Elaboration

This section represented by the literature review (background) successfully covered the first two research questions which implicated the presentation of the place of the agriculture, rural development, and land reform in achieving the SDGs and the analysis of the pivotal notions

such as urban economy, environmental competitive advantages, land productivity, land reform strategies, rural poverty, poverty reduction, agricultural income, and small farms.

The next sections are represented by the material and method, the results and discussion, and the conclusions. These sections cover the remaining of the research questions which accentuate, on the one hand, the way in which the smooth transition to the sustainable agriculture can be made by placing a particular accent on the Common Agricultural Policy (CAP) specific to the European Union (EU) countries and, on the other hand, by highlighting the latest figures published by the United Nations Food and Agriculture Organization (FAO) and by the United Nations (UN) state so that they express the successes and failures in promoting sustainable agriculture and rural development.

MATERIAL and METHOD

The methodology used in this paper is highly complex, due to the vital nature of the topic chosen for analysis. The theme chosen for the analysis focuses on addressing the importance and the role of the agriculture, rural development, and land reform, while tackling the most recent advances and contributions to environmental sustainability.

First of all, in terms of the material and method, the study centers on key theoretical concepts such as urban economy, environmental competitive advantages, land productivity, land reform strategies, rural poverty, poverty reduction, agricultural income, and small farms, in order to create the general framework. In addition, second of all, the analysis used in the next sections is of a practical nature, as follows: on the one hand, presenting the latest figures that are representative for the sustainable agriculture practices, placing a particular accent on the Common Agricultural Policy (CAP) specific to the European Union (EU) countries; and, on the other hand, showing the latest figures published by the United Nations Food and Agriculture Organization (FAO) and by the United Nations (UN) in order to highlight the successes and failures in promoting sustainable agriculture and rural development.

In the lines below a few sustainable agriculture practices encountered at the level of the European Union (EU) countries are presented, while emphasizing the importance and role of the Common Agricultural Policy (CAP) (see, in this matter, Table no. 2: Sustainable Agriculture Practices: Successes and Evolution in the EU Countries).

Table 2: Sustainable Agriculture Practices: Successes and Evolution in the EU Countries

Sustainable Agriculture Practices	The Key to Success
Focusing on more sustainable farming practices that take into account environmentally, economically, and socially sustainable practices: this implicates producing a diverse range of food adapted to the regional conditions and the local markets requirements (United Nations (UN), 2015).	The success is that environmental damage is minimized and productivity is maximized with the use of state-of-the-art sustainable agricultural practices focused on the real needs of the community and the regional markets (European Commission, 2023a).
Making room to all sizes farms implicates that a diverse range of agricultural products is produced while being environmentally sustainable: this means that the farms rely on natural systems and resources by considering all the facets of sustainability (United Nations (UN), 2018).	The success is that the soil is preserved; hence, erosion is prevented, while healthy soil is built (European Commission, 2023b). The water ought to be managed wisely, minimizing air and water pollution; hence, new ways to accomplish success (Popescu, 2019).
Economically and socially sustainable agriculture (agro-ecology and agro-forestry) implicates being profitable, while being able to contribute, in the same time, to the advancement of the local economy (United Nations (UN), 2022).	The success is that healthy food for all is produced, since the priority is shifted from the interests of corporations to the benefits of people and communities (European Environment Agency, 2023).
Sustainable agricultural practices could be, among others, the following ones: rotating crops, hence embracing diversity; plating cover crops and perennials; reducing or eliminating traditional plowing (tillage); applying integrated pest management (IMP); and integrating livestock and crops (Dharumarajan *et al.*, 2019; European Commission, 2015; Hiremath, 2022).	The success is that by adopting agro-ecology and agro-forestry practices farmers can diversify their activities and enhance their productivity (Hasnat & Hossain, 2021). In like manner, the whole system can be managed appropriately and the landscape can be adequately valued (Foncubierta-Rodríguez *et al.*, 2022).

Source: The Authors' Own Elaboration

By showing the latest figures published by the United Nations Food and Agriculture Organization (FAO) and by the United Nations (UN) the intention is to highlight the successes

and failures in promoting sustainable agriculture and rural development (see, in this matter, Table no. 3: Sustainable Agriculture Practices: Successes and Evolution in the EU Countries).

Table 3: Sustainable Agriculture Practices: Displaying the Latest Figures Published by United Nations Food and Agriculture Organization (FAO) and United Nations (UN)

Displaying the Latest Data Published by United Nations Food and Agriculture Organization (FAO) and United Nations (UN)	The Key to Success
Around 40% of these days global population agriculture (Food and Agriculture Organization (FAO) of the United Nations (UN), 2023).	Since agriculture is the single largest employer in the world, it should place a great emphasis on sustainability, with key features such as: environmental health, economic profitability, and economic and social equity (Popescu *et al.*, 2015; Popescu & Popescu, 2019b).
Factory farms have an industrial approach to food production, which is ecologically and socially harmful, leading to the loss of biodiversity, ecological disasters, deforestation, erosion, depleted and contaminated soil and water resources, and labor abuses (Management Association, 2019).	The factory farms models ought to be changed with family farms which lately declined due to the abusive practices of factory farms (Management Association, 2020b; Popescu, 2020a). The factory farms models need to base their activities on sustainable practices and techniques, such as: organic, free-range, low-input, holistic, and biodynamic (Management Association, 2020a).
The Top ten countries for sustainable food are: France, the Netherlands, Canada, Finland, Japan, Denmark, Czech Republic, and Sweden (Food and Agriculture Organization (FAO) of the United Nations (UN), 2023).	The accent ought to be put on: efficient and biological systems, safety human food needs, biofuel needs, enhancing the quality of lives for farmers, and increasing the importance of farm workers for the society as a whole (Management Association, 2021).

Source: The Authors' Own Elaboration

RESULTS and DISCUSSION

There are valuable previously published studies that come to support the outcomes and results displayed by this current paper. First of all, when it comes to agriculture, rural development,

and land reform the most recently published data comes to strengthen the discoveries of this current research: (a) agriculture represents the focal point on the United Nations SDGs Agenda, given the major influence that this sector has on the society as a whole (Popescu & Popescu, 2019a); (b) also, agriculture is an essential part of people's lives without which life would not be conceivable since food represents a vital element in individuals existence (Management Association, 2018a); and, (c) in addition, rural and land development are great concerns these days, especially with the increased levels of pollution the society confronts with, which implicates the need to focus on more sustainable practices (Management Association, 2017). Second of all, the most recent advances and contributions to environmental sustainability are displayed in numerous studies that come to support the current study, as follows: (a) family farms are the ones on which the sustainable future of the society ought to be based on, since the factory farms are harming the environment when using chemical and agricultural practices that are damaging to the land and water resources (OECD/FAO, 2016); (b) the United States of America are highly advanced in terms of agricultural science and are well-known for the advanced agriculture technology at a global level (OECD/FAO, 2016; Popescu, 2020b); (c) an interesting model of country focused on regenerative agriculture is New Zeeland, due to the fact that this country successfully manages to mitigate, manage, and measure the greenhouse gas emissions (OECD/FAO, 2016; Popescu, 2020c; Popescu, 2020d); and (d) in terms of food stability, the most stable food systems in the world are encountered in Sweden, Japan, Canada, Finland, and Austria – which occupy the top positions in the international charts in this matter (European Commission, 2023b; European Environment Agency, 2023).

CONCLUSIONS

There are several aspects that need to be taken into consideration while centering on understanding the importance and the role of agriculture, rural development, and land reform as well as while presenting the most recent and valuable advances and contributions to environmental sustainability.

First of all, agriculture technology these days is highly diverse and extremely advanced. Nevertheless, since the SDGs place agriculture on one of the top positions in terms of importance and visibility, it ought to be highlighted that the practices that are used in agriculture need to be sustainable in order to support the principles of green economy. In addition to all the aforementioned aspects, individuals these days are becoming more and more aware of the necessity to act sustainably for them, their families, and the future generations. Under these

circumstances, it is high time to seek support in determining the best agricultural practices that are truly sustainable on the long run for the society, hence concentrating more on health and well-being rather than profitability and productivity.

Second of all, even though big corporations choose to use practices that are harmful for the environment, family farms struggle to discover solutions to regain their power and role in the local communities and the regional markets by taking a stand and by making themselves heard and understood in order to receive help, support, and funding. These days, there is an increasing need for family farms and for specialized workers able to implement sustainable agricultural methods in order to secure the future of the present and of the future generations.

All in all, the society is prepared to receive the best that agriculture has to offer with the use of sustainable practices and technologies.

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The Authors declare that there are no conflicts of interest.

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PİTAYA *(Hylocereus spp.)*'NIN ÇİÇEK YAPISI VE DÖLLENME BİYOLOJİSİ

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Özet
Caryophyllales takımının *Cactaceae* familyasının *Hylocereus* cinsinde yer alan, Türkiye'de son yıllarda Mersin'de yetiştiriciliğine başlanan Antalya, Adana ve Muğla'da hasadı yapılarak üretim alanı genişletilen ve anavatanı tropikal ormanlar bölgesi olan pitayanın çekici görünümü, tadı ve besin içeriğiyle son yıllarda dikkatleri üzerine çekmektedir. Asya'da meyveyi kaplayan yeşil üst üste binen yüzgeçleri bulunan parlak kırmızı kabuğundan dolayı "ejder meyvesi" olarak adlandırılmaktadır. Genel olarak pitayalar et ve kabuk görünümlerine göre kırmızı et/kırmızı kabuk, beyaz et/kırmızı kabuk ve beyaz et/sarı kabuklu olarak bilinmektedir. En yaygın olarak yetiştirilen ve tüketilen türler arasında *Hylocereus polyrhizus, Hylocereus undatus* ve *Hylocereus megalanthus* bilinmektedir. Bitkinin çiçeklerinin karakteristik yeşilimsi sarı veya hafif beyaz renkte olduğu bilinmektedir. Çiçekleri, erkek ve dişi üreme organına sahip hermafrodit yapıda olmasına rağmen bazı pitaya türlerinin kendine uyumsuzdurlar. Pitaya bitkisinin çiçeklerinin büyümesi su varlığına değil, gün uzunluğuna bağlıdır ve çiçek tomurcukları haftalarca latent aşamada kalmakta ve çiçeklenme başlangıcı genellikle yağışlı mevsimden sonra gerçekleşmektedir. Meyveleri renk çekiciliğinin yanında genellikle oval yapılı ve dikenlerin büyüdüğü çıkıntılara sahiptir. Meyve kabuğu çoğunlukla kırmızı veya sarı renkte ve büyük pulsu yaprakçıklara sahiptir.
Anahtar Kelimeler: Pitaya *(Hylocereus spp.),* Ejder meyvesi, Kaktüs, Çiçek

PITAYA *(Hylocereus spp.)*' FLOWER STRUCTURE AND FERTILIZATION BIOLOGY

Abstract
Pitaya, which is included in the genus *Hylocereus* of the *Cactaceae* family of the *Caryophyllales* team, has been cultivated in Mersin in recent years in Turkey, harvested in Antalya, Adana and Muğla, its production area has been expanded and its homeland is a tropical forest region, it has been attracting attention in recent years with its attractive appearance, taste and nutritional content. In Asia, it is called the "dragon fruit" because of its bright red shell with green overlapping fins covering the fruit. In general, pitayas are known as red meat/red shell, white meat/red shell and white meat/yellow shell according to their meat and shell appearance. Among the most widely cultivated and consumed species, *Hylocereus polyrhizus*, *Hylocereus undatus* and *Hylocereus megalanthus* are known. The flowers of the plant are known to have a characteristic greenish yellow or slightly white color. Although the flowers have a hermaphrodite structure with male and female reproductive organs, some pitaya species are incompatible with themselves. The growth of the flowers of the Pitaya plant depends not on the presence of water, but on the length of the day, and the flower buds remain in the latent stage for weeks, and the onset of flowering usually occurs after the rainy season. In addition to their color attractiveness, their fruits are usually oval in structure and have protrusions where thorns grow. The fruit peel is mostly red or yellow in color and has large pulsating leaflets.
Keywords: Pitaya *(Hylocereus spp.),* Dragon fruit, Cactus, Flower

1. INTRODUCTION

One of the tropical climate fruit species, Pitaya (*Hylocereus* spp.) in our country, which is one of the countries with ecologies suitable for cultivation, its resistance to arid conditions, the attractiveness of its fruit's appearance, its richness in nutrients and antioxidants, and its cultivation outdoors and under cover in microclimate areas in subtropical conditions are increasing day by day and are of interest to both producers and consumers. However, in addition to large and medium-sized enterprises, pitaya has been the subject of preference by small-scale operators due to the high price in our country, its efficiency has decreased in the second year and it has reached full efficiency since the fifth year (Demirkaplan, 2020). In today's modern fruit growing, in addition to making the cultural processes correct in order to achieve high yield and quality, it is important to know the biology of the fruit species and varieties and to take the necessary measures in this regard from the point of view of cultivation (Demirkaplan, 2020).

Pitaya fruits are brightly colored in appearance, scaly and have a prickly structure, although they vary depending on the species. The fruit shell color is red, pink or yellow, and the fruit flesh varies according to species and varieties, but may have white, pink, red or purple colors (Demirkaplan, 2020). In pitaya, fruits consist of the ovary and the shell surrounding the ovary (Mizrahi and Nerd, 1999). 70-80% of its fruit consists of fruit flesh and is called a health fruit due to its high nutritional content and fresh consumption is more preferred (Gunasena et al., 2007). Although Pitaya has a wide variety of uses, it can be consumed as a table and is preferred in the food industry, especially in fruit juice, ice cream, yogurt, jelly, marmalade, jam, sugar, fruit chips and cake making (Gunasena et al., 2007).

Although the nutritional value of pitaya fruit varies depending on the type, origin, ecology and harvest time, it has a melon, kiwi, pear, mixed taste. It has been reported that the white (*Hylocereus undatus*) species has a taste of a mixture of unripe kiwi and pear, the red (*Hylocereus polyrhizus*) species has a taste of sweeter fruits such as strawberries, melons, kiwi, and the yellow (*Hylocereus megalanthus*) species has a more intense and sweeter taste than the other two species (Gunasena, et al., 2007; Anonymous 2020).

It is possible to produce pitayas with seeds and it is generally seen that they are propagated with steels (Zee et al., 2004). A fruit has a large number of black-colored seeds that are embedded

in the flesh of the fruit and are small in size (Altinkaya et al., 2016). It has been found that there is a relationship between fruit weight and seed number due to the presence of a large number of seeds, and it has been recorded that the number of seeds increases as the weight increases (Mizrahi and Nerd Dec, 1999).

The goal in fruit growing is to obtain abundant and high-quality fruits, and one way to ensure this is that pollination and fertilization events can take place in a healthy way. Pollination is defined as the transfer of flower dust (pollen) occurring in the anthers onto the stigma; fertilization is defined as the union of male and female gametes. Although pollination is necessary for fertilization to occur, this is not always enough (Ağaoğlu et al., 1997).

Pollination in cultivated plants according to the flower structure is carried out by wind or insects. Wind-pollinated plants are called "anemophyl" plants and usually have flowers with one gender. Nuts, walnuts, pecans, mulberries, chestnuts, such as monoic; dioic species such as dates and pistachios are anemophilic. In the flowers of anemophyl plants, the petals are either absent at all or very small. It has no nectar secretion properties. The number of pollen is very large and they are dry, small and light. Plants pollinated by insects are called "entomophyl" plants. Pollination of fruit species such as apples, pears, quinces, plums, cherries, cherries, peaches, almonds, pomegranates, figs, kiwis is due to insects. In entomophyl species, the flowers are usually hermaphrodite, the petals are colorful, fragrant and very showy, and most of the flowers have nectar secretory glands. There are very few flower powders in these, they have a large and sticky structure (Ağaoğlu et al., 1997). In the pitaya, whose pollination and fertilization biology are interesting, pollination occurs with insects or wind. One of the important issues that should be taken into account in the garden facility is the biology of fertilization. Fruit keeping and yield are increasing in gardens established by taking into account the biology of fertilization.

2. FLOWER STRUCTURE, POLLINATION AND FERTILIZATION

Pitaya has an androgynous or hermaphrodite flower (which houses male and female organs in the same place) in which the male and female organs are in a single night. In addition to the fact that the flowers are quite showy, fragrant and edible, their color is white in some species and pink in others. Some species and varieties also show discrepancy with themselves. Pitaya

flowers show a full opening between 22:00-24:00 at night with the Decaying of the sun and the dark beginning of the flower's outer green leaves and white, pink petals gradually opening (Anonymous, 2023a). In a study, it was reported that flowers open two hours before dark and can stay open for one night until three hours after the sun starts to rise, however, flowers belonging to some species can also stay open for several nights (Raveh et al., 1993). For this reason, bees and other insects play a role in pollination in the morning, and bats, moths and some large butterfly species play a role in pollination at night (Paul, 2014). Temperature and light intensity affect the opening of flowers. The opening time of flowers is delayed when the temperature and light are intense (Gunasena et al., 2007).

As a general structure, the length of the Pitaya flower is about 30-50 cm, the width is in the range of 25-35 cm, and there are green shell leaves (Sepals) with a protective layer on the outermost part, white or pink petals (Petal) on top of the dish leaves, as well as numerous male organs that carry pollen on the inside of the petals, and a female tube on the innermost part (Anonymous, 2023b). The male and female organs of the flower have cream color (Crane and Balerdi, 2005).

The female tube in the flower is longer than the male organs and there are seed beds and seeds at the bottom. In some varieties, the female tube is much longer than in males and remains in the outer region of the flower, in some it is almost immediately aligned with the male organs. Pollen is partially contained in the hillock section (Anther) of male organs, which are shorter than the female organ and dozens of times. The flower is quite large and invites insects and bees to it by emitting a wide magnificent smell.

In breeds that can self-fertilize, the female organ is very close to the male organs and because it is not in the form of a bulge towards the outer side, it dusts itself when the flower opens and closes, and fertilization will occur. But in breeds with manual fertilization, this is usually done by hand pollination, since the inner meat part is pink and purple, and the female organ remains slightly further outwards than the male organs. If commercial breeding is to be carried out, breeds that can fertilize the female organ on their own should be the reason for preference.

October May the flowering period of pitaya species in our country starts from the beginning of May and continues until the end of October. From the opening of the flowers to the fruit harvest the period lasts about 30-35 days. November June in our country, it is possible to find fresh fruits from the beginning of June to the end of November (Mizrahi and Nerd, 1999).

While the Pitaya (Queen of the Night) flower opens fully and closes with the morning sun, pollen is directed by male pollen from the female tube to the inner part and reaches the ovary, and pollen powders are fertilized here, the first fruit formation took place, and after this period, the formation process of the fruit is completed with a waiting period of up to 30 days (Anonymous, 2023b).

The fruit has 4 different colored inner flesh parts and there are two different outer color parts. The inner meat part is available in white, red, purple, pink and the outer shell part is available in pink and yellow colors. Each of the dragon fruit has different flavor values and aromas. It can be broken down more easily in the body and is quite low in calories, vitamin C, phosphorus, calcium, fiber and antioxidants have numerous nutritional effects (Anonymous, 2023b).

Dusting is an absolute must in the production of pitaya fruit. When the flowers open at night, they can be pollinated by bats, butterflies and hawk moths. In many countries that are just starting to grow, pollination is poor or no pollination in some varieties because there are no natural pollinators, and therefore manual pollination is performed to increase the fruit attitude in pitaya (Gunasena et al., 2007). There are varieties in the genus Hylocereus that can pollinate themselves and are sterile to themselves (Raveh et al., 1993). Since self-pollination will not cause fruit production, 2 plants are needed for pollination and fertilization.

The harvest time of Pitaya, which is not a climacteric fruit, must be determined correctly. In order for the fruits to be harvested, they must take the fruit shell color of the variety, the scales must turn from green to yellow, and the fruit shell floor must lose its veiny structure.

Marketplace fruits are sold directly without being stored in local markets, and when grown for foreign markets, storage should be carried out under appropriate conditions. Fruits can be kept for about 10 days after harvest (Mizrahi and Nerd, 1999).

3. RESULT

Pitaya, whose name has been heard frequently in recent years and whose production and consumption have been increasing day by day, is among the types of fruits suitable for the Turkish palate. Dec. Interest in its cultivation is increasing, especially due to its high nutrient content. In order to meet this interest in pitaya, manufacturers are setting up new pitaya gardens. One of the most important issues to know in order to get the product expected from the established gardens is the biology of fertilization. According to the biology of fertilization, the will increase in yield per decare with an increase in fruit attitude in established gardens. Pitaya has a hermaphrodite flower structure and pollination is carried out with the help of insects and bees. Chief among these are bats, butterflies and hawk moths. The goal in fruit growing is to obtain abundant and high-quality fruits, and the way to ensure this is that pollination and fertilization events can take place in a healthy way. At the Pitaya garden facility, there should be butterflies, bats and moths in the garden at night because they open their flowers at night.

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ANKARA'DA SONBAHAR EKIM SEZONUNDA SİYAH HARDAL HATLARININ VERIM VE KALİTESİ

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Özet
Brassica nigra, baharat ve endüstriyel tohum yağı olarak kullanılan, ekonomik acıdan önemli bir türdür. Bu calışma, Ankara'da yarı kurak iklim koşullarında 2020-21 sonbahar ekim sezonunda 3 siyah hardal saf hattının fenolojisi, morfolojisi ve verim performansı acısından karşılaştırılması amacıyla yapılmıştır. Bu calışmada kullanılan siyah hardal saf hatları, USDA gen bankasından temin edilen ve Türkiye'nin ceşitli ekolojilerinden toplanan siyah hardal genotiplerinden secilmiştir. Deneme tesadüf blokları deneme desenine göre 3 tekerrürlü olarak yürütülmüştür. Sonuclar siyah hardal hatlarının bitki boyu, dal sayısı, kapsül sayısı, kapsüldeki tohum sayısı, 1000 tane ağırlığı, tane verimi, ham yağ oranı ve ham yağ verimi acısından istatistiksel olarak önemli olduğunu göstermiştir. Cıkış süresi, 4-6 yapraklı rozet oluşturma süresi, %50 ciceklenme süresi, %50 kapsül bağlama süresi ve olgunlaşma süresi bakımından siyah hardal saf hatları arasında farklılık tespit edilmemiştir. En yüksek tane verimi (1632.50 kg ha^{-1}) ve ham yağ verimi (444.58 kg ha^{-1}) Bn5 hattında belirlenmiştir. Bu sonuclar, bu genotiplerin, baharat ve enerji endüstrilerine uygun yeni ceşitlerin geliştirilmesi amacıyla ileri ıslah programlarında değerlendirilebileceğini göstermiştir.
Anahtar Kelimeler: *Brassica nigra* L., Fenoloji, Morfoloji, Tane ve Ham Yağ Verimi

YIELD AND QUALITY OF BLACK MUSTARD LINES UNDER AUTUMN SOWING SEASON IN ANKARA

Abstract
Brassica nigra is an economically important species that is used as a spice and industrial seed oil. This study was conducted to compare the phenology, morphology, and yield performance of three black mustard pure lines during 2020-21 under autumn sowing conditions in semi-arid climatic conditions in Ankara, Turkey. The black mustard pure lines used in this study were selected from black mustard genotypes obtained from the USDA gene bank and collected from diverse ecologies of Turkey. The experiment was performed in a randomized block experimental design with three replications. The results indicated statistical significance for plant height, number of branches, number of capsules, number of seeds, 1000-seed weight, seed yield, crude oil percentage, and crude oil yield of black mustard pure lines. No difference was detected between black mustard pure lines in terms of emergence time, 4-6 leaf rosette stage time, 50% flowering time, 50% encapsulation time and harvesting time. The maximum seed yield (1632.50 kg ha^{-1}) and crude oil yield (444.58 kg ha^{-1}) were determined from the Bn5. These results suggested that these lines may be evaluated in further breeding programmes to develop new varieties suitable for the spice and energy industries.
Keywords: *Brassica nigra* L., Phenology, Morphology, Seed and Crude Oil Yield

INTRODUCTION

B. nigra L. (family *Brassicaceae* or *Crucifereae*) is an economically valuable annual plant that is a raw material for the spice and biodiesel industries (Kayacetin, 2020a). Previous studies show that *B. nigra* (black mustard) can be grown in autumn and spring in Ankara (Kayacetin, 2019; Kayacetin et al., 2022). Previous studies detected that *B. nigra* genotypes can be grown during autumn and spring in Ankara, Turkey. But it was determined that higher yield and quality were obtained from the autumn sowing of *B. nigra* (Kayacetin, 2019; Kayacetin et al., 2022).

With a 20-30% oil content, the black mustard seeds has the potential to be an important source of spice and energy (Kayacetin, 2019). Among black, brown, and yellow mustards, black mustard has the sharpest taste in terms of spice use, while brown mustard is used in making Dijon mustard (Palle-Reisch et al., 2013). There are a limited number of studies in Turkey on the use of local genotypes as spices and for the biodiesel industry (Kayacetin, 2021). Breeding this species and bringing it into agriculture is important for the protection, recording and evaluation of Turkey's genetic resources. The fatty acids of this species are considered non-edible oils due to the high content (30-40%) of erucic acid (C22:1) and are considered potential low-cost sources for biodiesel production (Kayacetin et al., 2021; Rezania et al., 2022).

Differences among genotypes of different species may also cause differences in the adaptation of plants to certain environments, resulting in variable responses depending on different genotypes (Nowosad et al., 2016). Some researchers have studied a considerable number of *Brassica* species and examined the responses of species under similar and/or different climatic conditions (Katche et al., 2019; Kayacetin, 2019). Responses of genotypes from different species could be similar or different depending on genotypic and environmental conditions (Bocianowski et al., 2019; Tariq et al., 2020). The more genotypes studied, the more different results were detected (Kayacetin et al., 2022). The seed and crude oil yield per unit are among the most important characteristics that determine the production efficiency of any oilseed plant. Sometimes certain genotypes may not show different phenotypic traits and yield performance under changing environmental conditions.

This study aimed to compare the phenology, morphology, and yield performance of three black mustard pure lines during 2020-21 under autumn sown conditions in semi-arid climatic conditions of Ankara, Turkey.

1. MATERIALS and METHODS

2.1. Experimental location, climate and soil traits

The experiment was carried out in the 2020-21 autumn growing season at the trial area of the Field Crops Central Research Institute (1050 m altitude). The average monthly total precipitation, minimum, and maximum temperatures were recorded during the autumn growing seasons for the long term and 2020-21 (Figure 1). When the long term (21 years) and experimental year climate data were evaluated, the total rainfall was 391.9 and 273.6 mm, respectively; the minimum temperature was -17.9 and -15.30 °C, respectively; and the maximum temperature was 40.4 and 37.9, respectively. The soil analysis results at a depth of 0-20 cm demonstrated low organic matter (1.97%), mild alkalinity (pH 7.7), limey (30%), and clay-loam soils during the year (Kayacetin, 2023a).

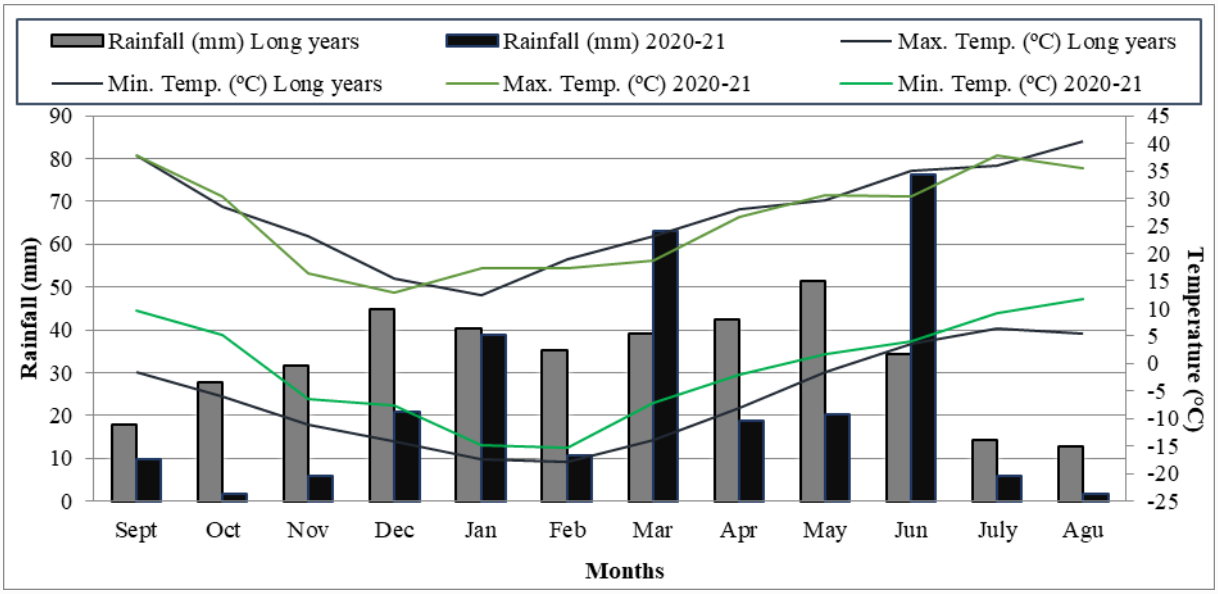


Figure 1. Some meteorological data about the vegetation period (September to August)

2.2.Experiment material and experimental design

The study used three *B. nigra* lines as material. This selection consisted of mustard genotypes collected from different locations in Turkey and the USDA gene bank. The pure lines used in the study were characterized by the Ankara Field Crops Central Research Institute and

developed with the "Pure Line Selection Method". The experiment consisted of a randomized complete-block design with three replicates. The seedling sowing was done at 200 seeds per m^2 and at a depth of 2-3 cm. Each parcel consisted of 6 rows with 30 cm row spacing; the parcel length and size were 6 m and 10.8 m^2, respectively. Nitrogen, phosphorus, and sulfur fertilizers were used at rates of 35, 50, and 100 kg ha^{-1}, respectively (Franzen and Lukack, 2007; Grant et al., 2007). Both phosphorus and sulfur were applied before sowing. The total nitrogen was measured at the sowing time and rosette stage.

2.3.Studied traits

The vegetative and generative growth observations were taken at the beginning and end of respective developmental stages. The phenotypic observations were made, including the time between emergence and sowing (d), the time between the 4-6 leaf rosette stage and emergence (d), the time between 50% flowering and emergence (vegetative growth stage) (d), and the time between 50% encapsulation and emergence (generative growth stage) (d).In addition, traits like plant height (cm), number of branches (branch $plant^{-1}$), number of capsules per plant (capsule $plant^{-1}$), number of seeds per capsule (seed $capsule^{-1}$), 1000-seed weight (g), and yield (seed yield and oil yield) (kg ha^{-1}) were determined (Kayacetin, 2019). The seed yield (kg ha^{-1}), crude oil percentage, and crude oil yield (kg ha^{-1}) were also calculated from the plants harvested from each parcel during the seed maturation period. The crude oil percentage (%) was determined in the laboratory of DB Agricultural Energy, Izmir. In accordance with ISO 734-1, the seeds were ground and then oil extracted with n-hexane in a Soxhlet extractor for 4 hours (Matthäus and Bruhl, 2001).

Statistical analyses: The data about morphological and yield traits were analyzed using ANOVA from the JMP statistical software. The significant differences among the mean values were compared with the LSD test ($p < 0.01$) (Kalayci, 2005).

2. RESULTS and DISCUSSION

Brassica nigra genotypes were sown on September 25, 2020. There was insufficient rain from September to mid-October, therefore irrigation was done during this period to ensure seed germination and emergence. The data about phenological observations are given in Table 1.

Statistically similar phenological observations were noted among the pure lines. The days to emergence, days to 4-6 leaves rosette stage, days to 50% flowering, days to 50% encapsulation and days to harvest of lines were noted as 64 d, 48 d, 171 d, 229 d, and 255 d, respectively (Table 1). The genetic structures of the lines did not differ in terms of phenological observations due to the influence of environmental conditions (Kayacetin, 2023).

Table 1. The phenological observations of black mustard lines

Genotype	Days/date to emergence	Days/date to 4-6 leaves rosette stage	Days/date to 50% flowering	Days/date to 50% encapsulation	Days/date to harvest
Bn2/Bn5/Bn6	64 d 28.11.2020	48 d 15.01.2021	171 d 18.04.2021	229 d 15.05.2021	255 d 10.08.2021

The plant height, number of branches, number of capsules, number of seeds, 1000-seed weight, crude oil percentage, seed and crude oil yield results showed significant differences among pure lines ($p < 0.01$) (Table 2).

Table 2. The morphological measurements of black mustard pure lines

		Plant height (cm)	Number of branches (branch plant^{-1})	Number of capsules (capsule plant^{-1})	Number of seeds (seed capsule^{-1})	1000-seed weight (g)	Seed yield (kg ha^{-1})	Crude oil percentage (%)	Crude oil yield (kg ha^{-1})
Bn2 (Turkey)		193.53a	12.33a	371.83ab	8.97b	0.64a	1573.50b	26.90b	423.26b
Bn5 (Ankara)		189.27a	12.47a	404.17a	9.07a	0.64a	1632.50a	27.23b	444.58a
Bn6 (Turkey)		183.07b	10.00b	268.83b	8.43c	0.62b	1466.50c	28.60a	419.32b
Source of variation	df								
F_G	2		**	**	**	**	**	**	**
LSD (0.01)		2.78							

** significant at $p < 0.01$

While the maximum plant height was determined as 193.53 cm in the Bn2 line, the minimum plant height was 183.07 cm in the Bn6 line. The maximum and minimum number of branches (12.47 branch plant^{-1}) were noted on the Bn6 line. The number of branches is an important

criterion that has a positive effect on yield. The maximum number of capsules was determined to be 404.17 capsules plant^{-1} on the Bn5 line while the minimum number of capsules was determined to be 268.83 capsule plant^{-1} on the Bn6 line. A small but statistically significant difference was detected among the lines in terms of 1000-seed weight. The 1000-seed weight of the lines varied between 0.64 g and 0.62 g. The maximum seed yield was obtained with 1632.50 kg ha^{-1} from the Bn5 line while the minimum seed yield of 1466.50 kg ha^{-1} was obtained from the Bn6 line. The maximum crude oil percentage obtained was 28.60% from the Bn6 line whereas at minimum crude oil percentage of 26.90% was obtained from the Bn2 line. The maximum and minimum crude oil yields of 444.58 kg ha^{-1} were obtained from the Bn5 line and 419.3 kg ha^{-1} from Bn6 line. Crude oil yield is an interaction of crude oil percentage and seed yield per hectare. Though the Bn2 and Bn6 lines showed lower performance than the oil yield of Bn5, the results showed that morphological traits show great differences due to the genetic characteristics of the lines (Shekhawat *et al., 2*012; Gizlenci, 2017). The differences in mophological traits for lines may be due to changable adaptation and genetic potential (Yousaf et al., 2013; Kayacetin, 2020b). Detecting significant differences in the crude oil percentage and yield of lines is also important for future breeding studies (Chauhan *et al., 2*010; Vedna *et al., 2*010; Mndolwa *et al., 2*019). The results showed that the differences determined in terms of yield and morphological traits among the lines in this study are consistent with the findings of Gizlenci, (2017), and Gunasekera *et al.* (2006).

CONCLUSION

The *Brassica nigra* lines used in the study were grown during the autumn under semi-arid climatic and rainfed ecological conditions of Ankara, Turkey during 2020-21. According to the results, significant differences were determined between *B. nigra* pure lines in terms of growth, development and yield. The maximum seed (163.50 kg ha^{-1}) and crude oil yield (444.58 kg ha^{-1}) detected from the Bn5 line. Although these three *B. nigra* lines are promising with their growth, development, adaptation, yield and quality, especially the Bn5 line can be evaluated for further breeding studies.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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Brassica nigra L.'NIN PRIMING UYGULAMALARI ALTINDA ÇİMLENME VE FIDE BÜYÜMESI ARASINDAKİ KORELASYON

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Özet
Brassica nigra L., alternatif enerji bitkisi olma potansiyelinin yanı sıra aromatik ve tıbbi kullanım açısından da Türkiye'nin genetik kaynakları arasında yer alan önemli türlerden biridir. Siyah hardal genotiplerinin hızlı ve homojen olarak çıkışının sağlanması Türkiye'deki ıslah çalışmalarında önemli bir konudur. Bu nedenle tohum priming uygulaması siyah hardal genotiplerinde eş zamanlı ve homojen çıkışın sağlanmasına katkıda bulunabilecek tekniklerdendir. Bu çalışmada Ankara orijinli saf hat siyah hardal tohumları kullanılarak; priming süreleri (TD1; 12 saat, TD2; 24 saat, TD3; 36 saat, TD4; 48 saat) ve priming uygulamaları (C; kontrol, TP1; hidro-priming, TP2; -0.1 MPa, TP3; -0.2 MPa, TP4; -0.4 MPa, TP5; 0.6 MPa, TP6; -0.8 MPa PEG)'nın 14 gün boyunca siyah hardalın tohum çimlenmesi ve fide büyüme özelliklerine etkisi tespit edilmiştir. Bu çalışmanın amacı, priming uygulamaları altında siyah hardalın çalışılan özellikleri arasındaki korelasyonu belirlemektir. Sonuçlar, priming uygulamaları altında çeşitli çimlenme ve fide özellikleri arasında pozitif ve anlamlı bir korelasyonun belirlendiğini göstermiştir. Kök uzunluğunun fide uzunluğu (0.854), fide yaş ağırlığı (0.620) ve fide kuru ağırlığı (0.427) ile anlamlı ve pozitif korelasyonu tespit edilmiştir. Benzer şekilde çimlenme yüzdesi, ortalama çimlenme süresi ile pozitif korelasyon göstermiştir (0.610). Bu tür bilgiler, bu türün ıslahı ve yetiştirme tekniğine ilişkin kritik parametrelerin belirlenmesinde faydalı olabilir.
Anahtar Kelimeler: Osmo– and Hydro–priming, Priming Süreleri, Correlation Coefficient, Çimlenme, Siyah Hardal

CORRELATION AMONG GERMINATION AND SEEDLING GROWTH OF *BRASSICA NIGRA* L. UNDER PRIMING APPLICATIONS

Abstract
Brassica nigra L. is an important species among the genetic resources of Turkey for aromatic and medicinal uses as well as its potential as an alternative energy plant. Achieving fast and uniform emergence of black mustard genotypes is an important issue in breeding studies in Turkey. For this reason, seed priming application is a technique that can contribute to ensuring fast and uniform emergence in black mustard genotypes. The seeds of pure line black mustard, orginated in Ankara, Turkey, was used in this study. The priming durations (TD1; 12 h, TD2; 24 h, TD3; 36 h, TD4; 48 h) and priming applications (C; control- non-priming, TP1; hydro-priming, TP2; -0.1 MPa, TP3; -0.2 MPa, TP4; -0.4 MPa, TP5; 0.6 MPa, TP6; -0.8 MPa of PEG) were used and detected seed germination and seedling growth traits of black mustard for 14 days. The present study focused on detecting the correlation among studies featuring black mustard under priming applications. The results showed that a significant positive correlation was demonstrated among the studied germination features. The root length demonstrated a significantly positive correlation with seedling length (0.854), seedling fresh weight (0.620), and seedling dry weight (0.427). Similarly, the germination percentages showed a positive correlation with the mean germination time (0.610). Such information may be useful in determining critical parameters regarding the breeding and agronomy of this species.
Keywords: Osmo– and Hydro–priming, Priming Durations, Correlation Coefficient, Germination, Black Mustard

INTRODUCTION

Germination is the first important stage of plant growth and development, which significantly affects yield (Kayacetin et al., 2018; Zhu et al., 2019). One of the biggest challenges in the growth and development of black mustard, which has significant potential as a spice and energy plant, is ensuring fast and uniform germination (Kayacetin, 2023). Priming techniques (osmo-priming with polyethylene glycol and hydro-priming) may be effective ways to shorten germination time and increase fast and uniform emergence/germination (Raj and Raj, 2019; Lutts et al., 2016; Rehman et al., 2015).

The correlation relationship between priming applications and various germination characteristics has been reported in studies conducted in different species (Singh et al., 2020; Rai-Kalal and Jajoo, 2021; Kayacetin, 2022a). Correlation determines the level of relationship between the features identified in the study and priming practices. It can provide information on the relationship among different germination characteristics, which may be useful in black mustard breeding for the selection of lines with desired features. Information about the correlation among the examined traits may be useful in the selection of lines with superior characteristics (Aasim et al., 2023).

The current study aimed at the detected correlation among the studies' features (root length, seedling length, seedling fresh weight, seedling dry weight, germination percentage, and mean germination time) of black mustard under priming applications [priming durations (12, 24, 36 and 48 h), non-priming, hydro-priming and five osmo-priming doses (-0.1, -0.2, -0.4, 0.6 and -0.8 MPa of PEG) applications].

1. MATERIALS and METHODS

The research was conducted at the Kalecik Vocational School, Ankara University. The experiment was conducted using a randomized block trial design with three replications.The osmotic potential of polyethylene glycol was arranged at -0.2, -0.4, -0.6, and -0.8 MPa according to Michel and Kaufmann (1973). Black mustard seeds were treated with an immersed solution of -0.2, -0.4, -0.6, and -0.8 MPa polyethylene glycol for 12, 24, 36, and 48 hours and

in distilled water (hydroprimed) for 12, 24, 36, and 48 hours (Kayacetin, 2023). The unprimed seeds were used as controls. The seeds were subjected to different priming durations and applications, then carefully dried and used 24 h after priming. The samples of 50 seeds were placed in 9 cm petri dishes containing two layers of filter paper. The seeds were considered germinated when ~2 mm radicles appeared. The number of seeds that germinated each day was recorded. After 14 days of germination, five seedlings were randomly selected from each replicate and root length, shoot length, seedling length and seedling fresh weight were measured and their averages were calculated. The root length, shoot length and seedling length were measured with a ruler. The dry weight of seedlings was determined by drying the samples in an oven at 70 °C for 48 h. The mean germination time and germination percentage were calculated according to Bakhshandeh et al. (2017).

Statistical analyses: The significant differences were tested by the analysis of variance and means separated by the LSD test ($P<0.05$) and correlation analysis performed using JMP ($P<0.05$). Correlation analysis was employed to assess the relationship among germination and seedling growth traits (Kalayci, 2005).

2. RESULTS and DISCUSSION

Root length, shoot length, seedling length, seedling fresh and dry weight, germination percentage and mean germination time were significantly decreased by seed priming durations as compared to 12 h (TD1) (Table 1) and by seed priming durations applications as compared to non-primed (C) (Table 2).

The results indicated that maximum root length (2.2 cm), seedling dry weight (0.5 mg), and mean germination (1.6 d) were noted for TD1 priming durations appications. The maximum shoot length (3.0 cm) and seedling length (5.0 cm) were noted for TD3; seedling fresh weight (5.4 mg) and germination percentage (91.2%) were noted for TD2 priming duration applications. Minimum root length (1.2 cm), seedling length (2.5 cm), seedling fresh weight (3.3 mg), seedling dry weight (0.3 mg), germination percentage (75.6%) and mean germination (1.4 d) were noted for TD4 priming duration applications (Table 1).

Table 1. Effect of priming durations on germination and seedling parameters of black mustard

Priming durations	Root length (cm)	Shoot length (cm)	Seedling length (cm)	Seedling fresh weight (mg)	Seedling dry weight (mg)	Germination percentage (%)	Mean germination time (day)
TD1	2.2±0.72a	2.7±0.63c	4.9±1.01a	5.3±1.50b	0.5±0.13a	91.1±8.16a	1.6±0.29a
TD2	2.1±0.60b	2.8±0.50b	4.9±0.89b	5.4±0.73a	0.4±0.04b	91.2±8.11a	1.6±0.29a
TD3	2.0±0.49c	3.0±0.94a	5.0±1.34a	4.8±0.95c	0.4±0.09c	85.6±8.43b	1.5±0.35b
TD4	1.2±0.22d	2.3±0.45d	2.5±0.62c	3.3±1.79d	0.3±0.09d	75.6±11.64c	1.4±0.37c

Data represent the mean values (Kayacetin, 2023)) ± standard deviations. Different letters indicate significant differences at $P<0.05$. TD1: 12 h, TD2: 24 h, TD3: 36 h, TD4: 48 h

The results showed that maximum root length (2.2 cm) was noted for TP4; shoot length (3.1 cm), seedling length (5.1 cm) and seedling fresh weight (6.0 mg) were noted for TP2; seedling dry weight (0.5 mg), germination percentage (96.7%), and mean germination (2.3 d) were for noted control. Minimum root length (1.4 cm), seedling length (3.2 cm), seedling fresh weight (3.2 mg), seedling dry weight (0.4 mg), germination percentage (72.7%), and mean germination (1.3 d) were determined for TP6 priming applications (Table 2).

Table 2. Effect of priming applications on germination and seedling parameters of black mustard

Priming applications	Root length (cm)	Shoot length (cm)	Seedling length (cm)	Seedling fresh weight (mg)	Seedling dry weight (mg)	Germination percentage (%)	Mean germination time (day)
C	1.5±0.42e	2.9±0.08c	4.3±0.42e	4.3±0.44e	0.5±0.48a	96.7±0.98a	2.3±0.05a
TP1	1.8±0.52d	3.0±0.74b	4.8±1.25d	4.6±0.35d	0.4±0.03d	87.3±15.12d	1.5±0.12b
TP2	2.0±0.56c	3.1±0.62a	5.1±1.02a	6.0±0.30a	0.4±0.03c	92.2±6.12b	1.4±0.11c
TP3	2.2±0.58a	2.7±0.91e	4.9±0.92c	5.5±0.70b	0.4±0.11c	90.3±7.52c	1.4±0.14cd
TP4	2.2±0.65a	2.8±0.71d	5.0±1.33b	5.3±2.38c	0.5±0.17b	84.8±7.79e	1.4±0.13cd
TP5	2.1±0.79b	2.7±0.71f	4.8±1.25d	4.0±1.77f	0.4±0.11e	77.2±6.46f	1.3±0.12d
TP6	1.4±0.60f	1.8±0.39g	3.2±0.52f	3.2±1.56g	0.4±0.05e	72.7±5.35g	1.3±0.09e

Data represent the mean values (Kayacetin, 2023) ± standard deviations. Different letters indicate significant differences at $P<0.05$. C: Non-primed, TP1: Hydro-primed, TP2: -0.1 MPa PEG primed, TP3: -0.2 MPa PEG primed, TP4: -0.4 MPa PEG primed, TP5: -0.6 MPa PEG primed

According to the correlation coefficient analysis between the studied traits of black mustard under priming applications, that is detected in Table 3, the results of this study showed that a significant positive correlation was observed among the studied traits at $P< 0.01$ probability. Root length demonstrated a significant positive correlation with shoot length (0.478), seedling

length (0.854), seedling fresh weight (0.620), seedling dry weight (0.427) and germination percentage (0.408). Shoot length showed a significant positive correlation with seedling length (0.865), seedling fresh weight (0.653), seedling dry weight (0.489) and germination percentage (0.526). Seedling length demonstrated a significant positive correlation with seedling fresh weight (0.741), seedling dry weight (0.533), and germination percentage (0.545). Seedling fresh weight was significantly positively correlated with seedling dry weight (0.628), and germination percentage (0.589). Seedling dry weight demonstrated a significantly positive correlation with germination percentage (0.541), and mean germination time (0.456). In addition, germination percentage was significantly correlated with the mean germination time (0.610). Catiempo et al. (2021) reported that the seedling dry weight and shoot length (0.608 to 0.694) had a positive correlation with priming. A significant positive correlation between traits indicates a linear relationship as the values increase or decrease together. Kayecetin (2022b) reported that there is a significant correlation between germination characteristics in the study conducted to evaluate the effects of individual and combined drought and salinity stress on safflower genotypes.

Table 3. Correlation analysis among germination and seedling parameters of black mustard under priming applications

	RL	ShL	SL	SFW	SDW	GP	MGT
Root length	1	0.478**	0.854**	0.620**	0.427**	0.408**	-0.112
Shoot length		1	0.865**	0.653**	0.489**	0.526**	0.169
Seedling length			1	0.741**	0.533**	0.545**	0.036
Seedling fresh weight				1	0.628**	0.589**	0.078
Seedling dry weight					1	0.541**	0.456**
Germination percentage						1	0.610**
Mean germination time							1

**$P<0.01$

Correlation with lines/varieties/genotypes under different experimental conditions can then be applied to further validate the obtained data (Ahmed et al., 2019; Griffo et al., 2023). The correlation among germination and seedling growth traits tested under priming applications in laboratory conditions can save time and labor during the selection of genotypes, because the improvement in the variables under priming applications can also improve another variable with which it has a positive correlation (Maurya et al., 2019; Kayacetin, 2022b).

CONCLUSION

The results demonstrated that a mostly significant positive correlation was determined among the studied features (root length, shoot length, seedling length, seedling fresh weight, seedling dry weight, mean germination time and germination percentage). This information may be useful in determining critical and desired parameters regarding the breeding and agronomy of this species. The finding could improve our understanding of seed priming and would be useful for healthy germination and growth.

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SÜRDÜRÜLEBİLİR ÜRÜN TASARIMINDA FUNGUSLARIN KULLANIMI

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ÖZET
Son yıllarda doğal kaynakların korunması ve atık miktarının azaltılması amacıyla sürdürülebilir malzemeler ve bunların ürün tasarımında kullanımları önem kazanmıştır. Gelişmiş enzim sistemleri sayesinde doğadaki organik atıkların dönüşümünü sağlayan funguslar, yeni ve çevre dostu sürdürülebilir ürünlerin tasarımında kullanılabilecek biyolojik materyaller olarak dikkat çekmektedir. Fungusların vejetatif yapısını oluşturan miselyum, ağ benzeri yapısı sayesinde organik liflerle doğal bir şekilde birleşerek dayanıklı ve esnek malzemelerin üretilmesini sağlamaktadır. Miselyumun değişik substratlar üzerinde geliştirilmesiyle elde edilen biyokompozitlerle hazırlanan materyaller çok farklı amaçlarla kullanılabilmektedir. Fungus miselyumunun gelişimi için tarımsal atıklar substrat olarak kullanıldığında, bunlar tekrar değerlendirilerek ekonomiye kazandırılmış olmaktadır. Kullanılmış plastik malzemeler gibi doğayı kirleten atıkların da çevreye zarar verilmeden dönüştürülmesi sağlanmaktadır. Düşük enerji tüketimi, düşük karbon ayak izi ve doğal kaynakların korunması, fungus kökenli ürünlerin avantajları arasında sayılabilir. Fungus bazlı malzemelerin üretim sürecinde zararlı bir kimyasal kullanılmaması da alternatifi olduğu malzemelerle kıyaslandığında çevre ve insan sağlığının korunması açısından önemli bir avantajdır. Fungus kökenli sürdürülebilir ürünler arasında kağıt ve deri benzeri malzemeler, mobilyalar, ambalaj, makyaj, tekstil ve yapı malzemeleri gibi ürünler bulunmaktadır. Fungusların sürdürülebilir ürün tasarımında kullanımları üretim yöntemlerinin sebep olduğu olumsuz çevre koşullarının azaltılması ve doğal kaynakların korunması açısından büyük öneme sahiptir. Mikoloji, biyoteknoloji, endüstriyel tasarım, elektronik, malzeme mühendisliği gibi farklı bilim alanlarında çalışan araştırmacıların bir araya gelerek disiplinlerarası çalışmalar yapmaları, fungus bazlı malzemelerin ve bu alandaki teknolojilerin daha hızlı gelişmesini sağlayacaktır. Bu derlemede, fungus kökenli malzemeler ve tasarım süreçleri ile bu konuya öncülük eden araştırmalar ve ürünler ele alınmıştır. Bu derleme yapılacak daha sonraki çalışmalara ışık tutacak ve fungus bazlı farklı ürün fikirlerine öncülük edebilecektir.

Anahtar kelimeler: Biyo-kompozit, biyo-malzeme, biyo-tasarım, funguslar, miselyum, sürdürülebilir materyaller

USE OF FUNGI IN SUSTAINABLE PRODUCT DESIGN

Abstract
In order to preserve natural sources and reduce the amount of waste, sustainable materials and their use in product design have gained importance in recent years. Fungi, which can transform organic wastes in nature with their complex enzyme systems, have attracted attention as biological materials that can be used in the design of novel environmentally friendly sustainable products. Thanks to their network-like structure, mycelia, forming the vegetative structure of fungi, naturally combine with organic fibers to produce durable and flexible materials. Materials prepared by biocomposites, obtained by growing mycelia on different substrates, can be used for various purposes. The use of agricultural wastes as a substrate for mycelial growth ensures their reusage and contributes to the economy. Wastes such as plastic materials, that cause environmental pollution, may also be recycled without harming the nature. Low energy consumption, low carbon foot print and preservation of natural resources can be mentioned among the advantages of fungus-based products. Fungi also contribute to the protection of the environment and human health as they reduce the use of chemicals in the production process. Sustainable products originating from fungi include products such as paper and leather-like materials, furniture, textiles, packaging and building materials. The use of fungi in sustainable product design is of great importance in implementing circular economy practices and protecting natural resources. Interdisciplinary studies made by researchers from different scientific fields such as mycology, biotechnology, industrial design, electronics and materials engineering will enable faster development of fungus based materials and related technologies. In this paper, fungi-derived materials and design processes, as well as pioneering research and products on this subject, were discussed. This review will shed light on future studies and lead to the development of novel fungi-based products.
Keywords: Bio-composite, bio-design, growing design, fungi, mycelium, sustainable materials

1. GİRİŞ

Dünya nüfusu endişe verici bir hızla artmaktadır. Küresel nüfus arttıkça sanayileşme ihtiyacı ve doğal kaynakların tüketimi de artmaktadır. Birleşmiş Milletler'in tahminlerine göre 2050 yılına kadar dünya nüfusunun yaklaşık %66'sı kentsel alanlarda yaşayacaktır. Ayrıca konut, altyapı, ambalaj ve diğer sanayi ürünlerine olan ihtiyaç da artmaya devam edecektir. Hızlı nüfus artışı ve kentleşmeyle birlikte 2016'da 2,01 milyar ton olan yıllık atık miktarının %70 artarak 2025 yılında 2,2 milyar tona ve 2050 yılında ise 3,4 milyar tona çıkması beklenmektedir. Ticari merkezler, evler, inşaat, tarım ve sanayi sektörleri atık ortaya çıkaran kaynaklardır. Bu atıkların uygun olmayan şekilde geri dönüştürülmesi suyun, havanın ve toprağın kirlenmesine neden olmaktadır. Bu tür atıkların çevreye olan olumsuz etkilerini azaltmak için geri dönüşüm sistemlerinin geliştirilmesi ve yaygınlaştırılması gerekmektedir. 2010 yılında sunulan IPCC (International Plant Protection Convention) verilerine göre, küresel sera gazı emisyonlarının yaklaşık %18'inin malzemelerin üretimi, nakliyesi ve geri dönüşümü aşamalarından kaynaklanabileceği belirtilmiştir (Alemu et al., 2022). Yenilenemeyen doğal kaynakların kullanımının azaltılması küresel sürdürülebilirlik açısından önemli bir stratejidir (Karana et al., 2018). Doğal kaynakların giderek azalması, yenilenebilir ve geri dönüştürülebilir malzeme arayışını zorunlu kılmakta, mevcut kaynakları kullanmanın alternatif yollarını keşfetmek de bilim insanlarının sorumlulukları arasında yer almaktadır (Alemu et al., 2022).

Son yıllarda ürün tasarımında yeni biyolojik malzemelerin kullanımı sürdürülebilir çözümlerden biri olarak görülmektedir. Poli-Laktik Asit (PLA) gibi biyo-plastiklerin yanı sıra, bakteriler, algler veya funguslar kullanılarak yapılan malzemeler, yenilikçi alternatifler olarak ürün tasarımında giderek daha fazla kullanılmaktadır. Bu alternatif malzemeler; tasarım, malzeme bilimi, biyoloji, sanat ve zanaatın birleşimiyle tasarımcının rolünü kökten değiştiren yeni bir tasarım pratiğinin ortaya çıkmasını sağlamaktadır (Karana et al., 2018). 'Büyüyen Tasarım', başlangıçta deri ve organlar gibi biyolojik dokuların tıbbi amaçlarla üretilmesi için geliştirilen biyoteknolojideki ilerlemelerin, ürün tasarımında yeni ortaya çıkan bir parçasıdır (Mironov et al., 2009). Bu uygulamada bakteri, alg veya funguslar gibi canlı organizmalardan yararlanılarak materyal geliştirilmesi, yenilikçi ürün fikirlerinin ortaya çıkışını sağlamakta ve yaratılan malzemelerin günlük hayatta kullanımının önünü açmaktadır. "Büyüyen Tasarım"da, tasarımcılar, genellikle organizmaların büyüyerek bir malzeme oluşturmasını ya da

organizmanın yarattığı malzemenin istenilen ürüne dönüşümünü yönlendirme görevini üstlenirler (Karana et al., 2018). Sürdürülebilir ürün tasarımı son zamanlarda farklı şirketlerin ilgi odağı olmuştur. Ünlü otomobil şirketi Ford, fungus bazlı köpüğü, tamponlar, yan kapılar ve gösterge panelleri gibi otomobil parçalarında bir bileşen olarak kullanmaya karar vermiştir. Mobilya şirketi olan Ikea ise, fosil yakıt bazlı malzeme kullanımını azaltmak amacıyla ambalaj köpüğü olarak kullanılabilecek alternatifler aramaktadır (Abhijith et al., 2018).

Funguslar, çeşitli substratlar üzerinde büyüyebilmeleri ve fonksiyonel özelliklere sahip çok çeşitli bileşikler üretebilmeleri gibi benzersiz özellikleri nedeniyle umut verici sürdürülebilir materyal alternatifleridir. Fungus bazlı malzemeler, çevresel sorunlara dost ve yenilikçi çözümler yaratmak için ürün tasarımında kullanılabilmektedirler (Karaca & Karaca, 2023).

Bu derleme, canlı organizmaların doğal büyüme ve üreme süreçlerinden yararlanılarak yeni sürdürülebilir ürünlerde özellikle fungusların kullanımını içeren çalışmaları ve projeleri ele almıştır. Bu alandaki artan bilgiler gelecekte fungusların tasarımda kullanımına daha fazla dikkat çekecek ve yeni malzemeler geliştirmek için yapılacak çalışmalara katkıda bulunacaktır.

2. SÜRDÜRÜLEBİLİR MATERYAL OLARAK FUNGUSLAR

Farklı habitatlarda yaşayabilen funguslar, böceklerden sonra tür bakımından en zengin ikinci gruptur. Ekosistemin ve besin zincirinin devamlılığı için önemli birçok işlevi olan funguslar, diğer canlı organizmalarla farklı ilişkileri olan ökaryotik organizmalardır. Bu ilişkilerin bazıları mikorizal funguslar ve bitki kökleri arasında olduğu gibi karşılıklı faydaya dayalıdır. Bu ilişkide funguslar, bitkilerin özellikle besince fakir topraklardan besin ve su alımlarını kolaylaştırırlar, ayrıca biyotik veya abiyotik stres faktörlerine toleranslarını artırırlar. Likenler ise, funguslar ve algler arasındaki ilişki sonucu ortaya çıkan canlılardır ve toprak oluşumunda önemli rolleri vardır. Fungusların bir kısmı canlı bitki veya hayvanlarla beslenen ve onlarda hastalıklara neden olan parazitlerdir, büyük bir grup fungus ise ölü organik maddeler üzerinde beslenen saproblardır. Özellikle saprotrofik funguslar, karbon döngüsünden ve dünya üzerindeki yaşamın devamlılığından sorumlu olan önemli ayrıştırıcılardır. Ayrıca tarımda biyolojik mücadele etmeni olarak, gıda ve kimya endüstrisinde ise enzimler, hormonlar, antibiyotikler veya aşılar gibi bazı temel kimyasal bileşiklerin üreticisi olarak kullanılmaları nedeniyle

insanlar için de çok yararlı canlılardır (Karaca & Karaca, 2023). Ancak yakın zamanda yapılan araştırmalar, fungusların biyoteknolojik potansiyellerinin yeterince araştırılmadığını göstermektedir (Attias et al., 2020).

Fungus miselyumu, organik substrat üzerinde üç boyutlu olarak gelişen, hif adı verilen ince iplikciklerden oluşan yoğun bir ağdır (Elkhateeb & Daba, 2019). Miselyum bazlı malzemelerin, düşük hammadde maliyeti ve doğal ısı direnci gibi özellikleri, onların giyilebilir teknoloji uygulamaları için uygun bir materyal olmalarını sağlamaktadır (Vasquez & Vega, 2019). Miselyum bazlı malzemeler, miselyumun maddeleri birbirine kenetleme özellikleri kullanılarak kompozit halinde, ya da sıvı miselyum kültürünün toplanması şeklinde iki farklı yöntemle geliştirilmektedir (Haneef et al., 2017).

Fungus bazlı kompozitler, sürdürülebilir ekonomi konseptini yerine getiren, yakın zamanda günlük hayatta kullanılmaya başlanmış malzemelerdir. Misel kompozit malzeme, fungus miselyumunun doğal yapışkan özelliği sayesinde organik substratlar ile beraber oluşturduğu bir yapıdır. Kompozitin kalitesi hem fungus türüne hem de substrata bağlıdır. Substrat türü, ortaya çıkan malzemenin niteliklerini etkilemektedir. Substrat üzerinde yapılacak küçük değişiklikler bile gelişen miselin morfolojik, kimyasal ve hidrodinamik özelliklerini farklılaştırabilmektedir (Antinori et al., 2020). Üretilen kompozitin fizikokimyasal özellikleri; miselyum morfolojisi, biyomoleküler içerik, yoğunluk, basınç direnci, termal stabilite ve hidrofobik özelliklere bağlı olarak değişmektedir. Misel kompozit malzemenin ambalaj, mimari uygulamalar ve yalıtım gibi farklı alanlarda kullanılabilirliği kanıtlanmıştır. Düşük maliyet ve geri dönüştürülebilirlik özellikleri yanında çevre dostu olmaları en önemli avantajlarıdır (Alemu et al., 2022; Muiruri et al., 2023).

Miselyum kökenli kompozitler, bir fungus türünün organik maddelerden oluşan bir substratta geliştirilmesiyle oluşmaktadır. Hifler yoğun bir ağ oluşturarak, organik substratı kullanarak üzerinde koloni oluşturur. Substrat, miselyumun büyümesi ve gelişmesi için gerekli karbon (örneğin, glikoz veya fruktoz), azot, mineraller, vitaminler ve su gibi maddeleri sağlamalıdır. Buğday veya pirinç samanı gibi tarımsal atıklar, odun talaşı veya keten ve pamuk gibi diğer lifler substrat olarak kullanılabilmektedir. Miselyum bazlı materyal, saf sıvı bir miselyum kültüründen de elde edilebilir. Fungusların sıvı fermantasyonu statik veya çalkalanarak gerçekleşebilir. Statik bir sıvı kültürde büyütüldüğünde funguslar sıvının yüzeyinde bir hif matı

oluşturur. Miseller kurutulduğunda ortaya çıkan malzeme deriye, kağıda veya plastiğe benzeyebilir. Gelişme sonunda miselyuma eklenen katkı maddelerine (örneğin, gliserol veya etanol) bağlı olarak renk, saydamlık ve sertlik açısından farklılıklar oluşabilmektedir (Karana et al., 2018). Hedeflenen ürüne bağlı olarak büyüme süreci iki veya üç hafta sürebilmektedir. Miselyumun büyümesini sağlamak için sıcaklığın ve nemin sabit tutulduğu kontrollü bir ortam gereklidir. Fungusun türüne bağlı olarak sıcaklık yaklaşık 25-30°C, nem oranı ise %60-65 arasında olmalıdır. Bu sürecin sonunda miselyum 60°C'de kurutulabilir. Miselyum bazlı malzemelerin üretiminde, CNC kesme, frezeleme, lazerle kesme gibi işlemler de dahil olmak üzere farklı teknikler de kullanılabilmektedir. Miselyum bazlı malzemeler kullanılan kalıbın şeklini aldığından, istenilen son ürünün şekline sahip kalıplar geliştirilebilmektedir (Camere & Karana, 2017). Fungus miselyumu, daha yüksek mekanik mukavemet, yalıtım veya yanmazlık, hidrofobiklik gibi çeşitli özelliklere sahip, lignoselülozik malzemeleri parçalayabilen ve karmaşık ağlar oluşturabilen bir yapıdadır. Bu özellikler, ambalaj malzemelerinin imalatında, izolasyon malzemesi olarak veya biyo-tekstil ürünlerinde kullanımını avantajlı olmalarını sağlamaktadır (Butu et al., 2020).

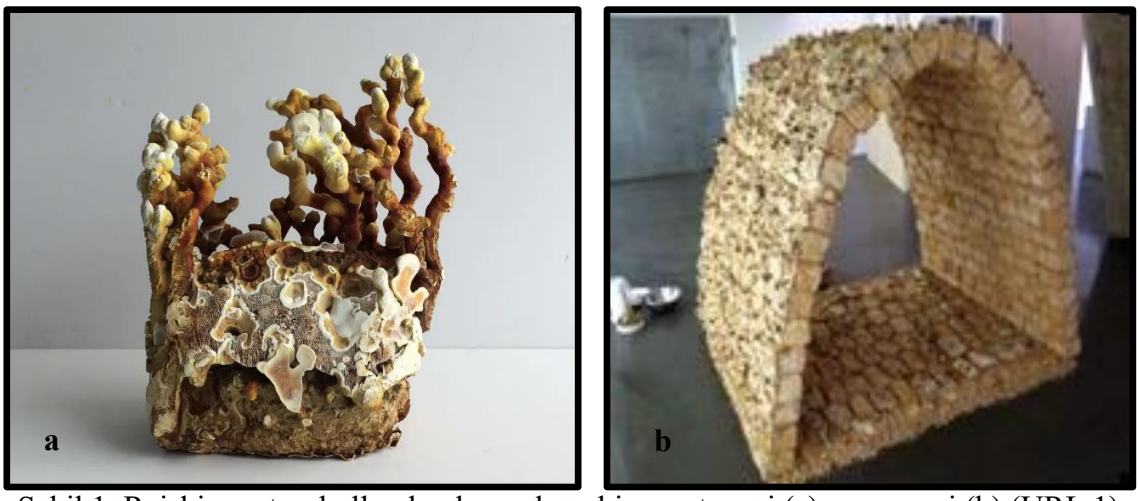
Günümüzde araştırma ve uygulamalar çoğunlukla misel veya makro mantarlara odaklanmıştır. Bununla birlikte, fungusların dayanıklı yapıları olan sklerotların kullanımı, malzeme dayanıklılığını önemli ölçüde artırma ve sürdürülebilir ürün tasarımına olumlu özellikler sunma potansiyeline sahip yeni bir yaklaşım olarak sunulmuştur. Sklerotlar, malzemelerin mekanik, termal ve kimyasal özelliklerine katkıda bulunabilen glikojen, protein ve lipit gibi depolama malzemeleri içermektedir. Bu benzersiz özellikler, stres koşullarına karşı direncin artmasına, daha uzun malzeme ömrüne ve sürdürülebilir tasarım çözümleri için yeni olanakların açılmasına yol açabilir (Karaca & Karaca, 2023).

3. FUNGUS BAZLI TASARIM ÜRÜNLERİ

Miselyum bazlı kompozitlerin geliştirilmesine yönelik çalışmalar 2006 yılından beri gerçekleştirilmektedir ancak çoğu 2015'ten sonra yayınlanmıştır. Araştırmalar oldukça yenidir ve giderek gelişmektedir. Bu nedenle hala bazı eksik bilgiler bulunmaktadır (Butu et al., 2020). Miselyumun malzeme olarak kullanılması fikri 2007 yılında Evocative şirketinin sahipleri Eben Bayer ve Gavin McIntyre tarafından ortaya atılmıştır (Karana et al., 2018; Alemu et al., 2022).

Günümüzde fungus miselyumu, biyoremediasyon ve tıbbi uygulamaların dışında, biyoçimento, biyoblok ve biyoenzim gibi biyomateryal üretiminde de kullanılmaktadır. MycoWorks, NEFFA (New Fashion Factory), Evocative Design ve MOGU gibi birkaç şirket dünyada miselyuma bağlı kompozitler tasarlayarak ticarileştirmeye başlamıştır. Son yıllarda tasarımcılar ve mimarlar tarafından; sentetik deri, mutfak eşyaları, ambalaj malzemeleri, çeşitli mobilyalar, duvar ve tavan panelleri, biyo-çimento ve bloklar, duvar aksesuarları gibi değişik alternatif kullanım alanları sunulmaktadır (Ghazvinian, et al., 2019; Alemu et al., 2022).

MycoWorks şirketinin kurucu ortağı Philip Ross, fungusların güzelliğinden ve yaşam döngülerinden ilham alarak 1990'larda sanat ve tasarım malzemesi olarak miselyum üretmeye başlamış ve kısa süre sonra reishi mantarı (*Ganoderma lucidum*) ile çalışarak heykeller yaratmıştır (Şekil 1). 2008 yılında miselyumla tasarlama sanatını tanımlamak için icat ettiği bir terim olan 'mikotektür' alanı da dünyada yankı uyandırmıştır. Miselyum bazlı sanat eserleri uluslararası sergilerde yer almış, patentleri ve yayınları miselyum malzeme bilimi alanının temelini oluşturmuştur. 2009 yılında, tasarımcı ve mucit Philip Ross, miselyum tuğlalardan inşa edilmiş küçük bir çay evi olan Mycotecture Alpha'yı oluşturmuştur (Şekil 1). Philip Ross, Sofia Wang ve Eddie Pavlu tarafından 2013 yılında kurulan MycoWorks, iç ve yapısal tasarım için paneller ve kalıplanmış formlar oluşturarak mimarların, mobilya tasarımcılarının ve çok çeşitli sektörlerden üreticilerin ilgisini çekmiştir (MycoWorks, 2023).



Şekil 1. Reishi mantarı kullanılarak yapılmış bir sanat eseri (a) ve çay evi (b) (URL 1)

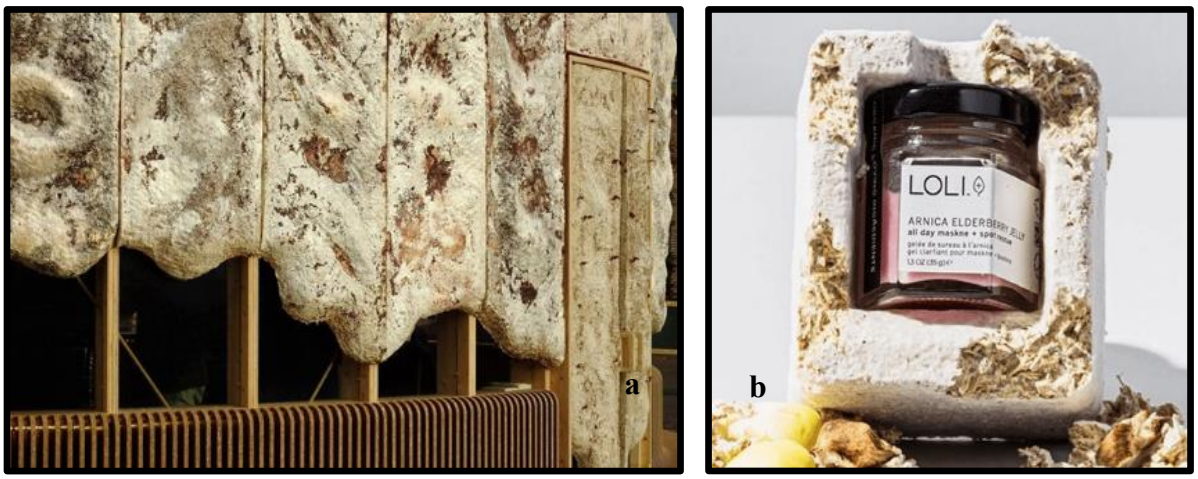
MycoWorks, marka ortakları ve deri zanaatkarları iş birliğiyle Reishi mantarı üzerinde yıllarca çalıştıktan sonra, 2020'de New York Moda Haftası'nda miselyum ve tarımsal ürünlerden

geliştirilen yeni bir deri türü olan Reishi Fine Mycelium'u piyasaya sürmüştür (Şekil 2) (Karana et al., 2018; MycoWorks, 2023).



Şekil 2. New York moda haftasında Reishi Fine Mycelium'un piyasaya sürülmesi (URL 2)

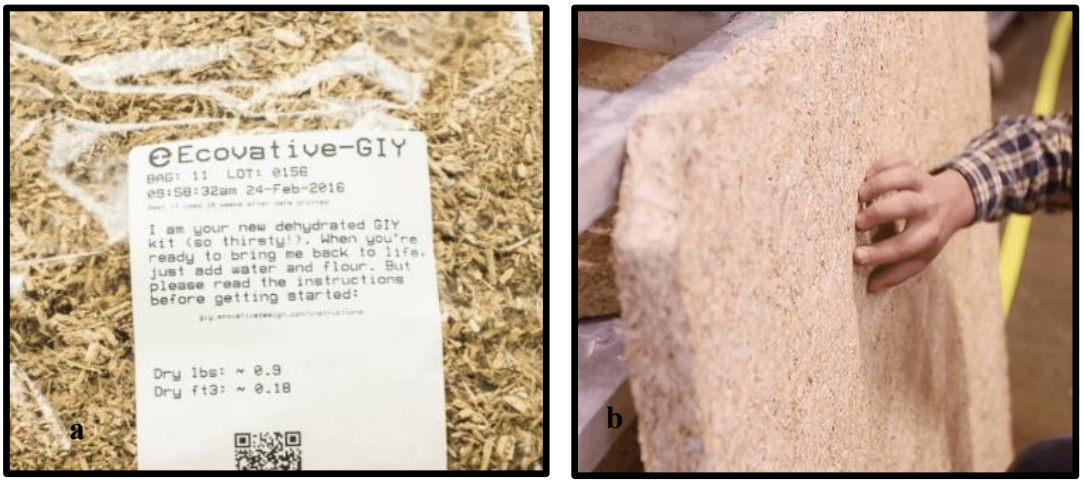
Geçtiğimiz yıllarda miselyum malzemeleriyle ilgili şirket ve patentlerde artış yaşanmıştır (Jones et al., 2017). Ecovative Design, dünyanın önde gelen miselyum teknoloji şirketlerinden birisidir. Fungus miselyumu kullanılarak parçalanmış kenevirden yapılan MycoComposite, plastik ambalaj ve yapı malzemelerine alternatif olarak sunulmuştur (Şekil 3).



Şekil 3. MycoComposite kenevir karışımı yanmaya dayanıklı, ısı ve ses yalıtım malzemesi (a) ve kompostlanabilir ambalaj (b) (URL 3)

AirMycelium teknolojisi ile deri benzeri esnek ürünlerin üretilmesi sağlanmaktadır. MyForest Foods teknolojisi ise, fungus miselyumundan lezzetli proteinler üreterek hayvansal ürünlere alternatifler sunmaktadır (Ecovative, 2023). 2014 yılında fungal malzemelerin kamuya sunulması amacıyla bir paket (Grow It Yourself) geliştirilmiştir (Şekil 4) (Rognoli et al., 2015).

Burada amaç, polistiren malzemelerin kullanıldığı koruyucu ambalaj ürünleri ve yalıtım malzemelerinde alternatif olarak miselyum bazlı malzemelerin üretilmesidir (Holt et al., 2012).



Şekil 4. 'Grow It Yourself' malzeme (a) ve havalandırmalı yatak sistemi, sulak alanlar için sal ya da kapı yapımında kullanılabilecek kompakt malzeme (b) (URL 3)

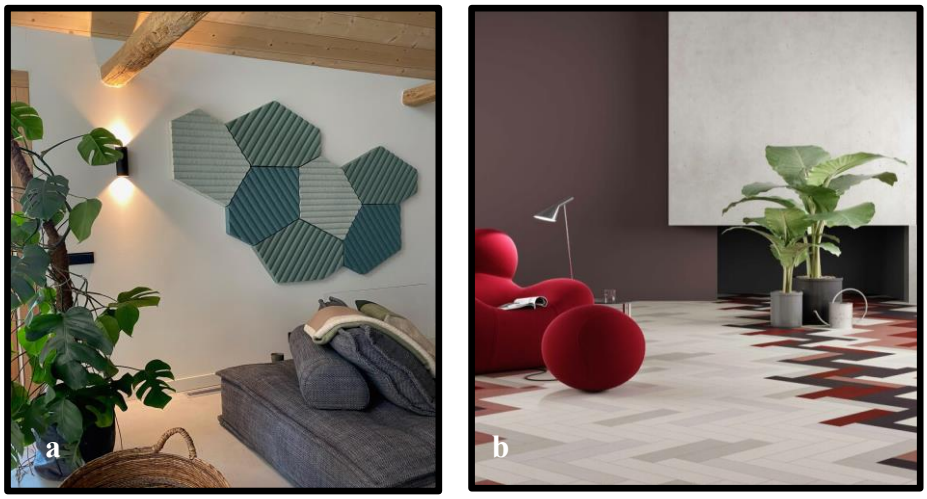
Genç Mimarlar Programı (MoMA PS1) çerçevesinde, şimdiye kadar genellikle ambalaj yapımında kullanılan bir tekniğe dayanan fungus tuğla teknolojisi ile, Hy-Fi adı verilen ilk büyük ölçekli yapı inşa edilmiştir (Şekil 5). Bu yapı, iki yeni malzemenin benzersiz özelliklerini birleştirerek tasarlanmış organik ve yansıtıcı tuğlalardan oluşan dairesel bir kuledir. Organik tuğlalar, Ecovative şirketi tarafından, mısır sapları ve özel olarak geliştirilmiş bitki kökleri gibi yenilikçi ve tamamen geri dönüştürülebilir malzemelerle inşa edilmiştir (Anonim, 2023d).



Şekil 5. Miselyum tuğlalardan yapılan ilk büyük ölçekli yapı (URL 4)

Miselyum bazlı kompozitlerin endüstriyel potansiyelini araştıran bir diğer şirket ise MyCoPlast'tır. Şirket çevreye duyarlı iç mekân ve ürün tasarımı uygulamaları için

sürdürülebilir alternatifler geliştirmektedir ve son zamanlarda zemin ve akustik döşemelere odaklanmıştır (Şekil 6). Şirket hem ticari ortaklarla hem de akademisyenlerle iş birliği yapmaktadır (Attias et al., 2020).



Şekil 6. Duvar panelleri (a) ve zemin kaplamaları (b) (URL 5)

Kendilerini Yeni Moda Fabrikası olarak isimlendiren Hollanda kökenli bir firma olan NEFFA, NWO (New World Order) tarafından finanse edilen 'Mycelium Design' projesinin bir parçası olarak, "MycoTEX"e odaklanmaktadır. Şirketin kurucusu Aniela Hoitink'in de içinde bulunduğu birçok sanatçı ve tasarımcının, miselyumları kullanarak yapmış oldukları çalışmalar başarılı bulunmuştur (Şekil 7) (Montalti, 2016; NEFFA, 2023).

Giysiler için tekstil benzeri malzemeler yapmak amacıyla saf miselyum kullanılmış ve bu yeni tekstilden kesmeye ve dikmeye gerek kalmadan dikişsiz mükemmel oturan giysiler oluşturmak için 3D modelleme kullanılmıştır. Elbise konsepti, elbisenin doğrudan vücut üzerinde oluşturulmasıyla üretilmektedir ve bu da kolay onarım ve ayarlama olanağı sağlamaktadır (Camere & Karana, 2017).

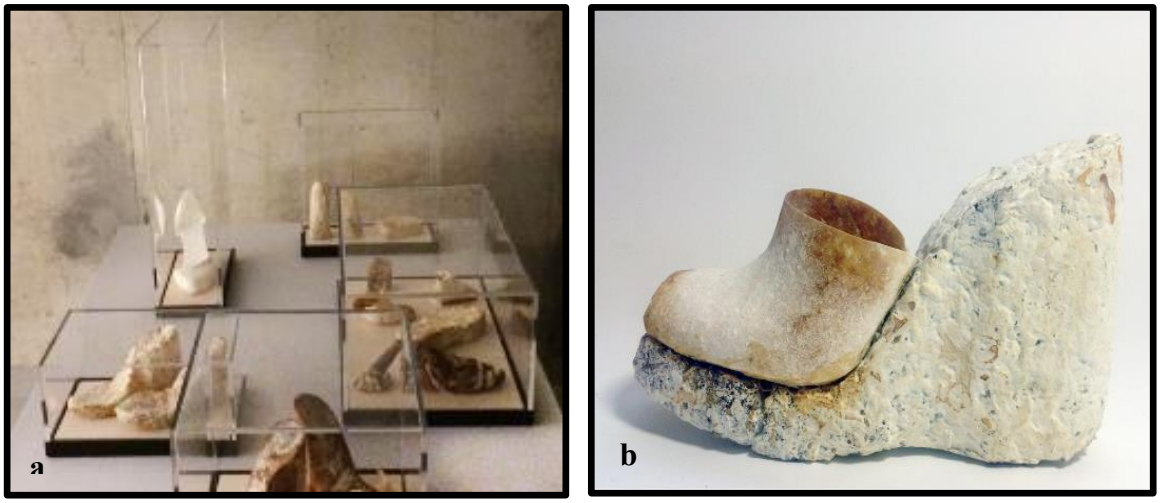


Şekil 7. Tekstilde saf miselyumun kullanımı ve ilk prototipler (URL 6)

Biyoçözünür kumaşlar, laboratuvar ortamında sürdürülebilir bir şekilde geliştirilebilen miselyumlar kullanılarak üretildiğinden, diğer tekstil malzemeleri gibi pahalı tarım arazilerine ihtiyaç duymamakta ve mevsimsel değişimler üretim sürecini etkilememektedir. Daha az su tüketilmesi ve herhangi bir kimyasala ya da pestisite maruz kalmadan üretilmesi de çevreye zararını en aza indirgemektedir. Nakliye giderleri de sınırlandırıldığından MycoTEX daha kısa bir tedarik zinciri oluşturmuş ve kıyafet tasarımları için yepyeni bir bakış kazandırmıştır. Bu kumaşlardan üretilen kıyafetler artık üstüne uymadığında ya da eskidiğinde çöpe atmak yerine toprağa gömülebilmektedir. Miselyum ile oluşturulan ilk giyilebilir giysi olan MycoTEX şu anda WEARsustain projesinin bir parçasıdır ve Avrupa Birliği Ufuk 2020 araştırma ve inovasyon programından finans desteği almıştır (Anonim, 2023a).

Son yıllarda fungal malzeme geliştirme süreci tasarımcılar için son derece çekici hale gelmiş ve canlı organizmalardan yapılan malzemelerin üretimine yönelik tasarım sergilerinin sayısının arttığı gözlenmiştir. Tasarımcılar arasında canlı organizmalardan malzeme üretimine yönelik artan ilgi sonucu, bu alandaki sergilerin (Fungal Futures; This is Alive), konferansların (Biofabricate) ve dergilerin (Pavlovich) sayıları da artmış, çevrimiçi toplulukların (Growing Materials) ve biyo-laboratuvarların (Open WetLab at Waag Society) kurulması ile sürdürülebilir bir alternatif olarak bu yeni materyallerin daha geniş kitlelere tanıtılması mümkün olmuştur. Bu büyük ilgiye rağmen, biyoloji ile tasarımı birleştiren bu yaklaşım henüz tam anlamıyla pratikte istenilen ölçüde yaygınlaşmamıştır (Camere & Karana, 2017; Haneef et al, 2017).

2016 yılında Utrecht Üniversitesinde gerçekleştirilen 'Fungal Futures' adlı sergide, 'Growing Shoes' ile ilgileri üzerine çeken Kristel Peters, sürdürülebilir ekonomi yaratma konsepti ve yenilikçi yöntemlerle fungal miselyumlardan geleceğin modası olabilecek ayakkabılar geliştirmiştir (Şekil 8). Dünyada her yıl 21 milyar çift üretilen ve kullanım sonrası %95 oranında atık haline gelen ayakkabılar düşünüldüğünde büyük bir çevresel etkiye sahip olacağı düşünülmektedir (Montalti, 2016).



Şekil 8. 'Growing Shoes'-Fungal Futures sergisi (a) ve bu sergide sunulan bir örnek (b) (URL 7)

Alman tasarımcı Emilie Burfeind, tabanı fungus miselyumundan, üst kısmı ise dökülen köpek tüylerinden oluşan örme çorap benzeri bir spor ayakkabı geliştirmiştir (Şekil 9). 'Sneature trainer', yalnızca üç biyolojik kökenli, yenilenebilir malzemeden oluşmakta ve kullanım ömrünün sonunda parçalara ayrılıp geri dönüştürülebilmekte veya endüstriyel olarak kompostlanabilmektedir. Günümüzde kullanılan spor ayakkabılar ise genellikle naylon kumaş ve etilen-vinil asetat (EVA) köpük gibi çoğu petrol bazlı ve bin yıla kadar yok olmayan yaklaşık 12 farklı bileşenden yapılmaktadır. Biyolojik olarak parçalanabilen spor ayakkabıların üretimi ileriye yönelik atılmış büyük bir adımdır (Anonim, 2023c).



Şekil 9. Tabanında fungus miselyumu kullanılan spor ayakkabı (URL 8)

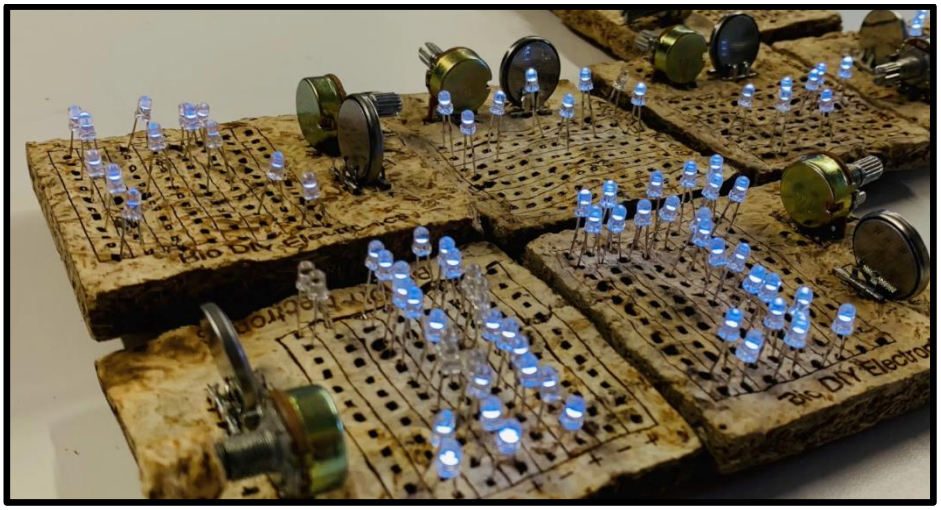
Sürdürülebilir yaşam döngüsünün sağlanması için 2019 yılında misellerle hazırlanmış ve laminasyon tekniğiyle elektronik parçalar eklenmiş aksesuarlar geliştirilmiştir (Şekil 10). İlerleyen süreçte aksesuarlar kullanılmaz hale geldiğinde elektronik malzeme yeniden kullanılabilecektir. Miselyumun doğal koşullarda (örneğin toprakta) parçalanması yaklaşık 90 gün sürmektedir. Böylece her iki malzemenin de sürdürülebilir kullanımı sağlanmaktadır (Vasquez & Vega, 2019a,b).



Şekil 10. Miselyumdan yapılan kolye ve bileklik (Vasquez & Vega, 2019a)

Miselyumun elektronikle birlikte kullanıma uygun bir malzeme olduğu yapılan araştırmalarla ortaya konulmuştur. Yapılan çalışmada, ticarileştirilmiş bir 'Grow It Yourself' fungus paketi kullanılarak 30 günde miselyumun 0,5-2 mm kalınlığında olması sağlanmış, daha sonra misel henüz ıslakken yüzey katmanı soyularak düzleştirilmiştir. Bu işlemin ardından miselyum, hava akımı olan açık bir alanda 1-2 gün güneş altında bırakılmıştır. Daha sonra malzemeye esneklik

kazanıncaya kadar bitkisel gliserin sürülmüş ve elektronik malzemeler içine yerleştirilmiştir (Şekil 11).



Şekil 11. Miselyum malzeme içine yerleştirilen elektronik parçalar (Vasquez & Vega, 2019b)

Renkler yaşamın hayati bir özelliğidir. Bu nedenle insanlar binlerce yıldır en cesur ve en parlak renkleri kullanma arayışı içindedir. Sentetik renklendiricilerin ortaya çıkışıyla, bitkilerden, hayvanlardan ve minerallerden elde edilen renklendiricilerin çok ötesinde renk tonları ve performans özellikleri elde edilmiştir. Sentetik renklendiriciler fosil yakıtlar olan yenilenemeyen kaynaklardan yapılmaktadır ve bunların insanlar üzerinde kanserojen etkileri ve çevreye büyük zararları olduğu kanıtlanmıştır (Jadler Design, 2023). Yapılan bir çalışmada fungal pigmentlerin uygulamaları veya biyolojik aktiviteleri araştırılmış ve gıda renklendiricisi, antimikrobiyal, antioksidan, sitotoksik, antikanser maddeler olarak ve kozmetik ve tekstil endüstrisinde, ağaçların boyanmasında veya elektronikte kullanılabildiği belirtilmiştir (Lagashetti, et al., 2019). Bu konulara ilişkin farkındalığın artması, gıda, kozmetik ve tekstil sektörlerinde alternatif yenilenebilir renk kaynaklarına yönelik küresel talebi de artırmıştır. Funguslar, toksik olmayan, biyolojik olarak parçalanabilen ve hatta bazılarının antioksidan ve UV koruması gibi faydaları olan, sürdürülebilir renklendirici materyallerdir. Jesse Adler, funguslardan pigmentler elde ederek bir kozmetik koleksiyonu oluşturmuş (Şekil 12) ve sentetik veya mineral renklendiricilere olan bağımlılığımızın azaltılarak, yenilenebilir renk kaynakları olarak nasıl kullanılabileceklerini araştıran çalışmalar yapmıştır. Araştırmacı, funguslardan yararlanarak güzellik, sağlık, çevre ve renklerle olan ilişkilerimize yeni bir bakış açısı kazandırmaktadır (Jadler Design, 2023).



Şekil 12. Funguslardan elde edilen boyalarla hazırlanmış kozmetik ürünler (URL 9)

Tasarım için miselyum bazlı malzemelerin geliştirilmesi konusunda tanınmış diğer araştırmacılar Eric Klarenbeek ve Maurizio Montalti'dir. Eric Klarenbeek, malzemeyi sanatsal mobilyalara dönüştürmekte ve 3D baskı gibi ileri teknolojileri de kullanarak özgün eserler yaratmaktadır (Şekil 13). Sanatçının tasarladığı ve Hollanda Tasarım Haftası'nda sunulan 'Miselyum sandalye', sağlam, dayanıklı ama son derece hafif bir malzemedir. Funguslar sandalyenin yüzeyinde oluşmaya başladığında, tasarımcı daha fazla büyümeyi önlemek için yapıyı kurutmuştur. Projede fungus olarak sarı istiridye mantarı (*Pleurotus citrinopileatus*), substrat olarak ise istiridye mantarının gelişimini destekleyen saman kullanılmıştır. Sandalye üzerinde görülen makro mantarlar sadece dekoratif amaçlıdır. Yapılan sandalye gelecekte 3D tekniği ile yapılabilecek diğer iç mekan ürünlerinin, hatta büyük ölçekli binaların sinyallerini vermektedir (Anonim, 2023b).



Şekil 13. Miselyumdan sandalye ve tabure (URL 10)

İşlev ve sanat arasındaki boşluğu kapatan Maurizio Montalti ise, biyolojik olarak tasarlanmış bir gelecek öngören çeşitli ürünlerle malzemeyi somutlaştırmaktadır (Karana et al., 2018). Araştırmacı tarafından 2010 yılında kurulan '*Officina Corpuscoli' adlı stüdyo*, genellikle canlı organizmalar ve funguslara derinlemesine odaklanan araştırma projeleri geliştirmektedir. Günlük kullandığımız ürünlere ve bunların içerdiği malzemelere alternatif bir bakış açısı sunarak, plastik atıkların çevresel etkilerini ele almış ve plastiklerin çok az adaptasyonla, doğal ve biyolojik olarak parçalanabilen miselyum bazlı maddelerle nasıl değiştirilebileceğini somut şekilde gösteren çalışmalar yapmaktadır.

'The Growing Lab', Maurizio Montalti'nin fungus misellerini kullanarak malzemeleri ve dolayısıyla ürünleri geliştirme stratejilerini araştıran bir projesidir. Araştırmacı, klasik üretim anlayışının yerini alan büyütme ve geliştirmeye dayalı yeni bir uygulama ile, ürünlerin bir tür doğal 3D baskıyla geliştirilmesine yönelik çalışmalarını sürdürmektedir. *İtalya'daki Hollanda Büyükelçiliği'nin desteğiyle gerçekleştirilen* 'Fungal Futures' ve 'Future of Plastic' sergileri, plastik malzemelerin gelecekte nasıl değişeceğine dair bir öneri sunmayı amaçlamaktadır. Sergilerde yer alan miselyum bazlı kaplar, çevresel sürdürülebilirliğe ve atıkların geri dönüşümüne dikkat çekmektedir (Şekil 14) (Montalti, 201; Officina Corpuscoli, 2023).



Şekil 14. Maurizio Montalti 'Plastiğin Geleceği' Sergisi (URL 11)

Rotterdam'da sürdürülebilir gıda üretimine odaklanan bir çiftlik olan 'Uit Je Eigen Stad' şirketi tarafından ortaya atılan, Emma van der Leest, Zoe Agasi ve Loeke Molenaar tarafından yürütülen bir başka projede, klasik plastik ambalajların yerine sürdürülebilir ambalajlar

geliştirilmiştir (Şekil 15). Tasarımcılar, Shiitake mantarları (*Lentinus edodes*) ve sebzelerin yetiştirilmesi sırasında çiftliğin atık akışına dayanan bir konsept geliştirmişlerdir. Tasarımcılar daha önce sebze hasadı için kullanılan ve artık kullanışlı olmayan kenevir keçelerini yeniden kullanmışlardır. Geliştirilen malzeme, iyi ısı yalıtımına ve su itici özelliklere sahip olup kompostlanabilmektedir. Bu durumda, tasarımcılar şirketin atıklarını kullanarak gıda üretim sisteminin sürdürülebilirliğini geliştirmeye yönelik bir süreç tasarlamışlardır (Camere & Karana, 2017).



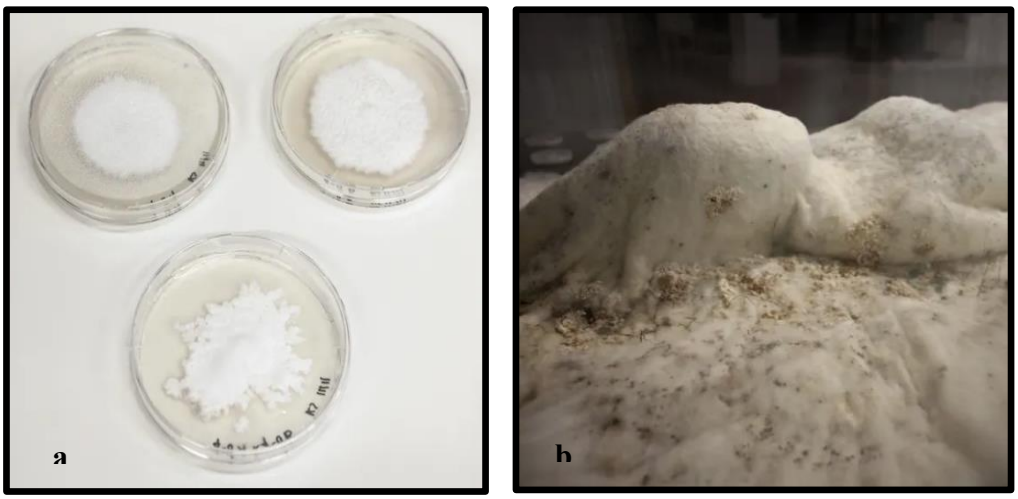
Şekil 15. Miselyum bazlı kompozitten yapılmış sürdürülebilir ambalaj konsepti (Camere & Karana, 2017)

'Fungi Mutuarium' Katharina Unger ve Julia Kaisinger tarafından tasarlanan bir başka devrim niteliğindeki projedir. Proje, yeni bir gıda ürünü olarak yenilebilir mantar biyokütlesi yetiştiren bir prototiptir. Funguslar, tasarımcıların 'FU' olarak adlandırdığı özel olarak tasarlanmış agar kalıpları üzerinde geliştirilmektedir. Agar, deniz yosunundan elde edilen jelatinimsi bir maddedir, ve nişasta ve şekerle karıştırılarak funguslar için besin işlevi görmektedir. 'FU' plastik atıklarla doldurulmakta ve fungusların ekim işlemi yapılmaktadır. Fungus zamanla plastiği sindirerek gelişimine devam etmekte ve ürün yenilmeye hazır hale gelmektedir (Şekil 16). Bilimsel araştırmalar, fungusların plastik gibi toksik atık maddeleri parçalayabildiğini ve bunları yenilebilir mantar ürünlerine dönüştürebildiğini göstermiştir. Burada, funguslar hem plastik atıklardan kurtulmayı sağlamakta, hem de besin olarak kullanılabilmektedirler (LIVIN Studio, 2023).



Şekil 16. 'Fungi Mutuarium' prototipi ve 'FU' üzerindeki fungus gelişimi (URL 12)

Maurizio Montalti tarafından geliştirilen bir projede, fungusların organik ve inorganik substratları ayrıştırma özelliklerinin farklı bir alanda kullanımına dikkat çekilmiştir. Fiziksel ölüm ve bedenin çürümesi hayatın doğal süreçleridir. Tasarımcının yine biyoloji bilimi ile tasarım arasındaki işbirliğini kullandığı bu projede, fungusların ayrıştırıcı olarak kullanılması, böylece ölü bedenlerin daha hızlı bir şekilde doğaya karışımı hedeflenmiştir. Tasarım, *Schizophyllum commune* fungus türüne ait miseller ile aşılanmış keçe bir örtüden oluşmaktadır (Şekil 17). Miselyum vücudun etrafına yerleştirildiğinde, organizmada ömür boyu depolanan toksik elementleri nötralize edecek ve kefenin üzerinde büyüyerek toprak altında gerçekleşebilecek ayrışma süreçlerini hızlandıracaktır. Ayrıca vücutta depolanmış olan farklı besin maddeleri tekrar doğaya dönecek ve yeni yaşam formlarının gelişimine fayda sağlayacaktır (Montalti, 2010).



Şekil 17. *Schizophyllum commune* gelişimi (a) ve fungus miseli ile hazırlanan kefen (URL 13)

Delft Teknoloji Üniversitesi'nde araştırmacı olan Bob Hendrikx de benzer şekilde ölü bedenlerin çevreye verdiği zararı azaltmak için, 'Living coffin' olarak adlandırdığı bir sistem geliştirmiştir (Şekil 18). Miselyum bazlı canlı tabut, birkaç ay içinde kendini ve vücudu parçalamakla kalmayıp, aynı zamanda hem vücuttaki hem de topraktaki toksinleri nötralize eden ve açığa çıkan besinleri kendi seçtiği bir bitki veya ağaca aktaran bakterilere de ev sahipliği yapmaktadır. Böylece ölü bedenlerin birkaç ay içinde mümkün olan en etkili şekilde parçalanması, çevrenin toprak kalitesinin zenginleşmesi ve biyolojik çeşitliliğin artması sağlanacaktır (Studio Hendrikx, 2022).



Şekil 18. Fungus miselyumu ile yapılan tabut (URL 14)

4. SONUÇ VE ÖNERİLER

Biyomateryaller, son zamanlarda önem kazanan sürdürülebilir süreçlerin gelişimini destekleyen kaynaklardır. Bu bağlamda, fosil kaynakların azalması, enerji tasarrufu ve benzeri çevre sorunlarıyla ilgili gelecekteki zorlukların üstesinden gelmek amacıyla, atıkların değerlendirilmesi ve yeşil teknolojilerin doğru kullanımı gibi bazı yaklaşımlar ortaya konulmuştur. Bu yaklaşımların uygulanması, ülkelerin ekonomileri üzerinde olumlu etki yapacağı gibi, aynı zamanda çevre kirliliğini de azaltacaktır (Kumar Gupta et al., 2015). Mikroorganizmaların biyomateryal üretiminde özellikle inşaat ve ambalaj sektöründe kullanılması, yakın gelecekte çevresel sürdürülebilirliği sağlayacak ileri teknolojilerdir (Zou & Gao, 2020). Funguslar, kendi hif ağlarını genişletirken atık maddeleri parçalayarak dönüştürmek suretiyle biyomalzemeler oluşturabilmektedirler. Bu malzemeler, %100 doğal olmaları, tamamen kompostlanabilir olmaları ve organik atık akışlarından üretilebilmeleri

nedeniyle sentetik malzemelere sürdürülebilir alternatifler olarak sunulmaktadır. Tarımsal atıklar gibi organik materyaller üzerinde fungusların gelişmesiyle oluşan miselyum bazlı kompozitler, sürdürülebilir ürün tasarımı ve üretimi için umut verici alternatiflerdir (Appels et al., 2019).

Son yıllarda; tekstil, mobilya ve mimari alanlarındaki çeşitli uygulamalar için miselyum kökenli teknolojilerin tasarım ilgisi, araştırılması ve geliştirilmesinde hızlı bir büyüme görülmüştür (Ivanova, 2022). Bu derlemede, tasarımda fungusların kullanımı ve gelecekteki uygulamalarını geliştirecek yeni nesil uygulamalar için bir kaynak oluşturulması ve büyüyen tasarım alanındaki önemli gelişmelere genel bir bakış sunulması amaçlanmıştır. Fungusların tasarım uygulamalarında kullanımı üzerinde çok sayıda çalışma olmasına rağmen, bu ürünlerin seri üretimleri ve günlük hayatta kullanımları istenilen düzeye ulaşmamıştır. Dünya üzerinde 2-11 milyon arasında türe sahip olduğu tahmin edilen fungusların yalnızca 150 bin kadarının keşfedilerek tanımlanabildiği (Phukhamsakda et al., 2022) varsayımından yola çıkılarak, mikolojinin henüz bilinmeyen yanlarının keşfiyle gelecekte fungus bazlı malzemelerin potansiyel uygulamalarının ve endüstriyel önemlerinin artacağı düşünülebilir.

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FARKLI SÜRELERDE UYGULANAN SU BASMASININ KAVUNUN MORFOLOJİK VE BAZI FİZYOLOJİK ÖZELLİKLERİ ÜZERİNE ETKİSİ

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Özet
Bu araştırmanın amacı farklı sürelerde su basması stresine maruz bırakılan kavun (*Cucumis melo* L.) bitkilerinin büyümesi ve bazı fizyolojik özelliklerindeki değişimi incelemektir. Laboratuvar koşullarında 2023 yılında yürütülen araştırmada, Kırkağaç 589 kavun çeşidine ait fideler kullanılmış ve 2, 4, 6 ve 8 gün süreyle su basması stresi uygulanmıştır. Çalışmada bitki boyu, sap çapı, bitki yaş ve kuru ağırlığı, yaprak sıcaklığı, klorofil oranı, yaprak nispi su içeriği ve elektrolit sızıntısı özellikleri incelenmiştir. Araştırma sonuçlarına göre, su basma stresindeki bitkilerde bitki boyu, sap çapı, bitki yaş ve kuru ağırlığı gibi incelenen morfolojik özellikler ile klorofil oranı ve elektrolit sızıntısı daha düşük, yaprak nispi su içeriği ise daha yüksek bulunmuştur. Bitki yaş ağırlığı 6.16 g/bitki'den 4.52 g/bitki'ye, kuru ağırlığı ise 405 mg/bitki'den 326 mg/bitki'ye düşmüştür. Su basma süresinin uzaması da bitkilerin gelişimini yavaşlatmıştır. Hem kontrol hem de su basması uygulanan bitkilerde en yüksek yaprak sıcaklığı 8 gün sonra elde edilmiştir. Ancak, bitki yaş ağırlığı ve klorofil oranı tüm sürelerde su basması uygulanan bitkilerde daha düşük bulunmuştur. Yaprak nispi su içeriği 6 gün'e kadar su basması uygulanan bitkilerde daha yüksek bulunurken, 8 gün su basmasında düşüş göstermiştir. Su basmasına maruz kalan bitkilerde elektrolit sızıntısı %36.3 olarak ölçülürken, kontrol bitkilerinde %40.3 olarak elde edilmiştir. Sonuç olarak, su basması klorofil oranı, bitki yaş ve kuru ağırlığını azaltmış, yaprak nispi su içeriğini de artmıştır. Altı günden daha uzun sürede su basması stresinin kavun fidelerinin fizyolojik faaliyetlerini bozarak büyümesini engellediği söylenebilir.
Anahtar kelimeler: *Cucumis melo*, su basması, bitki büyümesi, klorofil oranı, iyon sızıntısı

THE EFFECT OF DIFFERENT PERIODS OF WATERLOGGING ON MORPHOLOGICAL AND SOME PHYSIOLOGICAL CHARACTERISTICS OF MELON

Abstract
This study aimed to investigate the changes in the growth and some physiological characteristics of melon plants exposed to waterlogging stress for different periods. In the research conducted in 2023 under laboratory conditions, the seedlings of melon (*Cucumis melo* L.) cultivar Kırkağaç 589 were used, and waterlogging stress was applied for 2, 4, 6, and 8 days. Plant height, stem diameter, plant fresh and dry weight, leaf surface temperature, chlorophyll content, leaf relative water content, and electrolyte leakage were evaluated. According to the results of the study, morphological traits such as plant height, stem diameter, plant fresh and dry weight, chlorophyll ratio, and electrolyte leakage were lower, while leaf relative water content was higher in plants under waterlogging stress. Plant fresh weight decreased from 6.16 g/plant to 4.52 g/plant and dry weight decreased from 405 mg/plant to 326 mg/plant when they were subjected to waterlogging. The prolonged waterlogging period also slowed down the growth of the plants. The highest leaf temperature was obtained after 8 days in both control and waterlogged plants. However, plant fresh weight and chlorophyll content were lower in waterlogged plants at durations. Leaf relative water content was higher in waterlogged plants up to 6 days, while it was lower than the control after 8 days. Leaf relative water content was higher in plants subjected to waterlogging until 6 days, while it decreased after 8 days of waterlogging. Electrolyte leakage was measured as 36.3% in waterlogged plants and 40.3% in control plants. As a result, waterlogging decreased the chlorophyll content, plant fresh and dry weight and increased the leaf relative water content, and it can be said that waterlogging stress longer than six days impaired the physiological activities of melon seedlings and inhibited their growth.
Keywords: *Cucumis melo*, flooding, plant growth, chlorophyll content, electrolyte leakage

1. GİRİŞ

Cucurbitaceae (Kabakgiller) familyasına ait bir bitki olan kavun (*Cucumis melo* L.), gerek dünyada gerekse de ülkemizde ekonomik açıdan önemli düzeyde yetiştirilen yazlık bir sebzedir. Sarılıcı tipte gövdeye sahip olan kavunun farklı tip, büyüklük ve renkte meyveleri bulunmaktadır (Maynard and Maynard 2000). Genellikle meyve olarak taze tüketilmekte ise de meyvesi kışa dayanıklı çeşitler mevsimi dışında da satılmaktadır. Dondurma yapımında da kullanılan kavunun küçük meyveleri ise ülkemizde turşu yapımında değerlendirilmektedir (Vural et al. 2000). Türkiye'de 2022 yılı verilerine göre kavun ekim alanı 627.243 dekar ve üretim miktarı ise 1.587.230 ton' dur (Anonim 2023). Ülkemizde kavun üretiminin büyük kısmı açık tarla koşullarında *Cucumis melo* L. var. *inodorus* tipine giren iri meyveli çeşitler ile yapılmaktadır. Ayrıca, örtü altında *Cucumis melo* L. var. *cantalupensis* grubunda yer alan küçük meyveli ve erkenci kantolop tipli çeşitler tercih edilmektedir (Sarı ve ark. 1992).

Abiyotik stres faktörleri arasında yer alan su basması her yıl dünyanın farklı bölgelerinde önemli zararlar yapmaktadır (Dennis et al. 2000; Jackson and Colmer 2005). Su basması ve taşkınlar, yağışların yoğun ve düzensiz olduğu yerlerde ortaya çıkarak drenajı zayıf olan topraklarda bitkisel üretimi olumsuz yönde etkilemekte ve bitkilerin büyüme ve gelişiminde düzensizliklere neden olarak verimlerini düşürmektedir. Su basmasının yoğunluğu ve zarar oranı iklime bağlı olarak bölgeden bölgeye ve üründen ürüne değişiklik göstermektedir (Ghodke et al. 2018). Su basması stresi bitki köklerinde oksijen eksikliği nedeniyle birçok metabolik ve fizyolojik değişikliğe neden olmaktadır (Patel et al. 2014). Su basmasına maruz kalan bitkilerde gerçekleşen fizyolojik ve patolojik bozukluklar nedeniyle büyüme engellenmekte, verim ve kalitede ciddi kayıplar ortaya çıkmaktadır (Schwarz et al. 2010). Bununla birlikte, bitkilerin su basması stresine dayanımları farklılık göstermektedir. Su basması stresinde bitkilerin pigment içeriği, fotosentez hızı ve stoma iletkenliği önemli ölçüde azalmaktadır. Bitkiler stomalarını kapatarak fotosentezi azaltmaktadır (Ou et al. 2011). Kıratlı et al. (2023) farklı kavun çeşitlerinde su basması stresinin bitki gelişimini sınırlandırarak bazı morfolojik ve fizyolojik özellikleri olumsuz etkilediğini, Guang et al. (2012) ise su basmasının pamuk bitkisinin boyunu ve sap çapını artırdığını belirlemişlerdir. Bununla birlikte, su basmasının etkilerini ve zararını tolere edebilmek için bitkiler köklerinde, stomalarında, dokularında ve fotosentetik özellikleri gibi birçok fizyolojik olaylara farklı tepkiler vermektedir.

Bu çalışma, farklı sürelerde uygulanan su basma stresinin kavun bitkisinin erken büyüme döneminde morfolojik ve bazı fizyolojik parametrelerdeki değişimlerinin incelenmesi amacıyla yürütülmüştür.

2. MATERYAL VE YÖNTEM

Bu çalışma, Eskişehir Osmangazi Üniversitesi Tohum Bilimi ve Teknolojisi laboratuvarında 2023 yılında Kırkağaç 589 kavun çeşidi kullanılarak yürütülmüştür.

2.1. Bitkilerin yetiştirilmesi

Tohumlar 23°C sıcaklıkta 2 gün süreyle ön çimlendirme yapıldıktan sonra torf:perlit:vermikulit (3:1:1) karışımı ile doldurulan viyollere aktarılmıştır. Fideler 24°C gündüz, 18°C gece sıcaklığına ayarlı bitki büyüme kabininde yetiştirilmiştir. Bitkiler çıktıktan sonra ½ dozda Hoagland solüsyonu ile birer hafta aralıklarla iki kez sulanarak gübrelenmiştir. Bitkiler 4 yapraklı döneme geldiklerinde, sağlıklı ve homojen büyüklükte olanlar seçilerek 0,5 L hacmindeki saksılara şaşırtılmıştır. Saksılarda elenmiş tarla toprağı ve yanmış ahır gübresi ile hazırlanmış karışım kullanılmıştır. Bitkilerin 10 gün boyunca köklenmesi ve gelişmesi sağlandıktan (5 yaprak) sonra su basması stresi uygulanmıştır.

2.2. Su basması stresi

Çeşme suyu ile doldurulmuş derin plastik kapların içerisine saksılar yerleştirilmiştir. Su basmasını sağlamak amacıyla saksıların yüzeyinden yaklaşık 2 cm üstüne kadar suya batırılması sağlanmıştır. Daha sonra su baskınlarındaki hava sıcaklığını simüle etmek amacıyla 20°C sıcaklığa ayarlanan bitki büyütme kabininde 14 saat aydınlık 10 saat karanlık fotoperiyotta bekletilmiştir. Kontrol uygulamasında ise su basma stresi olmadan bitkiler aynı koşullara maruz bırakılmıştır. Hem kontrol hem de su basma stresindeki bitkilerden 2, 4, 6 ve 8. günlerde, tesadüfen alınan saksılarda ölçümler yapılmıştır. Her uygulama dört saksıdan oluşturulmuş ve her saksı bir tekerrür olacak şekilde değerlendirilmiştir. Bitkilerde, bitki boyu, sap çapı, bitki yaş ağırlığı, bitki kuru ağırlığı, yaprak yüzey sıcaklığı (Troctec BP21 infrared termometre), klorofil oranı (Konica Minolta 502 SPAD), elektrolit sızıntısı, yaprak nispi su içeriği ve kuru madde özellikleri incelenmiştir.

2.3. İstatistik analiz

Araştırma tesadüf parselleri deneme deseninde iki faktörlü ve 4 tekerrürlü olarak yürütülmüştür. Tüm analizler bilgisayarda JMP 13.0 istatistik programı kullanılarak yapılmıştır. Ortalamalar arasındaki farklılıklar LSD testi ile %5 seviyesinde tespit edilmiştir.

3. ARAŞTIRMA BULGULARI

Erken dönem su basma stresinin kavun bitkisinin büyüme özellikleri üzerine etkileri Çizelge 1'de ve fizyolojik özellikleri üzerine etkileri Çizelge 2'de özetlenmiştir. Varyans analiz sonuçları incelendiğinde, bitki boyu bakımından su basması ve süresi, sap çapını su basması, bitki yaş ve kuru ağırlığını ise su basması, süreleri ve interaksiyonu istatiksel olarak %1 düzeyinde önemli bulunmuştur. Su basması stresindeki kavun fidelerinin bitki boyu daha kısa (9.4 cm) ölçülmüştür. Artan su basma sürelerinde ise bitki boyu artmış, 2 gün süren su basma stresinde 8.16 cm olan bitki boyu, 8. günde 11.73 cm'ye ulaşmıştır. Ortalama sap çapı ise su basması stresindeki bitkilerde daha az (3.57 cm) ölçülmüştür. Su basması stresi, bitkilerin düşük oksijen koşulları altında büyümesine yol açarak bitki gelişim dönemlerini olumsuz etkilemektedir.

Su basması, aerobik solunumu engelleyerek bitki gelişiminin engellemesine neden olmaktadır (Zhou et al. 2020). Kolzada bitki boyu, gövde genişliği ve bitkide dal sayısı, fide ve çiçek tomurcuğu su basması ile önemli ölçüde azaldığı (Zhou and Lin 1995), kök ve sürgün gelişimini önemli ölçüde engellediği belirlenmiştir (Guo et al. 2020). Börülcede su basması stresinin yaprak alanında ortalama %65 azaldığını (Olorunwa et al. 2023) ve mısırda da bitki boyu ve yaprak alanı indeksinin azaldığı tespit edilmiştir (Huang et al. 2022). Benzer şekilde, bitki yaş ağırlığı su basma stresinde daha düşük bulunurken, artan stres süresi de bitki yaş ağırlığı artmıştır. Beklendiği gibi, kontrol bitkilerinde süre uzadıkça bitkilerin büyümesine bağlı olarak yaş ağırlık artarken, su basması stresindeki bitkilerin yaş ağırlığındaki artışı sınırlı kalmıştır. Bitki yaş ağırlığındaki değişime bağlı olarak, bitki kuru ağırlığı su basması stresinde daha düşük gerçekleşmiştir. Artan su basma süresi ile bitki kuru ağırlığı artsa da bu artış su basması stresinde daha az gerçekleşmiştir. Araştırma sonuçlarımız domateste sürgün ve kök kuru ağırlığının yanı sıra toplam biyokütlesi de su basması altında büyük ölçüde azaldığını bildiren Mohanty et al. (2020)'ın bulgularını desteklemektedir.

Çizelge 1. Kavun bitkisinin morfolojik özellikleri üzerine farklı sürelerde yapılan su basması stresinin etkisi

Faktör	Bitki boyu (cm)	Sap çapı (cm)	Bitki yaş ağırlığı (g/bitki)	Bitki kuru ağırlığı (mg/bitki)	Kuru madde (%)
Uygulama (A)					
Kontrol	10.4^{a}	4.00^{a}	6.16^{b}	405^{a}*	6.30^{b}
Su basması	9.4^{b}	3.57^{b}	4.52^{b}	326^{b}	7.30^{a}
Süre (B)					
2 gün	8.16^{b}	3.69	4.22^{c}	257^{b}	6.10^{c}
4 gün	8.75^{b}	3.88	5.17^{b}	327^{b}	6.43^{bc}
6 gün	10.92^{a}	3.73	5.55^{b}	408^{a}	7.61^{a}
8 gün	11.73^{a}	3.81	6.43^{a}	470^{a}	7.05^{ab}
Varyans analizi					
A	**	**	**	**	**
B	**	*ns*	**	**	**
A ×B	*ns*	*ns*	**	**	**

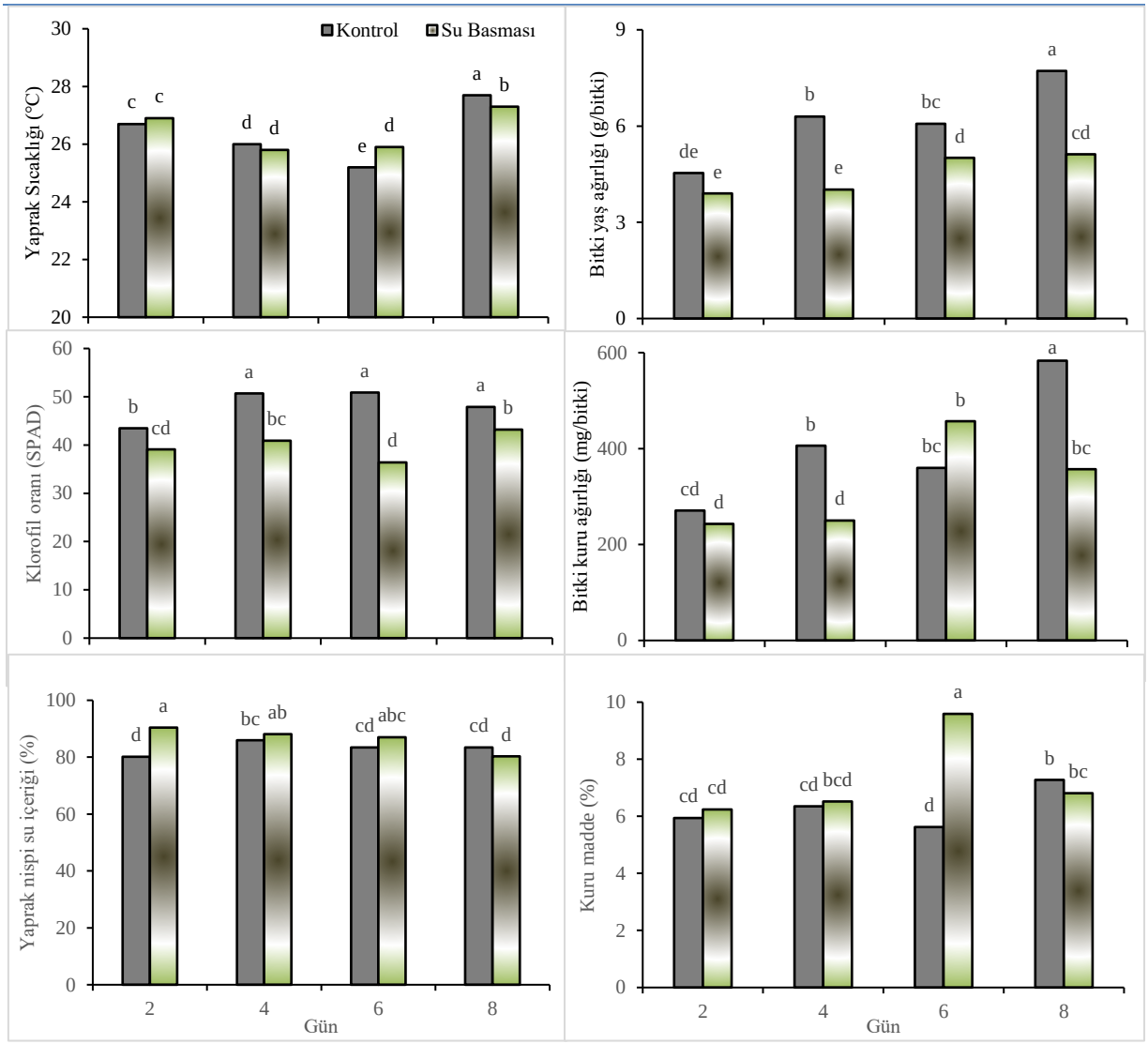
*: Aynı harfle gösterilen ortalamalar arasında fark yoktur p<0.05. ** %1 düzeyinde önemli

Çizelge 2'de görüldüğü gibi, yaprak sıcaklığı su basma stresi ile elektrolit sızıntısında su basması × süre interaksiyonu hariç tüm uygulamalar istatistiksel olarak %1 düzeyinde önemli bulunmuştur. Yaprak sıcaklığı en yüksek 8. günde ölçülürken, en düşük değer 25.5℃ ile 6. günde elde edilmiştir. Klorofil oranı su basmasındaki bitkilerde (29.9 SPAD) kontrol bitkilerinden (39.9 SPAD) daha düşük ölçülmüştür. Stres süresi uzadıkça klorofil oranı artsa da tüm sürelerde su basmasında daha düşük klorofil oranı elde edilmiştir (Şekil 1).

Çizelge 2. Kavun bitkisinin bazı fizyolojik özellikleri üzerine farklı sürelerde uygulanan su basması stresinin etkisi

Faktör	Yaprak sıcaklığı (℃)	Klorofil oranı (SPAD)	Yaprak nispi su içeriği (%)	Elektrolit sızıntısı (%)
Uygulama (A)				
Kontrol	26.4	48.2^{a}	83.2^{b}	40.3^{a}*
Su basması	26.5	39.9^{b}	86.4^{a}	36.3^{b}
Süre (B)				
2 gün	26.8^{b}	41.3^{b}	85.2^{a}	32.5^{c}
4 gün	25.9^{c}	45.8^{a}	86.9^{a}	39.1^{b}
6 gün	25.5^{d}	43.7^{a}	85.2^{a}	41.8^{a}
8 gün	27.5^{a}	45.5^{a}	81.9^{b}	39.8^{b}
Varyans analizi				
A	*ns*	**	**	**
B	**	**	**	**
A ×B	**	**	**	*ns*

*: Aynı harfle gösterilen ortalamalar arasında fark yoktur p<0.05. ** %1 düzeyinde önemli



Şekil 1. Farklı sürelerde su basması stresine maruz bırakılan kavun fidelerinin yaprak sıcaklığı, +klorofil oranı, yaprak nispi su içeriği, bitki yaş ağırlığı, bitki kuru ağırlığı ve kuru madde oranındaki değişimler

Su basması stresinde daha düşük klorofil içeriği börülcede (Olorunwa et al. 2023), mısırda (Huang et al. 2022), domateste (Yan et al. 2006; Mohanty et al. 2020) ve ekmeklik buğdayda (Pais et al. 2022) da tespit edilmiştir. Yaprak nispi su içeriği ise su basmasındaki kavun bitkilerinde daha yüksek bulunsa da süre uzadıkça aradaki fark azalmış ve 8. günde daha düşük gerçekleşmiştir (Şekil 1). Su basması stresindeki marul bitkilerinde daha yüksek yaprak nispi su içeriği Kal et al. (2023) tarafından belirlenmiştir. Benzer şekilde, su basma süresinin uzaması elektrolit sızıntısını artırmış, en yüksek değer ise %41.8 ile 6. günde ölçüm yapılan bitkilerden elde edilmiştir. Su basması nedeniyle domateste klorofil içeriğinde azalma, yapraklarda

sararma ile birlikte elektrolit sızıntısında artış Yan et al. (2006) tarafından da tespit edilmiştir. Benzer bulgular buğday bitkisinde de belirlenmiştir (Lama et al. 2020).

4. SONUÇ

Su basması, fide döneminde kavun bitkisinin büyümesini yavaşlatmıştır. Bitkilerin su basma stresine maruz kalma sürelerinin de etkili olduğu belirlenmiştir. Genel olarak, su basması kavun fidelerinde klorofil oranını azaltmış, yaprak su içeriğini ise artırmıştır. Elektrolit sızıntısı da su basma süresi uzadıkça artmıştır. Sonuç olarak, altı gün ve daha uzun süre su basmasına maruz kalan kavun bitkilerinde fizyolojik parametreler bozularak bitki büyümesinin engellediği söylenebilir.

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IMPROVING COMPLEMENTARY FEEDING IN NIGERIA: A REVIEW OF CRAYFISH'S NUTRITIVE AND HEALTH VALUES

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Abstract
The low consumption of animal-source foods (ASFs) among Nigerians, especially the poverty-stricken households, had contributed to high prevalence of malnutrition among under-five children. This study reviewed crayfish's nutritive and health benefits to encourage the consumption during complementary feeding in Nigeria with eventual promoting of better nourishment among the populace. Information used were narrative overview of findings from literature retrieved from searches of computerized databases, hand searches, and authoritative texts. The study revealed that in Nigeria the consumption of ASFs including crayfish was very low at 27% and 59% among children of 6 – 23 months old who were breastfeeding and non-breastfeeding, respectively. Owning to Nigeria annual production of about 12,000 metric tons, crayfish is relatively available in Nigerian markets all year-round and affordable to all classes of income. Crayfish contained, per 100g, high protein (68.47g), calcium (594.65 mg), iron (11.99 mg) and zinc (2.1 mg) contents, and low carbohydrate (2.83g) and fiber (0.71g) contents. The selenium (2000 µg) and copper (0.25 mg) contents were more than DRI for children between 6 – 23 months old. The content of Sulphur amino acids (3862 mg/100g sample) was more than RDA for children between 6 – 36 months old. The content of astaxanthin in crayfish ranged between 1000 – 33100 µg/100g. Crayfish diet was found to have reduced the incidence of eczema development in children at high-risk by about 17% compared with the non-intervention group whose reduction was about 39%. In some qualitative studies, crayfish diet had higher protein, iron, zinc, calcium, copper, selenium, and lower fiber contents than control. The diet also enhanced higher weight-gain, nitrogen-retention in muscle and liver than control. Equally, protein efficiency and net protein ratios of crayfish diet were found to be higher than the control. With the foregoing, introduction of crayfish diet during complementary feeding may lower undernutrition among Nigerian children. Advocacy through nutrition education is recommended for the utilization of ASFs such as crayfish during complementary feeding. The impact of crayfish diet on child nutrition and health, such as anti-obesity, cholesterol level reduction is recommended for further study.
Keywords: complementary feeding, animal source food, crayfish, nutritive values, nutrition and health, malnutrition, astaxanthin, obesity, Nigeria

INTRODUCTION

According to World Health Organization (WHO), ASFs are the best sources for high-quality nutrient-rich food for children between 6 to 23 months-old (Adesogan *et al.*, 2020). This was due to their ability to partly reduce childhood stunting and alleviate the global disease burden when consumed appropriately (Iannotti, 2018; Shapiro *et al.*, 2019). ASFs have a high abundance of macro-and micro-nutrients (Dror & Allen, 2011). Adesogan *et al.* (2020) and Haileselassie *et al*. (2020) reported that ASFs supplied greater quantities of high-quality protein and more bioavailable vitamin A, vitamin D_3, iron, iodine, zinc, calcium, folic acid, and key essential fatty acids which are essential for health and development of the infants and young children. Similarly, ASFs are the only natural source of vitamin B_{12} (Zhang, Goldsmith & Alex, 2016). Vitamin B_{12} deficiency was prevalent among individuals consuming low ASFs in developing countries and associated with developmental disorders, anemia, poor cognitive function, and lower motor development (Stabler & Allen, 2004). ASFs are rich in bioavailable micronutrients that aid the absorption of non-heme iron and zinc when consumed with cereals and other plant-based foods, PBFs, (Neumann, Harris & Rogers, 2002). Therefore, consumption of ASFs provides a potential strategic mechanism that can remediate micronutrient deficiency in a population, especially where the diets are predominantly anti-nutrient containing PBFs (Zhang *et al.*, 2016). Both interventional and observational studies have highlighted the potential of ASF consumption as an effective food-based strategy in reducing childhood malnutrition (Michaelsen *et al*., 2009). A recent randomized controlled trial (RTC) in Ecuador, where one egg per day was provided to 6-9 months-old infants for six months, showed a reduction of childhood stunting and underweight by 47% and 74% respectively among children with no cases of allergic reactions (Iannotti et al., 2017). In a study by Skau *et al.* (2015) in Cambodia, a mixture of rice-based complementary food (CF), small fish, and edible spiders (WinFood/small fish/edible spider) produced an increment in fat-free mass after nine months of trial among six months-old children. An observational study revealed that childhood stunting was markedly higher in regions with low ASF consumption such as South-Central Asia, Southeast Asia, West Africa, Central Eastern Africa, and Southern Africa (Adesogan *et al*., 2020).

Despite having higher nutritional values and the potential to reduce childhood stunting, the consumption of ASFs among children in developing countries is still very low (Dror & Allen, 2011; Haileselassie *et al*., 2020). The reasons are due to limited purchasing power for

conventional animal source foods such as meat, fish, eggs, and dairy products; and lack of nutrition education to utilize available underutilized, low-cost unconventional animal source foods such as lizards, frogs, insects, lobsters, crayfish, crabs, and snakes (Adi, Andrias & Rachman, 2020; Haileselassie *et al.*, 2020). In Nigeria, poverty affected food security among many households causing ASFs consumption at 27% and 59% among children of 6 to 23 months-old who were breastfeeding and non-breastfeeding respectively. Only 11% among 6 to 23 months-old children were fed with a minimum acceptable diet, which may have contributed to a high childhood stunting of approximately 37% under-five children in 2018 (National Population Commission, NPC, Nigeria & International Classification of Functioning Disability and Health, ICF, 2019). Nutrient-deficient PBF in traditional *pap/ogi* was commonly served to children by 90% of mothers or caregivers during complementary feeding (Uwaegbute, 1991). Realistically, unfortified complementary foods (CFs) should include ASFs to meet children's nutritional needs (Pan American Health Organisation, PAHO, & World Health Organisation, WHO, 2003).

Given the poverty situation in Nigeria in which about 133 million (63%) people suffer from multidimensional poverty (National Bureau of Statistics, NBS, 2023). This review was proposed for advocacy on supplementing traditional CFs with crayfish to provide sufficient nutrient needs among infants and young children. Crayfish was chosen for this review because of its nutritional values and cheapest animal source protein; it is relatively cheaper compared with other conventional and non-conventional ASFs, affordable, and readily available all year round across Nigerian markets, as a result of annual production of about 12 000 metric tons (Adegbusi, 2022). Furthermore, it has a relatively higher Sulphur-containing amino acids, SAAs, (Okoye et al., 2019; Adegbusi, 2022).

MATERIALS and METHODS

Through literature search, all the information for this study were generated from secondary sources. Ample of literature searches were performed to gather as much relevant information for the topic from previous studies in order to provide evidence on the topic and help validate the review. Searches of previous studies were conducted from Google Scholar and PubMed databases and manually from relevant journals and reference lists of retrieved literature from initial searches. Among the search or key terms employed to accomplish the search from databases included ‘’complementary feeding’’ AND ‘’ASF’’; "complementary food" AND

"animal source food" ‘’complementary feeding’’ AND ‘’Crayfish’’; ‘’Nigeria’’ AND ‘’crayfish’’; ‘’Nutritive value’’ AND ‘’Crayfish’’; ‘’Crayfish’’ AND ‘’Health benefits’’; ''Nigerian crab' AND 'Nutrition value''; ‘'Nigerian insect' AND 'Nutrition value''. Because this paper is not a systematic review, evaluations of methodological quality were not used to exclude papers from the study.

RESULTS and DISCUSSION

Crayfish Production, Availability, and Utilization in Nigeria

Crayfish, also referred to as crawfish, crawdads, shrimp, prawn, and spiny lobsters is the common name for freshwater crustaceans comprised of arthropod families of *Astacidae*, *Cambaridae*, *Parastacidae*, and *Astacidea* (Evans & Jussila, 1997). The commonly exploited species include *Palaemon hastatus*, *Hippolysmata hastatoides*, and *Macrobrachium sp*., which mixed with migratory larva and juveniles of pink shrimp called *Penaeus duorarum* or *notialis* (*Farfantepeneaus*) whose maturity occurred in the coastal and estuarine areas (Nsetip, 1985). The annual production of crayfish was approximately 12,000 metric tons and available at all seasons, relatively cheap and affordable (Adegbusi, 2022). Crayfish is used as a spice in Nigerian cooking (foraminifera market research, 2016), particularly in soup, concoction rice, and Moimoi (beancake) made among households, operators of a canteen, hotel, and restaurants (All Nigerian Recipes, 2022). It is usually milled into powder form with a dry mill before adding it to Nigerian cooking.

Comparison of Nutrient Composition of Nigerian Crayfish and Some Selected Locally Available Low-cost ASFs

As shown in Table 1, crayfish had a higher SAA (5.64 g/100g crude protein), lower lipid (4.75%) and fibre (0.71%) contents compared with those of Crab, Grasshopper, Termite, Cricket and Palm-weevil. This quality may give crayfish an advantage of good complementation with PBFs in complementary food formulation.

Table 1. Comparison of nutrient composition (dm^{-1}) of crayfish with other selected locally available ASFs in Nigeria

Nutrient	**ASFs**					
	Crayfish[e]	**Crab[f]**	**Grasshopper[g]**	**Termite[g]**	**Cricket[g]**	**Palm weevil[h]**
CHO (%)	2.83	1.23	8.26	2.94	12.46	6.79
Lipid (%)	4.75	5.35	6.5	40.83	7	33.25
Protein (%)	68.47	33.3	75.08	43.75	71.04	52.88
Energy (kcal/100g)	326.38	202.89	391.83	554	397	537.93[*]
Crude fibre (%)	0.71	8.31	5.96	6.76	8.28	4.91
Calcium (mg/100g)	594.65	2157.86	0.22	0.21	0.09	6.50
Iron (mg/100g)	11.99	27.95	0.17	0.14	0.15	7.01
Zinc (mg/100g)	2.1	15.23	0.24	0.21	0.24	0.50
Isoleucine (g/100g CP)	7.525	5.07[i]	1.52[j]	4.31[j]	3.36[j]	2.41
Leucine (g/100g CP)	7.505	9.73[i]	6.99[j]	7.76[j]	6.62[j]	6.74
Lysine (g/100g CP)	5.26	8.27[i]	6.32[j]	6.16[j]	5.29[j]	5.83
Methionine + cystine (g/100g CP)	5.64	4.64[i]	2.77[j]	1.18[j]	3.43[j]	3.67
Phenylalanine + tyrosine (g/100g CP)	13.48	7.53[i]	12.90[j]	9.23[j]	7.60[j]	7.37
Threonine (g/100g CP)	10.345	3.42[i]	10.60[j]	4.20[j]	3.09[j]	3.61
Tryptophan (g/100g CP)	1.33	1.18[i]	2.64[j]	2.36[j]	2.53[j]	NA
Valine (g/100g CP)	4.68	5.43[i]	6.66[j]	4.92[j]	4.63[j]	3.94
Histidine (g/100g CP)	3.23	3.23[i]	5.61[j]	3.07[j]	2.52[j]	2.58

[e]Average nutrient value of crayfish from Adegbusi (2022) & Ogunlade et al. (2005); [f] Crab Nutritional Fact (2016); [g]Obiokpa et al (2017); [h]Okunowo et al., (2017); [i]Moruf and Lawal-are (2019); [j]Obiokpa et al. (2018); [*]4 kcal/g CHO + 9 kcal/g lipid + 4 kcal/g protein (FAO, 2003); ASFs = Animal source foods CP = Crude protein; NA = Not available; CHO = Carbohydrate; dm = dry matter basis

Nutritive Values and Health Benefits of Crayfish

Crayfish is a very low-carbohydrate and fiber food, containing about 2.83% carbohydrate and 0.71% fiber contents (Adegbusi, 2022; Ogunlade et al., 2005). As shown in **Table 1 and Table 2**, crayfish is a highly rich source of protein (68.47 g) and energy (326.38 kcal) per 100 g dm. The protein content contributed 83.9% protein energy (PE), making it an excellent diet for complementing PBFs with low protein content. Meals containing crayfish can play a great role

in humans' functional and physical development, especially in developing countries where other protein sources were inadequate and comparatively costly (Iwuchukwu *et al*., 2017). Consumption of crayfish together with PBFs deficient in such amino acids as lysine and methionine, and such micronutrients as zinc, not only provides complete utilization of plant proteins but also improves zinc bioavailability in the diet (Iwuchukwu *et al.*, 2017; Maares & Haase, 2020). As suggested by Adeyeye & Adubiaro (2004), the low crude fiber level of crayfish may be adequate as a local CF supplement during complementary feeding in Nigeria, because it will neither increase the bulk of nor reduce the energy intake from the eventual porridge formed.

Table 2. Nutrient contents of 100 g crayfish flour per dm compared with selected IOM DRIs for children age groups

Nutrient	**Crayfish value**	**Age group (Month)**		
		6-8[b]	**9-11[b]**	**12-23[b]**
Energy (kcal)	326.38[a]	615	686	894
Protein (g)	68.47[a]	9.9	9.9	13
Calcium (mg)	594.65[a]	270	270	500
Iron (mg)	11.08[a]	11	11	7
Zinc (mg)	3.37[a]	3	3	0.7
Copper (mg)	0.25[c]	0.2	0.2	0.3
Riboflavin (mg)	1149[c]	0.4	0.4	0.5
Thiamine (mg)	1567[c]	0.3	0.3	0.5
Selenium (µg)	2000[d]	20	20	20

IOM = Institute of Medicine, United State; DRI = Dietary Reference Intake; [a]Average nutrient value of crayfish from Adegbusi (2022) & Ogunlade et al. (2005); [b]Lutter & Dewey (2003); [c]Sanusi (2020); [d]Abulude et al. (2006); dm = dry matter basis.

Crayfish is capable of supplying infants and young children with multiple essential micronutrients for growth and development. A 100 g per dm of unfortified crayfish provided about 1149 mg of riboflavin, 1189 mg of thiamine, 594.65 calcium (Table 2). Moreover, a 100 g per dm crayfish yielded 7.30 mg vitamin E (Andriamparany, Hanke & Schlecht, 2021), an amount that is about 46% more than the recommended dietary allowance (RDA) for children between 6 to 36 months-old (Rizvi *et al*., 2014). A study on preschool children between 18 to

30 months-old in Egypt, Mexico, and Kenya showed an association between low intake of ASFs and inadequate vitamin and mineral intake (Dror & Allen, 2011). A 100 g per dm of crayfish provided 2000 µg selenium and 0.25 mg copper. Selenium status was positively associated with cognitive function. A study that measured prenatal and childhood selenium status showed an association between selenium and higher cognitive function scores at 5 and 10 years of age (Skröder *et al.*, 2017). Hence, crayfish is an excellent source of absorbable selenium that can be used to supplemented traditional CFs to prevent inadequate intake during childhood. Copper was involved in the absorption and metabolism of iron in vertebrates, found to activate ceruloplasmin and hephaestin which prevent the formation of reactive oxygen species, and facilitate the eventual transport of iron into cells (Adegbusi 2022).

Crayfish had a very low crude lipid content of about 4.75% as showed in Table 1, but contains abundant amount of omega-3 long-chain polyunsaturated fatty acids (PUFAs) particularly eicosapentaenoic acid (EPA) (*cis*-5,8,11,14,17, C20:5) and docosahexaenoic acid (DHA) (*cis*-4,7,10,13,16,19, C22:6) (Venugopal & Gopakumar, 2017). DHA was reported to be essential for the growth and functional development of the brain and retina in infants and required to maintain normal brain function in adults. Intake of DHA during pregnancy and early life was reported to enhance growth and cognitive performance later in childhood (Huffman *et al.*, 2011). Both DHA and EPA have beneficial effects on health by lowering serum triacylglycerol levels, increasing membrane fluidity, and reducing the risk of thrombosis, coronary heart disease, hypertension, inflammation, and autoimmune disorders (Ayas, Ozogul & Yazgan, 2013). On this basis, supplementation of traditional CFs with low-cost crayfish may enhance the consumption of DHA and EPA and help preventing the negative impact of its inadequacy in infant and young children.

In addition to the presence of selenium and copper minerals in crayfish, carotenoids were also found to play a vital role in the crayfish antioxidant system (Larsen, Eilertsen & Elvevoll, 2011). Epidemiological studies revealed the consumption of carotenoid-rich foods reduced the incidence of cancers, cardiovascular diseases, age-related macular degeneration (AMD), cataracts, diseases related to weak immune function, and other degenerative diseases (Perera & Yen, 2007). In humans, the health-promoting benefits derived from carotenoids were attributed to its antioxidant property exhibited in the ability to quench singlet oxygen and scavenge free radicals (Rodriguez-Amaya & Kimura, 2004). Among these carotenoids, astaxanthin has more antioxidant properties than β-carotene, α-tocopherol, lycopene, lutein, and other members of

the carotenoid group. Tzanova, Agirova & Atanosov (2016) reported that astaxanthin antioxidant activity was 40, 550 and 6000 times higher than β-carotene, vitamin E and vitamin C respectively. Astaxanthin also has anti-obesity activity by restricting weight gain and promoting insulin sensitivity (Bhuvaneswari et al., 2010). The pinkish-red color of crayfish **(Figure 1)** is due to accumulated astaxanthin in the body, shell, and tissues (Morrow, 2011) that confers its aesthetic and organoleptic qualities. Astaxanthin content in crayfish ranged between 1000 to 33100 µg/100 g (Okada, Nur-E-Borhan & Yamaguchi, 1994; Sachindra, Bhaskar & Mahendrakar, 2005). Suggestively, the astaxanthin content of crayfish may be adequate to fight childhood infection when utilized during complementary feeding.

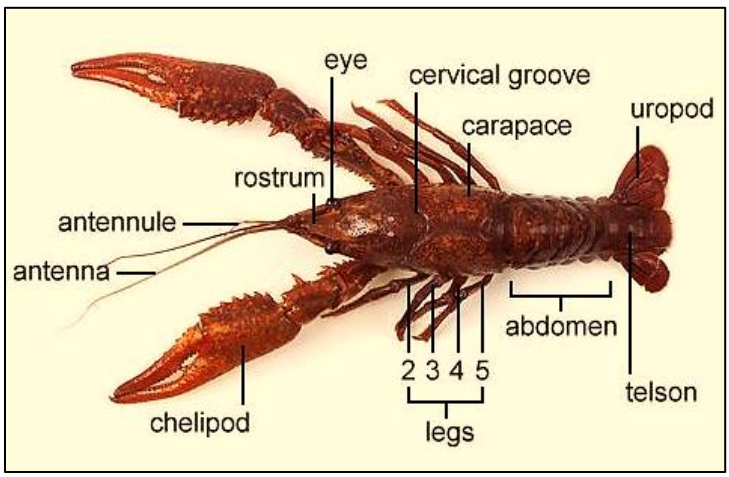


Figure 1: External structure of a crayfish (Adegbusi, 2022)

According to Solomon & Owolawashe (2012), protein quantity and quality were crucial in child nutrition as both were required for optimal growth and development. Protein quality is a function of the amino acids present in food. The essential amino acids available in the diet must be adequate for normal protein turnover in the body. The protein digestibility corrected amino acid score (PDCAAS), a measure of protein quality, of crayfish is 1, indicating high-quality protein lacking a limiting amino acid (Venugopal & Gopakumar, 2017). Thus, crayfish is a potential alternative source of essential amino acids to complement such limiting amino acids as lysine, methionine, and tryptophan in PBFs. The total essential amino acids of crayfish was 40,406 mg/100 g (Adegbusi, 2022; Ogunlade et al. (2005), as shown in **Table 3**, making

crayfish a potential ASF capable of meeting the recommended dietary allowance (RDA) of essential amino acids for older infants and young children.

Table 3. Essential amino acids of crayfish flour compared with children RDAs of the amino acids

Essential amino acid (mg/100g sample)	**[e]Crayfish value**	**Children RDA[d] for Amino Acids (mg/day)**	
		7-11 months	12-36 months
Isoleucine	5156	387	364
Leucine	5142	837	819
Lysine	3602	801	754
Methionine + cystine	3862	387	364
Phenylalanine + tyrosine	9230	756	702
Threonine	7087	441	416
Tryptophan	911	117	104
Valine	3204	522	481
Histidine	2212	288	273
Total essential amino acid	40406	4536	4277

Reference weight for 7-11 months old children = 9kg; Reference weight for 12-36 months old children = 13 kg (Institute of Medicine (US) Food and Nutrition Board, IOMFND, 1998); [e]Average essential amino acids of crayfish from Adegbusi (2022) & Ogunlade et al. (2005); [d] Institute of Medicine of the National Academies, IOMNA, (2005).

Evidence-based on Crayfish Interventional Study

In a randomized controlled trial, the consumption of crayfish meal improved immunity against infection in children whose parents were atopic and had umbilical cord IgE > 0.35 kU/L. The incidence of eczema development was reduced by approximately 17% compared to the non-intervention group at approximately 39% after 18-months follow-up study (Shao *et al.*, 2006). Feeding interventional study on crayfish food for children was not common, but animal experiments investigating the nutritional quality of plant-based CFs supplemented with crayfish had demonstrated the potential suitability of crayfish protein for improving PBF products. Some

positive nutritional effects of diets formulated with crayfish supplementation are as shown in Table 4.

Table 4. Some effects of crayfish supplementation on nutritional quality of plant-based CFs

Composition	Findings on nutritional quality	Reference
Sorghum, sesame, carrot, and crayfish flours (65:20:18:7) g	1. higher protein content 2. higher iron, zinc, copper, and selenium contents than control.	(Onabanjo, Akinyemi & Agbon 2009).
Crayfish flour and groundnut-*ogi* (1:1:8) g.	1. higher protein content, 2. higher protein efficiency ratio and 3. higher net protein ratio than control.	(Ibironke, Fashakin & Badmus, 2012).
Maize and crayfish flours (1:10) g.	1. higher weight gain than control 2. higher protein content and 3. higher nitrogen retention in liver and muscle than control.	(Ibironke, Fashakin & Ige, 2014).
Maize, sesame, and crayfish flours (55:30:15) g.	1. higher protein, fat content and 2. lower fiber content than control.	(Fasuan *et al*., 2017).
Maize, crayfish, and carrot flours (70:20:10) g.	1. higher protein efficiency ratio and protein retention and 2. higher biological value and net protein ratio than control.	(Umerah *et al*., 2020).
Maize, soybean, and crayfish flours (80:10:10) g.	1. most desirable nutritional characteristics compared with maize only, maize and soybean flours, and Cerelac powder.	(Adegbusi *et al*., 2022).

Control = Nestle Cerelac/Cereal only product/Group lacks crayfish

As presented in **Table 4,** the utilization of crayfish to supplement plant-based CFs can supply low-cost multiple nutrients for traditional CFs to reduce growth faltering and multiple micronutrient diseases (MMDs) observed in children fed with common traditional CFs. Crayfish only promote growth effects in experimental rats but also exhibit anti-obesity and hypolipidemic activities. Mezzomo *et al*. (2015) reported a considerable weight reduction in *Swiss Mus musculus* normal and knockout mice exposed to a high-fat diet combined with shrimp extracts for 30 days. This observation was not related to the absorption of lipid components as non-significant tendency of glucose reduction was detected. However, the observation may be due to astaxanthin, EPA, and DHA fatty acids cooperative effects (Mezzomo *et al*., 2015). While using crayfish for plant-based CF supplementation, a minimum amount of it that can produce adequate complementation should be used to avoid the high

viscosity of the formulation. An increasing quantity of crayfish was found to increase the viscosity of porridges (Ejigui & Desrosiers, 2011), which may eventually reduce the amount of recommended intake by children of targeted age.

CONCLUSION

ASFs were not often consumed by most Nigerians especially the poor populace, which was approximately 63% of the population. Approximately 90% of mothers commonly fed their children with *Ogi* during complementary feeding, an inadequate plant-based cereal gruel that was discovered to cause protein-energy malnutrition among Nigerian infants and preschool children. The low-cost ASFs can be substituted for a high-cost counterpart to meet children's nutritional needs. Despite so, ASFs were not commonly utilized due to poverty and lack of nutrition education. One of the low-cost ASFs is crayfish, which contains high-quality macro- and micro-nutrients that can supplement traditional CFs for alleviating malnutrition among infants and young children in Nigeria. Based on evidence from trials and investigations involving the impact of crayfish diet on nutritive value and health benefit, the utilization of crayfish c improve complementary feeding in Nigeria and other economy-deficit countries. When introduce to infants, crayfish diet may reduce the risk of obesity, high blood pressure, skin diseases, improve immunity. On the current review, supplementation of plant-based complementary foods with crayfish can produce high-quality foods characterized with the most desirable nutritional qualities compared with the controls. Nutrition advocacy on crayfish consumption during complementary feeding is recommended to enlightening the poor populace on its nutritional importance. The impact of crayfish diet on child nutrition and health, such as anti-obesity, cholesterol level reduction is recommended for further study.

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Finding

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LUPİN UNU GIDA SEKTÖRÜNDE KULLANIM OLANAKLARI

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ÖZET

Lupin ya da diğer adıyla "tremoço", baklagiller ailesinden, özellikle Akdeniz çevresinde ve Latin Amerika'da yaygın olarak bulunan ve tarihsel olarak hem gıda hem de yem olarak kullanılan bir bitkidir. Lupin, sağlık açısından çok sayıda fayda sunar. Özellikle bitkisel protein açısından zengin olması kas gelişimine ve onarımına yardımcı olur ve bu nedenle özellikle bitki bazlı diyetleri tercih edenler için idealdir. Yüksek diyet lifi içeriği ile sindirim sağlığını iyileştirir ve tokluk hissi sağlayarak kilo kontrolüne destek olur. Karbonhidrat içeriği düşük ve glisemik indeksi az olduğundan, kan şekeri seviyelerini dengelemeye yardımcı olur ki bu da diyabet hastaları için faydalıdır. Doymamış yağlar içerdiği için kalp sağlığını destekler ve çeşitli mineraller ve B grubu vitaminleri ile genel sağlığı geliştirebilir. Ayrıca, düşük alkaloid seviyeleri sayesinde olası toksik etkiler en aza indirgenir. Dengeli bir diyetin bir parçası olarak tüketildiğinde bu faydalar en iyi şekilde elde edilir, ancak alerjenlere karşı potansiyel tepkiler göz önünde bulundurulmalıdır. Lupin unu, besin değeri yüksek ve glüten içermeyen bir alternatif olarak, gıda sektöründe çeşitli kullanım alanlarına uygundur. Çölyak hastaları veya glüten hassasiyeti olanlar için buğday ununun yerine geçebilecek bir seçenek olarak öne çıkarken, ekmek, pasta ve kraker gibi fırın ürünlerinin üretiminde kullanılmaktadır. Et ürünlerinde hem dolgu maddesi olarak hem de yağ oranını azaltmak için tercih edilen lupin unu, ayrıca tekstür ve su tutma kapasitesini artırmak suretiyle et ürünlerinin kalitesini iyileştirebilmektedir. Bitki bazlı süt ve peynir alternatiflerinde süt proteini yerine geçen lupin unu, besin değerini artırmak ve ürün tekstürünü iyileştirmek için kullanılır. Protein bakımından zengin olan lupin unu, hamur işlerinin yanı sıra enerji barları ve protein tozları gibi ürünlerde de tercih edilerek sporcular ve aktif yaşam tarzını benimseyenler için ideal bir seçenektir. Fonksiyonel gıdalar alanında, yüksek lif içeriği ve kan şekerini düzenleyici özellikleri ile kalp hastalığı ve tip 2 diyabet riski taşıyan bireyler için yararlıdır. Lupin unu ayrıca bisküvi ve kek gibi tatlı ürünlerde, glüten içermeyen makarnalarda ve vegan ile vejetaryen ürünlerin üretiminde protein kaynağı olarak kullanılmaktadır. Atıştırmalık ürünler ve crackerslarda lif içeriği sayesinde doyuruculuk sağlarken, sağlıklı atıştırmalık seçenekleri olarak düşük glisemik indeksine sahip olması tercih sebebidir. Çorba ve soslar için ise doğal kıvam artırıcı ve emülsiyon stabilizatörü olarak işlev görmektedir. Lupin ununun gıda sektöründeki potansiyelini anlamak ve kullanım alanlarını genişletmek için daha fazla araştırmaya ihtiyaç duyulmaktadır. Aktif bir araştırma konusu olan lupin ununun, gıda formülasyonlarındaki işlevselliği, besin profili ve duyusal özellikler, lokal düzenlemeler, alerjen potansiyeli ile çevresel ve sürdürülebilirlik faktörleri göz önünde bulundurularak değerlendirilmelidir. Böyle bir değerlendirme, gıda teknolojisi, beslenme bilimi ve tarım uygulamalarını içeren multidisipliner

bir yaklaşım gerektirir. Bu çalışmada lupin ununun gıda endüstrisinde kullanım alanlarına yönelik çalışmalar derlenmiştir.
Anahtar kelimeler: Lupin, çölyak, glisemiks indeks, protein

LUPIN FLOUR USES IN THE FOOD INDUSTRY

ABSTRACT
Lupin, also known as "tremoço", is a member of the legume family that is commonly found around the Mediterranean and in Latin America, and has historically been used both as food and fodder. Lupin offers numerous health benefits. Its richness in plant protein aids muscle development and repair, making it ideal for those who prefer plant-based diets. The high dietary fiber content improves digestive health and provides a feeling of fullness, which supports weight control. With low carbohydrate content and a low glycemic index, it helps balance blood sugar levels, which is beneficial for diabetics. It contains unsaturated fats, which support heart health, and is enriched with various minerals and B vitamins that can improve overall health. Additionally, low levels of alkaloids reduce the potential for toxic effects. When consumed as part of a balanced diet, these benefits are best realized, but potential reactions to allergens should be considered. Lupin flour is used in the food industry for various applications due to its high nutritional value and gluten-free nature. It stands out as an alternative to wheat flour for people with celiac dişesek or gluten sensitivity and is used in the production of bakery products like bread, cakes, and crackers. Lupin flour is favored in meat products both as a filler and to reduce fat content; it also enhances the quality of meat products by improving texture and water retention capacity. Used as a substitute for milk protein in plant-based milk and cheese alternatives, lupin flour is utilized to increase nutritional value and improve product texture. Rich in protein, lupin flour is not only preferred in baked goods but also in products like energy bars and protein powders, making it an ideal option for athletes and those with an active lifestyle. In the functional foods domain, its high fiber content and blood sugar regulation properties are beneficial for individuals at risk of heart disease and type 2 diabetes. Lupin flour is also used as a protein source in the production of sweet products like biscuits and cakes, gluten-free pastas, and in the production of vegan and vegetarian products. In snack products and crackers, its fiber content provides satiety, making it a preferred option for healthy snacking due to its low glycemic index. For soups and sauces, it acts as a natural thickener and emulsion stabilizer. To understand the potential of lupin flour in the food industry and expand its uses, further research is needed. The functionality, nutrient profile, and sensory properties of lupin flour in food formulations should be evaluated considering local regulations, allergen potential, and environmental and sustainability factors. Such an evaluation requires a multidisciplinary approach involving food technology, nutrition science, and agricultural practices. This study compiles research on the applications of lupin flour in the food industry.
Keywords: Lupine, celiac, glycemic index, protein

GİRİŞ

Lupin, ya da bilinen diğer adıyla "tremoço", baklagiller ailesinden gelen ve özellikle Akdeniz çevresi ile Latin Amerika'da yaygın olan bir bitki türüdür. Tarihsel olarak gıda ve yem olarak kullanılan lupin, günümüzde sağlık ve beslenme biliminin ilgisini çekmektedir. Bu yazıda, lupin ununun beslenme ve sağlık üzerindeki etkileri, gıda endüstrisindeki potansiyel kullanım alanları ve bu kullanımların gelecekteki araştırmalara nasıl yön verebileceği ele alınmaktadır. Lupin ununun yüksek protein içeriği, diyet lifleri, düşük karbonhidrat ve glisemik indeksi gibi özellikleri, onu modern diyetler için cazip bir alternatif yapmaktadır. Kalp sağlığına faydaları, mineraller ve vitaminler bakımından zenginliği ve düşük alkaloid içeriği ile lupin, çeşitli sağlık yararlarına sahiptir. Gıda sektöründe ise, glüten içermemesi nedeniyle çölyak hastaları ve glüten hassasiyeti olanlar için ideal bir alternatif olarak karşımıza çıkmakta, ekmekten pastaya, et ürünlerinden bitki bazlı süt ve peynir alternatiflerine kadar geniş bir kullanım alanına sahiptir. Lupin ununun gıda sektöründeki uygulamalarının başarısında, tarımsal üretim süreçleri, işleme teknolojileri, tüketici kabulü ve çevresel etkiler gibi çeşitli faktörler belirleyici olmaktadır. Bu yazı, lupin ununun gıda endüstrisindeki rolünü ve potansiyelini incelemektedir.

LUPİN UNU BESİN PROFİLİ

Lupin unu, beslenme açısından oldukça zengin bir kaynak olarak kabul edilmektedir ve bu zenginlik, çeşitli önemli besin maddelerini içermesiyle dikkat çekmektedir (Duranti & Gius, 1997). Lupin ununun temel bileşenleri arasında yüksek kalitede bitkisel protein, lif, yağ ve karbonhidratlar bulunmaktadır. Bu proteinlerin özellikle amino asit profili, insan vücudu için gerekli olan temel amino asitleri içermesi bakımından önemlidir ve lysin bakımından zengin olması, protein kalitesini artırır (Kaur et al., 2020). Aynı zamanda, yüksek lif içeriği ile lupin unu, sindirim sağlığını desteklemekte ve bağırsak fonksiyonlarını düzenlemekte etkili olabilir. Lifler, sindirim sistemi için faydalıdır ve tokluk hissini artırarak kilo kontrolüne katkıda bulunabilirler.

Lupin unu, sağlıklı yağlar açısından da zengindir ve özellikle doymamış yağ asitleri (örneğin, oleik asit ve linoleik asit) bakımından yüksektir. Bu yağlar, kalp sağlığını destekleyebilir ve kardiyovasküler sağlık açısından olumlu etkiler sağlayabilir (Vilariño et al., 2019). Lupin unu, ayrıca B vitaminleri (örneğin, B1, B2, B3) ile mineraller (örneğin, demir, magnezyum, fosfor)

açısından da zengin bir kaynaktır. Bu besin ögeleri, enerji metabolizması, sinir sistemi fonksiyonları ve kemik sağlığı için önemlidir (Kourimska & Schlegel, 2017). Ancak, lupin ununun içeriğinde bulunan alkaloidler ve antinutritif faktörlerin sağlık üzerindeki etkileri daha fazla araştırma gerektirmektedir ve özellikle bu bileşenlerin alerjik potansiyelini ve güvenli tüketim koşullarını incelemek önemlidir.

LUPİN UNU GIDA SEKTÖRÜNDE KULLANIM ALANLARI

Lupin unu, gıda sektöründe geniş bir kullanım yelpazesi sunan çok yönlü bir bileşen olarak kabul edilmektedir. Bu kullanım alanları, lupin ununun besin değeri ve işlevselliği sayesinde giderek çeşitlenmektedir. İlk olarak, lupin ununun glüten içermeyen bir alternatif olarak kullanılması çölyak hastaları ve glüten hassasiyeti olanlar için büyük bir öneme sahiptir (Marti & Pagani, 2013). Ekmek, pasta, kraker gibi ürünlerin üretiminde glüten içermeyen alternatifler olarak değerlendirilir.

Et ürünlerinde, lupin ununun dolgu maddesi olarak ve yağ oranını azaltmak için kullanılması yaygındır (Jiménez-Colmenero et al., 2013). Ayrıca, tekstür ve su tutma kapasitesini artırarak et ürünlerinin kalitesini iyileştirir.

Bitki bazlı süt alternatifleri ve peynir ürünlerinde, lupin unu süt proteini yerine geçebilir ve besin değerini artırabilir (Sá et al., 2019).

Hamur işleri ürünleri, lupin unu ile yapıldığında yüksek protein içeriğine sahip besleyici alternatifler sunar ve düşük karbonhidrat içeriği sayesinde diyabetik ürünlerde de kullanılabilir (Bader Ul Ain et al., 2019).

Sporcular ve aktif yaşam tarzını benimseyenler için protein bakımından zengin enerji barları ve protein tozlarının üretiminde lupin unu tercih edilebilir (McCrory et al., 2010).

Lupin ununun kullanımı, fonksiyonel gıda bileşenleri olarak da değerlendirilebilir. Yüksek lif içeriği ve kan şekerini düzenleyici etkileri ile özellikle kalp hastalığı ve tip 2 diyabet riski taşıyan bireyler için fonksiyonel gıda bileşeni olarak kullanılabilir (Lee et al., 2006).

Bisküvi ve kek üretiminde, lupin unu buğday ununun bir kısmını veya tamamını yerine geçirebilir ve farklı tat profilleri oluşturmak için de araştırılmaktadır (Cappa et al., 2013).

Glüten içermeyen makarna üretiminde lupin unu, mükemmel bir protein kaynağı olarak ve makarnanın besin değerini artırmak için kullanılır (Rayas-Duarte et al., 1996).

Vegan ve vejetaryen beslenme trendlerinin yükselişiyle birlikte, lupin unu hayvansal kaynaklı ürünlerin yerini alabilecek protein kaynağı olarak önem kazanmıştır (Mir et al., 2019).

Atıştırmalık ürünlerde yüksek lif içeriği, sağlık yararları sunar ve düşük glisemik indeksi sayesinde sağlıklı atıştırmalık seçenekleri olarak değerlendirilir (Foschia et al., 2015).

Çorba ve sosların viskozitesini ve dokusunu iyileştirmek amacıyla lupin ununun kullanımı değerlendirilebilir (Lampart-Szczapa et al., 2003).

Tatlandırıcı ve aroma verici maddelerin taşıyıcısı olarak lupin unu kullanılabilir (Açıkgöz, 2017).

Son olarak, lupin proteinleri biyopolimer tabanlı yenilenebilir ve biyolojik olarak parçalanabilir gıda ambalajı malzemelerinin geliştirilmesinde kullanılabilir (Restuccia et al., 2010).

Bu kullanım alanları, lupin ununun gıda endüstrisindeki çeşitli potansiyelini yansıtmaktadır ve sürekli olarak genişlemektedir. Ancak, lupin ununun gıda formülasyonlarındaki fonksiyonelliği, besin profili ve duyusal özellikler üzerine yapılan araştırmaların devam etmesi gerekmektedir.

LUPİN UNU İLE ÜRÜN GELİŞTİRME VE İNOVASYON

Lupin unu, gıda endüstrisinde yeni ürünlerin geliştirilmesi ve inovasyon açısından önemli bir rol oynar. Yüksek protein içeriği, düşük glisemik indeksi ve gluten içermemesi gibi özellikleri, lupin ununu yenilikçi ürün formülasyonlarında değerli bir bileşen haline getirir.

Lupin ununun rolü, özellikle glüten intoleransı veya çölyak hastalığı gibi sağlık sorunlarına duyarlı tüketiciler için glüten içermeyen alternatif ürünlerin geliştirilmesinde vurgulanır. Araştırmalar, lupin ununun buğday unuyla yer değiştirebileceğini ve glüten içermeyen ekmekler, pastalar, krakerler gibi ürünlerin üretiminde başarılı bir şekilde kullanılabileceğini göstermektedir (Marti & Pagani, 2013).

Sürdürülebilirlik ve çevresel etkiler açısından, lupin bitkisinin azot bağlama yeteneği, toprak verimliliğini artırabilir ve kimyasal gübre kullanımını azaltabilir. Ayrıca, lupin bitkisinin az sulama gereksinimi, su kaynaklarının korunmasına katkı sağlayabilir. Bu, lupin ununun çevresel olarak daha sürdürülebilir ürünlerin geliştirilmesine katkıda bulunabileceği anlamına gelir (Adhikari et al., 2012).

Tüketici kabulü ve pazar trendleri de lupin unu ile ürün geliştirmenin önemli bir yönünü oluşturur. Özellikle bitkisel bazlı proteinlere olan talep arttıkça, lupin ununun bitkisel protein

kaynağı olarak kullanımı popülerlik kazanmıştır. Lupin unu, vegan ve vejetaryen tüketici segmentlerine yönelik ürünlerin geliştirilmesinde etkili bir çözüm sunar. Tüketici kabulü, lupin unu içeren ürünlerin tat, tekstür ve besin değeri açısından tatmin edici olmasına bağlıdır (Mir et al., 2019).

Sonuç olarak, lupin unu, yeni ürün geliştirmede ve inovasyonda önemli bir rol oynamaktadır. Bu, glüten içermeyen alternatiflerin oluşturulması, çevresel sürdürülebilirlik açısından katkı sağlama ve tüketici taleplerini karşılama açısından büyük potansiyele sahip olduğunu göstermektedir. Ancak, tüketici kabulü ve ürün kalitesi açısından daha fazla araştırma ve geliştirme çalışmasına ihtiyaç vardır.

İŞLEME VE TEKNOLOJİ

Lupin ununun işlenmesi ve gıda formülasyonlarında kullanımı, bazı teknik zorluklar ve çözümleri içerir. Bu süreçlerin başarılı bir şekilde yönetilmesi, lupin ununun ticari ürünlerde etkili bir şekilde kullanılmasını sağlar.

Lupin ununun işlenmesi, genellikle lupin tohumlarının öğütülmesi veya öğütülmesi ile başlar. Ancak, lupin tohumlarında doğal olarak bulunan antinutritif bileşenler (örneğin, alkaloidler) işleme sürecini karmaşıklaştırabilir ve ürünün tat ve kalitesini olumsuz etkileyebilir. Bu nedenle, işleme aşamasında alkaloid içeriğinin azaltılması veya nötralize edilmesi gerekebilir. Bu, lupin ununun kalite kontrolü açısından önemlidir ve bu süreçlerin gıda güvenliği açısından titiz bir şekilde yönetilmesi gerekmektedir (Lampart-Szczapa et al., 2003).

Gıda formülasyonlarındaki teknik zorluklar genellikle lupin ununun su emme kapasitesi ve tekstür özellikleriyle ilgilidir. Lupin unu, yüksek lif içeriği nedeniyle suyu emme eğilimindedir, bu da ürünlerde kıvamı ve doku özelliklerini etkileyebilir. Bu sorunun üstesinden gelmek için formülasyonlarda su miktarının ayarlanması veya uygun hidrokoloidlerin kullanılması gerekebilir. Ayrıca, lupin ununun tadı ve kokusu bazı tüketiciler için alışılmadık olabilir, bu da ürünlerin tatlandırılması veya aromalandırılması gerekebileceği anlamına gelir (Cappa et al., 2013).

Lupin ununun işlenmesi ve gıda formülasyonlarında kullanılmasıyla ilgili bu teknik zorluklar, araştırmacılar ve gıda mühendisleri tarafından sürekli olarak ele alınmaktadır. Bu, lupin ununun daha geniş bir ürün yelpazesi içinde başarılı bir şekilde kullanılabilmesi için gerekli olan gelişmelerin ve inovasyonların önünü açar.

YASAL DÜZENLEMELER VE ETİKETLEME

Lupin unu ile ilgili yasal düzenlemeler ve etiketleme konuları, gıda güvenliği ve tüketicilerin doğru bilgilendirilmesi açısından önem taşır. Bu konular, gıda endüstrisinin lupin ununu ürünlerinde kullanırken uyması gereken bazı düzenleyici gereklilikleri içerir.

Gıda güvenliği açısından, lupin bitkisi doğal olarak alkaloidler içerir ve bazı lupin türleri yüksek seviyelerde alkaloidlere sahip olabilir. Bu alkaloidler, insan sağlığına zarar verebileceğinden, lupin ununun işlenmesi sırasında alkaloid içeriğinin düşürülmesi veya uygun bir şekilde nötralize edilmesi gerekebilir. Bu nedenle, lupin unu üreticileri ve gıda işletmeleri, alkaloid düzeylerini düzenli olarak kontrol etmeli ve bu konuda ilgili düzenlemelere uymalıdır (Lampart-Szczapa et al., 2003).

Ayrıca, lupin unu içeren ürünlerin etiketlenmesi de önemlidir. Tüketicilerin ürünün içeriği hakkında doğru bilgilendirilmesi gerekir. Özellikle lupin unu, alerjik reaksiyonlara neden olabilen potansiyel bir alerjen içerebilir. Bu nedenle, lupin ununu içeren ürünlerin etiketlerinde alerjen içeriği belirtilmelidir ve bu, tüketicilerin ürünü güvenle tüketmelerini sağlar. Ayrıca, ürünün besin değeri ve kullanım talimatları da doğru bir şekilde etiketlenmelidir (Food Standards Australia New Zealand, 2017).

Lupin unu ile ilgili yasal düzenlemeler ve etiketleme konuları, gıda endüstrisi için önemli bir sorumluluk taşır ve tüketicilerin sağlık ve güvenliği açısından büyük bir öneme sahiptir. Bu düzenlemelere ve etiketleme gerekliliklerine uyulması, lupin ununu içeren ürünlerin güvenli ve doğru bir şekilde piyasaya sürülmesini sağlar.

SONUÇ VE GELECEK PERSPEKTİFLERİ

Lupin unu, gıda sektöründe önemli bir potansiyele sahip bir bileşen olarak değerlendirilmektedir. Gelecekteki gıda sektöründeki rolü, bir dizi faktör tarafından şekillendirilecektir. (Sá et al., 2019). Özellikle bitkisel bazlı proteinlere olan talebin artması, lupin ununun pazar payını genişletebilir. Lupin ununun glüten içermemesi, çölyak hastaları ve glüten hassasiyeti olan tüketiciler için cazip bir alternatif oluştururken, yüksek lif içeriği ve düşük glisemik indeksi, sağlıklı beslenme trendlerini desteklemesi açısından önemlidir. Ayrıca, lupin bitkisinin sürdürülebilir tarım uygulamaları için uygunluğu, çevresel etkiyi azaltma amacıyla gıda endüstrisinde daha fazla dikkate alınabilir. Gelecekteki kullanım alanları arasında bitkisel süt alternatifleri, et ürünleri, fonksiyonel gıdalar, atıştırmalıklar, vejetaryen ve

vegan ürünler, gıda ambalajı ve daha fazlası bulunabilir. (Mir et al., 2019). Potansiyel araştırma alanları ve gelişim yönleri açısından, lupin unu ile ilgili daha fazla çalışmaya ihtiyaç vardır. (Adhikari et al., 2012 Özellikle alkaloid içeriği, işleme teknikleri, tat ve dokusu iyileştirme stratejileri ve tüketici kabulü gibi konular üzerinde daha fazla araştırma yapılmalıdır. Lupin bitkisi çeşitliliği ve yetiştirme koşulları da incelenmelidir, çünkü bu faktörler lupin ununun kalitesini etkileyebilir. (Sá et al., 2019). Ayrıca, lupin ununun sağlık yararları ve besin profili üzerine daha fazla çalışma yapılmalıdır, bu da tüketicilere doğru bilgi sunma açısından önemlidir. (Mir et al., 2019).

Sonuç olarak, lupin unu gıda sektöründe önemli bir bileşen olarak değerlendirilmekte ve gelecekteki kullanım alanlarında büyük potansiyele sahip olabilir. Ancak, bu potansiyeli tam olarak değerlendirebilmek için daha fazla araştırma ve geliştirme çalışmalarına ihtiyaç vardır.

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FARKLI ORTAMLARDA AYVA ODUN ÇELİKLERİNİN KÖKLENDİRİLMESİ

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ÖZET
Ülkemizin üretim miktarı bakımından dünyada lider olduğu ayva türünün önemi gün geçtikçe artmaktadır. Gerek ülkemizde gerekse dünyada son yıllarda meydana gelen talep artışı ayva üretim alanlarını artırmaktadır. Ilıman iklim meyvesi olan ayvaların generatif olarak çoğaltımı oldukça kolaydır, fakat çeşitlerin kendi özelliklerini koruyabilmesi için vejetatif çoğaltım gereklidir. Ayvaların odun çelikleri, yarı-odun çelikleri, yumuşak odun çelikleri ve doku kültürü gibi yöntemlerle çoğaltımı olasıdır. Ancak odun çelikleriyle çoğaltma yöntemi diğer yöntemlere nazaran daha ekonomik ve daha basit bir yoldur. Bu çalışma 2023 yılında farklı köklendirme ortamlarında (torf, perlit, cüruf, leonardit, bahçe toprağı ve Torf+perlit+cüruf+leonardit+bahçe toprağı karışımı) Ege 22 ayva odun çeliklerinin köklenme durumlarını tespit etmek amacı ile 3 tekerrürlü ve her tekerrürde 5 odun çeliği olacak şekilde yapılmıştır. Elde edilen verilere göre, köklenme yüzdeleri köklendirme ortamlarına göre farklılıklar göstermiştir. Yapılan istatistiksel analizler sonucunda leonardit köklendirme ortamında en iyi sonuç elde edilmiştir.
Anahtar Kelimeler: Ayva, çelik, köklendirme ortamı, çoğaltma

QUINCE WOOD CUTTINGS IN DIFFERENT ENVIRONMENTS ROOTING

ABSTRACT
The importance of the quince species, of which our country is the world leader in terms of production amount, is increasing day by day. The increase in demand both in our country and in the world in recent years has increased the quince production areas. Quince, which is a temperate climate fruit, is quite easy to propagate generatively, but vegetative propagation is required for the varieties to maintain their own characteristics. It is possible to propagate quince by methods such as wood cuttings, semi-wood cuttings, softwood cuttings and tissue culture. However, the propagation method with wood cuttings is a more economical and simpler method compared to other methods. This study was conducted in 2023 with the aim of determining the rooting status of Aegean 22 quince wood cuttings in different rooting environments (peat, perlite, slag, leonardite, garden soil and peat + perlite + slag + leonardite + garden soil mixture) with 3 replications and 5 wood cuttings in each repetition. It was made to be. According to the data obtained, rooting percentages differed depending on the rooting media. As a result of the statistical analysis, the best results were obtained in Leonardite rooting medium.
Keywords: Quince, cutting, rooting medium, propagation.

1. INTRODUCTION

Quince is one of the fruits that has been known for a long time and has a historical past. Quince belongs to the *Cydonia* genus of the *Rosales* order, *Rosaceae* family, *Pomoideae* subfamily (Çetin and Soylu, 2006; Bel et al., 2011). It is reported that quince, one of the oldest fruits known to mankind, passed from Anatolia to Greece and Rome in the years before Christ, and was cultivated in Greece in the 650s, and that its passage to North America probably coincided with the beginning of the 18th century (Gökçe, 2019).). Although the exact center of origin is not known, Iran, Turkmenistan, and further west, Anatolia and Greece are possible regions (Bailey, 1963; Sykes 1972). Quince is grown in other continents and countries around the world, except Australia. This fruit type has not become widespread compared to other cultivated fruit types and its production has remained limited (Özçağıran et al., 2014).

Quince is rich in phenolics and antioxidants that promote human health (Silva et al., 2004), and is an important source of mineral substances such as potassium, phosphorus and calcium, vitamins, organic acids and sugars (Fattouch et al., 2007; Rodriguez-Guisado et al., 2009). In addition to the antioxidants and phenolic compounds contained in quince (Legua et al., 2013; Grygorieva et al., 2020), it is anti-carcinogenic (Carvalho et al., 2010), anti-inflammatory (Essafi-Benkhadir et al., 2012), is interesting due to its anti-ulcerative (Hamauzu et al., 2006), anti-allergic, anti-microbial (Shaida et al., 2020) and hypoglycemic (Szychowski et al., 2014) properties. It has a protective and preventive effect against many diseases (Sharma et al., 2011; Wojdylo et al., 2013).

Fast and cheap propagation methods are very important in the development of the cultivation of a species. Generative propagation of quinces is quite easy, but vegetative propagation is mandatory for the varieties to maintain their own characteristics (Rumpunen, 2002). It has long been known that a plant obtained from the seed of any variety does not have the same characteristics as the parent plant and usually bears fruit later (Roach, 1988). On the other hand, mutation etc. Unless changes occur, young plants obtained by asexual propagation exhibit all the same characteristics of the parent plant from which the propagation material was taken. It is possible to propagate quince by methods such as wood cuttings, semi-wood cuttings,

softwood cuttings and tissue culture. However, the propagation method with wood cuttings is a more economical and simpler method compared to other methods (Tsipouridis et al., 2005).

There are not as many cultivars in quince as in its close relatives, apples and pears. The reason for this is that the selection and breeding of new varieties is not emphasized because the culture has not gained importance, and also because there are not many hybrids in this self-pollinating variety, there is little chance of the emergence of new varieties naturally. In addition, the use of vegetative propagation (cuttings, bottom shoots) method since ancient times has been effective due to the low number of varieties (Gencer, 2011).

This study was carried out in 2023 to determine the rooting status of Aegean 22 Quince wood cuttings in different rooting environments (peat, perlite, slag, leonardite, garden soil and peat + perlite + slag + leonardite + garden soil mixture).

2. MATERIALS and METHODS

2.1. Materiel

The plant material to be used in the study is Aegean 22 Quince wood cuttings. Rooting media are peat, perlite, slag, leonardite, garden soil and a mixture of peat + perlite + slag + leonardite + garden soil.

2.2. Method

When taking cuttings, one-year-old, smooth, disease-free and lignified shoots should be taken from the middle parts; Care was taken to ensure that the steel length was between 20-25 cm. While preparing the cuttings, care was taken not to damage the leaves and especially the eyes. Then, plant growth regulator (IBA) was applied. The cuttings were then planted in rooting media (peat, perlite, slag, leonardite, garden soil and peat+perlite+slag+leonardite+garden soil) at a depth of 8-10 cm on 15.03.2023. In each rooting medium, 3 replicates and 5 cuttings in each repetition were used, for a total of 90 cuttings. Moisture control was carried out on the cuttings regularly and operations such as watering and weed control were carried out when

necessary. Cuttings were taken from the environment at the end of May; Rooting rate (%), root length (cm), root diameter (mm) were measured.



Figure 1. Quince cuttings planted in rooting media

3. FINDINGS and DISCUSSION

Rooting characteristics of wood cuttings in the study are shown in Table 3.1. is also stated.

Table 3.1. Average values of rooting properties of Quince cuttings according to rooting media

Rooting Media	**Rooting rate (%)**	**Root length (cm)**	**Root diameter (mm)**
Peat	40	1,03	0,45
Perlite	49	1,07	0,45
Slag	30	0,45	0,30
Leonardite	58	1,55	0,75
Garden soil	40	1,01	0,37
Peat+perlite+slag+leonardite+garden soil	35	0,97	0,35

In the experiment, the average rooting percentage of Aegean 22 quince variety was 58% in Leonardite rooting medium. Rooting percentages differed according to the environments, and these differences were found to be statistically significant.

Tsipouridis et al. (2005) reported that there were great differences in terms of rooting ability in cuttings of species and varieties within these species. Hepaksoy and Ünal (1995) determined that the rooting percentages of wood cuttings of 7 quince varieties (Kirli, Limon, Ören, Söbü, Şeker Gevrek, Turgutlu, Ayva A) differed according to the varieties. In the study conducted by Ersin (2011), Ege-2 was found to have a rooting rate of 64%, followed by Ege-22 (40%) and Eşme (25%) varieties, respectively. The findings obtained in the experiment are in accordance with the literature results.

4. CONCLUSION

The best rooting rate of 58% of the wood cuttings of the Aegean 22 quince variety included in the experiment in different rooting environments was achieved in Leonardit rooting medium. In order to increase the rooting percentage, different methods can be tried in future studies. As a matter of fact, rooting of cuttings depends on the age of the plant from which the cutting is taken, IBA, etc. It is affected by many factors such as concentration of chemicals, cutting time, cutting length, rooting environment and temperature.

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MAHLEP MEYVESİNİN ÖNEMİ VE YAPILAN ÇALIŞMALAR

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ÖZET
Mahlep (*P. mahaleb* L.) önemli ancak az bilinen meyve türlerinden birisidir. Orta ve Güney Avrupa, İran ve Orta Asya'nın bazı kesimlerinde doğal olarak yayılım göstermektedir. Türkiye'de Tokat, Çorum, Amasya ve Giresun başta olmak üzere Kuzey Anadolu'da yetiştiriciliği yaygındır. İç Anadolu, Ege Bölgelerinde de dağılım gösterir. İdris olarak da adlandırılan türün kara ve sarı mahlep olmak üzere iki tipi bulunmaktadır. Kiraza benzeyen oldukça küçük, aromalı meyveleri vardır. Doğada kuşlarında severek tükettiği bir meyvedir. Haziran ayında olgunlaşır. Sarı mahlebin meyveleri olgunlaştığı zaman kırmızı renkte, kara mahlebin meyveleri ise çok koyu kırmızı-siyah renktedir. Meyveler daldan sıyrılarak veya tam olgun dönemde dal silkelenerek yapılabilir. Daldan sıyırarak toplama işlemi bir sonraki yılın ürününü olumsuz etkilemektedir. Daha çok tohumları ile çoğaltılmaktadır. Kiraz ve vişnenin önemli bir anacıdır. Kiraz ağaçlarında yarı bodurluk sağlar, ancak aşı uyuşmazlığı problem olabilmektedir. Meyveleri likör ve alkollü içecek yapılır. Tohumları pasta yapımında aroma verici olarak kullanılmaktadır. Geleneksel tıpta önemli bir meyve türüdür. İdrar söktürücü, balgam söktürücü özellikleri vardır. Nişasta içeriği düşüktür ve antidiyabetik olarak değerlendirilebilir. Çeşitli toprak tiplerine uyum sağlayabilir, kuraklığa oldukça dayanıklıdır. Ağaçları genel olarak soğuklara dayanıklıdır. Tohumlarının çimlenmesi, çoğaltılması, besin içeriği, sağlık açısından faydaları, klon anaçlarının seleksiyonu ve çoğaltılması konularında mahlep üzerine birçok çalışma yürütülmüştür. Mahlep çekirdeği fenolik bileşiklerce zengindir. Esansiyel yağ asitlerinden linoleik asit en fazla bulunmaktadır. İnsan sağlığında lösemi hastalığına karşı etken madde olarak değer taşımaktadır. Mineral maddelerden kalsiyum ve magnezyum bakımından oldukça zengin bir tohumu vardır. Zaman zaman dış ticarette de değeri artan mahlep ihraç edilen ürünler arasında yer bulmuştur. Bu çalışmada mahlep konusunda yürütülen çalışmalar derlenmiştir.
Anahtar Kelimeler: *P. mahaleb* L., meyve, çoğaltma, besin içeriği, seleksiyon

THE IMPORTANCE OF MAHALEB CHERRY AND RESEARCH ON IT

ABSTRACT
Mahlep (*P. mahaleb* L.) is one of the important but little-known fruit species. It spreads naturally in Central and Southern Europe, Iran, and some parts of Central Asia. In Turkey, its cultivation is widespread in Northern Anatolia, especially in the cities of Tokat, Çorum, Amasya and Giresun. It is also distributed in Central Anatolia and Aegean Regions. The species, also named as idris that has two different types: black mahlab and yellow mahlab. It has very small, aromatic fruits that resemble cherries. It is a fruit that birds enjoy consuming in nature. It ripens in June. The fruits of yellow mahlab are red when ripe, while the fruits of black idris are very dark red-black. Fruits can be made by stripping them from the branch or by shaking the branch when they are fully ripe. Harvesting by scraping negatively affects the next year's crop. It is mostly propagated by seeds. It is an important rootstock of cherry and sour cherry. It provides semi-dwarfing in cherry trees, but graft incompatibility may be a problem. Its fruits are made into liqueurs and alcoholic beverages. Its seeds are used as flavoring in cake making. It is an important type of fruit in traditional medicine. It has diuretic and expectorant properties. It has low starch content and can be considered antidiabetic. It can adapt to various soil types and is quite resistant to drought. Trees are generally resistant to cold. Many studies have been carried out on mahaleb regarding the germination and propagation of its seeds, nutritional content, health benefits, selection and propagation of clone rootstocks. Mahaleb seed is rich in phenolic compounds. Among the essential fatty acids, linoleic acid is the most abundant. It has value in human health as an active ingredient against leukemia. It has a seed that is very rich in mineral substances calcium and magnesium. Mahaleb, whose value has increased in foreign trade from time to time, has found a place among the exported products. In this study, studies on mahaleb have been compiled.
Keywords: *P. mahaleb* L., fruit, propagation, nutrition composition, selection

1.GİRİŞ

Prunus mahaleb L. (*Cerasus mahalep* (L.) Miller) mahlep bitkisi, ekonomik önemi olan, meyve türleri bakımından zengin, *Rosacea* familyasında yer alan, 8- 10 m' ye kadar boylanabilen ve kışın yaprağını döken bir meyve türüdür (Baytop, 1997). Bir ağaçtan ortalama olarak 20–50 kg meyve alınabilmektedir. Anavatanı, Avrupa ve Batı Asya'dır. Güney Avrupa, Fransa, Güney Almanya, Kuzey Asya, Kafkasya ve Türkistan içlerine kadar uzanan oldukça geniş bir sahada doğal olarak yayılmıştır. Türkiye'de birçok yerde mahlep ağaçlarına rastlanmaktadır. Türkiye florasında Kuzey, Doğu ve Güneydoğu Anadolu Bölgelerinde yayılım göstermektedir (Boydağ, 1996). Önceleri Kuzey Anadolu Bölgesinde sınır bitkisi olarak yetiştirilen mahlep, iç tüketiminin artması, ihracat olanaklarının gelişmesi ile kapama bahçeleri kurulan bir meyve durumuna gelmiştir. Tokat, Mardin, Çorum, Amasya, Ordu, Erzurum, Uşak ve Van gibi çok farklı illerimizde yetiştiriciliği yapılmaktadır (İlisulu, 1992; Mataracı, 1997). Türkiye'nin yıllık iç mahlep tüketimi 5 ton, üretim değerleri ise 400 ton civarındadır (Meraler, 2010). En yaygın olarak mahlep ya da idris isimleriyle bilinen tür, ülkemizde meltem, acı melem, enderes gibi isimlerle de tanınmaktadır (Yeşiloğlu, 2005). Sarı meyveli ve kara meyveli genotipleri bulunmaktadır (Özbek, 1978; Çelik, 1983, Gerçekçioğlu ve Güneş, 1992).

2. İKLİM VE TOPRAK İSTEKLERİ

Mahlep bir ılıman iklim meyvesidir. Sert, soğuk ve kısmen kurak iklimlere dayanımı iyidir. Kış dinlenme devresinde gövde -25 C°'ye kadar dayanabilir. Açmış çiçekleri ise -3 C°' ye kadar dayanabilir. 2ila 4 C°' de 90–120 gün dinlenme ihtiyacı vardır. Ilıman iklim meyveleri arasında kış dinlenme isteği bakımından orta sıralarda yer alır. Şiddetli kış soğukları tomurcuk ve genç dalların soğuktan zarar görmelerine, gövde ve dallarda çatal kısımlarda kabuğun çatlamasına neden olabilir. Buralarda yaralar meydana gelir. Bu nedenle kışın hava sıcaklığının -20 C°'nin altına sık sık düştüğü yerler mahlep için uygun değildir. Çiçeklenmeye yakın dönemdeki yağışlar, döllenmeye engel olduğundan ve olgunlaşmaya yakın dönemdeki yağışlarda meyve çatlamasına neden olduğundan bu dönemdeki yağışlar zararlıdır (WEB1)

Mahlep anacı soğuk ve kurak iklime karşı tolerans gösterebilen, toprak bakımından fazla seçici olmayan bir türdür (Bean, 1981; Perry, 1987; Gerçekçioğlu ve Çekiç, 1999). Kireçli, taşlı, çakıllı, kayalık topraklara uyum sağlayabilmektedir (Özbek, 1978). Ağır bünyeli, su tutan topraklarda ve taban suyunun yüksek olduğu yerlerde kök çürüklüğü sorun oluşturabilmektedir. Sulama suyunun kısıtlı olduğu yerlerde anaç olarak önerilmektedir (Revin, 1990; Huxley 1992).

Böyle yerlerde sık sık kök çürüklüğü hastalığına yakalanır. Türkiye'de genelde dağ yamaçlarında, kalkerli arazilerde rastlanır. Son zamanlarda orman-step sınırlarındaki kurak yerlerin ağaçlandırılmasında iyi sonuç elde edilmiştir (Öner ve Uysal 2005).

3. MAHLEBİN BOTANİK ÖZELLİKLERİ

Ağacı boylu çalı veya 10 m' ye kadar boylanan dağınık ve geniş tepeli bir ağaçtır. Genç sürgünler ince, çıplak veya kısa tüyler ile örtülmüştür. Kök sistemi yarı kazık köklüdür (WEB2). Ağacın kabuğu gri-kahverengidir, üzerinde reçine benzeri salgılar vardır. Yaşlı gövdelerde çatlaklar oluşur. Oval ila kordat arası, tüysüz ve yeşil renkli, sivri uçlu, tırtıklı kenarlara sahip yaprakları 1,5–5 santimetre uzunluğunda, 1–4 cm genişliğinde, alternatif dizilişlidir. Yaprak sapı 5-20 milimetre uzunluğundadır ve iki adet siğilli olabilir. Yaprakları kışın dökülür. Mahlebin yaprak tomurcukları çiçek tomurcuklarından önce uyanmaktadır. Fakat odun tomurcuklarının uyanmadan sonraki gelişimi, çiçek tomurcuklarının gelişimine göre daha yavaş olmasından dolayı çiçeklenme daha baskın şekilde görülmüştür. Çiçeklenme ilkbaharın ortasında gerçekleşir. Tam çiçeklenme döneminde kalma süresi ise genotipler arasında farklılık göstererek 2 ile 7 gün arasında değişmiş ve ortalama 5 gün olarak belirlenmiştir (Guitian, 1993; Guitian, 1994; WEB3). Çiçekler kokulu, saf beyaz, küçük, 8-20 mm çapında, 8-15 mm saplıdır; 3-4 cm uzunluğunda bir salkım üzerinde 3-10 adet birlikte dizilmiştir, salkım şekli rasemözdür (Rushforth, 1999; WEB4). Çiçeklerin tozlaşması esas olarak arılar tarafından gerçekleştirilir.

İspanyanın mahlep popülasyonlarında *Prunus mahaleb*'in döllenme biyolojisi incelendiğinde; incelenen bireylerde dişi çiçekler ve karma bireyler belirlenmiştir. Gynodiocious bitkilerin %55,4'ü erkek verimlidir ve %44,6'sı işlevsiz, polensiz küçülmüş anterleri bulunmaktadır ve işlevsel dişi gibi davranmaktadır. Kontrol, kendi kendine üreme ve melezlemede ortalama meyve tutumu, erkek verimli ağaçlar için sırasıyla %29,05, %41,9 ve %38,6; erkek kısırlar için olanlar sırasıyla %25,3, %0 ve %39,2 olmuştur (Jordano, 2008).

Meyvesi, 8-10 mm çapında, küçük, ince etli, kiraz benzeri sert çekirdekli bir meyvedir. İlk geliştiğinde yeşildir, olgunlaştığında kırmızıya ve olgunlaşma ilerledikçe siyaha yakın kırmızı renge döner. Meyveler Temmuz-Ağustos gibi olgunlaşır (Blamey, 1989). Meyveler uzun sapları nedeniyle salkım gibi görünür. Meyvesi kokulu, buruk ve acımsı bir tada sahiptir. Meyveleri sulu ve tek çekirdeklidir. Ağaç başına verim 15 kg civarındadır. Mahlep tohumu çok küçük, yumurta şeklinde ve sivri uçludur. Krem renkli, kabuk yumuşaktır (WEB5, WEB6).

4. ÇOĞALTILMASI:

Tohumlarının çimlenmesi yavaştır, bazen 18 ay kadar sürebilmektedir (Dirr ve Heuser, 1987). Mahlep tohumlarında in vivo koşullarda yapılan laboratuvar deneylerinde en yüksek çimlenme oranı (% 93.33), 1000 ppm GA_3 solüsyonunda 24 saat süre ile tutulan, ardından, 12 hafta süre ile katlamada bırakılan kabuksuz tohumlardan sağlanmıştır. Soğuk ve sıcak ortamlarda kuru olarak muhafaza edilen tohumlar aynı süre zarfında çimlenmemiştir. GA_3 uygulamaları çıplak tohumlardaki dinlenmeyi kırmış, 200, 500 ve 1000 ppm GA_3 uygulanan kabuksuz tohumlar katlamanın daha başında çimlenme göstermiştir. Aynı doz GA_3 uygulanan kabuklu tohumlarda ise 2 ay süre katlama sonucunda çimlenme görülmüştür (Gerçekçioğlu ve Çekiç, 1999).

Temmuz-Ağustos aylarında yarı odun çelikleri, ilkbahar-erken yaz döneminde ise kuvvetli ve sağlıklı gelişme gösteren bitkilerinden yeşil çelikleri ile çoğaltılabilmektedir (Dirr ve Heuser, 1987). Mahlep yeşil uç çelikleri % 95-100 nem seviyesinde, 2500 ppm ve 3500 ppm IBA doz uygulamalarından (% 100 köklenme göstermiştir (Kalyoncu ve ark., 2008).

5. BESİN MADDESİ İÇERİĞİ VE BESİN OLARAK KULLANIMI

Mahlep çekirdekleri protein ve yağ bakımından zengindir (Aydın ve ark., 2002). Beyaz mahlep tohumunun bileşimi %6.2 nem, %30.9 yağ, %28 protein, %2.1 kül, %18.7 lif ve %14.1 karbonhidratlardan oluşmaktadır (Mariod ve ark. 2009). Mahlep tohumunda amino asitlerin %50.9'unu esansiyel aminoasitler oluşturmaktadır. Mahlep tohumlarının ana yağ asidi konjuge linoleik asittir (%39.76). İçeriğinde bulunan diğer önemli yağ asitleri oleik asit (%31,33) ve linoleik asit (%23,01)'tir. Ayrıca palmitik asit ve stearik asit, araşidonik asit gibi bazı doymuş yağ asitlerini de içermektedir (Ercişli ve Orhan, 2008; Oral, 2014). Mahlepte başlıca şeker glikoz ve fruktozdur. Mahlep tohumu ve çekirdeksiz meyveleri kumarinler, dihidro-o-kumarik asit 2-O-glukozit ve o-kumarik asit 2-O-glukozit içermektedir. Kumarin serbest formda veya glikozla birleşmiş olarak bulunur, hoş kokulu aromatik bir maddedir (Ieri ve ark. 2012). Tartarik asit ve Askorbik asit içeriği bakımından zengindir. Fenolik madde içeriği nedeniyle antioksidan deposudur. Doğal bir gıda renklendiricisi olarak kullanılabilecek özelliktedir (Gerardi ve ark., 2016). Mahlebin yenebilme durumu 5 üzerinden 3 puan almış, sağlık açısından değerlendirildiğinde 1 puan, diğer kullanım nitelikleri bakımından ise 2 puan almıştır (WEB7). Mahlebin tohumları badem-kiraz arasında aroma tadı ile çok küçük miktarlarda bile fırıncılık sektöründe lezzet verici olarak kullanılmaktadır. Mahlep meyvelerinde fenolikleri ve flavonoidleri 200 g kuru meyvede 2.3 mg gallik asit, 946,6 mg kateşin oluşturmaktadır.

Meyvenin toplam antosiyanin içeriği ise 505,7 mg/100 g kuru madde olarak belirlenmiştir (Öztürk ve ark. 2014; Oral 2014).

Mahlep meyvelerinin ekstraktlarının antosiyanin, flavanol ve kumarin içeriğinin çok yüksek olmasına bağlı, güçlü bir antioksidan kapasitesinin olmasından dolayı meyve ekstraktlarının yeni doğal bir gıda renklendiricisi olarak ilgi çekici olabileceği, taze meyve olarak tüketiminden öte, bu zengin biyolojik aktiviteye sahip fenolik bileşiklerin kaynağı olarak kullanılabilecek konsantre bir meyve özütü elde etmek için işlenebileceğini göstermiştir. Bunun için elde edilen ürünlerin stabilitesi ve fonksiyonel özellikleri üzerine daha fazla çalışmaya ihtiyaç bulunmaktadır (Gerardi ve ark 2016). Yüksek antioksidan kapasitesine sahip mahlep püresi meyve barları ve cipslerin içeriğinde kullanılabilecek hammadde niteliktedir (Türker ve İşleroğlu, 2017). Mahlep püresi şarap üretiminde kullanılmaktadır (Özbey ve ark., 2011; Ieri ve ark. 2012).). Kurutulup toz haline getirilen meyveleri baharat olarak kullanılır. Özellikle kurabiyelere, muhallebilere, çöreklere ve tüm hamurlu yiyeceklere katılarak kullanılabilir. Yöresel olarak Tokat'ta meyve tohumlarından mahlep ezmesi veya püresi yapılarak tüketime sunulmaktadır (WEB 8)

Mahlepten %18'lik alkol oranı ile vermut sınıfına giren likör şarabı niteliğinde aromalı şaraplar üretilmektedir. Arılar tarafından bal yapımında da önemlidir. Gaz spektrofotometresi ve kütle spektrofotometresi ile mahlep bal örnekleri analiz edilmiştir (Jerković ve ark., 2011).

6. MAHLEBİN SAĞLIK AÇISINDAN ÖNEMİ VE KULLANIMI

Mahlep farklı kısımları geleneksel tıpta böbrek ve gaz sancılarının giderilmesinde, karaciğer hastalıklarında ve antidiyabetik olarak kullanılabilmektedir. Mahlep meyvelerinde antosiyanin, kaumarik asit ve flavonollerin de aralarında bulunduğu zengin fenolik içermesi hastlaıklara karşı önemini de artırmaktadır (Gerardi ve ark., 2016). Antosiyanin değeri maviyemişlerden ve kuş üzümünden daha yüksek olup, süper antioksidan özelliği olan bir meyve olarak tanımlanabilir (Aydin et al., 2002; Blando, 2016). Astım ve nefes darlığı, kalp rahatsızlıkları, sinir sistemi rahatsızlıkları, kanser gibi hastalıkların etkilerini azaltıcı veya önleyici etki gösterebilmektedir. İçeriğinde bulunan oleik asit meme kanserine karşı kullanılacak temel bileşen yağı olarak öne çıkar (Tsuda, 2012).). Düşük şeker içeriği antidiyabetik olarak etkilidir, zamkı öksürük kesici ve bağırsak sorunlarını iyileştirici, prostat üzerinde etki yapabilmektedir (Özbey, 2011).

7. ANAÇ OLARAK KULLANIMI

Mahlep aynı zamanda önemli bir kiraz anacıdır, ülkemizde kiraz yetiştiriciliğinde yaygın olarak kullanılmaktadır. Yamaç arazilerde, eğimli arazilerde kiraz için iyi bir anaçtır (Edizer, 1994). Mahlep anaçları, kuş kirazına göre daha yarıya yakın oranda küçük ağaçlar oluşturmaktadır (Özbek, 1978; Çelik, 1983; Rom ve ark., 1987). Mahlebin seleksiyonla elde edilen birçok klon anaç bulunmaktadır. Mahlep anaçları ve mahlepten elde edilen SL-64 klon anacı sulu şartlarda kendisini çok daha iyi geliştirebilmekte, aşırı su kısıtı uygulandığında ise tamamen kuruyabilmektedir. Öte yandan yine mahlep anaçlarından klonal olarak üretilen 60TM30 klon anaç adayı aşırı su kısıtı uygulandığında canlılığını koruyabilmiş ve ümit var mahlep klon anacı" olarak seçilmiştir (Özyurt ve Akça, 2017). Macaristan'da yürütülen çalışmalarda Bogdány, Egervár ve Magyar olmak üzere üç anaç tescil edilmiş ve patentlenmiştir. Bunların en büyük avantajları, tekdüze gelişim göstermeleridir. Anaçlardan Bogdány kuvvetlidir (%95-110), Egervár (%80-85) ve Magyar (%75-80) orta derecede kuvvetli anaçlardır. Magyar ağaç başına verim açısından en verimli anaç olarak belirlenmiştir (Hrotkó ve Magyar, 2004). Magyar ve Bogdány anaçları üzerine kirazlar spindle bahçe sisteminde 1250 ağaç/ha yoğun dikimlere daha uygun olmuştur (Hrotkó ve ark., 2023).

8. MAHLEBİN ENDÜSTRİ ALANINDA KULLANIMI

Mahlebin farklı kısımları boya ve kozmetik endüstrisinde kullanılabilmektedir. Mahlep tohumlarından elde edilen yağın, önemli kimyasal özellikleri sebebiyle boya sanayinde geniş kullanım alanı bulunmaktadır. Mahlep tohumlarından elde edilen yağ cila ve vernik üretiminde oldukça değerlidir. Bu yağ, suya dayanıklı olması sebebiyle gemi boyaları ve vernik imalatında önemli bir yere sahiptir (Aydin ve ark., 2002). Mahlep tohumları kozmetik sanayinde ince toz haline getirilerek renklendirmede kullanılır. Dinlendirici ve ferahlatıcı özelliğinden dolayı ilaç sanayinde bazı toniklerin, tabletlerin ve antibiyotiklerin üretimine katılır. Çekirdeğinin içindeki beyaz kısım ise aspirinin bileşenlerindendir. Odunu sert ve damarlı yapısı ile değerli bir mobilya ağacıdır. Kumarin içeren hoş kokulu kabuklarından dolayı ağacından sigara ağızlığı ve baston yapılmaktadır (Yaltırık ve Efe, 2000).

9. MAHLEPDE YAPILAN BAZI ÇALIŞMALAR

Mahlep popülasyonlarının fenolojik ve pomolojik özellikleri çalışılmıştır. Türkiye'nin farklı yörelerinden seçilmiş genotipler Ege Üniversitesi Ziraat Fakültesi'nde incelenmiş, fenolojik ve pomolojik olarak popülasyondaki varyasyon ortaya konmuştur (Eroğul ve Hepaksoy, 2013).

Tokat ekolojisinden alınan mahlep tohumlarının tohum yağının kimyasal bileşimi gaz kromatografisi-kütle spektrometresi ile analiz edilmiştir. Sonuç olarak tohum yağlarının ağırlıklı olarak %35,8 oleik asit, %24,9 metillinoleat, %22,6 linolelaidik asit, %5,6 palmitik asit, %3,0 α-linoleik asit, %2,2 stearik asit ve %1,3 linoleik asit içerdiğini göstermişti. Mahlep tohumunun soğuk preslenmesi ve ardından elde edilen yağın gıda ve fonksiyonel gıda uygulamalarına yönelik olarak kullanımının ortaya konmasının amaçlandığı bir çalışma yürütülmüştür. Çalışmada uçucu aroma bileşikleri profili ortaya çıkarılmıştır. Yağın kristalleşme ve erime sıcaklıkları sırasıyla -44,45 °C ve -8,41 °C olarak belirlenmiştir. Genel olarak mahlep tohumu yağı, konjuge linolenik, oleik ve linoleik yağ asitleri, β-sitosterol ve γ-tokoferol açısından zengin, çok aromatik ve tüketicilerin beğendiği bir yağ örneği olmuştur. Çeşitli gıda uygulamaları ile ileri çalışmalar öngörülmektedir (Yılmaz ve Karataş, 2023).

Bir diğer çalışmada mahlep tohumlarının sulu ekstrakt çözeltisi basit ve güvenli bir yöntem kullanılarak hazırlanmıştır. Sonrasında bu çözeltinin karbon çeliğinin çözünmesini önlemek için çevreci (yeşil) korozyon önleyici olarak hareket etme potansiyeli iki farklı konsantre asit ile test edilmiştir. Çalışma sonucunda H2SO4'e (%86) kıyasla H3PO4'ün (%89) inhibisyon etkinliğinde hafif bir artış sağlanmış; mahlep ekstraktı çözeltisinin bir koruma mekanizması olarak rolü tartışılmıştır (Ganash, 2019).

Mahlep ekstraktlarının patojenlere ve patojen olmayan bakteri türlerine karşı etkileri incelenmiştir. Çalışmada, mahlep meyvelerinin antibakteriyel aktivitesinin gözlenmediğini, ancak tohumlarının tüm bakterilere karşı antibakteriyel aktivite gösterdiği belirlenmiştir (.

10. SONUÇ

Mahlep kullanım alanlarının çeşitliliği ve sağlık açısından yarayışlılığı ile dikkat çekmesi gereken bir meyvedir. Küresel ısınma ve iklim değişikliği nedeniyle yetiştiriciliği devam eden meyvelerin yaşam döngülerinin kısıtlanması ve zorlaşması alternatif meyve arayışlarını artırmaktadır. Günümüzde sağlıklı beslenme ve doğal besinler, yaşam kalitesini artırıcı katkı maddeler talep edilmektedir. Antioksidan deposu ve sağlıklı katkı ürünü olarak mahlep ve mahlep ürünleri üzerinde durulması gereken ürünlerdir. Bu nedenle yetiştiriciliğinin geliştirilmesi, üretiminin desteklenmesi gereklidir.

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A FRAMEWORK FOR ASSESSMENT OF BIOLOGICAL NITROGEN FIXATION (BNF) SERVICES BY RHIZOBIUM BACTERIA IN AGROECOSYSTEMS (BNF-MEA FRAMEWORK)

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ABSTRACT
Biological nitrogen fixation (BNF) provides many functional benefits for agroecosystems. In this study, we investigated BNF services by Rhizobium bacteria in agroecosystems and developed a new framework for BNF services based on the modified MEA (Millennium Ecosystem Assessment). In the new framework (BNF-MEA), all services, roles and benefits related to BNF in agroecosystems were collected and classified. Data collated from around the world indicate that BNF can play role in provision of 31 services/benefits as direct and indirect. Based on BNF-MEA framework, services, goods and benefits divided into 4 sections. In the BNF-MEA framework, we added new indicators to structure such as forage production, healthy food, soil nitrogen amount, global carbon cycle, earthworms abundance, global nitrogen cycle, soil health, photosynthesis, soil microbial activates, intercropping, soil biodiversity, carbon sequestration, greenhouse gases emission, cover crop effect and fixation of atmospheric nitrogen. These changes were based on the current conditions in the legumes agroecosystems.
Keywords: Agroecosystems, BNF-MEA framework, Ecosystem services, Legume.

1. INTRODUCTION

The definition of ecosystem services is "the circumstances and mechanisms by which naturally occurring ecosystems and the species that comprise their composition ensure the continuation of human life and satisfy his needs" (Daily 1997). Generally speaking, they fall into four general structures (MEA, 2005), provisioning services, such as a) the supply of goods and materials like food, water, fuel, wood, fiber, genetic resources, biochemical products, and medications, b) regulating services: advantages from controlling ecological processes include managing water resources, purifying water, controlling erosion, regulating air quality, managing climate, regulating pests and diseases, controlling natural disasters like floods and droughts, controlling the amount of organic carbon in soil and plants, producing oxygen, c) cultural services: including education, entertainment, and cultural diversity, d) Supporting services, including food, water, nitrogen, and primary production cycles. (MEA, 2005; Mirzad et al. 2023).

Rhizobia are a very specific type of beneficial bacteria that fix atmospheric nitrogen while living in nodules in soil. Ammonia, which is transformed into amino acids and amides, is the initial byproduct of the biological nitrogen fixation (BNF) process. Plant growth depends on these products. The rhizobia are given a home, nutrients, and energy in the form of carbon compounds in exchange. The term "symbiosis" refers to this cooperative relationship (Farquharson et al. 2022). BNF offers numerous practical advantages to agroecosystems. Compared to chemical nitrogen fertilizer, it is an essential mechanism for restocking soil nitrogen reservoirs, increasing soil N availability to support crop growth, and aiding in efforts to reduce adverse environmental externalities (Peoples et al. 2009; Ladha, et al. 2022). According to Liu et al. (2011), quantifying BNF will help farmers manage nitrogen more effectively in order to maximize output and minimize negative losses to the environment.

Yan et al. (2023) studied the networks of interactions between legume plants, bacteria, and soil that are related to increased plant productivity and soil fertility in intercropping systems. They emphasized that intercropped legumes had higher levels of beneficial root-associated bacteria, and that plant productivity and soil fertility were increased in this system with moderate fertilizer. In order to protect natural resources, it is helpful to understand their value. The evaluation of ESs also gives decision-makers vital information for sustainable development.

Regarding the BNF services provided by Rhizobium bacteria, no published paper exists. Consequently, using desktop research, we examined the BNF services in contemporary agroecosystems and provided an answer to the question, "What services are produced by Rhizobium bacteria throughout BNF?"

2. MATERIALS AND METHODS

We examined all available literature and examined the ES assessment in relation to BNF in order to fulfill our research goal. Articles from 1997 to 2023 were collected from scientific databases such as Scopus and Science Direct, and then the articles were analyzed and classified. In this study, the keywords BNF, Rhizobium, agroecosystem and ecosystem service were used. In the study, all services, roles and benefits related to BNF in agroecosystems were collected and classified according new framework (BNF-MEA). Based on the available data and the practicality of the methods, we created a modified framework based on the Millennium Ecosystem Assessment and separated 31 services, goods, and benefits into 4 sections. The goal of the Millennium Ecosystem Assessment was to evaluate how ecosystem change would affect human well-being and to provide the scientific justification for the necessary actions to improve ecosystem conservation and sustainable use as well as the benefits that ecosystems provide to human well-being (MEA, 2005).

3. RESULTS AND DISCUSSION

The BNF-MEA framework was expanded to include additional indicators, including the production of forage, nutritious food, soil nitrogen, earthworm abundance, global carbon cycle, photosynthesis, soil microbial activation, intercropping, soil biodiversity, carbon sequestration, greenhouse gas emissions, cover crop effect, and atmospheric nitrogen fixation. The state of the agroecosystems supporting legumes served as the basis for these modifications. According to Table 1 of our results, BNF can offer 31 services and/or goods in legumes. The majority of BNF's services fall under the category of regulating services. Rhizobium can contribute directly or indirectly to the provision of many soil-related services by fostering favorable soil conditions. Peoples et al. (2008) proposed certain non-nitrogen benefits of BNF as a byproduct of nitrogen fixation due to its effects on soil biology. BNF has benefits in agroecosystems that

help prevent or lessen dis-services like nitrates, leaching, eutrophication, and greenhouse gas emissions indirectly (Table 1). Additionally, BNF plays a crucial role in efforts to reduce the negative environmental externalities associated with chemical nitrogen by helping to replenish soil organic nitrogen reservoirs and increase their availability (Peoples et al. 2009; Ladha, et al. 2022). According to studies by Peoles et al. (2009) and Anglade et al. (2015), the introduction of nitrogen into agricultural systems has resulted in significant harm to the environment, such as nitrate contamination of groundwater and surface water, eutrophication of coastal marine areas, and greenhouse gas emissions. These days, intercropping or using legumes cultivated in rotations is thought to be a sustainable and alternative method of adding nitrogen to low-input cropping systems. Furthermore, Rhizobium can offer auxiliary functions like enhancing the nitrogen and carbon cycles and enhancing soil formation through BNF. Increases in soil biodiversity may result from Rhizobium activity (Table 1). The study's findings also demonstrated how BNF can regulate and enhance agricultural systems. Positive effects on photosynthesis and plant growth are another advantage of BNF (Table 1). Given the symbiotic relationship that exists between legume roots and bacteria, BNF will make more nitrogen available for plant uptake. Plant growth and photosynthesis can be enhanced continuously. BNF's analysis of the biological state of the soil can raise microbial activity and, often, earthworm abundance. In another study, Nasrat (2020) noted that the soil quality and earthworm abundance were enhanced by the cultivation of faba beans (Vicia faba L.) in an intensive agricultural system. By nitrogen fixation, rhizobium can reduce the amount of chemical fertilizers used, and BNF can supply the nitrogen plants need. As a result, there was a decrease in nitrate and nitrate accumulation, which has the potential to produce nutritious food for both humans and animals. In addition, the absence of chemical fertilizers creates an environment that is favorable for soil biological activity by supplying nitrogen, which enhances microbial activity and increases soil organic carbon production. The most popular methods for incorporating legumes and the BNF that goes along with them into agricultural systems were crop rotation, simultaneous intercropping, alley cropping, enhanced fallows, and green manuring, according to Peoples et al. (2009) and Kebede (2021).

Table 1. Rhizobium services, effects and roles by BNF in agroecosystems based on BNF-MEA framework

No.	BNF effect /role	Role	Service	Goods	Function	Benefit	Type of service
1	Crop production	Increase		√			Provision
2	Protein production	Increase		√			Provision
3	Oil production	Increase		√			Provision
4	Forage production	Increase		√			Provision
5	Biomass production	Increase		√			Provision
6	Healthy food	Increase		√			Provision
7	Crop growth	Increase				√	Regulating
8	Photosynthesis	Increase			√		Regulating
9	Nitrogen fertilizer	Reduce				√	Regulating
10	Soil N amount	Improve				√	Regulating
11	Soil organic matter	Increase				√	Regulating
12	Soil fertility	Improve	√				Regulating
13	Soil health	Improve			√		Regulating
14	Soil microbial activates	Increase				√	Regulating
15	Carbon sequestration	Increase	√				Regulating
16	greenhouse gazes	Reduce				√	Regulating
17	Fixation of atmospheric	Increase	√		√		Regulating
18	Nitrogen leaching	Reduce				√	Regulating
19	Cropping rotation	Improve				√	Regulating
20	Eutrophication	Reduce				√	Regulating
21	Fossil fuels consumption	Reduce				√	Regulating
22	Intercropping	Improve				√	Regulating
23	Green manuring	Improve				√	Regulating
24	Cover crop management	Improve				√	Regulating
25	Earthworms abundance	Increase				√	Regulating
26	Soil biodiversity	Improve	√				Supporting
27	Global N cycle	Improve	√				Supporting
28	Soil structure	Improve	√				Supporting
29	Global carbon cycle	Improve	√				Supporting
30	Education opportunities	Increase	√				Culture
31	Research subject	Increase	√				Culture

4. CONCLUSION

Global data collection shows that BNF can contribute to the direct and indirect provision of 31 services and benefits. This study revealed certain services and benefits that are associated with BNF in addition to the BNF service itself. They were referred to as the BNF-related services. Numerous services were part of the group that provided regulating services. BNF appears to be impacted by genotype-specific interactions, Rhizobium strain, and crop genotype-related BNF services.

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ÖZET
Pelet yakıtı, genellikle biyokütleden elde edilen ve yüksek enerji yoğunluğuna sahip küçük silindirik veya prizmatik formda olabilen yakıt türüdür. Biyokütle peletleri; tarım atıkları, enerji bitkileri ve diğer organik materyallerin işlenmesiyle üretilir. Bu materyaller önce kurutulur, sonra öğütülerek küçük parçalara ayrılır ve yüksek basınç altında ekstrüzyon yoluyla peletlere dönüştürülür. Peletler, düşük nem oranına ve homojen bir yapıya sahip oldukları için yanma sırasında yüksek verimlilik ve düşük emisyon sağlar. Aynı zamanda, standart boyutları sayesinde; taşıması, depolanması ve otomatik yakma sistemlerinde kullanılması kolaydır. Pelet yakıtlar, ısınma amaçlı sobalar ve kazanlarda, büyük ölçekli elektrik üretimi için enerji santrallerinde ve endüstriyel buhar ve ısı ihtiyacının karşılanmasında kullanılmaktadır. Pelet yakıtı, Türkiye için yenilenebilir enerji kaynaklarının çeşitlendirilmesinde ve fosil yakıtlara olan bağımlılığın azaltılmasında stratejik bir öneme sahiptir. Orman varlığı ve tarımsal faaliyetlerden kaynaklanan zengin biyokütle potansiyelini değerlendirerek yapılan pelet üretimi, enerji güvenliğini artırarak dışa bağımlılığı azaltabilir. Ayrıca, daha düşük karbon emisyonu sayesinde küresel ısınma probleminin çözümüne de katkı sağlar. Ekonomik açıdan bakıldığında pelet üretimi, özellikle kırsal kesimlerde ekonomik kalkınmayı teşvik edecek yeni istihdam olanakları sunabilir. Tarımsal ve orman atıklarının değerlendirilmesiyle, atık yönetimi sorunlarına etkin çözümler üretilebilir, bu sayede sürdürülebilir bir çevre yönetimi sağlanabilir. Enerji verimliliği yüksek olan pelet yakıtlar, standart boyutları sayesinde ısınmada ve endüstriyel proseslerde otomatik yakma sistemlerine entegre edilebilir, böylece enerji tüketimi daha verimli hale getirilebilir. Isıtma sistemlerindeki yakıt çeşitliliğinin artırılması gerekliliği göz önünde bulundurulduğunda, Türkiye'nin geleneksel yakıtlar olan doğalgaz ve kömürün yanı sıra pelet yakıtını da bir alternatif olarak kullanması önerilebilir. Yenilenebilir enerji politikaları ve teşvikler, pelet yakıtı sektörünün büyümesini hızlandırabilir. Bu araştırmada endüstriyel anlamda pelet üretim yöntemleri değerlendirilerek üretim aşamasında dikkat edilmesi gereken konular incincelenmiştir.
Anahtar Kelimeler: Biyokütle, alternatif enerji, yakıt, emisyon

INDUSTRIAL PELLET FUEL PRODUCTION: CONVERSION FROM RAW MATERIALS TO ENERGY

ABSTRACT

Pellet fuel is a type of fuel that is generally obtained from biomass and can be in small cylindrical or prismatic form with high energy density. Biomass pellets; It is produced by processing agricultural waste, energy crops and other organic materials. These materials are first dried, then ground into small pieces and turned into pellets by extrusion under high pressure. Pellets provide high efficiency and low emissions during combustion because they have a low moisture content and a homogeneous structure. At the same time, thanks to its standard dimensions, it is easy to carry, store and use in automatic combustion systems. Pellet fuels are used in stoves and boilers for heating purposes, in power plants for large-scale electricity production and to meet industrial steam and heat needs. Pellet fuel has a strategic importance for Turkey in diversifying renewable energy sources and reducing dependence on fossil fuels. Pellet production by utilizing the rich biomass potential resulting from forest assets and agricultural activities will increase energy security and minimize foreign dependency. Additionally, it will contribute to the solution of the global warming problem thanks to lower carbon emissions. From an economic perspective, pellet production can offer new employment opportunities that will stimulate economic development, especially in rural areas. By utilizing agricultural and forest wastes, effective solutions to waste management problems can be produced, thus sustainable environmental management can be achieved. Pellet fuels, which are highly energy efficient, can be integrated into automatic combustion systems in heating and industrial processes thanks to their standard sizes, thus making energy consumption more efficient. Considering the need to increase fuel diversity in heating systems, it can be recommended that Turkey use pellet fuel as an alternative in addition to the traditional fuels natural gas and coal. Renewable energy policies and incentives can accelerate the growth of the pellet fuel sector. In this research, industrial fuel pellet production methods will be evaluated and the issues that need to be taken into consideration during the production phase will be examined.

Keywords: Biomass, alternative energy, fuel, emissions

1. GİRİŞ

Son yıllarda, yenilenebilir enerji kaynaklarına olan artan ilgi ile birlikte, biyokütlenin enerji formuna dönüşmüş hali olan pelet yakıtlarının önemi hızla artmaktadır. Peletler genellikle odun, tarımsal atıklar veya diğer biyokütle kaynaklarından yapılan sıkıştırılmış düşük nem içeriğine sahip silindirik formlu yüksek enerjili yakıtlardır. Pelet yakıtlar, özellikle 20. yüzyılın ortalarından itibaren odun atıklarının değerlendirilmesi ve daha verimli bir ısıtma kaynağı olarak kullanılması amacıyla geliştirilmiştir (Japhet, ve ark., 2019). 1970'lerde meydana gelen enerji krizinin ardından alternatif enerji kaynakları olarak gündeme gelmiş ve 2000'lerin başından itibaren Avrupa ve Kuzey Amerika'da kullanımları önemli ölçüde artmıştır.

Pelet yakıtların üretimi; hammaddenin öğütülmesi, kurutulması ve yüksek basınç altında sıkıştırılması işlemlerini içerir (Wei ve ark., 2024). Bu işlemler sayesinde, yakıtın enerji yoğunluğu artırılır, taşıma ve depolama kolaylığı elde edilir. Ayrıca pelet yakıtlar, ısıtma sistemleri ve bazı durumlarda büyük ölçekli enerji üretiminde kullanılabilirler. Peletler yakıt amaçlı kullanıldığında kömüre kıyasla daha düşük karbon emisyonu üretirler (Hamzah ve ark., 2018). Pelet yakıtların gelecekteki potansiyeli, özellikle sürdürülebilir enerji kaynaklarına olan ihtiyacın artmasıyla önem kazanmaktadır. Dünya genelinde pelet yakıtının kullanılması atık materyalin değerlendirilmesi açısından büyük önem arz etmektedir (Japhet ve ark., 2020).

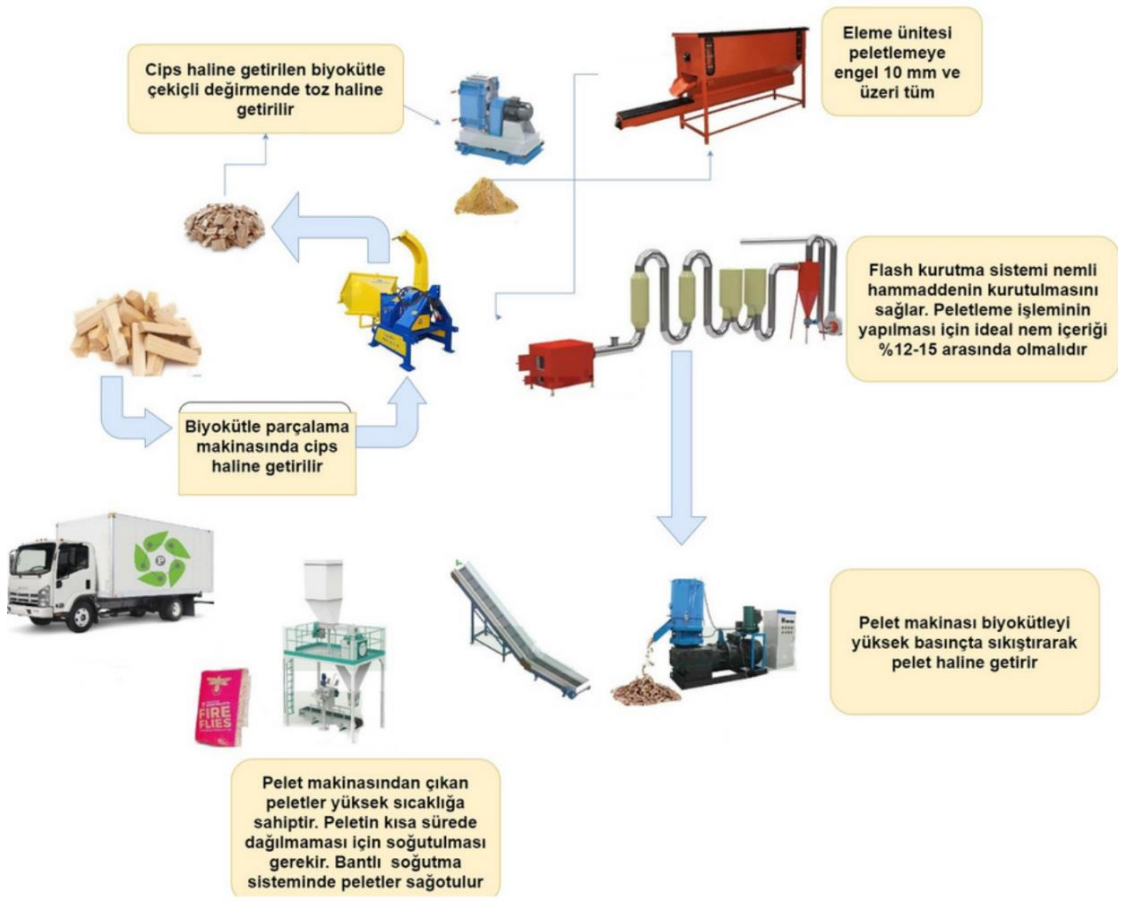
Pelet yakıtının üretiminde, çeşitli lignoselülozik materyaller kullanılabilmektedir. Bu materyaller; odun, tarımsal atıklar ve diğer bitkisel kaynaklardan elde edilen biyokütleler olarak tanımlanabilir. İçerdikleri yüksek oranda selüloz, hemiseliloz ve lignin ile bu materyaller, enerji yoğunluğu yüksek ve çevreye duyarlı yakıtların üretiminde önemli bir rol oynarlar.

Pelet üretiminde tercih edilen lignoselülozik materyaller, üretilen peletlerin enerji verimliliği, dayanıklılığı ve çevresel etkileri açısından önem taşımaktadır. Pelet yakıtı üretiminde kullanılan lignoselülozik materyallerin özellikleri ve bu materyallerin pelet kalitesi üzerindeki etkilerini inceleyen çok sayıda araştırma yapılmış ve konu halen öncelikli araştırma alanları arasında yerini korumaya devam etmektedir. Farklı biyokütle kaynaklarından elde edilen peletlerin özelliklerini incelemek amacıyla yapılan bir çalışmada, pelet üretimi için kullanılan lignoselülozik materyallerin fiziksel ve kimyasal özellikleri, peletlerin kalitesini belirleyen unsurlar ve enerji verimliliği incelenmiştir (Kaliyan ve Morey, 2009). Tumuluru ve

ark., (2011) tarafından yapılan bir araştırmada ise, biyokütle peletlerinin üretim süreçleri ve bu süreçlerde kullanılan lignoselülozik materyallerin özellikleri incelenmiştir. Araştırma sonucunda pelet üretiminde kullanılan farklı biyokütle türlerinin, özellikle selüloz, hemiselüloz ve lignin içeriklerinin, peletlerin kalitesi üzerinde önemli etkileri olduğu belirlenmiştir. Benzer şekilde Mani ve ark., (2006) yaptıkları araştırmalarında pelet üretiminde kullanılan lignoselülozik materyallerin mekanik özelliklerini ve bu özelliklerin pelet kalitesi üzerindeki etkilerini incelemişlerdir.

2. PELET ÜRETİM AŞAMALARI

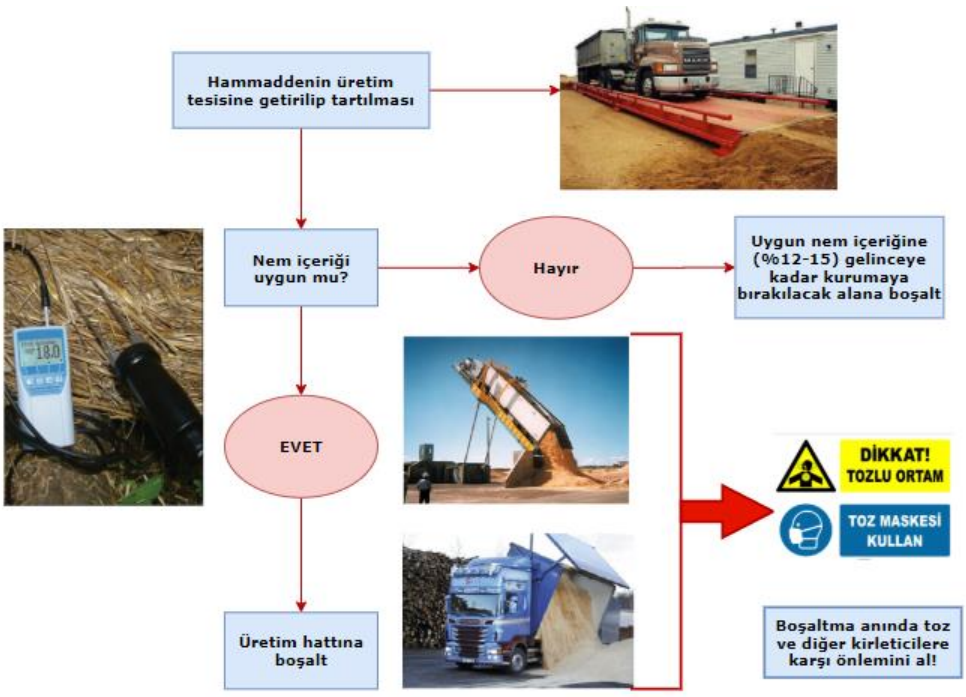
Pelet üretimi; hammaddenin üretim hattına getirilmesi, ön kurutma, eleme, öğütme, pelet üretimi, üretilen peletlerin soğutulması, depolama, paketleme aşamalarından oluşmaktadır (Şekil 1).



Şekil 1. Pelet üretim aşamaları

2.1.HAMMADDENİN ÜRETİM HATTINA GETİRİLMESİ

Büyük üretim tesislerinde pelet üretimine uygun hammadde kamyonlarla tesise getirilerek büyük kantarlarda tartılır. Bu aşamadan sonra kamyon depolama alanına yönlendirilerek hammadde boşaltılır. Bu aşamada hammaddenin içeriğine bağlı olmak ile birlikte meydana gelecek aşırı talaş tozu insan sağlı üzerinde olumsuz etkilere yol açabilir. Bu nedenle boşaltma aşamasında araç sürücüleri ve işçiler dahil tüm personele uygun bir toz maskesi takmalıdır. Çok fazla talaş işleyen büyük tesislerde düşük basınçlı sistemler, tozu bina içinde tutmak ve yayılmasını önlemek için kullanılabilir. Hammaddenin nem içeriği pelet üretiminde önemli bir konudur. Pelet üretimi için en uygun nem içeriği %12-15 arasında değişim gösterir. Nem içeriği yüksek olan hammadde ön kurumaya tabi tutulmak zorundadır. Nem içeriğinin belirlenmesinde dijital nem ölçerlerden yararlanılır. Hammaddenin üretim hattında yapılması gereken işlemler Şekil 2'de verilen akış diyagramında sunulmuştur.



Şekil 2. Hammadde boşaltma aşaması

2.2. HAMMADDENİN ELENMESİ

Pelet üretiminde kullanılacak hammadde üretim hattına girmeden önce eleme sürecinden geçirilerek taş, metal ve diğer yabancı maddelerden ayrıştırılması gerekir. Eleme aşamasında elekler ve mıknatıslardan yararlanılabilir. Pelet üretiminde; titreşimli, trommel, diskli, yıldızvari ve paralel çubuklu olmak üzere beş farklı elek tipinden yararlanılabilinir.

Titreşimli elekler: Pelet üretiminde en fazla kullanılan elek tipidir (Şekil 3a). Bu eleklerde titreşim oluşturmak için motor veya eksantrik mekanizmasından yararlanılır. Titreşim, elek tablasının, hammaddeyi farklı boyutlara ayıran dairesel veya eliptik bir ızgarada hareket etmesini sağlar. Eleme esnasında büyük parçalar elek yüzeyinde tutulurken, daha küçük parçacıklar elek açıklıklarından geçer. Elek tablasının titreşim frekansı motor hızı veya eksantrik ağırlıkların konumu ayarlanarak değiştirilebilir (Makinde ve ark., 2015).

Trommel elekler: Silindir şeklindedir ve ham maddeyi ayırmak için dönen bir tambur kullanır (Şekil 3b). Büyük parçacıklar tambur içinde tutulurken daha küçük parçacıklar deliklerden geçer. Çalışma sırasında ham madde, besleme hunisi yoluyla trommel tamburuna beslenir. Tambur döndükçe, büyük parçacıklar tambur içinde tutulur ve boşaltma ucuna ulaşana kadar tambur boyunca hareket eder. Küçük parçacıklar elek açıklıklarından geçer ve boşaltma oluğunda toplanır. Tamburun dönme hızı ve elek açıklıklarının boyutu, trommel eleğin ayırma verimliliğini ve verimini kontrol edecek şekilde ayarlanabilir. Ek olarak, trommel elekler, eleme sürecini daha da iyileştirmek için fırçalar veya püskürtme çubukları gibi ek bileşenlerle donatılabilir (Chen ve ark., 2010).

Diskli elekler: Diskli eleklerde, ham maddeyi ayırmak için belirli modellere sahip bir dizi dönen disk kullanır (Şekil 3c). Çalışma sırasında, hammadde besleme hunisi aracılığıyla disklerin üstüne beslenir. Diskler dönerken, küçük parçacıklar elek açıklıklarından geçer ve boşaltma oluğunda toplanır. Daha büyük parçacıklar disklerin yüzeyinde tutulur ve boşaltıldıkları yığının dibine taşınır. Disklerin dönme hızı ile elek açıklıklarının boyutu ve şekli, eleğin ayırma verimliliğini etkiler. Diskli eleklerde kullanılan diskler metal ya da plastik malzemeden üretilebilir (Cripps ve ark., 2000).

Yıldız tip elekler: Bu elekler, üzerinde yıldız formundaki bıçaklar bulunan bir rotorun dönmesi prensibine göre çalışır (Şekil 3d). Elek rotoru döndükçe, eleğin içindeki yıldız şeklindeki bıçaklar da dönerek hammaddenin elek boyunca hareket etmesi sağlanır. Kademeli

bir şekilde düzenlenmiş yıldız formundaki bıçaklar hammaddeyi; boyutlarına, şekillerine ve ağırlıklarına göre ayırabilir. Hammadde elek boyunca hareket ettikçe, büyük parçacıklar elek yüzeyinde tutulurken, daha küçük parçacıklar eleğin ağından geçer. İstenmeyen maddeler elek ucundan atılırken, diğer ucunda uygun boyuttaki peletler toplanır (Woo ve ark., 2018).

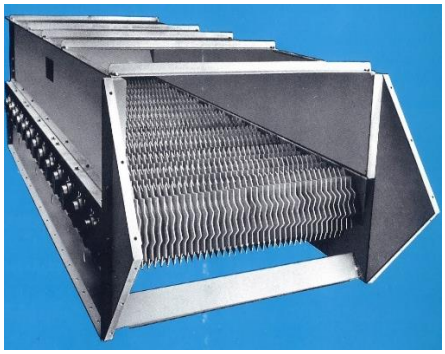
Grizzly elekler: Grizzly elekler, genel olarak güverte boyunca konumlandırılan bir dizi paralel çubuktan oluşur (Şekil 3e). Pelet üretiminde kullanılacak hammadde güverteye beslenir, titreşim anında daha büyük parçacıklar grizzly barlarda yakalanır ve alt güverteye geçmesi engellenir. Bu elekler genelde pelet değirmeninden önce konumlandırılır. Böylece, büyük boyutlu parçacıklar ve ince taneler içermeyen homojen bir hammadde elde edilir (Wilson ve ark., 2014).



a) Titreşimli elek



b) Trommel elek



c) Diskli elek



d) Yıldız tip elek



e) Grizzly tip elek

Şekil 3. Pelet üretiminde kullanılan elekler

2.3. HAMMADDENİN KURUTULMASI

Pelet üretiminde kullanılan hammaddenin üretim hattına girmeden önce belirli nem düzeylerine kadar kurutulması gerekmektedir. Hammaddenin kurutulması amacıyla farklı tip kurutuculardan yararlanılmaktadır. Kurutucunun sıcaklığı; alıkonma süresine, alıkonma süresi ise kullanılan hammaddenin nem içeriğine bağlı olarak değişkenlik gösterir. Üretim aşamasında daha düşük nem içeriğine ihtiyaç duyulursa, malzeme daha uzun süre alıkonulmalıdır, bu da daha yüksek alıkonma süresi anlamına gelir. Pelet üretiminde döner tamburlu, flaş, akışkan yataklı, tepsili ve bantlı olmak üzere beş farklı tipte kurutucudan yararlanılmaktadır.

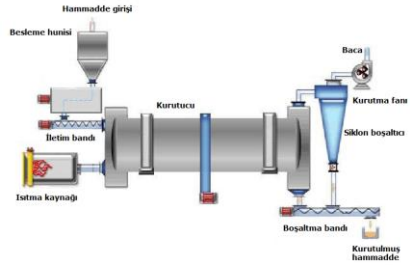
Döner Tamburlu Kurutucular: Döner tamburlu kurutucular pelet üretiminde yaygın bir şekilde kullanılırlar. Bu tip kurutuculardа ısıtıcı olarak; doğrudan yanabilen yakıtlar, sıcak hava veya baca gazı kullanılabilmektedir (Şekil 4a). Kurutma işlemi doğrudan veya dolaylı olarak gerçekleştirilebilir. Hammadde tambura vidalı besleyici veya oluk aracılığıyla beslenir ve hız sensörler kullanılarak kontrol edilir. Kurutulmuş malzeme, bir boşaltma vidası kullanılarak siklon haznelerinden boşaltılır (Stahl ve ark., 2004).

Flaş Kurutucular: Flaş kurutuculardа hammadde sıcak hava ile hızlı bir şekilde temas ettirilerek mevcut nem içeriğinin aniden buharlaşması sağlanır (Şekil 4b). Kurutulacak hammadde bir konveyör ya da pnömatik bir taşıyıcı ile kurutucuya iletilir. Kurutma için gerekli olan ısı doğrudan yakma, dolaylı ısıtma ya da elektrikli ısıtma sistemleri ile elde edilir. Isıtma sonucunda elde edilen sıcak hava yüksek bir hızla kurutma odasına yönlendirilir ve hammadde kurutulur. Kurutma işleminden sonra kurutulan malzeme ile kurutma sonucu açığa çıkan gazların ayrıştırılması gerekir. Ayrıştırma işleminde filtreler, elektrostatik çökelticiler veya siklon ayırıcılardan yararlanılır. Ayrıştırma işleminden sonra materyal kurutucudan boşaltılır. Boşaltma aşamasında mekanik cihazlardan yararlanılacağı gibi, pnömatik taşıma sistemleri de kullanılabilir (Amos,1999).

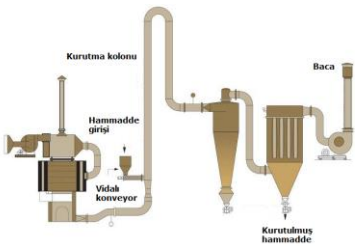
Akışkan Yataklı Kurutucular: Bu tip kurutuculardа içerisinden yüksek hızla havanın geçtiği kum veya silika gibi katı parçacıklardan oluşan bir yatak kullanılır (Şekil 4c). Kurutulacak ürün titreşim ve havanın etkisi ile yatak üzerinde hareket halindedir. Hammadde yatak içinde sabit kalmaz bu sayede iyi bir karışım sağlanıp homojen bir kurutma sağlanır.

Tepsili Kurutucular: Tepsili kurutucular, üst üste istiflenmiş bir dizi tepsiden oluşur (Şekil 4d). Kurutulacak hammadde tepsiler üzerine serilir. Tepsili kurutucularda kullanılan tepsiler uygun hava sirkülasyonu ve ısı transferine izin vermek amacıyla deliklidir. Kurutma sistemine verilen sıcak hava bir ısıtma sistemi sayesinde elde edilir. Hava bir fan sayesinde tepsiler arasına yönlendirilir. Sisteme gönderilen sıcak hava sayesinde hammaddenin nemi alınarak buharlaştırılır. Nem yüklü hava bir filtreden geçirilerek kurutucudan uzaklaştırılır. Tepsili kurutucuda sıcaklık kontrolü amacıyla sensörlerden yararlanılır. Kurutucuda yer alan tepsiler sıcak havaya maruz kalacak şekilde özel olarak dizayn edilip konumlandırılmıştır. Kurutma süresi ve sıcaklığı, kurutulan malzemenin özel ihtiyaçlarına göre ayarlanabilir.

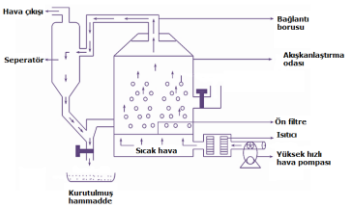
Bantlı Kurutucular: Bantlı kurutucular hammaddenin bir bant üzerinden kurutma odasından geçirilerek nem içeriğinin düşürülmesi prensibine göre çalışan sürekli kurutma sistemleridir (Şekil 4e). Nem içeriği yüksek hammadde bant üzerine homojen bir şekilde yayılır. Kullanılan bant ısı transferinin etkin bir şekilde sağlanması için delikli bir yapıya sahiptir. Bant sürekli hareket halinde olup hammaddeyi kurutma odasına doğru taşır. Bant hızı ayarlanabilir özelliktedir. Bu sayede hammaddenin kurutma odasında kalma süresi de ayarlanabilir. Kurutma odasında ki sıcaklık sıcak hava sayesinde elde edilir. Sıcak hava fanlar yardımıyla kurutma odasına yönlendirilir. Bantlı kurutucuların çoğu iki bantlı sistemdir ve kurutma sıcaklığı, hava akışı ve hızı her bant için ayarlanabilir. Her bant doğrudan veya dolaylı olarak ısıtılabilir. Bu amaç için; yağ, buhar, sıcak su veya sıcak gaz gibi ısıtma yöntemleri kullanılabilir (Fagernas ve ark., 2010).



a) Döner tamburlu kurutucu



b) Flaş kurutma



c) Akışkan yataklı kurutucu



d) Tepsili kurutucu



e) Bantlı kurutucu

Şekil 4. Pelet üretiminde kullanılan kurutucular

2.4. HAMMADDENİN ÖĞÜTÜLMESİ

Pelet üretim sürecinde kullanılacak hammadde, eleme ve kurutma aşamalarından sonra istenilen boyutlara getirilmek amacıyla öğütme işlemine tabi tutulur. Yüksek kaliteli pelet üretimi için hammaddenin uygun boyutlara getirilmesi önemli bir husustur. Pelet üretiminde öğütme aşamasında çekiçli ve valsli değirmenlerden yararlanılmaktadır.

Çekiçli değirmen: Çekiçli değirmenler şaft üzerine monte edilmiş rotor, rotor üzerine monte edilmiş çekiçlerden meydana gelir (Şekil 5a). Değirmene yükleme ağzından hammadde ilave edilir. Rotorun dönme etkisi ile hammadde çekiçlere doğru yönlendirilir. Çekiçler hammaddenin boyutunu çarpma etkisi ile küçültür. Boyutları küçülen hammadde bir elek sisteminden geçirilerek istenilen büyüklük elde edilir. Öğütme sırasında ortamda yoğun toz gözlenebilir. Bu nedenle değirmenin açık havada konumlandırılmasında fayda vardır. Çekiçli değirmenlerin kullanım kolaylığı ve ilk yatırım maliyetlerinin düşük olması avantajları arasında sıralanabilir. Buna ilaveten çalışma anında toz oluşumu, valsli değirmenlere göre daha fazla enerji harcaması ve meydana getirdiği yüksek gürültü düzeyi dezavantajları arasında yer alır (Tumuluru ve ark., 2011).

Valsli Değirmen: Valsi değirmenlerde hammadde, valsler ile öğütme tablası arasında ezilerek öğütülür. Değirmen içine hammadde beslenmesi merkezi bir oluk vasıtası ile yapılır ve kurutulacak materyal buradan dönen bir öğütme tablası üzerine düşer. Öğütme tablası belirli bir düzene göre sıralanmış çok sayıda silindirden oluşur. Silindirlerin dönmesi ile kurutulacak hammadde aşağı doğru çekilerek alt bölümdeki silindirlere yönlendirilir. Hammadde silindirler arasından geçerken ezilerek öğütülür ve boyutu küçültülür (Şekil 5b). Silindirler ile öğütme tablasındaki boşluk oranı değiştirilerek nihai ürünün boyutu değiştirilebilinir (Williams ve ark., 2016). Valsli değirmenler ezme prensibine göre öğütme işlemini yaptıklarından dolayı ürünün lif içeriğinde bir değişikliğe yol açmaz. Bu değirmenler çekiçli değirmenlere göre daha sessiz çalışır, enerji gideri çekiçli değirmenlere göre daha azdır ve çalışma anında daha az toz oluşur. Bununla beraber valsli değirmenlerin ilk kurulum maliyeti ve bakım masrafları çekiçli değirmenlere göre daha yüksektir. Ayrıca elde edilen nihai ürünün şekli düzensizdir.



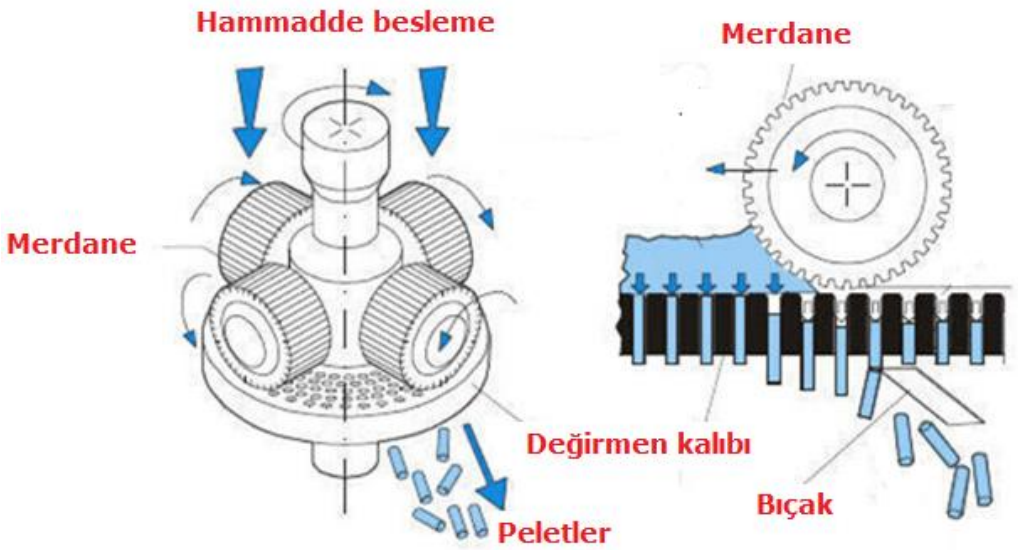
a) Çekiçli değirmen b) Valsli değirmen

Şekil 5. Pelet üretiminde kullanılan değirmenler

2.5. PELET PRESİ

Ön işlemlerden geçirilen hammadde pelet presine gönderilerek peletleme işlemi yapılır. Pelet presi; kalıp, bir veya daha fazla sayıda rulo merdane ve bıçaklardan oluşur. Rulo merdane ve kalıbın konumuna göre pelet pres makinalarında rulo merdane ve kalıp; düz, içten makaralı

halka kalıp, dıştan makaralı halka kalıp ve doğrusal olmak üzere 4 farklı biçimde konumlandırılabilir (Şekil 6). Halka tip kalıplar pelet preslerinde en yaygın kullanılan kalıplardır.



Şekil 6. Pelet presinin şematik ve kesit görünüşü

2.6. PELETLERİN SOĞUTULMASI

Peletler değirmenden 70 °C sıcaklık ve %12-18 nem içeriğinde kırılgan durumda çıkar. Soğutma işleminde, peletler 20–25 °C'ye ve %8–12'ye kadar hava ile söndürülür (Tumurlu ve ark., 2011). Herhangi bir pelet hasarını ve toz oluşumunu önlemek için peletler doğrudan soğutucuya gönderilmelidir (Fagernas ve ark., 2010). Genel olarak, pelet soğutma iki ana amacı karşılamak için gerçekleştirilir. Bunlar sıcaklığın ortam sıcaklığına düşürülmesi ve şartlandırma işleminde eklenen nemin azaltılmasıdır. Soğutma işlemi ayrıca peletlerin yoğuşmasını ve küflenmesini önlememize yardımcı olur. Soğutucu, ortam havasını peletlerin dış yüzeyi ile temas ettirecek şekilde tasarlanmıştır. Peletlerin yüzeyinde hava aktıkça ısınır ve bu da havanın nem alma kabiliyetini artırır. Yüzey nemi buharlaştıkça, peletlerin iç kısmındaki iç nem kılcal hareketle yüzeye geçer (Fagernas ve ark., 2010).

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KURAKLIK KARŞISINDA BİTKİLERİN SAVUNMA MEKANİZMALARI

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ÖZET
Abiyotik stres faktörlerinden olan kuraklık, fosil yakıtların kullanımına bağlı olarak atmosfere salınan karbondioksit, sera etkisi göstermektedir. Bu etki sonucunda ortaya çıkan küresel ısınma etkisini gün geçtikçe artırmakta ve bu yıkıcı etki, günümüz dünyasında hissedilir düzeyde artmaya devam etmiştir. Bitki gelişim dönemlerinde kuraklığa maruz kalan bitkiler olumsuz yönde etkilenirken, bu etki neticesinde verim de önemli miktarda düşüşler meydana gelmiştir. Bu olay dünya gıda temininde ciddi aksamalara neden olmuştur. Bitkiler tür ve çeşitlerine göre kuraklık stresinden farklı oranlarda etkilenmektedirler. Genel itibariyle kuraklık, kuruma ve su noksanlığı şeklinde teşekkül etmektedir. Kuraklığın bitkiler üzerinde farklı şiddetlerde görülme seviyesi, genotiplerin stres koşulları altında oluşturabildikleri metabolik değişimlere yani fizyolojik ve biyokimyasal olaylara bağlı olarak değişik şekillerde ortaya çıkabilmektedirler. Kuraklık stresine maruz kalan bitkiler bu yıkıcı etkiden kurtulabilmek adına bir takım savunma mekanizmaları geliştirmişlerdir. Bu mekanizmalardan biri, bitkiler gereksinim duydukları suyu karşılayamadıkları zaman ya su kayıplarını azaltarak veyahut su alımlarının daha da artırarak bu durumdan etkilenmeyi en aza indirmeye çalışırlar. Ayrıca kuraklığın ortaya çıktığı dönemlerin ilk aşamasında bitikler gövde büyümesini durdurup kök gelişimini artırmaktadırlar. Yapılan biyokimyasal çalışmalar neticesinde kuraklık stresine uyum sağlayan bitkilerin yapraklarında prolin düzeyinin fazla olduğu ve kuraklık stresine uyum sağlamayan bitkilerde bu değerin daha düşük olduğu bilinmektedir. Bitkiler kuraklıktan korunma ve kuraklığa tolerans gösterme şeklinde ortaya koyabildikleri bir takım mekanizmalarla birlikte dayanımlarını artırabilmektedirler. Örneğin, bu gibi bitkiler daha geniş bir kök yapısına sahiptirler ve ayrıca bu bitkiler yapraklarındaki stomaları kapatarak kuraklıktan daha az etkilenmeyi sağlarlar.
Anahtar Kelimeler: Kuraklık Stresi, Verim, Metabolik Mekanizma, Bitki

DEFENSE MECHANISMS OF PLANTS AGAINST DROUGHT

ABSTRACT
Drought, which are abiotic stress factors, and carbon dioxide released into the atmosphere due to the use of fossil fuels, have a greenhouse effect. The effect of global warming resulting from this effect is increasing day by day, and this destructive effect has continued to increase at a noticeable level in today's world. While plants exposed to drought during plant development periods were negatively affected, significant decreases in yield occurred as a result of this effect. This event caused serious disruptions in the world food supply. Plants are affected by drought stress at different rates depending on their species and varieties. Generally, it occurs as drought, drying and water deficiency. The level of drought at different intensities on plants can occur in different ways depending on the metabolic changes that genotypes can create under stress conditions, that is, physiological and biochemical events. Plants exposed to drought stress have developed a number of defense mechanisms to escape this devastating effect. One of these mechanisms is that when plants cannot meet the water they need, they try to minimize the impact of this situation by either reducing their water loss or increasing their water intake. In addition, in the first stages of drought, plants stop stem growth and increase root development. As a result of biochemical studies, it is known that the proline level is high in the leaves of plants adapted to drought stress, and this value is lower in plants that do not adapt to drought stress. Plants can increase their resistance through a number of mechanisms that they can use to protect against and tolerate drought. For example, such plants have a wider root structure, and these plants also close the stomata on their leaves, making them less affected by drought.
Keywords: Drought Stress, Yield, Metabolic mechanism, Plant

KURAKLIK VE KÜRESEL ISINMA

Gün geçtikçe her alanda etkisini bariz bir şekilde gördüğümüz ve bu etkilerin tarımsal alanlarda meydana getirdiği değişiklikler ayrıca sorun olmaya başlamıştır. Tüm bunların müsebbibi konumunda olan küresel ısınma ve ona bağlı olarak ortaya çıkan iklim değişikliği, günümüz dünyasında kendinden söz ettirmeye başlamıştır. Gerek doğal olarak meydana gelen yangınlar ve gerekse fosil yakıtların kullanımı neticesinde yukarıda bahsettiğimiz yıkıcı etkiler daha etkili bir şekilde ortaya çıkmaya başlamıştır. Daha açık bir ifadeyle; organik karakterli materyallerin yakılması neticesinde oluşan CO_2, atmosferde bulunması gereken değerin üstüne çıkmış ve bu artan oranlar yerkürenin daha ısınmasına neden olmuştur. Artan ısı değerleri ile birlikte suyun fazla buharlaşması neticesinde kuraklık faktörü ortaya çıkmıştır. Dolayısıyla küresel ısınma ve kuraklık arasında direk bir bağlantıdan bahsedebiliriz. Bitikler üzerinde genel anlamda çok ciddi etkilere sahip olan abiyotik stres faktörü olan kuraklık, bitkilerin yaşam döngüsü ve verim parametreleri üzerinde olumsuz ve yıkıcı etkilere neden olmaktadır. Bunun bir sonucu olarak artan dünya nüfusunun gıda temininde ciddi problemlerin yaşanabileceği kaçınılmaz bir son olarak görülmektedir.

Karbondioksitin sera etkisi göstermesi ve sonuç olarak ortaya çıkabilen küresel ısınma, günümüz dünyasında insanoğlunun karşılaşabileceği en ciddi problemlerden birini temsil etmektedir (Çepel, 2008). Küresel ısınma neticesinde ortaya çıkan iklim değişikliğinin daha anlaşılır olması bakımından yapılan modellemelere göz atıldığında, 2100 yılına kadar yerkürenin ortala sıcaklığının 1 ile 3 ^{0}C arasında artış gösterebileceği ve bunun bir neticesi olarak orman yangınlarında artışın olacağı ve ayrıca şiddetli kuraklığın baş gösterebileceği anlaşılmaktadır (Demir ve ark., 2013). Küresel ısınmayla birlikte ürün kayıpları ve gıda temininde karşılaşılabilecek zorlukların yanı sıra zorlanan hayat koşullarının yanında ciddi manada sağlık sorunlarının da meydana gelebileceği muhtemel olaylar içerisindedir. Tüm bu değişikliklere karşın adaptasyonu sağlayan canlı türleri yaşamlarını devam ettirirken, uyum noktasında zorluk çeken canlı türleri yok olmakla karşı karşıya kalabileceklerdir. Böylelikle, yukarıda bahsettiğimiz olumsuzlukların devam etmesine bağlı olarak ekosistem ciddi manada zarar görebilecektir (Aksay ve ark., 2005).

BİTKİLER VE KURAKLIK STRESİ

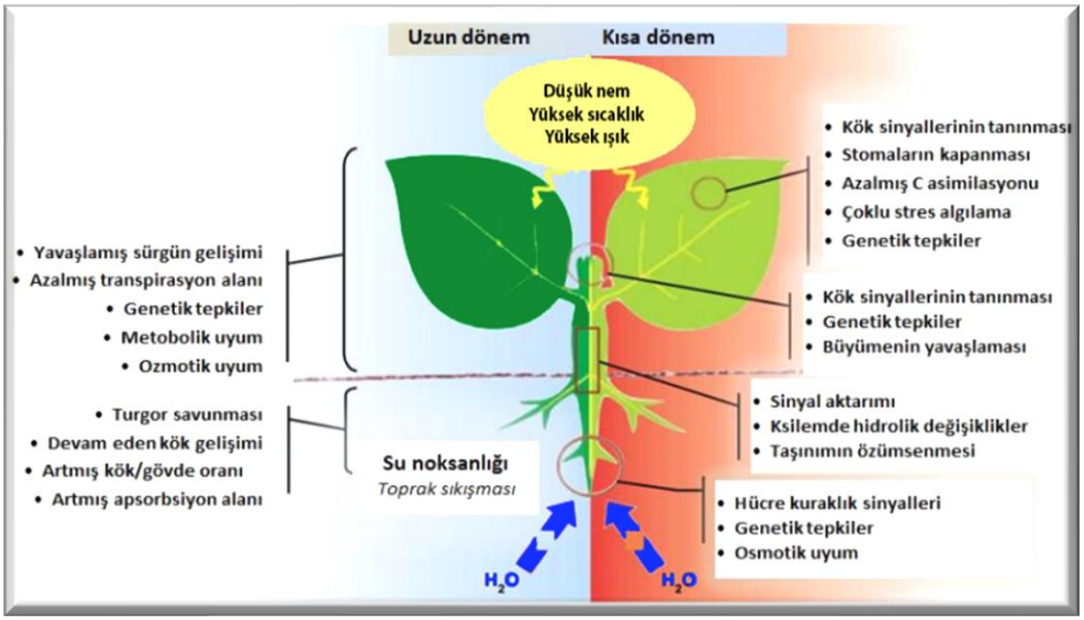
Kuraklık, belli bir zaman aralıklarında suyun, belli alanlarda her ne sebeple olursa olsun gerek duyulan miktarının altında bir seyir izlemesi şeklinde tanımlanmaktadır. Bu stres faktörü

bitkide birçok anlamda bir takım olumsuz sonuçlarla kendini ortaya koymaktadır. Bu olumsuzluklar arasında doğal bitki örtüsünün zayıflanması ya da yok olması, tarımsal üretimlerin azalması, zararlı bitiklerin ve zararlı otların yayılması gibi bir takım olumsuzluklar olabileceği gibi, rüzgâr erozyonlarının artması ve yeraltı su kaynaklarının azalması da ayrıca sıralanacaklar arasında yer almaktadır (Türkeş, 2012).

Su, ağaçların taze ağırlıklarında %50 ve diğer bitkilerin ise taze ağırlıklarında %89 ile %90 oranında bir değer ihtiva eder (Anjum ve ark., 2011). Kuraklık, bitkilerin büyümelerini ve gelişmelerini ciddi manada etkileyen abiyotik stres faktörüdür. Verim bakımından bitkiler üzerinde kuraklık stresi birçok fizyolojik olaylara tesir etmektedir. Bitkilerin kuraklığa olan hassasiyetleri en çok generatif dönemde kendini gösterebilmektedir. Bu konularda yapılan çalışmalar göstermiştir ki, tohum oluşumunun başladı dönemlerde meydana gelebilecek ciddi bir su noksanlığının %95 gibi bir seviyeye ulaştığında, verim kayıplarının ortaya çıkmıştır. Özellikle bitkiler de generatif dönemde yani çiçeklenmenin başladı dönemlerde meydana gelebilecek bir kuraklığın bitkilerde kısırlığa neden olabileceği bilinmektedir (Farooq ve ark., 2009). Kurak koşullarda bitki büyümesi ciddi manada etkilenmektedir. Bu etkilenmenin süresi kuraklığın devam ettiği süreye göre farklılıklar gösterebilmektedir. Kuraklığın ortaya çıktığı ilk dönemlerde bitkiler daha fazla sudan yararlanmak için gövde gelişimlerini durdurarak kök gelişimlerini teşvik ederler. Fakat bu sürenin fazla devam etmesine bağlı olarak bitkiler zarar görmeye başlar ve hem gövde hem de kök gelişmeleri durmaktadır. Bitki yaprak sayısında ve yaprak alanında düşüşler meydana gelir ve ayrıca yapraklar sararıp dökülmeye başlarlar. Kuraklık stresine bağlı olarak bitkilerin kök ve sürgün meristem dokularında hücre bölünmelerinin ve gelişmelerinin sekteye uğramasıyla bitki büyümesinde bariz düşüşler meydana gelebilmektedir. Bu gibi olayların fotosentez oranındaki azalmalar ile yakın bir ilişkisi vardır (Anjum ve ark., 2011).

Bitkiler üzerinde etkisi bakımından kuraklık stersi iki şekilde etkisi göstermektedir. Bu etkilerden bir su noksanlığı iken diğer ise kuruma şeklinde ortaya çıkmaktadır (Smirnoff, 1993). Burada bahsi geçen su eksikliği, yaprak stomalarında kapanma ve gaz değişiminde azalmalar şeklinde ortaya çıkabilen orta seviyedeki su kayıplarıdır. Bitkilerde oransal su içeriğindeki %70'lik azalmanın bir sonucu olarak yapraklardaki stomalar kapanmaya başlar ve böylece karbondioksit asimilasyonu da azalmaya başlar. Bir diğer olumsuzluk olan kuruma ise hücrenin metabolizmasında ve yapısındaki yapısal olarak ortaya çıkan dejenerasyonun meydana gelmesi ve benzeri durumların cereyan etmesi gibi aşırı düzeyde su kaybı şeklinde tanımlanabilmektedir

(Smirnoff, 1993; Kalefetoğlu ve Emekçi, 2005). Bitkide solma neticesinde bitki turgor basıncında ortaya çıkan çökmeler nedeniyle hücresel bazda kayıplar oluşmaktadır. Fakat gereksinim duyulan suyun bitki tarafından tedarik edilmesiyle birlikte bitki kolaylıkla solmadan önceki haline geri dönebilmektedir. Ancak, kuruma olayında solma ileri düzeylere vardığından her ne kadar bitkinin kaybettiği su karşılansa da bitkinin önceki haline dönebilmesi pek mümkün olamamaktadır (Kaçar, 2015). Bilhassa oransal su içeriğinin %30 gibi oranlara varması, kurumaya duyarlı vasküler bitkilerin birçoğunda vejetatif dokularda iyileşme süreci gerilerken aynı zamanda dönüşü mümkün olmayan bir süreç işlemeye başlamaktadır (Kalefetoğlu ve Emekçi, 2005). Bitki yapraklarında meydana gelen terlemeyle su kaybı ortaya çıkar ve bu eksikliğin geri kazanılmamasıyla birlikte turgor basıncında çökmeler meydana gelir ve bunun neticesinde yaprak hücrelerinde ortaya çıkan plazmolizden dolayı pörsümeler görülür (Günay, 2005).



Şekil 1. Bitkide kuraklık stresinin uzun dönem ve kısa dönemde görülen reaksiyonları (Chavez ve ark., 2003)

Gövde boyu üzerindeki olumsuz etkilerinin yanı sıra kuraklık stresinin kavun ve domates bitkilerinde çok belirgin olabilecek bir şekilde bitki gövde çapında da azalmalara neden olduğu belirlenmiştir (Gallardo ve ark., 2004). Kuraklık stresiyle tanışan bitkilerin hacimsel oranları ile stres ile karşılaşmayan bitkilerin hacimsel oranları bir birlerinden farklıdır. Diğer bir ifadeyle, kuraklık stresi bitkilerin hacimsel olarak küçülmelerine neden olmaktadır (Anjum ve ark., 2011). Ayrıca kuraklık stresinin bitkide fotosentezi olumsuz etkilediğini birçok

araştırmacı tarafından tespit edilmiştir (Chavez, 1991; Ganieva ve ark., 1997; Ruiz-Lozano ve ark., 2012; Osakabe ve ark., 2014, Ragazzi ve ark., 2014; Ashraf ve Arfan (2005).

Kuraklık stresinin bitkiler üzerindeki olumsuz bir başka etkisi de, yapraklarda su oranının düşmesine bağlı olarak stomalar kapanmakta ve bununla birlikte yaprak sıcaklığında ortaya çıkan artışlar neticesinde hücrenin membran sistemlerinde cereyan eden zararlanmalar gibi bir takım ardışık olaylar neticesinde hücresel ölümler görülmektedir (Farooq ve ark., 2009; Flexsas ve ark., 2007; Dolferus, 2014). Bu gibi hasarlar hücresel metabolizmayı genellikle dönüşü olmayacak bir şekilde tahrip edebilmektedir (Kalefetoğlu ve Ekmekçi, 2005).

KURAKLIK VE BİTKİLERİN SAVUNMA MEKANİZMALARI

Kuraklık toleransı, suya ulaşmanın kısıtlı olduğu dönemlerde bitkilerin yaşamsal aktivitelerini sürdürebilme yeteneği olarak tanımlanabilmektedir. Kuraklık stresine karşı bitkiler geliştirebildikleri kuraklık toleransı ile savunma sistemlerini ve dayanımlarını sağlayabilmektedirler. Kuraklık karşısında bitkiler geniş bir kök sistemi oluşturarak ve stomalarını kapatarak kuraklıktan korunma mekanizmalarını oluştururlar. Kuraklığa tolerans mekanizmasına sahip olan bitkiler, bilhassa düşük su seviyelerinde membran sistemi koruyarak ve ozmatiği düzenleyerek hücresel düzeylerde bir mekanizma geliştirebilmektedirler (Franco ve ark. 1997; Asraf ve Iram 2005; Kuşvuran ve ark. 2008; Kuşvuran 2010).

Kurak koşulların oluştuğu ilk dönemlerde bitkiler kuraklıktan korunma adına gövde büyümelerini yavaşlatarak kök gelişimlerini artırırlar (Öztürk, 2015). Ayrıca bitkiler gereksinim duydukları suyu kök bölgelerinden temin edemediklerinde stres koşulları meydana gelir ve böylece bitkiler karşılaştıkları bu durumdan sıyrılabilmek için su kayıplarını azalmak ya da su alımlarını artırmak gibi bir takım önlemler geliştirirler (Bray, 1997). Kuraklığa dirençli bazı bitkilerin yapraklarının mumla kaplı olması, güneş ışınlarına karşın yaprak yönlerinin değiştirmesi ve yaprakların kıvrılması bitkilerin kuraklık stresinden kaçmak için geliştirdikleri mekanizmalar arasında yer almaktadır (Sağlam, 2004). Su noksanlığına maruz kalan bitkilerin ilk aşamada gösterdikleri tepki, stomalarını kapatıp veya daraltarak su kaybını minimum seviyede tutma şeklinde gerçekleşmektedir (Osakabe ve ark., 2014). Bu durumda fotosentez olayında düşüşler meydana gelebilmektedir (Chavez ve ark., 2003). Kuraklık stresine bağlı olarak bitkide fotosentez hızının düşmesiyle ortaya çıkan, sinyal iletişim mekanizmasında önemli bir rolü olan ve hücre metabolizmasının doğal bir ürünü olan tekli oksijen, süperoksit anyonu ve hidrojen peroksit benzeri reaktif oksijen türevleri, bitkilerin kuraklık stresine karşı

geliştirdikleri adaptasyon mekanizmaları arasında yer alır (Anjum ve ark., 2011; Bhargava ve Sawant, 2013; Cabello ve ark., 2014).

Tür ve çeşitlere göre bitkilerin kuraklık stresinden etkilenme düzeyleri arasında farklılıklar olduğu gibi, bitki organları arasında bile farklılıklar ortaya çıkabilmektedir (Belkhodja ve ark., 1994). Böylece genotiplere göre farklı düzeylerde ortaya çıkabilen kuraklığın bitkideki etkisi, strese maruz kalan o genotipin fizyolojik ve biyokimyasal reaksiyonlara göre farklılıklar ortaya koyabilmektedirler (Kayabaşı, 2011).Bu anlamda yapılan biyokimyasal çalışmalar göstermiştir ki, kuraklık stresine uyum sağlayabilen bitkilerin yapraklarında prolin biriktirdikleri saptanmıştır. Yapılan karşılaştırmalarda kuraklık stresine dayanıklı ve dayanıksız varyetelerde kuraklığa dayanıklı olan varyetelerin daha çok proline sahip oldukları belirlenmiştir (Singh ve ark., 1972). Soyada yapılan bir çalışmada böyle bir durumun gözlemlendiği tespit edilmiştir (Guo ve Ark., 1988).

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A REVIEW OF ECONOMIC IMPORTANCE AND VIABILITY OF GOLD: A CASE STUDY OF ILESHA SCHIST BELT, SOUTHWESTERN NIGERIA

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ABSTRACT
Nigeria, endowed with the precious metal gold, holds significant economic potential in its northwest and southwest regions within the Schist Belts. Artisanal mining in the Iperindo axis of the Ilesha Schist Belt has been reported, yet the absence of comprehensive geoscience data hinders optimal resource development. This study highlights the economic viability of gold occurrences in the area, leveraging geoscience research findings. Geonics EM34-3 and SuperSting R8/IP/SP meters were used for frequency domain electromagnetic (FDEM) and electrical resistivity tomography (ERT) profiling, along with geochemical sampling of soil and stream sediment, to assess gold mineralization potential in the studies that were reviewed. Apparent resistivity data from ERT profiles were inverted using RES2DINV software, and Oasis Montaj was used to generate 2D conductivity/resistivity sections, maps, and 3D subsurface models. The results showed that gold or base metals might be present in pegmatitic veins in low-resistivity and high-conductivity areas. Processed geochemical data indicated areas with substantial mineralization potential. The study's findings are crucial, presenting an opportunity for the commercial exploitation of gold in the Ilesha Schist Belt. Rather than expanding artisanal mining operations in the region, this may result in the government collecting a royalty tax and creating jobs and economic growth for both the local community and the country as a whole.
Keywords: Gold Mineralization, Low Resistivity/High Conductivity Zones, Pegmatitic Veins, Threshold, Iperindo.

INTRODUCTION

Nigeria, endowed with the precious metal gold, holds significant economic potential in its northwest and southwest regions within the Schist Belts. Artisanal mining in the Iperindo axis of the Ilesha Schist Belt has been reported, yet the absence of comprehensive geoscience data hinders optimal resource development. Nigeria's gold mineralization is orogenic, which means that it is controlled by deep-seated fractures. It can be found in amphibolites in the Ilesha and Egbe areas, where it is found in higher concentrations than the normal primary gold content for rocks of the same type (Osinowo et al., 2020). This study reviewed the works of Osinowo et al., 2020; Usman et al., 2020; and Usman et al., 2021 to highlight the economic viability of gold occurrence in the area. The studies that were looked at used Geonics EM34-3 and SuperSting R8/IP/SP meters for frequency domain electromagnetic (FDEM) and electrical resistivity tomography (ERT) profiling, along with soil and stream sediment sampling geochemical methods to figure out how likely it was that the study area would have gold deposits. A lot of research has reported that ERT gives accurate information about the subsurface (conductivity distribution) that can be used to figure out where metal deposits are located (Osinowo et al., 2020). The ease with which electric current can pass through the earth is measured by electromagnetic (EM), and its techniques depend on how the ground reacts to an alternating field that is spreading. An alternating current flows through a large loop of wire or a small coil with many wire turns (Usman et al., 2021). The apparent ground conductivity σ_a (equation 1) is measured by electromagnetic technology and depends on various factors such as coil separation (s), operating frequency f, magnetic permeability of the vacuum, and the ratio of the amplitudes of the primary and secondary electromagnetic fields $\frac{H_s}{H_p}$.

$$\sigma_a = \frac{4}{\omega \mu_0 s^2} \frac{H_s}{H_p} \quad \text{.....(1)}$$

where, $\omega = 2\pi f$. According to Telford et al. (1990) and Kearey et al. (2002), this suggests that the depth of investigation is dependent on the frequency of the inducing field and the conductivity of the medium of propagation. The deeper the penetration, the lower the frequency and conductivity of the terrain. Finding good field features, like cracks and joints, that could be good places for minerals to form and finding streams where sediments from streams were collected are some of the things that the reconnaissance study for a pre-geochemical examination tries to do.

MATERIALS AND METHODS

Study Area

The study area is situated in the Basement Complex of southwest Nigeria, it lies between latitudes 7o25' N and 7o45' N and longitudes 4o35' E and 4o55' E. The area is primarily composed of granite gneiss, with pegmatite veins intruding, along with quartzite and quartz schist that may contain gold (Figure 1). The majority of the rocks in the study region mostly strike in a north-south direction and dip in schist between 70° and 80°W and in quartz schist up to 80°W (Usman, 2019).

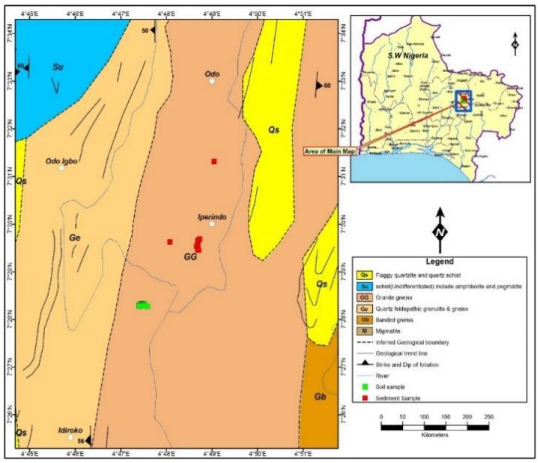


Figure 1: Geological Map of the Study Area (Adapted from NGSA, 2009).

Data Acquisition

A multi-electrode Supersting R8/IP/SP resistivity meter (Figure 2a) was used to collect data for ERT. This resistivity meter can measure ground resistance at multiple electrode stations simultaneously along the established profile, making field measurement quicker and less laborious (Griffiths et al., 1990). The Geonics EM34-3 Terrain Conductivity Meter was used to collect data for EM (Figure 3a). It is a frequency domain electromagnetic magnetic (FDEM) geophysical device that interacts with the subsurface and gathers information on the electrical characteristics of the earth using the electromagnetic induction principle. The transmitter and receiver coils of the system connect via cables to various console units. The primary electromagnetic fields were produced using the transmitter coil and console, and the secondary electromagnetic fields were analyzed and readings were taken using the receiver coil and console. Figures 2b and 3b show that five ERT profiles and six EM profiles were set up, with 10 m between each profile, which is 336 m long. For ERT, this was accomplished by using an

electrode configuration with two dipoles spaced three meters apart (Osinowo et al., 2020; Usman et al., 2021). For the geochemical technique, soil (9 samples) and stream sediment (11 samples) were collected and analyzed at Bureau Veritas Minerals Laboratories, Vancouver, Canada (Usman et al., 2020).



Figure 2a: Geophysical Crew Deploying ERT meter

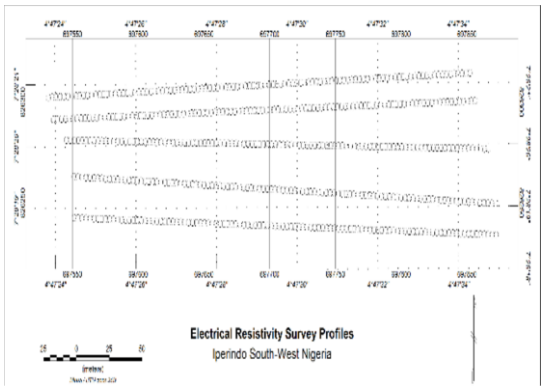


Figure 2b: ERT Survey Profiles Base Map.



Figure 3a: Geophysical Crew Deploying
EM Conductivity Meter

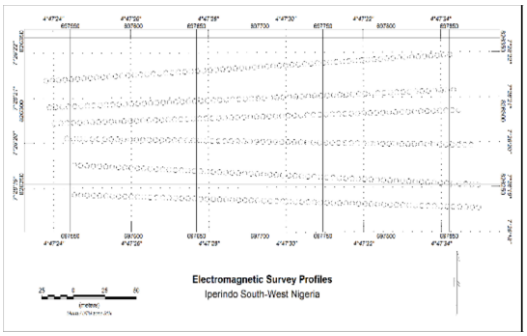


Figure 3b: EM Survey Profiles Base Map.

The resistivity meter directly measured the apparent ground resistivity data, which was then quality-checked (QC) and consistency-verified. Apparent resistivity data from ERT profiles were inverted using Loke and Baker's (1996) RES2DINV inversion program, and Oasis Montaj was used to generate 2D conductivity/resistivity sections, maps, and 3D subsurface models (Osinowo et al., 2020; Usman et al., 2021) using kriging gridding techniques (Chiao et al., 2014). According to Usman et al., 2020, the data from the analyzed soil and stream sediment

samples were processed with R, SPSS, and MS Excel. These were utilized to assess the ground conductivity distribution's ability to identify anomalous ground conductivity zones, as well as the gold potential of the Iperindo axis inside the Ilesha Schist belt.

FINDINGS AND DISCUSSION

Table 1 below reveals the ERT profiles that trend along the E-W direction of the study area and are imaged up to 66 m below the surface. The profiles show that the resistivity distribution values range from 3.41 to 18836 **Ω**m for profile 1, 4.41 to 9875 **Ω**m for profile 2, 24.4 to 4572 **Ω**m for profile 3, 6.91 to 134456 **Ω**m for profile 4 and 4.91 to 87000 **Ω**m for profile 5. For all the profiles, three geoelectric layers were delineated. The near-surface overburden layer, about 4 to 9.56 m below the surface, generally displays a relatively low resistivity distribution. The result also presents heterogeneous low-resistivity faults and fractured zones extending up to a depth of about 40 m, that is, having a thickness of about 21.5 to 30.44 m. The final high-resistive fresh basement generally characterizes the deeper part of the subsurface.

Table 1: Summary of Resistivity Layers with Depth and Thickness of the ERT Profiles

Profile No.	No. of Layers	Description	Thickness (m)	Depth (m)	Resistivity Range (Ωm)
1	1	Overburden	5.50	5.50	3.41 – 137
	2	Faults/Fractured Basement	23.5	29.00	4 – 100
	3	Fresh Basement	37.10	66.10	1500 – 18836
2	1	Overburden	7.56	7.56	4.41 – 60
	2	Faults/Fractured Basement	27.94	35.50	14 – 470
	3	Fresh Basement	30.60	66.10	1486 – 9875
3	1	Overburden	5.00	5.00	24.4 – 74.6
	2	Faults/Fractured Basement	13.30	18.30	2.6 – 229
	3	Fresh Basement	47.80	66.10	229 – 4572
4	1	Overburden	4.00	4.00	6.91 – 58.7
	2	Faults/Fractured Basement	21.50	25.50	58.7 – 490
	2	Fresh Basement	40.60	66.10	2818–134456
5	1	Overburden	9.56	9.56	4.91 – 95
	2	Faults/Fractured Basement	30.44	40.00	21.6 – 418
	3	Fresh Basement	26.10	66.10	1802–87000

Table 2 below reveals the EM profiles that trend along the E-W direction of the study area and are imaged up to 60 m below the surface. The profiles show a conductivity distribution that ranges in value from 2.61 to 22.59 mS/m for profile 1, 4.26 to 22.16 mS/m for profile 2, 4.72 to 22.65 mS/m for profile 3, 4.27 to 22.95 mS/m for profile 4, 4.27 to 24.20 mS/m for profile

5, and 4.27 to 22.51 mS/m for profile 6. Three geoelectric layers were delineated for all the profiles. The near-surface overburden layer, about 12.6 to 20.5 m below the surface, generally displays a relatively low conductivity distribution. The result also presents zones with high conductivity distribution values extending up to a depth of about 50 m, that is, having a thickness of about 30.5 to 35.5 m. The final low-conductivity fresh basement generally characterizes the deeper part of the subsurface.

Table 2: Summary of Conductivity Layers with Depth and Thickness of the EM Profiles

Profile No.	No. of Layers	Description	Thickness (m)	Depth (m)	Conductivity Range (mS/m)
1	1	Overburden	14.50	14.50	2.69 – 10.70
	2	Faults/Fractured Basement	30.50	45.00	13.13 – 22.59
	3	Fresh Basement	15.00	60.00	4.61 – 11.76
2	1	Overburden	12.60	12.60	4.26 – 10.98
	2	Faults/Fractured Basement	31.90	44.50	14.83 – 22.16
	3	Fresh Basement	15.50	60.00	5.92 – 14.83
3	1	Overburden	13.00	13.00	4.72 – 11.02
	2	Faults/Fractured Basement	35.50	48.50	12.96 – 22.65
	3	Fresh Basement	11.50	60.00	6.02 – 11.02
4	1	Overburden	15.00	15.00	4.27 – 10.00
	2	Faults/Fractured Basement	34.00	49.00	13.93 – 22.95
	2	Fresh Basement	11.00	60.00	5.90 – 12.09
5	1	Overburden	20.50	20.50	4.27– 12.61
	2	Faults/Fractured Basement	29.5.50	50.00	14.59 – 24.20
	3	Fresh Basement	10.00	60.00	5.92 – 12.61
6	1	Overburden	18.50	18.50	4.27 – 10.43
	2	Faults/Fractured Basement	31.00	49.50	14.09 – 22.51
	3	Fresh Basement	10.50	60.00	6.21 – 12.27

The 3D subsurface conductivity distribution of the research area was delineated using integrated individual georeferenced, filtered, gridded, and depth-sorted conductivity profiles (Figures 4a & b). The figures show that the conductivity values in the entire research region range from less than 4.44 to 22.12 mS/m. The near-surface region is primarily low in apparent conductivity distribution (4.44 to 11.00 mS/m), with isolated high conductivity zones (19.00 to 23.00 mS/m) limited to the study area's eastern and western regions. Additionally, the figures reveal that the

bottom section, which corresponds to the fresh or unweathered basement, has low apparent conductivity values.

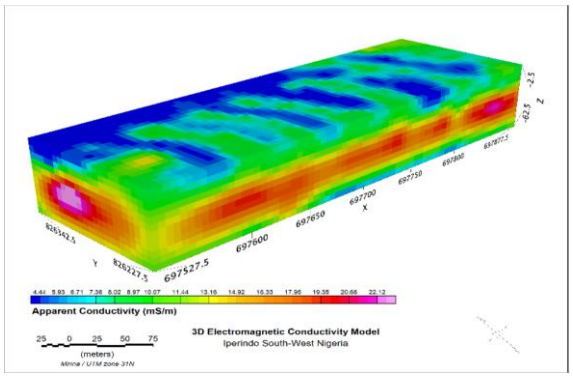


Figure 4a: 3D EM Conductivity Distribution Image of the Study Area

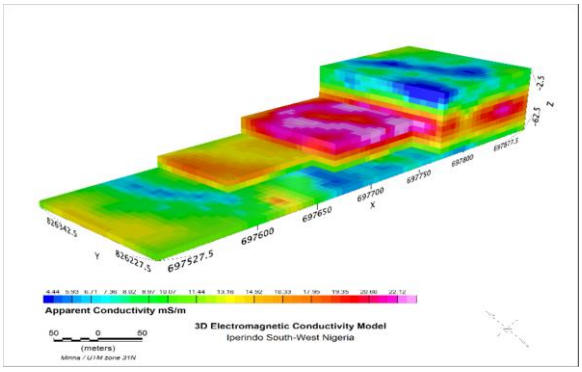


Figure 4b: Sliced EM Conductivity 3D Model to Reveal Desired Parts of the Model.

The estimated background values for Au in soil samples and stream sediments for the study area were 1.3 ppb each, and thresholds were 4.44 and 2.60 for soil and stream sediments, respectively. Au concentration ranges from 0.2–5.4 ppb with a mean of 1.36 ppb in soil samples and ranges from 0.4–3.1 ppb with a mean of 1.2 ppb in stream sediments (Tables 3 and 4). As shown in Figure 5a, the stream sediment in location 11 (SS11) has the highest recorded Au content (3.1 ppb), while the stream sediment in location 4 (SS4) has the lowest recorded Au value (0.4 ppb). Soil samples in locations 8 and 9 also have the highest recorded Au content (5.4 ppb) and the lowest recorded Au value (0.2 ppb) (Figure 5b) (Usman et al., 2020).

According to the bivariant plot (Figure 6) that illustrates the correlation between As, Sb, and Au concentrations, Au concentrations are highest in soil samples where As concentrations are relatively high and Sb concentrations are low. This indicates that there is an enrichment (positive correlation) between Au and As (Usman et al., 2020)

Table3: Metal Distribution Result for Soil Samples

Elements	Soil Samples (n = 9)		Threshold (2SD+Mean)	Calculated Background Values (ppm)
	Range	Mean±SD		
Cu	13.5 – 74.1	42.19±19.18	80.55	42
Pb	46.28 – 68.55	54.97±7.18	69.33	55
Zn	40 – 1197.2	219.06±350.69	920.44	250
Ni	1.8 – 29.7	10.50±7.65	25.80	13
Co	0.9 – 15.4	7.93±5.13	18.19	10
Mn	99 – 568	337.22±185.05	707.32	320
Au (ppb)	0.2 – 5.4	1.36±1.54	4.44	1.3
V	19 – 76	46.67±16.10	78.87	50
Cr	12 – 58	29.56±12.17	53.90	32

Table: Metal Distribution Result for Stream Sediments

Elements	Stream Sediments (n=11		Threshold (2SD+Mean)	Calculated Background Values (ppm)
	Range	Mean±SD		
Cu	15.5 – 33.7	26.26±5.93	38.12	28
Pb	39.23 –57.64	47.84±4.95	57.74	48
Zn	189.7 – 1083.5	468.6±245.09	958.78	550
Ni	3.1 – 10.7	5.38±2.55	10.48	8
Co	2.7 – 15	5.48±3.36	12.20	5
Mn	153 – 406	240.55±69.80	380.15	240
Au (ppb)	0.4 – 3.1	1.2±0.70	2.60	1.3
V	17 – 55	26.82±10.00	46.82	28
Cr	12 – 33	17.09±5.84	28.77	18

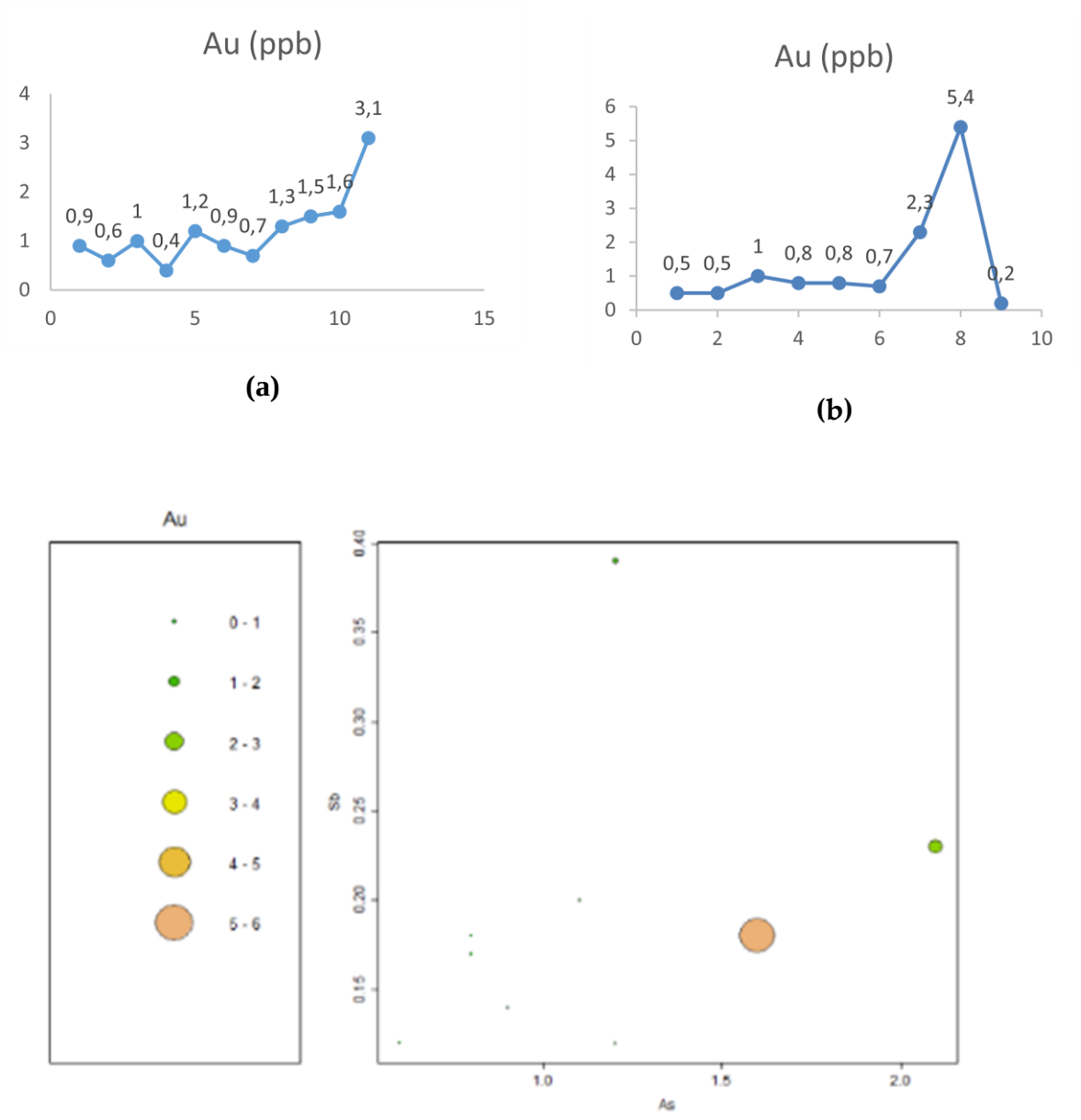


Figure 6: Bivariant Plot Displaying correlation between As, Sb, and Au concentrations

According to Osinowo et al., 2020 and Usman et al., 2021, a few discrete areas with a distribution of high conductivity and low resistivity were revealed. Zones of low resistivity and high conductivity are identified in the eastern and western parts of the study area. These zones are probably made up of a number of veins and faults that seem to be saturated with conductive elements like gold, groundwater, or base metals, which most likely occur in conjunction with mineralized pegmatitic veins.

As seems to be the most suggestive pathfinder element in the study area, according to Usman et al., 2020. The highest amounts of Au were found in the soil and stream sediments that were analyzed, which are higher than the statistical threshold values used to separate background from Au anomalies in the study area. The computed background value of Au for the research area was determined to be 1.3 ppb, while Au concentrations greater than 1 ppb are regarded as anomalous enough to merit curiosity for future exploration.

CONCLUSION

The results revealed potential gold or base metal mineralization in pegmatitic veins within low-resistivity and high-conductivity zones. Processed geochemical data indicated areas with substantial mineralization potential. The findings in this study are of utmost significance and value, especially for the exploitation of the gold resource mineralization potential of the study area. Rather than expanding artisanal mining operations in the region, this may result in the government collecting a royalty tax and creating jobs and economic growth for both the local community and the country as a whole.

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STATISTICAL MODELS FOR EVALUATE TO EFFICACY OF CHRONIC KIDNEY DISEASE CONTROL MEASURE

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ABSTRACT
Chronic kidney disease (CKD) is a potentially life-long condition that can result from kidney cancer or reduced kidney function. However, it is possible to slow or stop the progression of this disease before it reaches a critical stage where dialysis or surgery is the only option to save the patient's life. Timely diagnosis and proper treatment can significantly increase the chances of success. This paper introduces the shock model approach, which is utilized to assess the effectiveness of treatment for CKD patients in achieving the threshold level. The model is accompanied by graphical illustrations for ease of use.
Keywords: Chronic Kidney Disease, Non-Communicable Diseases, Glomerular Filtration Rate, Diabetes, Hypertension and Burr-XII distribution,

INTRODUCTION

Health and health issues are a matter of concern for the human being right from the origin of human life. WHO defined health as a state of complete physical, social, and mental wellbeing, and not merely the absence of disease or infirmity. The health system over the globe never before thought of splitting the terms of health into two broad categories such as Communicable and Noncommunicable Disease (NCD), had the firm belief that such a move might make more considerable distributional implications favoring the rich (Gwatkin, Guillot and Heuveline 1999[6]. Major noncommunicable diseases (NCD) identified are 'cardiovascular diseases (like heart attack and stroke), cancer, chronic respiratory diseases (such as chronic obstructed pulmonary disease and asthma), and diabetes apart from other co-morbid diseases WHO, 2010[15].

WHO defined chronic diseases as conditions of ill health which usually present with a prolonged period, produce, incapacity, or residual disability caused by irreversible pathological alterations, demand, and rehabilitation, and follow-up, over a long time and may present periods of improvement or visa vera in acute stages Barros et.al., 2006[4]. Most of the chronic diseases are life-threatening but can adopt the conventional approaches of care and management since it has a chronic course WHO, 2004[13]. Human beings suffer from communicable and non-communicable diseases.

Kidneys are vital organs whose basic function is to remove the waste products from the blood, which cleanses harmful toxins and ultimately convert the waste products into urine, which then flows to the urinary bladder where it is eventually discharged via the urethra. In the first step of making urine, the plasma is separated. The glomerulus called microscopic filter present in each nephron in kidney continuously filters the blood. The walls of the glomerulus permit smaller size molecules, wastes, and fluid (mostly water) to excrete into the tubule. Bigger molecules, such as proteins and blood cells, reside in the blood vessel Webster et.al[3],

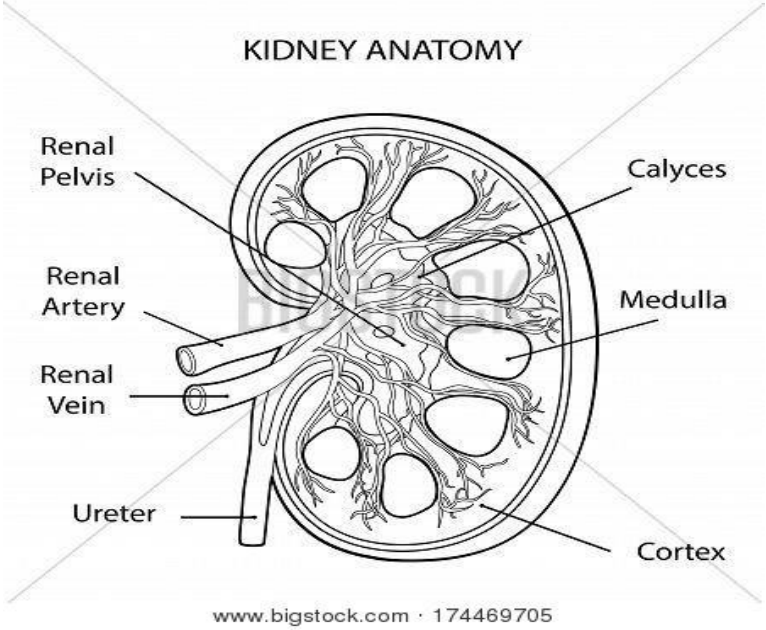


Figure: 1- Kidney Anatomy

Symptoms of CKD as follow:

- Lack of appetite
- Skin becomes itchy and dry
- Frequent need to urinate especially at night
- Muscle cramp during the night
- Unable to sleep at night
- Eyes look puffy especially in the morning
- Lack of energy and fatigue
- Unable to concentrate on a task
- Feet and ankles become swollen

Chronic Kidney Disease is one of the emerging major Noncommunicable Diseases, getting more attention of researchers and the medical community. In many cases, it leads to early death and disability. These diseases were considered to be affecting mostly the elderly and the wealthy, thus terming it to be a disease of affluence, affecting only those who are wealthy and the old. This belief prevented the timely intervention of strategies among patients who live in lower-income WHO, 2007[14]. Chronic Kidney Disease (CKD) carries high morbidity and mortality, as many patients live life through a frightening diagnosis.

According to WHO global health estimates, 864 226 deaths (or 1·5% of deaths worldwide) were attributable to this condition in 2012. Ranked fourteenth in the list of leading

causes of death, CKD accounted for 12·2 deaths per 100 000 people. Since 1990, only deaths from complications of HIV infection have increased at a faster rate than deaths from CKD. Projections from the Global Health Observatory suggest that although the death rate from HIV will decrease in the next 15 years, the death rate from CKD will continue to increase to reach 14 per 100 000 people by 2030.[16]

Burr (1942)[2] suggested twelve different forms of the cumulative distribution functions of Burr distribution. Among those twelve distribution functions, Burr type X and Burr type XII have received the maximum attention. The Burr-XII distribution, which was originally derived by Burr (1942)[2] and received more attention by the researchers due to its broad applications in different fields including the area of reliability, failure time modeling and acceptance sampling plan. Reader can find the applications in various fields from Ali and Jaheen 2002[7] and Burr (1942). Abdel-Ghaly et.al., (1997)[1] applied the Burr type XII distribution to measure software reliability. Zimmer et.al., (1998)[18] also studied statistical and probabilistic properties of the Burr type XII distribution and described its relationship to other distributions used in reliability analyses. Moore and Papadopoulos (2000)[11] derived Bayesian estimators of the parameter and the reliability function for the Burr type XII distribution under three different loss functions. Ali Mousa and Jaheen (2002)[2] considered Bayesian estimation of the parameters of the Burr distribution based on progressively censored samples. Wu and Yu (2005)[17] proposed pivotal quantities to test the shape parameter and establish confidence interval of the shape parameter of the Burr type XII distribution under the failure censored plan. Li et.al., (2007)[10] proposed the empirical estimators of reliability performances for Burr XII distribution under LINEX loss function.

BACKGROUND OF THE STUDY

Chronic kidney disease (CKD) is becoming a major public health problem worldwide. The current burden of disease is due to pathogenic progression of kidney disease. Patients with chronic kidney disease are at high risk for progression to the end stage renal disease (ESRD) – a condition in which kidney is no longer adequate to sustain life and renal replacement therapy requiring dialysis or kidney transplantation to maintain patient's long-term survival is required. The huge cost of treatment leads to a large burden for these patients and health care system, particularly in developing countries. Progress to kidney failure or other adverse outcomes could be prevented or delayed through early detection and treatment of chronic kidney disease[5].

Chronic kidney disease (CKD) as a progressive, irreversible deterioration in renal function in which the body's ability to maintain metabolic, fluid and electrolyte balance fails, resulting in uremia or azotemia which disturbs the homeostasis of all systems of the body. It can progress to end-stage renal disease (Stage -5 CDK) in which glomerular filtration rate (GFR) falls to 15 ml/minute/1.73 m^2 (Normal GFR=125 ml/minute/1.73 m^2)[8].

In India, there is a rising burden of chronic diseases like hypertension and diabetes mellitus. India has the largest number of diabetics in the world with a prevalence of 3.8% in rural and 11.8% in urban adults. The prevalence of hypertension has been reported to range between 20-40% in urban adults and 12-17% among rural adults. It is estimated that 25-40% of these patients are likely to develop chronic kidney disease with a significant percentage requiring renal replacement therapy. Prevalence of chronic kidney disease is associated with a large increase in cardio-vascular disease (CVD) risk. The cardio-vascular disease risk increases proportionally as estimated glomerular filtration rate (eGFR) falls below 60 ml/minute/1.73m^2 , lastly death from cardiovascular disease is eight-fold higher in chronic kidney disease, much higher than death from cancer. For non-communicable diseases like diabetes mellitus, hypertension and chronic kidney disease , the focus has been on developing advanced treatment facilities at the tertiary level.[9]

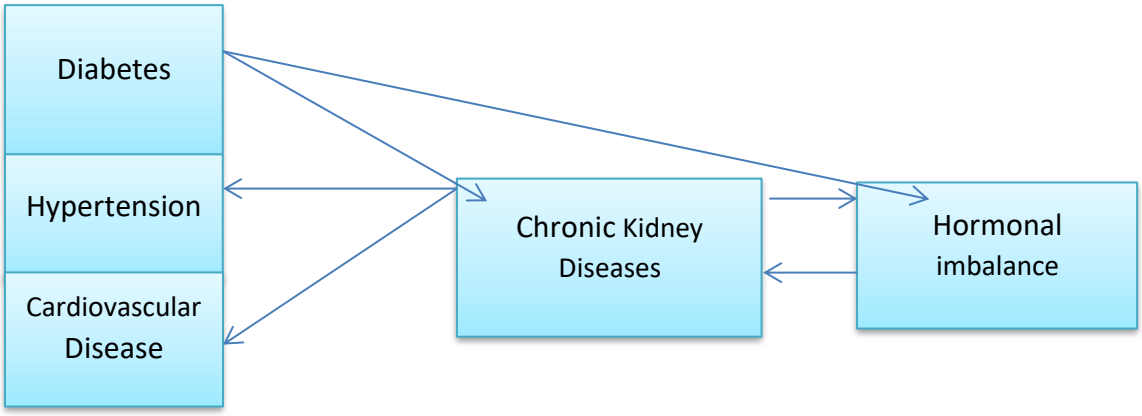


Figure: 2- Prognosis of persistent CKD

MODEL DESCRIPTION AND SOLUTIONS

It is proposed herein that the extended three-parameter Burr XII distribution be defined by the cumulative distribution function Quanxi Shao et.al., (2004)[12].

$$F_{EBXII}(x; c, k, \lambda) = 1\text{-}\left\{1\text{-}k\left(\frac{x}{\lambda}\right)^{c}\right\}^{\frac{1}{k}} \qquad k \neq 0$$

$$F_{EBXII}(x; c, k, \lambda) = 1\text{-}e^{-\left(\frac{x}{\lambda}\right)^{c}} \qquad k = 0 \qquad \ldots (1)$$

and the corresponding Probability Density Function (PDF) is

$$f_{EBXII}(x; c, k, \lambda) = c\lambda^{-1}\left(\frac{x}{\lambda}\right)^{c-1}\left\{1\text{-}k\left(\frac{x}{\lambda}\right)^{c}\right\}^{\frac{1}{k}-1} \qquad k \neq 0$$

$$f_{EBXII}(x; c, k, \lambda) = c\lambda^{-1}\left(\frac{x}{\lambda}\right)^{c-1} e^{-\left(\frac{x}{\lambda}\right)^{c}} \qquad k = 0 \qquad \ldots (2)$$

The corresponding Survival Function is (SF)

$$\bar{H}(x) = e^{-\left(\frac{x}{\lambda}\right)^{c}} \qquad \ldots (3)$$

Now, assuming that the threshold Y follows an extended three parameter Burr XII distribution with parameter λ, it can be proved that

$$P(X_i < Y) = \int_0^{\infty} g_k(x) e^{-\left(\frac{x}{\lambda}\right)^{c}} dx$$

$$= \left[g^{*}\left(\frac{1}{\lambda}\right)^{c}\right]^{k} \qquad \ldots (4)$$

$g_k(x)$ is the result of the Laplace Transformation of the convolution property and $\bar{H}(x)$ Evaluate to efficacy of Chronic Kidney disease patients. The survival function $S(t)$ which is the probability that an individual's survives for a time *t*

$$P(T > t) = \sum_{k=0}^{\infty} V_k(t)\, P(X_i < Y)$$

It is also known from renewal theory that

$$= \sum_{k=0}^{\infty} [F_k(t)\text{-}F_{k+1}(t)] \left[g^{*}\left(\frac{1}{\lambda}\right)^{c}\right]^{k} \qquad \ldots (5)$$

Using convolution theorem for Laplace transforms, $F_k(t) = 1$ and on simplification, it can show that $L(T) = 1\text{-}S(t)$

Taking Laplace Transformation of $L(T)$, we get

$$= 1-\left\{\sum_{k=0}^{\infty}[F_k(t)-F_{k+1}(t)]\left[g^*\left(\frac{1}{\lambda}\right)^c\right]^k\right\}^k \quad \ldots (6)$$

On simplifications we get,

$$L(T) = \left[1-g^*\left(\frac{1}{\lambda}\right)^c\right]\sum_{k=1}^{\infty}F_k(t)\left[g^*\left(\frac{1}{\lambda}\right)^c\right]^{k-1} \quad \ldots (7)$$

Let the random variable U denoting inter arrival time which follows exponential distribution Laplace transforms with parameter v. Now, $f^*(s) = \left(\frac{v}{v+s}\right)$, substituting in the below equation we get,

$$l^*(s) = \frac{v\left[1-g^*\left(\frac{1}{\lambda}\right)^c\right]}{\left[v+s-g^*\left(\frac{1}{\lambda}\right)^c v\right]} \quad \ldots (8)$$

$g^*(.)$~Exponential distribution with laplace Tranformation $\therefore \frac{\mu}{\mu+\lambda} \Rightarrow \lambda = \left(\frac{1}{\lambda}\right)^c$

$$= \frac{1}{v\left[1-\frac{\mu}{\mu+\left(\frac{1}{\lambda}\right)^c}\right]}$$ on simplification we get

$$E(T) = \frac{\mu+\left(\frac{1}{\lambda}\right)^c}{v\left(\frac{1}{\lambda}\right)^c} \quad \ldots (9)$$

NUMERICAL ILLUSTRATION

The influence of parameters on the performance measures namely the expected time to Chronic kidney disease are studied numerically. In the following table these performance measures are calculated by varying the parameters one at a time and keeping the parameters and fixed μ, λ and C .

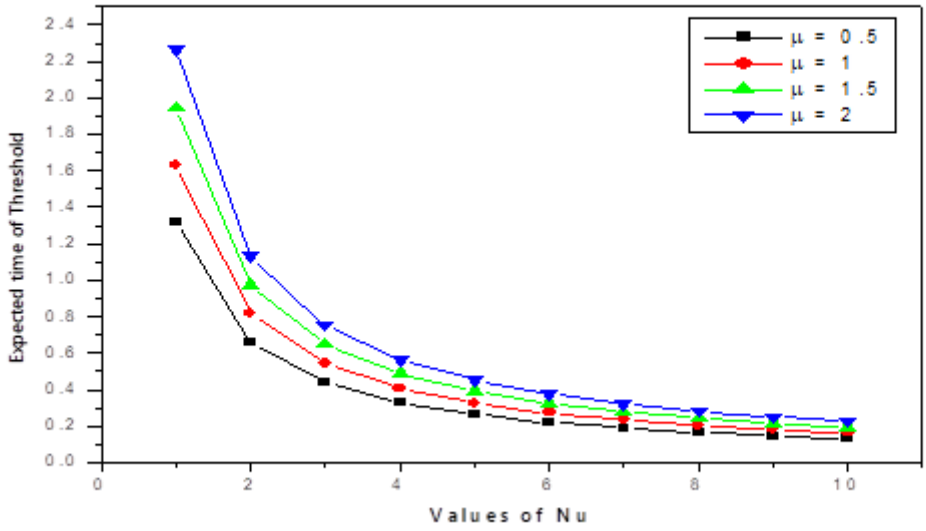


Figure-3: Expected times of parameter μ increases at different level in chronic kidney disease patients.

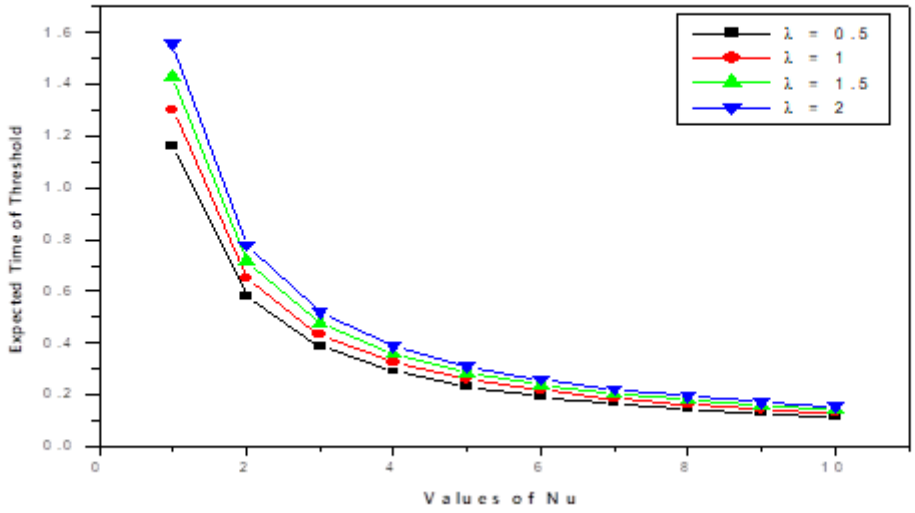


Figure-4: Expected times of parameter λ increases at different level in chronic kidney disease patients.

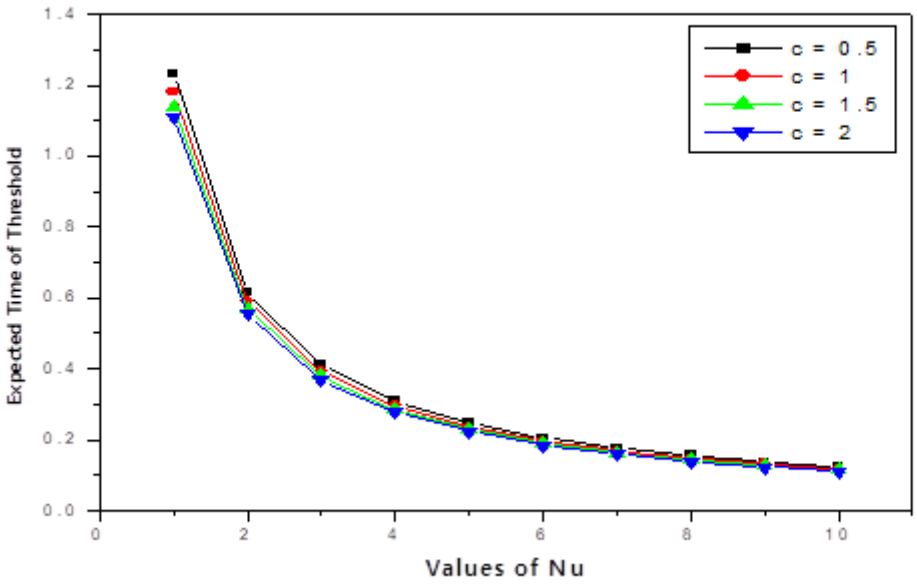


Figure-5: Expected times of parameter C increases at different level in chronic kidney disease patients.

CONCLUSIONS

Burr distribution was originally known as Burr Type XII distribution which was one of the twelve types of the continuous distributions in Burr system. It has two shape parameters k and c, which implies that its probability density function and hazard rate function can be either decreasing or non-monotone. It is implied from the probability density function which can be either decreasing or unimodal, and the hazard rate function which can be either decreasing or upside-down bathtub shaped. This non-monotone hazard rate function has an important role in survival analysis. On the other hands, Burr distribution has a certain moment only because of its tail behavior. It has a tail index like Pareto distribution. This fact implies that Burr distribution is heavy-tailed.

When μ is kept fixed the inter-arrival time 'ν' which follows exponential distribution, is an increasing case by the process of time to Chronic kidney disease. Therefore, Evaluate to Efficacy time E(T) to cross the time to chronic kidney disease is found to be decreasing, in all the cases of the parameter value $\mu = 1, 1.5, 2, 2.5, 3$. When the value of the parameter μ

increases, the Evaluate to Efficacy time is also found decreasing, this is observed in Figure 3.

When λ is kept fixed and the inter-arrival time 'ν' increases, the value of the Evaluate to Efficacy time E(T) to cross the time to Chronic kidney disease is found to be decreasing, in all the cases of the parameter value $\lambda = 1,1.5,2,2.5,3$. When the value of the parameter λ increases, the Evaluate to Efficacy time is found increasing, this is indicated in Figure 4.

When c is kept fixed and the inter-arrival time 'ν' increases, the value of the Evaluate to Efficacy time E(T) to cross the time to Chronic kidney disease is found to be decreasing, in all the cases of the parameter value $c = 1,1.5,2,2.5,3$. When the value of the parameter c increases, the Evaluate to Efficacy time is found increasing, this is indicated in Figure 5.

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Özet
Nitrik oksit, bitkilerde geniş bir düzenleyici fonksiyon yelpazesine sahip yaygın bir hücre içi ve hücreler arası sinyal molekülüdür. Nitrik oksidin yaygın biyolojik önemi, 1992 yılında Science tarafından serbest radikal NO• 'Yılın Molekülü' olarak adlandırılmış ve 1998 yılında nitrik oksidin bir molekül olarak keşfedilmesine yol açan çalışmalara memeli hücreleri tarafından üretilen biyolojik araç olarak Nobel Fizyoloji ve Tıp Ödülü verilmiştir. Bitkilerde nitrik oksit üzerine yapılan araştırmalar son yıllarda oldukça ilgi görmüştür ve bu molekülün çevresel stres faktörlerine karşı bitki savunma tepkilerindeki rolüne dair kanıtlar giderek artmaktadır. Stres faktörlerine karşı toleransın geliştirilmesi için bitkilerde savunma mekanizmalarının arttırılması gerekmektedir. Son yıllarda yapılan birçok deney nitrik oksidin stres koşullarında bitki büyümesine ve gelişmesine yardımcı olduğunu göstermiştir. Nitrik oksit, hücre ölümünün uyarılması, stoma hareketi, fotosentezin düzenlenmesi ve çiçeklerin düzenlenmesi gibi bitkilerde birçok süreçte rol oynamaktadır. Nitrik oksit birçok bitkide lignin biyosentezini desteklemektedir. Nitrik oksit, programlanmış hücre ölümünü tetikleyerek ksilemin farklılaşmasına yol açar. Nitrik oksit, stres koşulları altında bitkinin toleransını arttırmak için kullanılabilir. Nitrik oksit donörleri arasında sodyum nitroprussid (SNP) en çok kullanılanlardan biridir. Birçok çalışma, eksojen SNP'nin bitkilerde abiyotik stres faktörlerinin neden olduğu hasarı azaltabileceğini ortaya koymuştur. SNP bitkilerde absisik asit miktarını tetikleyerek stoma açıklığını kapattığı ve bitkileri kuraklığa karşı koruyabildiği belirlenmiştir. Stres sonucunda oluşan rekatif oksijen türlerini yok ederek bitkilerin streslerden daha az zarar görmesini sağlamaktadır. SNP uygulamaları bitkinin tuzluluk ve kuraklık streslerine karşı toleransının arttırılmasında başarılı olmuştur. Ayrıca SNP meyve ağaçlarının tomurcuklarında ksilemin erken dönemde oluşmasını sağlayarak tomurcuğa su geçişini ve böylece erkenciliği sağlamıştır. Bu derlemede nitrik oksidin bahçe bitkilerindeki fonksiyonları ve kullanım alanları tartışılacaktır.
Anahtar Kelimeler: Bahçe Bitkileri, Nitrik Oksit, Sodyum Nitroprussid, Stres.

USE OF NITRIC OXIDE IN HORTICULTURE

Abstract
Nitric oxide is a widespread intracellular and intercellular signalling molecule in plants with a broad spectrum of regulatory functions. The widespread biological significance of nitric oxide was recognized by Science in 1992 which named the free radical NO• 'Molecule of the year' and in 1998 the Nobel Prize in Physiology and Medicine was awarded for works that led to the discovery of nitric oxide as a biological mediator produced by mammalian cells. Research on nitric oxide in plants has gained considerable attention in recent years and there is increasing evidence of a role of this molecule in plant defence responses against environmental stress factors. Increase of defence mechanisms in plants is necessary for improving the tolerance to stress factors. In recent years, many experiments showed that the nitric oxide helps plant growth and development under stress conditions. Nitric oxide is involved in many processes of plants such as induction in cell death, stomatal movement, photosynthesis regulation and floral regulation. Nitric oxide promotes lignin biosynthesis in many plants. Nitric oxide leads differentiation of xylem by triggering programmed cell death. Nitric oxide can be used to improve plant tolerance under stress conditions. Among the nitric oxide donors, sodium nitroprusside (SNP) is one of the most utilized one. Many studies revealed exogenous SNP could mitigate the damage caused by abiotic stress factors in plants. It has been determined that SNP closes the stomatal aperture by triggering the amount of abscisic acid in plants and can protect plants against drought. It eliminates reactive oxygen species formed as a result of stress, thus ensuring that plants are less damaged by the stress. SNP applications succeeded in the increment in the plant tolerance against salinity and drought stresses. In addition, SNP ensured early formation of xylem in the buds of fruit trees, thus ensuring water transfer to the bud and thus earliness. In the current review, the functions and utilizes of nitric oxide in horticultural plants will be discussed.
Keywords: Horticultural Plants, Nitric Oxide, Sodium Nitroprusside, Stress.

GİRİŞ

Bahçe bitkileri yetiştiriciliği dünya genelinde büyük bir ekonomik öneme sahiptir. Bahçe bitkilerinde optimum meyve verim ve kalitesine ulaşabilmek için çevresel stres faktörleriyle mücadele edilmesi gerekmektedir. Çevresel stres faktörleri abiyotik ve biyotik olmak üzere genel olarak ikiye ayrılmaktadır. Kuraklık, düşük ve yüksek sıcaklık, tuzluluk gibi çevresel stresler abiyotik stres altında yer almakta olup bu stres faktörleriyle mücadele edilmesi gerekmektedir. Bitkiler stres faktörleri altında iken bazı mesajcı rolünü üstlenen fitokimyasal maddeler ile savunma mekanizmalarını tetikleyerek strese karşı dayanıklı hale gelirler. Savunma mekanizmalarını tetikleyen mesajcılardan biri nitrik oksittir (NO). Nitrik oksit, stres altında birikimi artarak mesajcı rolünü üstlenir ve farklı mekanizmaların tetiklenmesini sağlayarak savunmayı sağlar. Bitkilerde nitrik oksit donörleri arasında sodyum nitroprussid (SNP) en çok kullanılanlardan biridir. SNP bitkilerde nitrik oksit birikimini artırabilmektedir. Bu derlemede nitrik oksidin bitkilerdeki stres faktörlerine karşı önemini ve kullanımını tartışılacaktır.

TUZ STRESİNE KARŞI NİTRİK OKSİT KULLANIMI

Tuzlu topraklar bitkilerde meyve verim kalitesini sınırlandıran en önemli sınırlayıcı faktörlerden biridir. Sulamayla birlikte yetersiz drenaj, yoğun gübreleme ve sahil kesimlerinde yetiştiricilik toprak tuzluluğu görülen bölgeler arasında yer almaktadır. Tuz stresi birçok bitkide potasyum alımını, fotosentezi ve metabolizmayı olumsuz etkilemekte ve bitki gelişimi ve su durumunda azalmalar şeklinde tuz stresinin olumsuz etkileri olmaktadır (Niu ve ark., 1995; Yin ve ark., 2010). Tuz stresi altında yetiştirilen bitkilerde toprak su potansiyelinde azalma, dokularda toksik seviyede sodyum (Na) ve klor (Cl) birikimi ve bitki bünyesinde besin elementi alımında azalış gibi zararlı etkiler görülebilmektedir (Marschner, 1995; Grattan ve Grieve, 1999). Bunun yanında stres etmenleri sonucunda bitkilerde reaktif oksijen türleri (ROT) birikir ve bitki bünyesinde sıcaklık artışına ve hücresel düzeyde zararlanmalara sebep olur (Apel ve Hirt, 2004).

Tuz stresine karşı nitrik oksit donörü olan SNP' nin kullanılması üzerine birçok çalışma bulunmaktadır. Tuz stresi sonucunda bitkilerin hücrelerinde reaktif oksijen türleri (RO T) birikmekte olup hücresel düzeyde ölümler gerçekleşmektedir ve SNP ROT'lara karşı mücadele vermektedir. Ayrıca, SNP hücre membranlarında lipid peroksidasyonunu azaltarak hücrelerin membran bütünlüğünü korumaktadır. 1 mM SNP' nin elma ağaçlarında tuz stresine

karşı dayanıklılığını arttırdığı, klorofil biyosentezinin iyileştiği bildirilmiştir (Aras ve ark., 2020). Ayrıca domates (0.1 mM SNP, Wu ve ark., 2011) ve hıyar (0.1 mM SNP, Lin ve ark., 2012) bitkilerinde SNP uygulamasının tuz stresine karşı dayanıklılık sağladığı belirlenmiştir.

KURAKLIK STRESİNE KARŞI NİTRİK OKSİT KULLANIMI

Su kıtlığı veya kuraklık son zamanlarda sıkça karşılaşılan bir sorun hale gelmiştir. Bitkiler kuraklık stresine karşı stoma açıklıklarını kapatarak su kaybını önleme yoluna gitmektedir ve absisik asit (ABA) stomaların kontrolünde rol oynayan hormondur (Ali ve ark., 2020). Nitrik oksit ABA hormonuyla etkileşime girerek stomaların kapanmasını sağlamakta ve su kaybının azalmasını sağlayabilmektedir (Zhang ve ark., 2023). 0.2 mM SNP uygulamasının erik anacını (Myrobolan 29 C) kuraklık stresine karşı koruduğu bildirilmiştir (Bolat ve ark., 2022). Elma (0.4 mM SNP, Zhang ve ark., 2016) ve karpuz (0.1 mM SNP, Hamurcu ve ark., 2020) bitkilerinde de SNP'nin kuraklık stresine karşı olumlu etkileri belirlenmiştir.

KİREÇ STRESİNE KARŞI NİTRİK OKSİT KULLANIMI

Bahçe bitkileri birçok çevresel stres faktörlerine maruz kalmakta olup kireç stresi en önemli stres etmenlerinden biridir. Kireçli ortamda yetiştirilen birçok bahçe bitkilerinde demir (Fe) eksikliğinden dolayı kloroz görülmektedir. Fe bahçe bitkileri için önemli bir mineral olup bitki büyümesinde, hücre metabolizmasında, nitrojen fiksasyonunda ve fotosentezde önemli rol oynar. Toprakta Fe olmasına rağmen toprağın kireçli olması ve toprağın pH değerinin yüksek olması nedeniyle Fe çözünürlüğünün düşük olması bitkilerde bazı semptomlara neden olur. Toprakta ve/veya sulama kaynağında karbonatın varlığı toprağın ve suyun pH'ını artırmaktadır. Fe noksanlığı, klorofil biyosentezinin azalmasına bağlı olarak yapraklarda kloroz oluşmasına neden olur. Demir klorozu birçok meyve ağacında meyve verimini ve kalitesini sınırlamaktadır. Birçok meyve ağacının Fe eksikliğine duyarlı olduğu bilinmektedir. Bu nedenle meyve bahçelerinde Fe noksanlığının oluşması yetiştiriciler için ciddi bir sorun oluşturmaktadır. Demir Fe^{3+} formunda bulunur ancak bitkilerde Fe^{2+} formu yarayışlı form olarak kullanılır. Bu nedenle Fe^{3+}'ün bazı mekanizmalarla Fe^{2+}'ye indirgenmesi gerekmektedir (Garcia ve ark., 2018). Fe iki mekanizma ile indirgenerek yarayışlı hale gelmektedir; mekanizmalardan biri, Fe^{3+}'nin Fe^{2+}'ya indirgenmesinde anahtar rol oynayan bir enzim olan demir şelat-redüktazdır (FC-R), strateji I olarak adlandırılır. Bir diğeri ise strateji II olarak adlandırılır ve siderofor kullanılarak Fe yarayışlı hale gelmektedir.

Kireçli topraklarda SNP kullanımı üzerine yeterli çalışma bulunmamaktadır. Yüksek pH koşullarında yetiştirilen armut ağaçlarında SNP uygulanması üzerine yapılan bir çalışmada, SNP FC-R enzim aktivitesini artırarak Fe yarayışlılığını artırmıştır (Liu ve ark., 2022). Ayrıca Fe'nin membranlar arası taşınmasından sorumlu IRT geninin ifadesini artırarak Fe alımı artmıştır. Başka bir çalışmada, nitrik oksit birikiminin elma ağaçlarında Fe eksikliğine karşı önemli olduğu bildirilmiştir (Zai ve ark., 2016). Çalışmada, nitrik oksidin hormon yolaklarında sinyal görevi üstlendiği belirlenmiştir. Nitrik oksidin Fe alımını artırması üzerine brokoli (Kabir ve ark., 2023), hıyar (Yu ve ark., 2013) ve çilek (Kaya ve ark., 2019) bitkilerinde de çalışmalar bulunmaktadır.

NİTRİK OKSİDİN KSİLOGENESİS ÜZERİNE ETKİLERİ

Bitkilerde su ve besin elementleri aşağıdan yukarı doğru (akropetal) ksilem iletim demetinde taşınmaktadır. Ksilem şikimik asit yolağında üretilen ve bir fenolik bileşik olan ligninden oluşmaktadır (Boerjan ve ark., 2003). Ayrıca ksilem bir ölü dokudur. Ksilem oluşumu (ksilogenesis) programlanmış hücre ölümü ile tetiklenmektedir. SNP'nin bitkilerde programlanmış hücre ölümünü tetikleyerek ksilogenesisi artırdığı bildirilmiştir (Monzón ve ark., 2014; Wang ve ark., 2021). Ayrıca şeftali ağacında SNP uygulanması sonucunda ksilem iletim demetinin çapının arttığı belirlenmiştir (Aras, 2022a).

SNP'nin şeftali ağacının tomurcuklarında ksilogenesis üzerine çalışma bulunmaktadır (Aras, 2022b). SNP uygulanan şeftali ağaçlarının tomurcuklarında erken dönemde ksilem oluşmaya başlamış olup tomurcuklara su geçişi sağlanmıştır ve böylece çalışmada SNP uygulanan ağaçlarda erkencilik sağlanarak çiçeklerin SNP uygulanmamış ağaçlara göre daha erken açması sağlanmıştır.

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SEL BASKINI STRESİNİN MEYVE TÜRLERİNE ETKİLERİ

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Özet
Bitkiler yaşamları boyunca kuraklık, sel baskını, düşük ve yüksek sıcaklık, kireç, tuzluluk gibi birçok çevresel strese maruz kalmakta olup meyve verim ve kalitesinde kayıplar yaşanmaktadır. Sel baskını bitki gelişimini sınırlayan önemli çevresel faktörlerdendir. Subtropikal bölgelerde uzun süreli mevsimsel yağışlar ciddi ürün kayıplarına sebep olabilir. Ayrıca eğimi olmayan ve/veya çukur arazilerde su birikimi de sel baskınına sebep olabilmektedir. Bu stres bitkilerin hayatta kalmasını, biyokütlesini ve bitki uzunluğunu olumsuz yönde etkilemektedir. Sel baskını stresi bitkilerin köklerinde oksijen azalmasına ve köklerin boğulmasına (asfeksi) sebep olur. Bitkilerin sel olayları nedeniyle tamamen suya batması, toprak üstü organlarında oksijen yetersizliğine yol açabilir. Oksijen solunum için sınırlayıcı hale geldiğinde bitkiler hipoksi yaşarken, oksijenin tamamen yokluğu (anoksi) bitkinin ölümüne sebep olabilir. İklim değişiklikleri, su varlığında aşırı uç noktalara yol açabilir ve bu da bazı bölgelerde şiddetli kuraklığa neden olurken, aşırı yağış olaylarından kaynaklanan seller diğer coğrafi alanları etkileyebilir. Bahçe bitkilerinden otsu bitkiler sel baskınına hassas olup çilek bu hassas bitkiler içerisinde yer almaktadır. Sel baskını uzun sürdüğü taktirde odunsu olan meyve ağaçları da zarar görmektedir. Meyve ağaçlarından özellikle şeftali asfeksi stresine oldukça hassas olup bu stres altında gövdede zamk akıntısı meydana getirmektedir. Bitkiler farklı savunma mekanizmalarıyla sel baskını stresine karşı toleransını artırabilmektedir. Bitkiler, hava depolanmasını sağlamak amacıyla gaz boşlukları olan aerenkimayı artırabilir ve/veya yapısal olarak geliştirebilir. Aerenkimanın artması ile birçok bitkinin sel baskınına karşı dayanıklılıklarını arttığı bildirilmiştir. Aerenkima oluşumu programlanmış hücre ölümü ile tetiklenmektedir. Nitrik oksit (NO) birikiminin programlanmış hücre ölümünü etkileyerek aerenkima oluşumunu arttırdığı belirlenmiştir. Bu derlemede, meyve türlerinin sel baskınına karşı hassasiyetleri, savunma mekanizmaları ve alınabilecek önlemler değerlendirilecektir.
Anahtar Kelimeler: Aerenkima, Asfeksi, Meyve Ağaçları, Sel Baskını.

EFFECTS OF FLOOD STRESS ON FRUIT SPECIES

Abstract
Plants are exposed to many environmental stresses throughout their lives, such as drought, floods, low and high temperatures, lime, salinity that cause losses in fruit yield and quality. Flooding is one of the important environmental factors that limits plant growth. Long-term seasonal rains in subtropical regions can cause serious crop losses. In addition, water accumulation in unsloping and/or hollow lands can cause floods. This stress negatively affects plant survival, biomass and plant height. Flood stress causes a decrease in oxygen in the roots of plants and causes suffocation (asphyxia). Complete submersion of plants in water due to flood events may lead to oxygen deficiency in the above-ground organs. Plants experience hypoxia when oxygen becomes limiting for respiration, while complete absence of oxygen (anoxia) can cause plant death. Climate changes can lead to extremes in water availability, resulting in severe droughts in some regions, while floods resulting from extreme rainfall events can affect other geographical areas. Herbaceous plants among garden plants are sensitive to floods, and strawberries are among these sensitive plants. If the flood lasts for a long time, woody fruit trees are also damaged. Fruit trees, especially peaches, are very sensitive to asphyxia stress and under this stress, gum flow occurs on the trunk. Plants can increase their tolerance to flood stress with different defence mechanisms. Plants may increase and/or structurally develop aerenchyma, which are gas spaces to provide air storage. It has been reported that the resistance of many plants to flood increases with the increase of aerenchyma. Aerenchyma formation is triggered by programmed cell death. It has been determined that nitric oxide (NO) accumulation increases aerenchyma formation by affecting programmed cell death. In this review, the susceptibility of fruit species to floods, their defense mechanisms and the precautions that can be taken will be evaluated..
Keywords: Aerenchyma, Asphyxia, Fruit Trees, Flooding

GİRİŞ

Bahçe bitkileri yetiştiriciliğinde sel baskını stresiyle karşılaşılabilmektedir. Uzun süreli mevsimsel yağışlar ciddi ürün kayıplarına sebep olabilmektedir. Ayrıca eğimi olmayan ve/veya çukur arazilerde su birikimi de sel baskınına neden olabilmektedir. Sel baskını stresine otsu bitkiler genel olarak hassas olup odunsu meyve ağaçlarından şeftali hassas olarak bilinmektedir. Sel baskını stresi asfeksi olarak da isimlendirilmektedir. Bu stres ile köklerde ilk önce oksijen yetersizliği (hipoksiya), ardından oksijenin tamamen yokluğu (anoksiya) gerçekleşir. Bu derlemede, meyve türlerinin sel baskınına karşı hassasiyetleri, savunma mekanizmaları ve alınabilecek önlemler değerlendirilecektir.

MEYVE AĞAÇLARINDA SEL BASKININA KARŞI DAYANIKLILIK

Sel baskını stresi bitkilerde oksijen yetersizliğine, mitokondriyal solunumu sınırlandırmaya ve enerji kaybına sebep olmaktadır (Wang ve ark., 2002; Setter ve Waters, 2003). Bu stres geçici olarak oksijensiz solunumun yapılmasına sebep olur ve bunun sonucunda zararlı metabolik ürünler oluşup bitkilerin ölümü gerçekleşebilir.

Bitkiler bazı anatomik ve biyokimyasal adaptasyonlar gerçekleştirerek sel baskını stresine karşı dayanıklı hale gelebilmektedir. Sel baskınına karşı alınan ilk önlem stoma açıklığının kapatılmasıdır (Arbona ve ark., 2008). Bitkilerde su alımı stomanın açık olması ile gerçekleşmekte olup sel baskını altında stomalar kapatılarak bitki içine su alımı azaltılmaya çalışılır. Başka bir savunma mekanizması antioksidatif savunmadır. Sel baskını altında hücre düzeyinde reaktif oksijen türleri (ROT) oluşarak hücreler zarar görmekte ve hücre ölümü gerçekleşebilmektedir. Bazı bitkiler süperoksit dizmutaz (SOD), katalaz (CAT), guyakol peroksida (POD) gibi antioksidan enzim aktivitelerini artırarak sel baskını stresi sonucunda oluşan ROT'lara karşı hücreleri korur (Mittler ve ark., 2004, Edreva, 2005).

Meyve türlerinden sert çekirdekli meyveler sel baskınına hassas olup şeftali en hassas olan türlerdendir. Bazı anaçlar üzerine aşılanan çeşitleri bu strese karşı dayanıklı hale getirebilmektedir. Marianna-2624, Myrobalan 29-C ve Marianna GF 8-1 en dayanıklı anaçlar, GF-557 ve GF-677 en hassas türler arasında yer almaktadır (Amador ve ark., 2012).

Sel baskını stresine karşı alınan en önemli adaptasyonların başında anatomik tepkiler gelmektedir. Köklerde hava boşluğu adı verilen aerenkima dokusunun oluşumu ile savunma mekanizması sağlanmaktadır. Köklerdeki aerenkima ile kök uçlarına oksijen difüzyonu gerçekleşmekte, etanol gibi toksik bileşiklerin dışarı atılması sağlanmaktadır (Calvo-Polanco

ve ark., 2012, Le Provost ve ark., 2012). Ayrıca, adventif kök oluşumu ile de sel baskınına karşı dayanıklılık sağlanmaktadır ve bu adaptasyon elma, ayva ve erik türlerinde belirlenmiştir (Pistelli ve ark., 2012). Sel baskını altında adventif kök oluşumu ve köklerde aerenkima oluşumu sert çekirdekli meyve türlerinde Pimentel ve ark. (2014) çalışmasında saptanmıştır. Bu çalışmada, 'Mariana 2624′ (*Prunus cerasifera* × *Prunus munsoniana* W. Wight & Hedrick), 'Cab6P' (*Prunus cerasus* L.), 'Colt' (*Prunus avium* (L.) L. × *Prunus pseudocerasus* Lindl.), 'Maxma 14′ (*Prunus mahaleb* L. × *Prunus avium*), 'Maxma 60′ (*Prunus mahaleb* × *Prunus avium*), 'Garnem' (G × N15) (*Prunus dulcis* (Mill.) Rchb. × (*Prunus persica* (L.) Batsch × *Prunus davidiana* (Carrière) N.E.Br.)) and 'Mazzard F12/1′ (*Prunus avium*) anaçları 14 gün boyunca sel baskına maruz bırakılmıştır. Çalışma sonucunda Mariana 2624 en dayanıklı, Mazzard F12/1 en hassas olanı olarak bulunmuştur.

Köklerde aerenkima oluşumu programlanmış hücre ölümü ile gerçekleşmektedir. Önceden yapılan çalışmalarda, programlanmış hücre ölümünün nitrik oksit birikiminin sağlanması ile arttığı belirlenmiştir (Wany ve ark., 2017). Nitrik oksit bitkilerde birçok stres faktörlerine karşı savunma mekanizmalarını tetiklemede rol alan bir mesajcıdır. NO donörleri bitkilere uygulandığında bitkilerde NO birikebilir ve en çok kullanılan NO donörlerinden biri sodyum nitroprussiddir (SNP). Bitkilere SNP uygulanması ile aerenkima dokusu oluşarak sel baskını stresine dayanıklılık sağlanabilmektedir (Khan ve ark., 2019; Zhang ve ark., 2022).

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PAPATYADA (*Matricaria* L.) FITOKIMYASAL MADDE IÇERIĞI: DERLEME

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Özet
Matricaria L. (Papatya) bitkisi, Papatya bitkisi, Spermatophyta (Tohumlu bitkiler) bölümü içinde Magnoliophyta (Kapalı tohumlular) alt bölümüne aittir ve Asteraceae ailesinin bir üyesidir. Alman papatyası Matricaria L. cinsi içerisinde sınıflandırılırken, Roman papatyası Chamaemelum Mill cinsi içerisinde (*Anthemis* L. ile eşanlamlı) bulunmaktadır. Bu derlemede, Matricaria L. cinsine ait türlerin fitokimyasal bileşimini eleştirel bir şekilde özetlemiştir. Dünyada, *Matricaria recutita* (Alman papatyası) ve Chamaemelum nobile (*Anthemis nobilis* - Roman papatyası) türlerinin tarımı, papatya tarımında yaygın olarak uygulanmaktadır. Papatya üzerine yapılan birçok çalışmada, uçucu yağların genellikle terpenoidlerden, örneğin α-bisabolol ve oksitleri A ve B, bisabolone oksit A, chamazulene ve β-farnesen gibi bileşenlerden oluştuğu, chamazulene ve α-bisabolol ile oksitleri A ve B'nin önemli ve ana bileşikler olduğu bulunmuştur. Bu iki tür, botanik ve kimyasal bileşimlerinden dolayı birbirinden farklıdır. Alman papatyası, özellikle uçucu yağında chamazulene ve α-bisabolol gibi zengin fenolik ve flavonoid içeriği nedeniyle Orta Avrupa'da yaygın bir şekilde ilaç olarak kullanılmaktadır. erleme, mevcut bilgileri sistematik bir şekilde bir araya getirerek, Matricaria L. bitkisinin fitokimyasal özellikleri üzerine kapsamlı bir bilgi sunmayı amaçlamıştır.
Anahtar kelimeler: Papatya, Matricaria, fitokimyasallar, fenoller

THE PHYTOCHEMICAL COMPOSITION OF CHAMOMILE (*Matricaria* L.): A REVIEW

Abstract
The *Matricaria* L. (Chamomile) plant belongs to the Magnoliophyta (Angiosperms) subdivision of the Spermatophyta (Seed plants) division and is a member of the Asteraceae family. German chamomile is classified under the *Matricaria* L. genus, while Roman chamomile is found within the Chamaemelum Mill genus (synonymous with Anthemis L.). In this review, the phytochemical composition of species within the *Matricaria* L. genus has been critically summarized. Worldwide, the cultivation of *Matricaria recutita* (German chamomile) and *Chamaemelum nobile* (*Anthemis nobilis* - Roman chamomile) species is extensively practiced in chamomile farming. Many studies on chamomile have found that volatile oils are typically composed of terpenoids, such as α-bisabolol and its oxides A and B, bisabolone oxide A, chamazulene, and β-farnesene, with chamazulene and α-bisabolol and its oxides A and B being significant and major compounds. These two species differ from each other due to their botanical and chemical compositions. German chamomile is widely utilized for medicinal purposes in Central Europe, primarily because of its rich phenolic and flavonoid content, including chamazulene and α-bisabolol in its volatile oil. This review aims to provide comprehensive insights into the phytochemical properties of the *Matricaria* L. plant by systematically compiling existing information.
Keywords: Chamomile, Matricaria, phytochemicals, phenolics

GİRİŞ

Papatya bitkisi, Tohumlu bitkiler aleminin Spermatophyta bölümü içinde yer alan, Kapalı tohumlular alt bölümüne ait olan Asteraceae familyasına mensup şifalı bitkidir. Alman papatyası, *Matricaria* L. cinsine, Roman papatyası ise *Chamaemelum* Mill (synonym A*nthemis* L.) cinsine dahildir. Papatya ailesi, karmaşık bir taksonomiye sahiptir ve cinsler içindeki tür sayıları botanikçilere göre değişiklik gösterebilir. *Matricaria* L. özellikle Avrupa, kuzey Afrika, Macaronesia, batı, güneybatı ve orta Asya ile batı Kuzey Amerika'da yaygın olarak bulunan 6 tür içeren küçük bir Compositae familyası cinsidir (Oberprieler vd. 2007; İnceer, 2019). Matricaria'nın dağıldığı bölgeler arasında bozulmuş çayırlar, boş araziler, yollar, demiryolu kenarları, atık ve kuru alanlar gibi geniş bir coğrafi dağılım ve habitat çeşitliliği bulunmaktadır, bu da farklı ortamlarda farklı adaptasyonlara yol açabilir (Inceer, 2011; Inceer, 2019; El Mihyaoui ve ark., 2022).

Asteraceae familyasına ait olan papatya çiçekleri karakteristik otsu bir kokuya sahip önemli bir tıbbi ve aromatik bitkidir. Papatya, Avrupa ve Batı Asya kökenlidir Papatya, dünyanın çeşitli bölgelerinde tıbbi ve aromatik bir bitki olarak geniş çapta yetiştirilmektedir. Papatya, tarım ürünü olarak Mısır, Almanya, Arjantin, Polonya gibi ülkelerde yetiştirilmekte ve daha az ölçüde Şili, Çek Cumhuriyeti, Slovakya, İspanya ve Balkan ülkelerinden bazılarında (Bosna Hersek, Bulgaristan, Hırvatistan ve Sırbistan) tarım yapılmaktadır. Ayrıca, doğadan toplama pratikleri, Macaristan, Arnavutluk, Bulgaristan, Hırvatistan, Kosova ve Makedonya gibi ülkelerde de gerçekleştirilmektedir. Papatya, dünya genelinde yaklaşık 26 ülkenin monograflarında ve farmakopelerinde yer almaktadır (Inceer, 2019; El Mihyaoui ve ark., 2022)

Papatya bitkisi, geçmişten günümüze geleneksel ve modern ilaçlarda, kozmetik ve parfümeri ürünlerinde, ayrıca gıdalarda aroma amacıyla kullanılan önemli bir tıbbi ve aromatik bitki olarak kabul edilmektedir. *Matricaria recutita* (Alman papatyası) ve *Chamaemelum nobile* (*Anthemis nobilis*-Roman papatyası) türleri, papatya tarımında yoğun olarak kullanılan türlerdir. Her iki tür de bitkisel ve kimyasal içerik bakımından farklılık gösterir. Alman papatyası, Orta Avrupa'da chamazulene ve α-bisabolol içeren zengin fenolik ve flavonoid içeriği nedeniyle yoğun bir şekilde ilaç endüstrisinde kullanılmaktadır. Özellikle tıp alanında, birçok hastalığı tedavi etmek için birçok ülkede kullanılmakta olup özellikle; gastrointestinal rahatsızlıklarda (Menale ve ark., 2021), soğuk algınlığında ev solunum problemleri (Neves ve ark., 2006; Güzel ve ark., 2015) karaciğer hastalıklarında (Živkovi´c ve ark., 2021) nörolojik

ve pisikiyatrik hastalıklarda (Neves ve ark., 2006) ağrı ve enfeksiyonlara ve cilt, göz ve ağız hastalıklarını tedavi etmek için de kullanılmaktadır (Petrakou ve ark., 2020). Özellikle papatya uçucu yağları, antioksidan, antibakteriyel, antifungal, antikanser, antidiyabetik, antiparazitik, anti-inflamatuar, anti-depresan, anti-piretik, anti-alerjik ve analjezik aktiviteler gösterdiği birçok çalışmada belirtilmiştir (Roby ve ark., 2013; Villa-Rodriguez ve ark., 2018; Das ve ark., 2019; Asadi,ve ark., 2020; Karam ve ark., 2020; Al-Mekhlafi ve ark., 2021; Mailänder ve ark., 2022; Yousefbeyk ve ark., 2022). Ayrıca papatyanın (özellikle *M. Chamomilla*) en önemli uygulaması tıbbi alanda hayvanlar ve insanlar üzerinde olduğu belirtilmiştir. Özellikle yapılan çalışmalarda, *M. chamomilla* uçucu yağı (EO) ve ekstraktlarında 120'den fazla fitokimyasal bileşen içerdiği rapor edilmiştir. Genel olarak, terpenoidler, *M. chamomilla* EO'da en önemli bileşik grubunu oluşturmuş olup, en önemli bileşikler bisabolol ve oksitleri A ve B, bisabolone oksit A, chamazulene ve farnesen gibi görünmektedir. *Anthemis nobilis*-Roman papatyasında ise terpenoidler, (chamazulene ve bisabolone), flavanoidler, kumarinler ve diğer bileşikler olduğu rapor edilmiştir (Orav ve ark., 2010; Ghasemi ve ark., 2016; Mavandi ve ark., 2019; Mailänder ve ark., 2022; Mihyaoui ve ark., 2022). Bu fitokimyasal içeriklerinin bitki tür ve çeşitleri, coğrafi bölgeler ve genetik faktörler gibi çeşitli faktörlerden etkilendiği. Ayrıca, kurutma teknikleri ekstraksiyon teknikleri gibi diğer faktörler de bu kimyasal kompozisyonunu etkileyebildiği görüşü hakimdir (Piri ve ark., 2019; Mavandi ve ark., 2019; Abbas ve ark., 2021; El Mihyaoui ve ark., 2022; Mihyaoui ve ark., 2022). Türkiye'de M. recutita'ya ait üç alt tür bulunmasına rağmen, chamazulene içermemesi nedeniyle dış pazarda kabul görmemektedir. Türkiye'de yapılan papatya üretimleri, chamazulene içeriği yüksek genotiplerle desteklenmektedir, çünkü bu türler yurt dışından getirilmektedir (İnceer, 2019)

Doğanın sevimli bir armağanı olarak kabul edilen papatya (*Matricaria*, L.) binlerce yıldır tıbbi ve terapötik amaçlar için kullanılan bir bitkidir. Bu sevimli beyaz çiçeklerin sadece güzelliği değil, aynı zamanda içerdikleri fitokimyasal maddelerle de büyüleyici bir özelliği bulunmaktadır.

1. Flavonoidler

Papatya, birçok bitkide bulunan flavonoidlerin zengin bir kaynağıdır. Flavonoidler antioksidan özelliklere sahiptir ve vücuttaki serbest radikallerle savaşarak hücresel hasarı azaltabilir. Papatyanın içerdiği apigenin, luteolin ve kamfer gibi flavonoidler, bitkinin antioksidan

potansiyelini artırır (Schütz ve ark., 2005; Jaiswal ve ark., 2014; El Mihyaoui ve ark., 2022; Mailänder ve ark., 2022).

Apigenin:

Papatya çiçeği ekstraktları ve kaynatmalarında apigenin ve glukozidi gibi flavonoidler, biyoaktif polifenoller olarak tanımlanmıştır (McKay ve Blumberg, 2006). Papatya çiçeklerinde, apigenin ve apigenin-7-glikozit yüksek oranda bulunduğu (Cvetanovi´c ve ark., 2019: 231–1501 mg/kg ; Piri ve ark.,2019; 1.19 mg/g) ve bu sayede antioksidan özellikleri sayesinde serbest radikallerle savaşarak hücresel hasarı azaltabildiği. Ayrıca, antienflamatuar etkileri ile bağlantılı olarak inflamasyonu hafifletmeye yardımcı olabileceğini araştırmacılar vurgulamışlardır (Hassanpour ve ark., 2020; El Mihyaoui ve ark., 2022).

Luteolin:

Luteolin, bitkilerde yaygın olarak bulunan doğal bir flavonoid türüdür. Bu bileşen, antioksidan özelliklere sahiptir ve çeşitli bitkisel gıdalarda ve bitkisel ekstrelerde bulunabilir. Papatya bitkisinde, özellikle de *Matricaria chamomilla* türünde, luteolin adlı bir flavonoid bulunduğu belirtilmiştir. Cvetanovi´c ve ark., 2019' yaptıkları bir çalışmalarda, papatya çiçeklerinde, Luteolin-7-O-glucoside (166–1101 mg/kg) belirlemiştir. Diğer bir çalışmada papatya çiçeklerinde Luteolin: 2,2 mg/g olduğunu belirlemiştir (Piri ve ark., 2019). Bu bileşen, antioksidan özelliklere sahiptir ve çeşitli bitkisel gıdalarda ve bitkisel ekstrelerde buluna bilinirliği vurgulanmıştır (Gupta ve ark., 2010; Franco ev ark., 2018; El Mihyaoui ve ark., 2022)

Phenolic compounds

Papatya, diğer biyoaktif hidrofilik çeşitli polifenol bileşenlerin kaynağıdır. Yapılan birçok çalışmada, çiçekğin farklı kısımlarında, quercetin ve quercetin-3-O-rutinoside (rutin olarak da bilinir) ile flavanon naringenin, benzoik, rosmarinik asitler kumarinler ve bazı fenolik asitler (p- kumarik, kafeik, ferulik, klorojenik, ellagik asit, vanilik, katekol, asitler) bulumuştur (Elsemelawy, 2017; Zhao ve ark., 2019; Petrulova ve ark., 2020; Catani ve ark., 2021; Ghoniem ve ark., 2021; Tsivelika ve ark., 2021; Mailänder ve ark., 2022).

2. Sesquiterpenler

Genel olarak, papatyanın uçucu yağında terpenoidler en önemli bileşik grubunu oluşturur; Papatyanın çiçeklerden ve çiçek başlarından çıkarılan uçucu yağda yaygın olarak bulunan tıbbi ve sağlık açısından anti-enflamatuar, antiseptik ve antispazmodik özellikleri ile bilinen seskiterpenler (ağırlıklı olarak bisabolol, bisabolol oksitler A ve B ve chamazulene'den oluşur)

içerir. Bisabolol: $C_{15}H_{24}O$ formülüne sahip olan bisabolol, anti-inflamatuar ve antispazmodik özelliklere sahip olup, özellikle cilt sağlığı için kullanılır (Hajaj ve ark., 2015; Catani ve ark., 2021; Tsivelika ve ark., 2021). Bu bileşik içerikleri bitki türlerine ve çeşitleri, genetik faktörlere, ekstraksiyon yöntemleri ve bölgelere göre değişik gösterebilmektedir (Mavandi ve ark., 2019; Abbas ve ark., 2021; Zarezadeh ve ark., 2021; El Mihyaoui ve ark., 2022).

Bisabolol: $C_{15}H_{24}O$ formülüne sahip olan bisabolol, bitki özünden izole edilen bir terpenoid alkoldür. Bu bileşik genellikle bitkilerin uçucu yağlarında bulunur ve bu bitkilerden ekstrakte edilir veya sentetik olarak üretilir. Bisabolol, özellikle Alman papatyası (*Matricaria chamomilla*) ve diğer bitkilerde bulunur. Bisabolol'ün çeşitli izomerleri vardır, ancak en çok kullanılan formu genellikle α-bisabolol'dür. Bu bileşik, özellikle kozmetik, cilt bakımı ve ilaç endüstrilerinde anti-enflamatuar, anti-irritan, antimikrobiyal ve rahatlatıcı özellikleri nedeniyle popülerdir. Genel olarak terpenoidler *M. chamomilla* uçucu yağlar'da en önemli bileşik grubunu oluşturmuştur; en önemli bileşikler bisabolol ve onun oksitleri A ve B 'dir. Yapılan bazı çalışmalarda, Bisabolol oxide A: %7,27- 70,2 arasında değiştiğini saptamışlardır (Orav ve ark., 2010; Ayoughi ve ark., 2011; Farhoudi ve ark., 2013; Ghasemi ve ark., 2016; Ayran ve ark., 2018; EL-Hefny ve ark., 2019; Abbas ve ark., 2021; El Mihyaoui ev ark., 2022). Bisabolol oxide B: %2,4-35,7 arasında değiştiğini belirlemişlerdir Orav ve ark., 2010; Ayoughi ve ark., 2011; Demarque ve ark., 2012; Mavandi ve ark., 2019; Zarezadeh ve ark., 2020; El Mihyaoui ev ark., 2022).

3. Azulen

Azulen, aromatik bir bileşiktir ve özellikle bitki özlerinde bulunur. Azulen, bir tür azuleno adı verilen bir halka sistemine sahip bir hidrokarbon bileşiğidir. Azuleno, 7-azulen ve 5-azulen adlı iki izomeri içerir. Azulenin kimyasal formülü $C_{10}H_8$'di. Azulen, özellikle mavi kamomil bitkisinde (*Matricaria chamomilla* veya *Matricaria recutita*) ve diğer bazı bitki özlerinde bulunur. Bu bitkiler genellikle anti-inflamatuar ve rahatlatıcı özelliklere sahiptir. Azulenin biyolojik aktiviteleri üzerine yapılan araştırmalar devam etmekle birlikte, özellikle anti-inflamatuar etkileri üzerinde odaklanılmıştır. Azulen, mavi renkte bir kristal toz olarak görünebilir. Bu özellik, azulenin bazı kozmetik ürünlerde ve cilt bakım ürünlerinde kullanılmasının nedenidir (El-Assri ve ark., 2021; El Mihyaoui ev ark., 2022).

Chamazulene: Chamazulene: $C_{14}H_{16}$ formülüne sahip olan chamazulene, papatya () uçucu yağında bulunan bir azulen türevidir ve mavi renkte bir pigment içerir. . Azulen, karakteristik

mavi renkleri ile bilinen ve anti-inflamatuar özelliklere sahip olan bir grup bileşiktir. Chamazulene, rengini değiştirebilme özelliğine sahiptir. Bu bileşiğin çiçek özütleri veya uçucu yağlar içinde bulunması durumunda, mavi rengi ile tanınır. Çiçeklerden ve çiçek başlarından elde edilen uçucu yağda yaygın olarak bulunan ve antiinflamatuar özellikleriyle bilinen chamazulene, antiseptik ve antispazmodik özellik gösterir. Yapılan bazı çalışmalarda, chamazulene içeriklerinin %3,5 ile %31,2 arasında olduğu saptanmıştır (Ganzera ve ark., 2006; Orav ve ark., 2010; Farhoudi, 2013; Homami, ve ark., 2016; Ayran ve ark., 2018; Mavandi ve ark., 209; Piri ve ark. ,2019; El-Assri ve ark., 2021; El Mihyaoui ev ark., 2022).

4. Tanenler

Tanenler, bir veya daha fazla fenolik halka içeren kompleks moleküllerdir. Fenolik halkalar genellikle birbirine bağlıdır ve bu bağlantılar, tanenin tipine bağlı olarak değişiklik gösterir. Tanenler, bitkilerde bulunan ve genellikle polifenolik bileşikler olarak sınıflandırılan bir grup organik bileşiktir. Bu bileşenler, bitkilerin dokularında bulunan tanen hücresel yapısını oluşturur ve bitkilere çeşitli biyolojik fonksiyonlarda yardımcı olur. Tanenlerin kimyasal yapısı çeşitlidir, ancak genellikle fenolik halkalar içerirler. Her bir tanen türü, kendine özgü bir kimyasal yapısına sahiptir ve bu türler bitkiden bitkiye, hatta aynı bitki içinde bile değişiklik gösterebilir (Amarowicz, 2007; Bakkalbaşı ve ark., 2012) Birçok bitki türünde bulunabilir ve kimyasal yapıları büyük ölçüde değişiklik gösterebilir. Örnek tanen türleri arasında gallik tanenler, elajik tanenler, kateşinler, ve kondanse tanenler bulunmaktadır (Serrano ve ark., 2009; Hagerman, 2011). Papatya bitkisi (Matricaria L.), tanen adı verilen bileşenleri içerir. Tanenler, genellikle antioksidan özelliklere sahip oldukları için sağlık yararları sunabilir. Bu bileşenler, serbest radikallerin neden olduğu hücresel hasarı azaltabilir ve bağırsak sağlığını destekleyebilir (Abidi ve ark., 2018; Ullah ve ark., 2020). Papatya bitkisinde bulunan tanenler arasında şu öne çıkanlar; **gallik asit, kateşin ve ellajik Asit** tir (Abdalla ve Abdelgadir, 2016; Hassanpour ve Niknam, 2020; El Mihyaoui ev ark., 2022).

SONUÇ

Bu inceleme, papatya bitkisinin önemli fitokimyasal içeriğine odaklanmaktadır. Papatya bitkisi, geleneksel ve modern tıpta, kozmetik ve parfümeri ürünlerinde, ayrıca gıdalarda aroma amacıyla uzun bir geçmişe sahip önemli bir tıbbi ve aromatik bitkidir. *Matricaria recutita* (Alman papatyası) ve *Chamaemelum nobile (Anthemis nobilis*-Roman papatyası) papatya bitkisinin önemli türleridir. Bu bitkinin temel bileşenleri arasında, literatür çalışmalarında

belirtilen terpenoidler α-bisabolol ve bunun oksitleri ile chamazulene ve tanenler gibi azulenler bulunmaktadır. Alman papatyası uçucu yağında, chamazulene ve α-bisabolol gibi zengin fenolik ve flavonoid içeriğine sahiptir. Bu bileşenler, özellikle Matricaria türlerinin antioksidan, anti-inflamatuar, anti-kanser, stres ve depresyon tedavisi, anti-alerjik vb. gibi çeşitli farmakolojik aktiviteler gösterdiği ve insan sağlığına fayda sağladığı için dikkat çekmektedir. Papatya bitkisinin bu özellikleri, onu geleneksel tıp ve alternatif tedavilerde çeşitli amaçlar için kullanılan popüler bir bitki haline getirmiştir.

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ESANSİYEL YAĞ EKSTRAKSİYON YÖNTEMLERİ

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Özet
Esansiyel yağlar, bitkilerin çeşitli kısımlarından elde edilen doğal ve aromatik bileşenlerdir. Bu değerli yağlar, bitkilerin özlerini ve karakteristik kokularını içerir. Bu yağlar; gıda, sağlık, kozmetik ve parfüm endüstrileri gibi çeşitli sektörlerde hammadde olarak kullanılan oldukça değerli doğal ürünlerdir Esansiyel yağların elde edilmesinde kullanılan çeşitli yöntemler, bu özel bileşenlerin kalitesi, miktarı ve özellikleri üzerinde önemli etkiler yapabilir. Bu derleme, esansiyel yağ ekstraksiyon yöntemlerini kısa ve özet bir şekilde incelemeyi amaçlamaktadır. Esansiyel yağlar, özelliklerinin çeşitliliği ve esas olarak hoş kokuları nedeniyle, deterjanlar, sabunlar, tuvalet ürünleri, kozmetikler, tıbbi ilaçlar, parfümler, şekerleme ürünleri, alkollü içecekler ve böcek ilaçları gibi birçok alanda yaygın olarak kullanılmaktadır. Dünya genelinde esansiyel yağlar üretimi ve tüketimi çok hızlı bir şekilde artmaktadır. Bu nedenle bitkilerde, esansiyel yağ ekstraksiyonu ve çıkarılması büyük bir öneme sahiptir. Üretim teknolojisi, esansiyel yağın genel verimini ve kalitesini artırmak için esas bir unsurdur. sansiyel yağ işleme ile ilgili geleneksel teknolojiler büyük öneme sahiptir ve dünya genelinde birçok bölgede hala kullanıldığı yapılan araştırmalardan görülmüştür. Bu derlemede esansiyel yağ ekstraksiyon yöntemleri incelenmiştir. Sonuç olarak esansiyel yağların çıkarılmasında, buhar damıtma, çözücü ekstraksiyon, maserasyon ve soğuk presleme (soğuksıkım-enfleurage) ve CO2 Ekstraksiyonu yaygın kullanılan yöntemler olduğu görülmüştür.
Anahtar Kelimeler: Esansiyel yağlar, Ekstraksiyon yöntemleri,Uuçucu yağların üretimi

ESSENTIAL OIL EXTRACTION METHODS

Abstract
Essential oils are natural and aromatic compounds obtained from various parts of plants. These valuable oils contain the essence and characteristic scents of plants. They are highly prized natural products used as raw materials in various industries such as food, health, cosmetics, and perfume. The methods employed in the extraction of essential oils can significantly impact the quality, quantity, and characteristics of these unique components. This review aims to provide a brief and summarized examination of essential oil extraction methods. Essential oils, due to their diverse properties and primarily pleasant aromas, find widespread applications in industries such as detergents, soaps, toiletries, cosmetics, medicinal drugs, perfumes, confectionery, alcoholic beverages, and insecticides. The global production and consumption of essential oils are rapidly increasing. Therefore, the extraction and isolation of essential oils from plants hold great importance. Production technology is a key factor in enhancing the overall yield and quality of essential oils. Traditional technologies related to essential oil processing are still of significant importance and are observed to be in use in many regions worldwide. In this review, various essential oil extraction methods have been explored. Steam distillation, solvent extraction, maceration, cold pressing (enfleurage), and CO2 extraction are commonly used methods for extracting essential oils.
Keywords: Essential oils, Extraction methods, Production of volatile oils

GİRİŞ

Bitkilerde esansiyel yağlar, doğal dünyanın büyüleyici bir parçasıdır. Bu özel bileşenler, bitkilerin farklı organlarında bulunur ve bitkilere karakteristik kokularını, lezzetlerini ve işlevlerini kazandırır. Bitkilerde esansiyel yağlar, doğanın zarif bir hediyesi olarak kabul edilir ve insanlar tarafından çeşitli alanlarda kullanılırlar. Esansiyel yağlar, bitkilerin biyokimyasal bileşenlerinin bir sonucu olarak oluşan doğal uçucu yağlardır. Ayrıca bitkiyi hastalıklardan, zararlılardan koruma, çekici olma ve tozlaşmaya yardımcı olma gibi doğal işlevlere hizmet ederler. Bu yağların aromatik özellikleri insanlar için çekici ve kullanışlıdır. Esansiyel yağlar, bitkilerin dokularında bulunan minik keseciklerde saklanır ve bitkilerin kesilmesi veya ezilmesi sonucu serbest bırakılır. Bu yağlar bitkilerin doğal kokularını ve aromalarını taşırlar. "Esansiyel" terimi, bitkinin esansını veya temel özünü ifade eder ve bu yağların bitkilerin temel özelliklerini içerdiğine inanılır. Bu özel yağlar, bitkilerin farklı organlarında bulunur ve bitkilere özgü karakteristik kokuları taşırlar. Bitkilerin farklı kısımlarında (çiçekler, yapraklar, kabuklar, kökler, tohumlar, odun vb.) bulunan uçucu yağlardır. Esansiyel yağlar, bitkilerin aromasından ve özel özelliklerinden sorumludur ve bitkilerin doğal savunma mekanizmalarının bir parçası olarak oluşturulur. Esansiyel yağlar, bitkileri hastalıklardan, zararlılardan ve çevresel stres faktörlerinden korurken aynı zamanda tozlaşmaya yardımcı olurlar. Bu uçucu yağlar bitkilerin yapısına, renklerine, tatlarına ve kokularına karakteristik özellikler katar. Esansiyel yağların kimyasal yapısı, çeşitli bileşenler içerir ve her bir yağın bileşimi bitki türüne ve büyüdüğü coğrafi bölgeye göre değişebilir. (Kılıç, 2008; Chemat, 2011; Reyes-Jurado ve ark., 2014; Sticher ve ark., 2015; Groot and Schmidt, 2016; Yaman ve Kuleşan, 2019; Sarkic and Stappen, 2018).

Küresel olarak esansiyel yağlar üretimi, tüketimi ve kullanımı hızla artmaktadır. Üretim teknolojisi, esansiyel yağların genel verimliliğini ve kalitesini artırmada önemli bir rol oynar. Esansiyel yağların üretimi, uçucu aromatik bileşiklerin bitki materyallerinden çıkarılmasını içerir. Ekstraksiyon yönteminin seçimi bitki materyalinin türüne, istenen uçucu yağ kalitesine ve prosesin maliyet etkinliğine bağlıdır. Her yöntemin avantajları ve sınırlamaları vardır ve bazıları belirli bitki materyalleri için diğerlerinden daha uygundur. Esansiyel yağların saflığını ve kalitesini korumak için uygun ekstraksiyon teknikleri gereklidir. Esansiyel yağ işleme ile ilgili geleneksel yöntemler dünya genelinde birçok bölgede hala büyük öneme sahip olup kullanılmaktadır. Esansiyel yağların üretimi için çeşitli yöntemler vardır ve yöntemin seçimi

genellikle kullanılan bitki materyalinin türüne bağlıdır. Buhar damıtma, buhar distilasyonu, karbondioksit (CO2) ekstraksiyonu,, maserayon ve soğuk basınç yöntemi (enfleurage) gibi yöntemler en geleneksel ve yaygın olarak kullanılan teknikler arasındadır (Rangahau, 2001; Araujo ve ark., 2007; Subramanian, ve Anandharamakrishnan, 2023). Bu teknikler:

BUHAR DAMITMA

Damıtma, büyük ölçekte uçucu yağlar üretmenin en yaygın yöntemlerinden biridir. Basitçe söylemek gerekirse, damıtma, bir sıvıyı buhara dönüştürmek ve ardından yoğunlaştırmaktan ibarettir. Buhar distilasyonu, bitkilerden esansiyel yağların çıkarılması ve doğal ürünlerde kullanmak en yaygın olarak kullanılan bir yöntemdir. Burada, buhar ve basıncın bitkiden uçucu bileşenleri açığa çıkarma yeteneğinden faydalanılmaktadır. Bu yöntemde buhar, bitki materyalinin uçucu bileşenlerini buharlaştırarak ayrıştırır ve ardından bu buharı yeniden sıvı hale getirir. u işlemde, sıvı önce buharlaştırılır ve ardından bu buhar yoğunlaştırılarak tekrar sıvı hale getirilir. Buhar distilasyonu genellikle uçucu yağların elde edilmesi, su arıtma ve kimyasal maddelerin saflaştırılması gibi birçok endüstriyel ve laboratuvar uygulamasında kullanılır. Bu yöntem, bitki özlerinin ve uçucu yağlarının çeşitli uygulamalarda kullanılmasını sağlar (Chaintreau, 2001; Boydağ, 2004; Kılıç, 2008; Sruthi ve ark., 2023). İşte buhar distilasyonu yönteminde izlenecek adımlar:

Bitki Malzemesinin Hazırlanması: İlk adım, kullanılacak bitki materyalinin hazırlanmasıdır. Bitki materyali genellikle yaprak, çiçek, dal veya kök gibi bitkinin uçucu yağlarını içeren kısımlarından seçilir. Bitki malzemesi temizlenir, kurutulur ve gerekirse öğütülür.

Buhar Kazanı (Still) Hazırlığı: Bitki materyali, genellikle paslanmaz çelikten yapılmış büyük bir kap olan "Still" adı verilen bir kazana yerleştirilir. Still, bitki materyali ile temas eden buharın eklenmesi için bir girişe sahiptir.

Buhar Enjeksiyonu: Temiz su buharı, Still'e enjekte edilir. Bu buhar, bitki materyali ile temas ederken bitkinin uçucu bileşenlerini buharlaştırır.

Kondansasyon: Buharlaşan bitki bileşenleri, bir kondansasyon kabına veya kondansatöre taşınır. Kondansatör, sıcak suyun çıkmasına ve soğuk suyun girişine izin veren iki ayrı boruya sahiptir. Bu, buharın tekrar sıvı hale gelmesini sağlar.

Toplama: Kondansatörden gelen sıvı, esansiyel yağı içeren aromatik sıvı yan ürünüdür. Bu sıvı, bir altındaki bir kabın içinde toplanır. Bu kabın adı Ayırıcıdır. Su ve yağ karışmaz, bu nedenle

esansiyel yağ suyun üstünde kalır. Ayırıcıdan çekilerek toplanır. (Bazı esansiyel yağlar, suya göre daha yüksek yoğunluğa sahip olduğu için, Ayırıcı'nın altında bulunurlar. Yoğunlaşan sıvı, distilasyonun sonucunda elde edilen hedef ürünü içerir. Bu ürün, uçucu yağlar, kimyasal saflaştırılmış maddeler veya su arıtımı gibi çeşitli olabilir.

SOĞUK PRESLEME (SOĞUK SIKIM)

Soğuk presleme, bitkilerden yağların elde edilmesi için kullanılan bir yöntemdir ve aynı zamanda "soğuk sıkım" olarak da adlandırılır. Ekspresyon veya soğuk presleme en eski ekstraksiyon yöntemidir ve öncelikle turunçgil esansiyel yağlarının üretiminde kullanılır. Bu yöntem, kabuğun ve kütiküllerin içindeki uçucu yağ bezlerinin, yağın salınması için parçalandığı çeşitli fiziksel süreçleri kapsar ve bitki materyalinin düşük sıcaklıkta ve mekanik olarak sıkılması yoluyla uçucu yağların çıkarılmasını sağlar 20. yüzyılın başlarına kadar soğuk sıkım narenciye yağlarının endüstriyel üretimi elle yapılıyordu (Kaufmann and Christen, 2002; Konsanty, 2013). Şu anda teknolojik gelişmeler ışığında makineler ile yapılabilmekte. Soğuk presleme yönteminin nasıl çalıştığına dair temel adımlar:

Bitki Malzemesinin Hazırlanması: İlk adım, kullanılacak bitki materyalinin hazırlanmasıdır. Bitki materyali, genellikle meyve kabuğu, tohumlar veya fındık gibi bitkinin uçucu yağlarını içeren kısımlardan seçilir. Bu materyal temizlenir, kurutulur ve gerekirse öğütülür.

Sıkım: Hazırlanan bitki materyali, bir pres makinesine veya sıkma cihazına yerleştirilir. Bu cihaz, bitki materyalini düşük sıcaklıkta (genellikle oda sıcaklığında veya biraz daha düşük) sıkar. Mekanik baskı, bitki materyalinin içinde bulunan yağları serbest bırakır.

Sıcaklık Kontrolü:

Soğuk presleme işlemi düşük sıcaklıklarda gerçekleşir, genellikle 40 °C'nin altında. Bu, ürünün kalitesini ve besin değerini korumaya yardımcı olur, çünkü yüksek sıcaklıklar bazı besin maddelerinin bozulmasına neden olabilir.

Yağ ve Atık Ayırma:

Presleme süreci sonucunda elde edilen karışım, yağ ve atık içerir. Bu karışım daha sonra bir ayrıştırma sürecinden geçirilir, genellikle çalkalama veya santrifüjleme gibi yöntemlerle yağ ve diğer bileşenler ayrılır**.** Bu işlem, yağın bitki artıklarından ayrılmasını sağlar.

Toplama: Elde edilen saf uçucu yağlar toplanır ve genellikle bir cam veya paslanmaz çelik kap içinde saklanır. Bu yağlar, doğal ve saf bir formda kalır ve daha sonra kozmetik ürünler, parfümler, aromaterapi ve diğer uygulamalarda kullanılabilir.

Elde Edilen Yağın Kalitesi:

Soğuk presleme yöntemi, düşük sıcaklıkta gerçekleştiği için, elde edilen yağın genellikle daha yüksek besin değerine sahip olduğuna inanılır. Ayrıca, bu yöntemle üretilen yağların daha belirgin bir aroma ve tat profiline sahip olduğu düşünülmektedir.

Soğuk presleme veya soğuk sıkım, özellikle sağlıklı ve doğal yağları tercih eden tüketiciler arasında popülerdir. Soğuk presleme, uçucu yağların yüksek sıcaklıkta veya kimyasal çözücüler kullanılmadan elde edilmesini sağlar. Bu yöntem, geleneksel sıcak presleme yöntemlerine göre daha düşük sıcaklıklarda çalıştığı için besin maddelerinin daha iyi korunduğu düşünülmektedir. Bu yöntem, yağların doğal kokularını ve özelliklerini korur, bu nedenle aromaterapi ve kozmetik ürünlerde tercih edilen bir yöntemdir.

ÇÖZÜCÜ EKSTRAKSİYON

Ekstraksiyon, organik çözücüler olarak adlandırılan birçok çözücüde farklı kimyasal bileşikler için kullanılan bir yöntemdir. Bu yöntemde çözücüler, kimyasal bir maddeye batırılmış bitki materyalinden kaynaklanan belirli bir uçucu yağı kimyasal olarak bağlar. Çözücü ekstraksiyon, özellikle çiçekler gibi termal olarak hassas kaynaklardan elde edilen esansiyel yağları çıkarmak için kullanılan bir yöntemdir. Bu süreçte, bitki malzemesi bir çözücü banyosuna yerleştirilir ve çözülür. Ekstraksiyon sonrası, esansiyel yağı içeren sıvı karışımı, diğer bileşenlerle birlikte bir filtrasyon işlemine ve ardından distilasyona tabi tutulur. Bu yöntem için yaygın olarak kullanılan çözücüler arasında alkol, hekzan, etanol, petrol eter ve metanol bulunur (Linskens ve Jackson, 1997; De Groot, ve Schmidt, 2006; Subramanian, ve Anandharamakrishnan, 2023). Çözücü ekstraksiyonun distilasyona göre başlıca avantajlarından biri, işlem sırasında daha düşük sıcaklıkların kullanılmasıdır, bu da distilasyon sırasında yüksek sıcaklıklar nedeniyle meydana gelebilecek kimyasal değişiklik riskini azaltır. Çözücü ekstraksiyonu maliyet açısından uygun ve oldukça hızlıdır ve işlem hızını artırmak için ısınmış çözücülerin difüzyon hızı üzerindeki etkileri nedeniyle kullanılabilir. Çözücü ekstraksiyonu ile üretilen esansiyel yağın, kalıntı olarak küçük miktarda çözücü içerebileceği unutulmamalıdır, bu nedenle bu yağların doğrudan gıda uygulamaları için uygun olmadığı belirtilmelidir. Bununla birlikte,

tercih edilen çözücü alkol ise "gıda kalitesi" olarak kabul edilir ve tüketim için güvenlidir (Lo and Boird, 2003; Kaufmann ve ark., 2007; Friedl ve ark., 2015). Bu yöntem genellikle parfüm endüstrisinde kullanılır. İşte çözücü ekstraksiyonunun temel adımları:

Bitki Materyalinin Hazırlanması: İlk adım, kullanılacak bitki materyalinin hazırlanmasıdır. Bitki materyali temizlenir, kurutulur ve gerekirse öğütülür. Bu işlem, bitki materyalinin daha iyi çözünmesini ve çözücü ile etkileşimini artırır.

Çözücünün Seçimi: Bir çözücü seçilir. Bu çözücü, bitki materyalinin uçucu yağlarını çözebilecek özelliklere sahip olmalıdır. Tipik olarak eter, hekzan, etanol veya benzen gibi organik çözücüler kullanılır.

Ekstraksiyon İşlemi: Bitki materyali ve çözücü, bir ekstraksiyon cihazında bir araya getirilir. Bu cihaz, çözücünün bitki materyali ile temasını artırmak için tasarlanmıştır. İletken bir madde olan çözücü, bitki materyalinin uçucu yağlarını çözer ve bunları taşır.

Ayırma İşlemi: Ekstraksiyon işlemi sonucunda elde edilen karışım, hem uçucu yağları hem de çözücüyü içerir. Bu karışım daha sonra bir ayırma işlemine tabi tutulur. Ayırma işlemi, uçucu yağları ve çözücüyü birbirinden ayırır.

Çözücü Geri Kazanımı: Ayırma işlemi sonrasında, çözücü geri kazanılabilir. Bu, çevresel etkiyi azaltmak için önemlidir. Geri kazanılan çözücü, bir sonraki ekstraksiyon için kullanılabilir.

Esansiyel Yağın Toplanması: Ayırma işlemi sonucunda elde edilen uçucu yağ, saflaştırılabilir ve toplanabilir. Bu esansiyel yağlar daha sonra kozmetik ürünler, aromaterapi veya parfüm yapımında kullanılabilir.

Çözücü ekstraksiyonu, bazı bitki materyallerinden daha fazla yağ elde etmek için etkili bir yöntem olabilir. Ancak, çözücülerin kullanımı dikkatle kontrol edilmelidir ve geri dönüşüm önlemleri alınmalıdır, çünkü bazı çözücüler çevreye zarar verebilir.

SÜPERKRİTİK CO2 EKSTRAKSİYONU

Bu yöntem, yüksek kaliteli esansiyel yağlar elde etmek için kullanılır ve özellikle hassas bitki materyali için tercih edilir. Karbondioksit (CO2) ekstraksiyonu, esansiyel yağların çıkarılması için modern ve etkili bir yöntemdir. Bu yöntem, yüksek basınç altında karbondioksitin kullanılmasıyla gerçekleşir Bitkilerin süperkritik CO2 ekstraksiyonu ile elde edilen esansiyel yağlar, distilasyon yoluyla üretilen yağlarla benzerlik gösterir ve bu nedenle aromaterapi ve

doğal parfümeride kullanılmak üzere uygundur (Chienthavorn ve ark. 2014: Yand and Hu, 2014; Kaya ve Ergönül, 2015; Yaman ve Kuleşan, 2016).

Buhar distilasyonundan elde edilen yağlar, işlem sırasında uygulanan sıcaklık, basınç ve süreye bağlı olarak kalitelerinde değişiklikler gösterir. Öte yandan, CO2 ekstraksiyon yöntemi, buhar distilasyonu işlemi gibi yüksek ısı uygulamadan elde edilen daha yüksek kaliteli yağlar üretebilir. CO2 ekstraksiyonunda ise hiçbir yağ bileşeni ısı nedeniyle zarar görmez. Geleneksel distilasyon ile süperkritik ekstraksiyon arasındaki temel fark, bu son yöntemde çözücü olarak CO2'nin kullanılmasıdır, bu da ısıtılmış su veya buhar yerine. Süperkritik ekstraksiyon işlemi, 95 ila 100 derece Fahrenheit arasındaki sıcaklıklarda çalışırken buhar distilasyonu, 140 ila 212 derece Fahrenheit arasındaki sıcaklıklarda çalışır. Buhar distilasyonunda hem bitki materyalinin hem de esansiyel yağın moleküler bileşimi uygulanan sıcaklıktan dolayı değişir. Buna karşın, CO2 özü, türetildiği orijinal bitkinin kimyasal bileşimine daha yakın olup bitkinin daha geniş bileşen yelpazesini içerir (Congiu et al. 2002; Ramos ve ark. 2002; Pourmortazavi, 2004: Yamani ve ark., 2007). CO2 ekstraksiyonunun temel adımları:

Basınçlı Odada Malzeme Hazırlığı: Bitki malzemesi, CO2 ekstraksiyonu için özel bir basınçlı odada hazırlanır. Bu odada malzeme kurutulur ve uygun boyutlara getirilir.

Yüksek Basınç ve Düşük Sıcaklık: Hazırlanan bitki malzemesi, yüksek basınç altında düşük sıcaklıklarda CO2 ile temas ettirilir. Bu koşullar altında CO2, süperkritik bir hal alır, yani gaz ve sıvı arasında bir noktada bulunur. Bu süperkritik CO2, bitki materyalinin uçucu bileşenlerini çözer.

Ayırma ve Toplama: Süperkritik CO2, bitki malzemesi ile birlikte taşıdığı uçucu yağlarla birlikte bir başka odada toplanır. Bu oda basınç azaltıldığında CO2 gaz haline döner ve sadece uçucu yağları bırakır.

Saf Esansiyel Yağın Toplanması: Toplanan uçucu yağ, daha sonra saflaştırılır ve elde edilen saf esansiyel yağ ayrı bir kapta toplanır.

Karbondioksit ekstraksiyonunun bir avantajı, düşük sıcaklıkta gerçekleşmesi nedeniyle termal olarak hassas bileşenlerin korunmasına yardımcı olmasıdır. Ayrıca, kullanılan CO2, toksik olmayan bir çözücüdür ve kalıntı bırakmaz. Bu yöntem, yüksek kaliteli ve saf esansiyel yağların üretiminde yaygın olarak kullanılır.

SOĞUK BASINÇ YÖNTEMİ (ENFLEURAGE)

Soğuk basınç yöntemi, Geçmişi antik çağlara kadar uzanan başka bir geleneksel ekstraksiyon yöntemidir. Esansiyel yağların elde edilmesi için kullanılan geleneksel bir tekniktir ve genellikle çiçeklerden (örneğin yasemin) yağ çıkarmak için kullanılır. Günümüz standartlarına göre zaman alıcı, emek yoğun ve maliyetli bir yöntemdir. Gıda endüstrisinde kullanılan uçucu yağlar için herhangi bir uygulamaya sahip görünmüyor ve günümüzde neredeyse geçerliliğini yitirmiş durumda. Enfleurage yöntemi hem "sıcak" hem de "soğuk" varyasyonlarıyla uygulanabilir. Her iki durumda da, kokuyla doyurulmuş yağa "enfleurage pomad" adı verilir (Mukhopadhyay, 2000; Konstanty ve ark., 2013; Yang ve Hu, 2014; Subramanian ve Anandharamakrishnan, 2023). Bu yöntemin temel adımları:

Cam Plakaların Hazırlanması: İlk olarak, cam plakalar özel bir yağ veya yağ karışımı ile kaplanır. Bu yağ, esansiyel yağların çözünmesini sağlar.

Çiçeklerin Yerleştirilmesi: Temizlenmiş çiçekler dikkatlice cam plakalara yerleştirilir. Çiçeklerin uçucu yağları yağa nüfuz eder.

Yağ Değişimi: Belirli bir süre boyunca (genellikle birkaç saat veya gün) çiçeklerin yağlarını alması için yağ sık sık değiştirilir.

Esansiyel Yağların Toplanması: Yağın doyması ve çiçeklerin uçucu yağlarını emmesinin ardından, yağdan esansiyel yağları ayırmak için özel bir işlem kullanılır. Bu, esansiyel yağların konsantre bir formda toplanmasını sağlar. Sonuç hem yağ hem de kokulu yağ içeren enfleurage pomad adını taşır. Bu pomat, botanik özü yağdan ayırmak için alkolle yıkanır, kalan yağın sabun yapımı için kullanılmasına olanak tanır. Alkol bu karışımdan buharlaştığında geriye kalan ise "absolute" olarak adlandırılır.

Soğuk basınç yöntemi, özellikle termal olarak hassas bileşenlerin korunmasına yardımcı olur çünkü işlem sırasında düşük sıcaklıklar kullanılır. Ancak bu yöntem oldukça zaman alıcıdır ve büyük miktarlarda esansiyel yağ üretimi için uygun değildir. Genellikle küçük ölçekli ve özel üretimlerde tercih edilir. Bu yöntem, özellikle çiçeklerin narin kokularını ve uçucu yağlarını korumak istediğinizde kullanışlı olabilir.

MASERASYON

Maserasyon yağları aynı zamanda infüze yağlar olarak da bilinir. Bunlar bitki materyalinden terapötik özellikleri çıkarmak için taşıyıcı yağları çözücü olarak kullandığında oluşturulur.

Maserasyon yağları, buhar distilasyonu süreci ile elde edilen yağlara göre bitkinin daha kapsamlı bir özünü yakalarlar. Bu, distilasyon süreciyle elde edilen yağlardan daha ağır ve büyük bitki moleküllerini yakalayarak elde edilir. Sonuç olarak, maserasyon yağları bitkinin daha fazla değerli özelliklerini korurlar. Maserasyon, bitkisel materyalin bir çözücü içinde belli bir süre boyunca bekletilmesine dayanır. Bu süreçte çözücü, bitki materyalini çözer ve içindeki biyoaktif bileşenleri çıkarır. Maserasyon için kullanılan çözücüler genellikle etanol, metanol, gliserol veya su olabilir. Çözücü seçimi, çıkarmak istenilen bileşenlere bağlıdır. (Mukhopadhyay, 2000; Morata ve ark., 2019; Subramanian, ve Anandharamakrishnan, 2023). En uygun infüzyon için bitki materyali mümkün olduğunca kuru olduğunda hasat edilmelidir, çünkü bitkideki herhangi bir nem yağın bayatlamasına ve mikroorganizma büyümesini teşvik etmesine neden olabilir. Bitki materyalinden terapötik özellikleri çıkarmak için bir taşıyıcı yağ veya solvent kullanma yöntemidir. İşte maserasyon yönteminin nasıl uygulandığına dair temel adımlar:

Bitki Materyalinin Hazırlanması: İlk adım, bitki materyalini hazırlamaktır. Taze bitki materyali kullanıyorsanız, onları iyice kurutun. Daha sonra bitki materyalini ince bir toz haline getirebilir, ezebilir veya iri toz haline getirebilirsiniz.

Taşıyıcı Yağın veya Solventin Seçimi: Bitki materyalini örtmek için bir taşıyıcı yağ veya solvent seçin. Özellikle zeytinyağı veya badem yağı gibi taşıyıcı yağlar tercih edilir. Alternatif olarak, alkol gibi bir solvent kullanabilirsiniz.

Karıştırma: Bitki materyalini seçtiğiniz yağ veya solventle karıştırın. Bitki materyali iyice kaplanmalıdır. Bu karışım, bitki materyalinin özünü çekmeye başlayacaktır.

Macerasyon Süreci: Hazırlanan karışımı kapalı bir cam kavanoza veya kapaklı bir kapta yerleştirin. Kapalı bir şekilde serin, karanlık bir yerde muhafaza edin. Bu adım, bitki materyalinin taşıyıcı yağ veya solventle etkileşime girmesine ve terapötik özelliklerin transferine olanak tanır.

Zaman: Maserasyon süreci birkaç hafta ile birkaç ay arasında sürebilir, bu süre bitki materyalinin türüne ve istediğiniz özün yoğunluğuna bağlıdır. Düzenli olarak karıştırın veya sallayın.

Süzme: Maserasyon süreci tamamlandığında, bitki materyalini yağdan veya solventsiz ayırmak için karışımı süzün. Bu adım, maserasyon sürecinin sona erdiğini ve elde edilen yağın veya ekstraktın kullanıma hazır olduğunu gösterir.

Macerasyon yöntemi, bitki materyalinin taşıyıcı yağ veya solvent içindeki terapötik bileşenlerini yakalayan etkili bir yöntemdir. Bu elde edilen yağlar veya ekstraktlar, cilt bakım ürünlerinden aromaterapiye kadar çeşitli uygulamalarda kullanılabilir.

SONUÇ

Esansiyel yağ ekstraksiyonu, bitkisel materyallerden uçucu ve aromatik bileşenlerin elde edilmesini sağlayan önemli bir süreçtir. Farklı yöntemler, bu değerli yağların çıkarılmasında kullanılır ve her biri belirli avantajlara sahiptir. Bu yöntemler arasında damıtma, soğuk presleme, çözücü ekstraksiyonu ve süperkritik CO2 ekstraksiyonu gibi çeşitli teknikler bulunmaktadır. Her yöntemin avantajları ve dezavantajları vardır. Distilasyon, geleneksel ve yaygın bir yöntem olup, CO2 ekstraksiyonu gibi modern yöntemler ise daha etkili ve hassas sonuçlar elde etmeye yöneliktir. Esansiyel yağ endüstrisi, bu yöntemlerin kombinasyonu ile sürekli olarak gelişmektedir ve doğru seçim, kaliteli esansiyel yağların elde edilmesinde kritik bir rol oynamaktadır. Sonuç olarak, esansiyel yağ ekstraksiyon yöntemleri, bitkisel materyalin özelliklerine, hedeflenen yağ bileşenlerine ve uygulama amaçlarına bağlı olarak seçilir. Her bir yöntemin avantajları ve sınırlamaları vardır, ancak bu çeşitlilik, endüstriyel, kozmetik ve tıbbi alanlarda geniş bir uygulama yelpazesi sunar. Bu çeşitli yöntemlerin kullanılması, kaliteli esansiyel yağların elde edilmesini sağlamak için önemlidir.

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DÜNYA PATATES TARIMINDA DEĞİŞİMLER VE EĞİLİMLER

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ÖZET
İnsan beslenmesinde önemli yeri bulunan ve her geçen gün daha da önemi artan patates dünyaya Güney Amerika'nın Ant Dağlarından yayılmıştır. Patates; taze veya işlenmiş olarak insan beslenmesinde, yumruları direkt olarak veya fabrika artıkları şeklinde hayvan beslenmesinde, bitkisel üretimin devamlılığını sağlamak için tohumluk olarak ve çeşitli şekillerde gıda sanayinde işlenerek kullanılan önemli bir endüstri bitkisidir. Dünyada ekim alanı bakımından 15. sırada yer alırken üretim miktarı olarak Şekerkamışı, Mısır, Pirinç ve Buğdaydan sonra 5. sırada üretilmektedir. Dünya patates ekim alanı 200 yılına kadar artış göstermiş ve 19.9 milyon hektara ulaşmıştır. 2000 yılından başlayan azalma ile 2019 yılında 16.5 milyon hektara gerileyen patates üretimi 2021 yılında 18.1 milyon hektar olarak gerçekleşmiştir. Üretim miktarı ekim alanı artışına paralel artış göstererek 1990 yıllarda 257 milyon tondan 2000 yılında 323 milyon tona ve 2021 yılında ise 376 milyon ton üretim gerçekleşmiştir. Dünyada patates tarım alanı 2021 yılında 1990 yılına göre %1.8 düzeyinde artışa karşılık üretimde ise %46.4 düzeyinde artış sağlamıştır.
Anahtar Kelimeler: patates, üretim, verim, değişimler

CHANGES AND TRENDS IN WORLD POTATOES AGRICULTURE

Abstract
Potatoes, which has an important place in human nutrition and is becoming more important day by day, spread to the world from the Andes Mountains of South America. Potatoes; It is an important industrial plant used in human nutrition as fresh or processed, in animal nutrition as tubers directly or as factory residues, as seed to ensure the continuity of plant production, and processed in various ways in the food industry. While it ranks 15th in the world in terms of cultivation area, it ranks 5th in terms of production amount after Sugarcane, Corn, Rice and Wheat. Potatoes cultivation area ranks 15th in the world in terms of cultivation area, while it is produced in the 5th place after Sugarcane, Corn, Rice and Wheat in terms of production amount. The world potatoes cultivation area increased until 2000 and reached 19.9 million hectares. Potatoes production, which decreased to 16.5 million hectares in 2019 with a decrease starting from 2000, reached 18.1 million hectares in 2021. The production amount increased in parallel with the increase in the cultivation area, from 257 million tons in 1990 to 323 million tons in 2000 and 376 million tons in 2021. The world's potatoes farming area increased by 1.8% in 2021 compared to 1990, while the production increased by 46.4%.
Keywords: potatoes, production, yield, changes

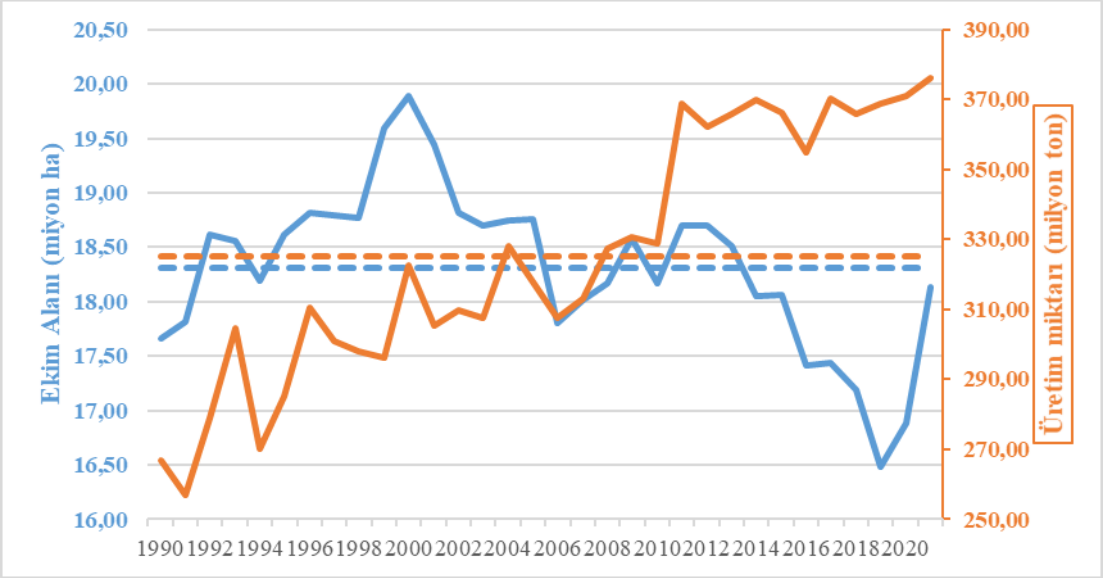
1. GİRİŞ

Patates (*Solanum tuberosum* L) yabani türünden elde edilen ticari patatesin kökeni Güney Amerika'daki And Dağlarına dayanır ve yaklaşık 8.000 yıl önce Peru ve Bolivya'yı ayıran sınır yakınında yetiştirilmiştir. İspanyollar 16. yüzyılda patatesi Avrupa'ya getirmeleriyle birlikte hızla yayılarak gönümüzde dünya çapında insan ve hayvan beslenmesinde önemli bir karbonhidrat kaynağı haline geldi (Lokossou 2010). Patatesin adaptasyonu, yetişme periyodu, tat, kabuk rengi, şekil, nişasta içeriği, pişirme türü vb. yönlerden çeşitlilik sağlanması ile patatesin önemi artmaktadır (Brown 1990; Hawkes 1994). Patatesin küçük arazilerde yetiştirilmesi ve hızlı büyüme özelliği ile birçok aile için ekonomik bir gıda olmaktadır. Dünya çapında yüz milyonlarca insan hayatta kalabilmek için patatese bağımlıdır. Patates, 100'den fazla ülkede ılıman, subtropikal ve tropikal koşullarda yetiştirilmekte olup, pirinç ve buğdaydan sonra dünyanın en önemli üçüncü gıda ürünüdür. Açlık ve yetersiz beslenme sorunlarının çözümüne katkı sağlayacak bir ürün olarak görülen patatesin bu özelliğine dikkat çekmek isteyen Birleşmiş Milletler Tarım ve Gıda Örgütü (FAO) 2008 yılını "Dünya Patates Yılı" ilan etmişti. Patates gittikçe artan dünya nüfusunun gıda güvencesinin sağlanmasında, farklı kullanım ve yararlanma özellikleri ile önemli bir üründür.

Dünya patates üretiminin yarısına yakın kısmı insan tüketiminde taze olarak değişik formlarda (fırında pişirme, haşlama, kızartma) yemeklik olarak tüketilmektedir. Geri kalan kısmı ise işlenmiş gıda ürünü (dondurulmuş parmak patates ve cips), hayvan yemi, endüstriyel nişasta ve tohumluk olarak kullanılmaktadır. Patatesin nişasta yönünden zengin olan kabukları ve işlendikten sonra kalan diğer değersiz atıklarından sıvılaştırılarak, etanol üretimi amacıyla yararlanılmaktadır (Anonim, 2018).

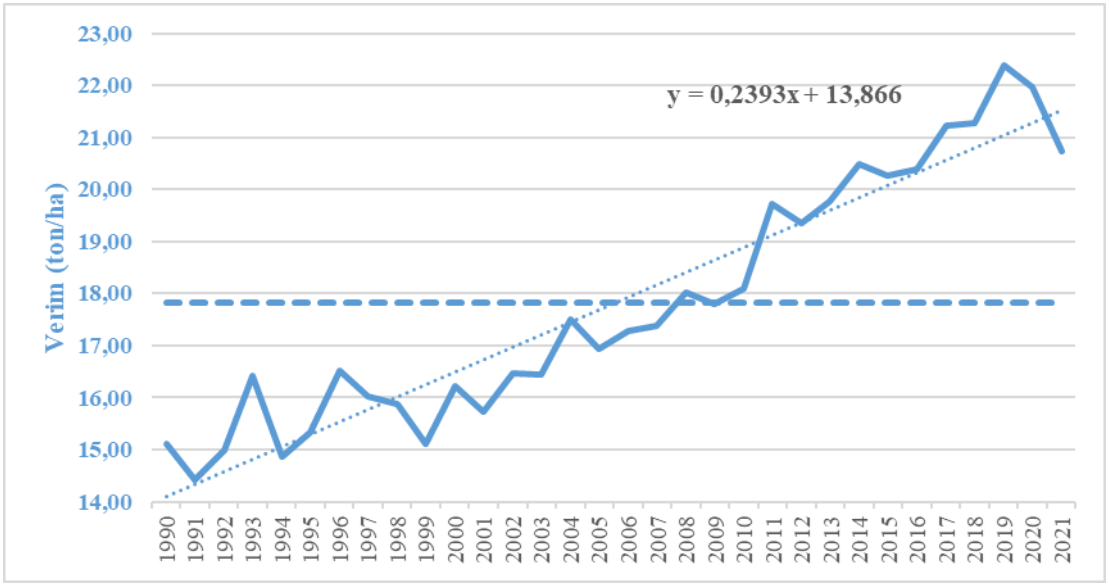
2. DÜNYADA PATATES TARIMI

Patates tarım alanı 1990-2021 yılları arasında ilk 10 yılda artış eğilimi hakim iken son 20 yılda azalma eğilimi göstermiştir. Patates tarım alanı 1990 yılında 17.6 milyon ha iken 2000 yılında 19.9 milyon ha ulaşmış ve son 32 yılın en yüksek değeridir. Ekim alanı 2000 yılından sonra önemli düzeyde azalarak 2019 yılında 16.5 milyon ha gerilemiştir. Günümüzde ise artış ile 18.1 milyon ha ulaşmıştır (Şekil 1). Tarım alnındaki önemli artış ivmeleri 1992 (%4.5), 1999 (%4.4) ve 2020 (%7.4) yıllarında gerçekleşmiştir. En önemli düşüş ise 2006 yılında -%5.4 ve 2019 yılında -%4.1 olarak gerçekleşmiştir.



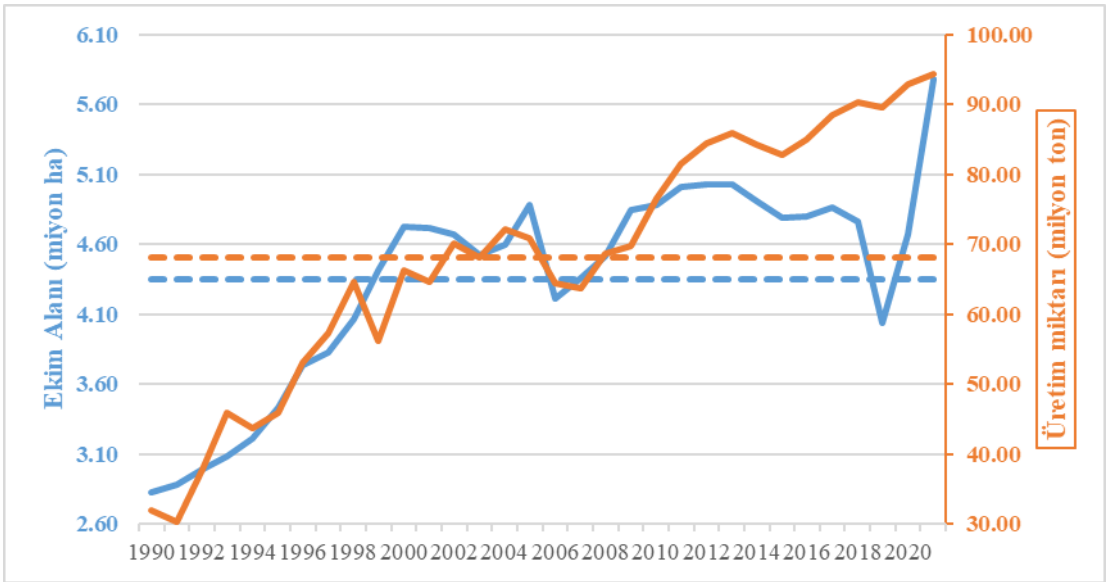
Şekil 1. Dünyada patates ekim alanı (milyon ha) ve üretim miktarı (milyon ton) değişimi (1990-2021)

Ekim alanındaki artış ve azalış trendlerine karşın üretim miktarında ise genel olarak artış eğilimi hakimdir. Patates üretim miktarı 1990 yılında 266.8 milyon ton iken 1991 yılında önemli bir düşüşle son 32 yılın en düşük üretimi olan 260.0 milyon tona gerilemiş fakat düzenli artış eğilimi ile 2021 yılında 376.1 milyon tona ulaşmıştır (Şekil 2). Üretim miktarında önemli artış ivmeleri 1992 (%8.6), 1993 (%9.2), 1995 (%5.6), 1996 (%8.9), 2000 (%9.0), 2004 (%6.7) ve 2011 (%12.3) yıllarında gerçekleşmiştir. En önemli düşüş ise 1994 yılında -%11.3 ve 2001 yılında -%5.4 olarak gerçekleşmiştir. Her iki düşüş dönemlerinde ekim alanında önemli düzeyde azalmanın da üretimdeki düşüşte etkili olduğu görülmektedir. Ekim alanı ve üretim arasında korelasyon incelendiğinde ise negatif yönlü ve istatistiksel anlamda önemli olmayan ilişki tespit edilmiştir.



Şekil 2. Dünyada patates verimi (ton/ha) değişim (1990-2021) grafiği

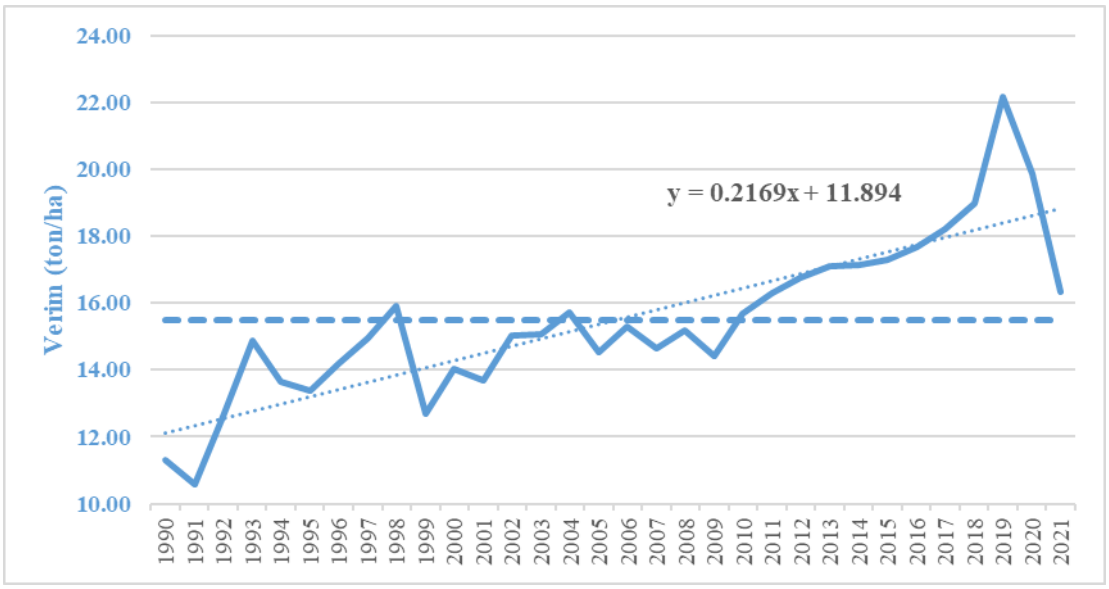
Dünya patates ekim alanındaki daralmaya rağmen üretimdeki artışın asıl kaynağı olarak verim artışı olduğu görülmektedir. Patates verimi 1990 yılında 15 ton/ha iken 2021 yılında 20.78 ha/tona ulaşmıştır. Dünyada en yüksek verim 22.38 ton/ha olarak 2019 yılında gerçekleşmiştir. Verim değişim grafiğinde doğrusal eğriye göre yıllık 240 kg bir artışın olduğu görülmektedir. Dünya patates tarım alanlarının önemli bir kısmı Çin'de gerçekleştirilmektedir. Çin patates tarım alanı 1990 yıllarda 2.83 milyon hektar iken 2021 yılında 5.78 milyon hektara ulaşmıştır (Şekil 3).



Şekil 3. Çin patates ekim alanı (milyon ha) ve üretim miktarı (milyon ton) değişimi (1990-2021)

Patates tarım alanı genel orak artış gösterse de özellikle 2006 yılında -%13.7 düzeyinde ve 2019 yılında -%15.2 düzeyinde önemli azalma gerçekleşmiştir. Bunun yanında ekim alanında artışın önemli olduğu yıllar ise sırasıyla 1992(%4.0), 1995(%7.1), 1999(%8.8), 2000(%6.9), 2005(%6.2), 2009(%7.2), 2020(%15.2) ve 2021(%23.7). Çin'de patates tarım alanı genel olarak artış eğilimi göstermektedir. Dünya patates tarım alanının 1990 yıllarda %16'sı Çin'de gerçekleşirken günümüzde ise %31.9'u gerçekleşmiştir. Çin'de son 32 yılda ekim alanı %14.4 düzeyinde artış göstermiştir.

Ekim alanında artışla birlikte üretim miktarında da önemli artış gözlenmektedir. Çin'de patates üretimi 1990 yılında 32.0 milyon ton iken 2021 yılında üretim 94.3 milyon tona ulaşmıştır (Şekil 2). Üretim miktarında 1991(-%5.0), 1999(-%13.1) ve 2006(-%9.0)yıllarında önemli azalma eğilimleri gözlenirken 1992(%24.2), 1993(%21.5), 1996(%15.4), 1998(%12.9), 2000(%18.1), 2010(%9.6) ve 2011(%6.6) yıllarında önemli düzeyde artış eğilimi gözlenmiştir. Çin Dünya patates üretiminin 1990 yılında %12.0 karşılarken 2021 yılında %25.1'e yükselmiştir. Çin patates üretimi son 32 yılda %194.7 olarak gerçekleşmiştir. Ekim alanı artış oranının yaklaşık 2 katı düzeyde üretim artışı sağlamıştır. Bu durum daha çok verim ile ilişkilendirilebilir.

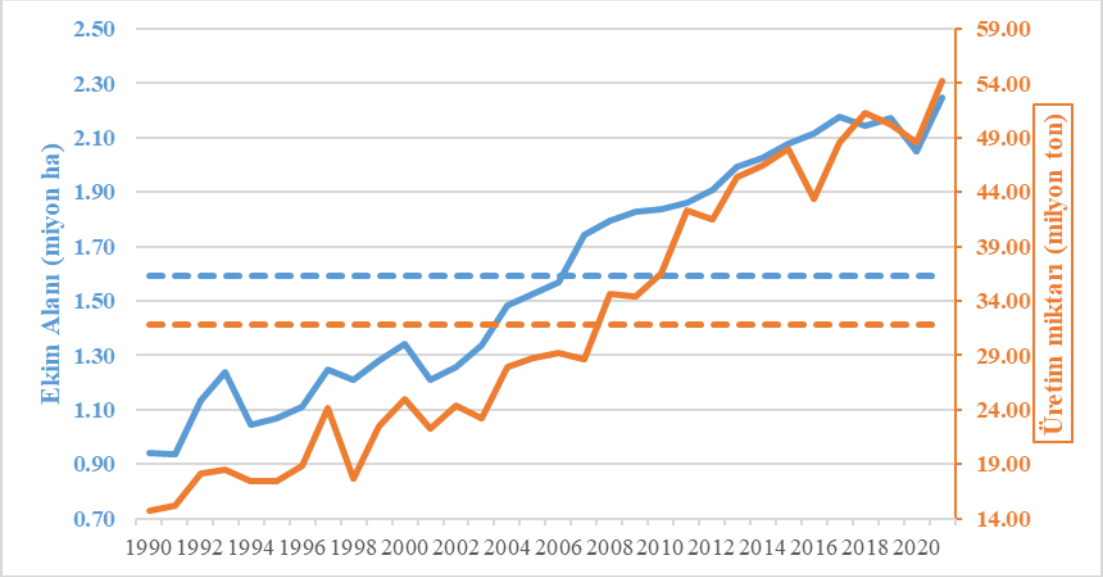


Şekil 4. Çin patates verimi (ton/ha) değişim (1990-2021) grafiği

Çin'de patates verimi 1990 yılında 11.32 ton/ha iken 2021 yılında 16.32 ton/ha ulaşmıştır. En yüksek verim ise 2019 yılında 22.17 ton/ha olarak gerçekleşmiştir (Şekil 4). Ayrıca verim

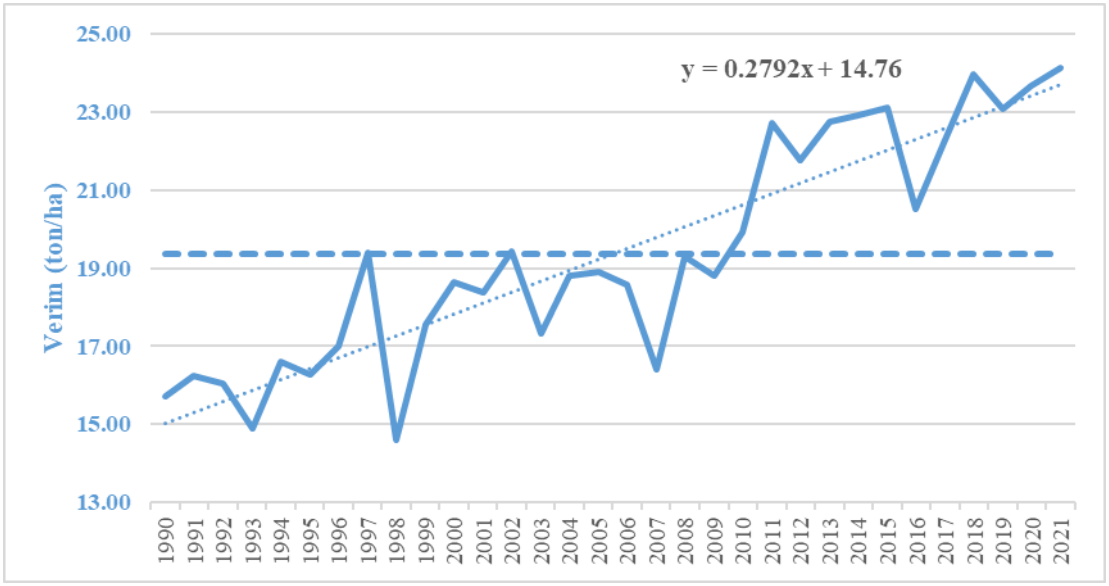
grafinin eğim grafine göre son 32 yılda Çin'de patates verimi her yıl ortalama 217 kg/ha artışı olduğu hesaplanmıştır.

Diğer önemli bir üretici olan Hindistan'da ise patates tarım alanı 1990 yılında 940 bin hektar iken yaklaşık %139.1 oranında artış ile 2021 yılında 2.2 milyon hektara ulaşmıştır. Ekim alanında önemli düzeyde artış eğilimi gözlenmiştir. Önemli artış eğilimleri özellikle 1992(%21.3), 1997(%12.6), 1999(%5.9), 2003(%6.2), 2004(%11.0), 2007(%11.1) ve 2021(%9.6) yıllarında gerçekleşmiştir. Ekim alanında her ne kadar artış eğilimi hakim olsa özellikle 1994(-%15.6), 2001(-%9.7) ve 2020 (-%5.6) yıllarında önemli azalmada gözlenmiştir (Şekil 5). Hindistan patates ekim alanı bakımında dünya patates ekim alanının 1990 yılında %5.3'nü karşılarken 2021 yılında bu oran %12.4'e yükselmiştir.



Şekil 5. Hindistan patates ekim alanı (milyon ha) ve üretim miktarı (milyon ton) değişimi (1990-2021)

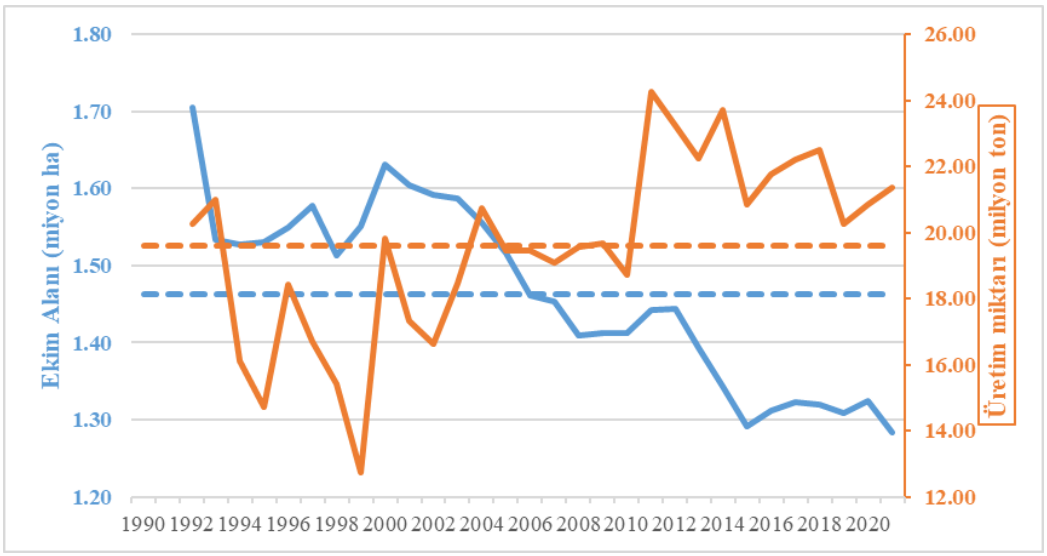
Hindistan patates üretim miktarı 1990 yılında 14.8 milyon ton iken 2021 yılında %267.1'lik artışla 54. 2 milyon tona ulaşmıştır. Üretim alnı artışına paralel üretim miktarında artış eğilimi hakim olmakla birlikte özellikle 1994 yılında -%12.1ve 2020 yılında ise -%7.7 lik düzeyde azalma gözlenmiştir. Önemli düzeyde artışlar ise 1992 yılında %12.5, 2007 yılında %10.9 ve 2021 yılında %12.4 oranında gerçekleşmiştir. Hindistan patates üretim bakımından dünya patates üretiminin 1990 yılında %5.5'ini karşılarken 2021 yılında %14.4'ünü karşılamaktadır.



Şekil 6. Hindistan patates verimi (ton/ha) değişim (1990-2021) grafiği

Hindistan'ın patates verimi 1990 yılında 15.7 ton/ha iken 2021 yılında %53.5'lik artış ile 24.1 ton/ha olarak gerçekleşmiştir. Eğilim grafiği incelendiğinde Hindistan'da yıllık verim artışı ortalama 279 kg/ha olarak değiştiği tespit edilmiştir (Şekil 6). Hindistan'da önemli patates verimi düşüşleri 1998 yılında -%24.7,2003 yılında -%10.8, 2007 yılında -%11.7 ve 2016 yılında -%11.3 oranında gerçekleşmiştir.

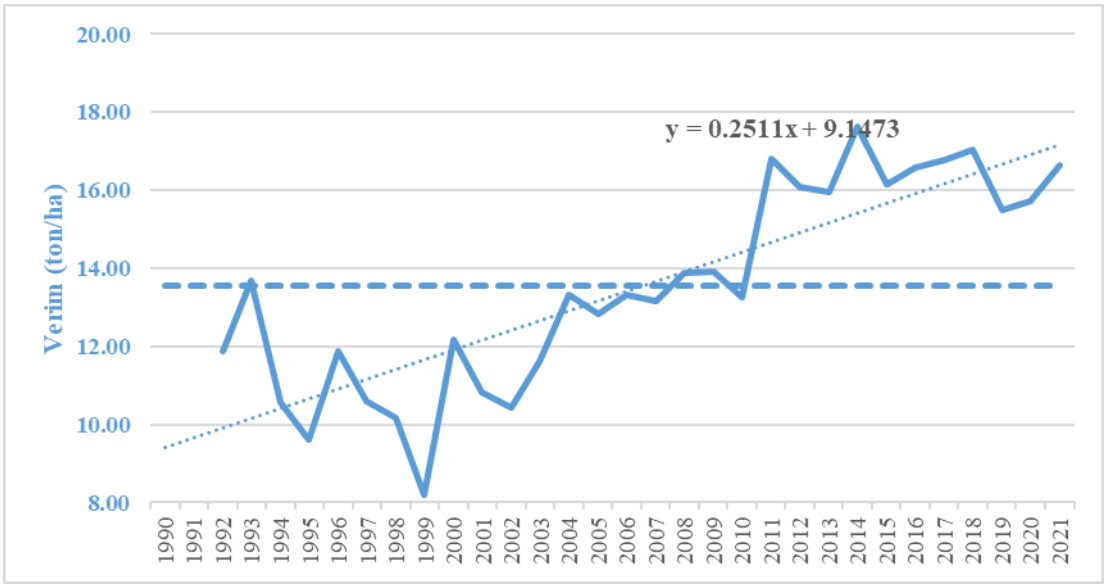
Ukrayna patates ekim alanı 1992 yılında 1.7 milyon hektar iken 2021 yılında yaklaşık -%24.8'lik düşüş ile 1.3 milyon hektara gerilemiştir. Ukrayna dünya patates tarım alanının 1990 yılında %9.2'sini karşılarken 2021 yılında bu oran %7.1 gerilemiştir (Şekil 7).



Şekil 7. Ukrayna patates ekim alanı (milyon ha) ve üretim miktarı (milyon ton) değişimi (1990-2021)

Ekim alanında azalma eğilimi hakim olmaktadır. Ekim alanında önemli düşüşler 1993(-%10.0), 1998(-%4.1), 2013(-%3.5), 2014(-%3.7), 2015(-%3.9) ve 2021(-%3.2) yıllarında gerçekleşmiştir.

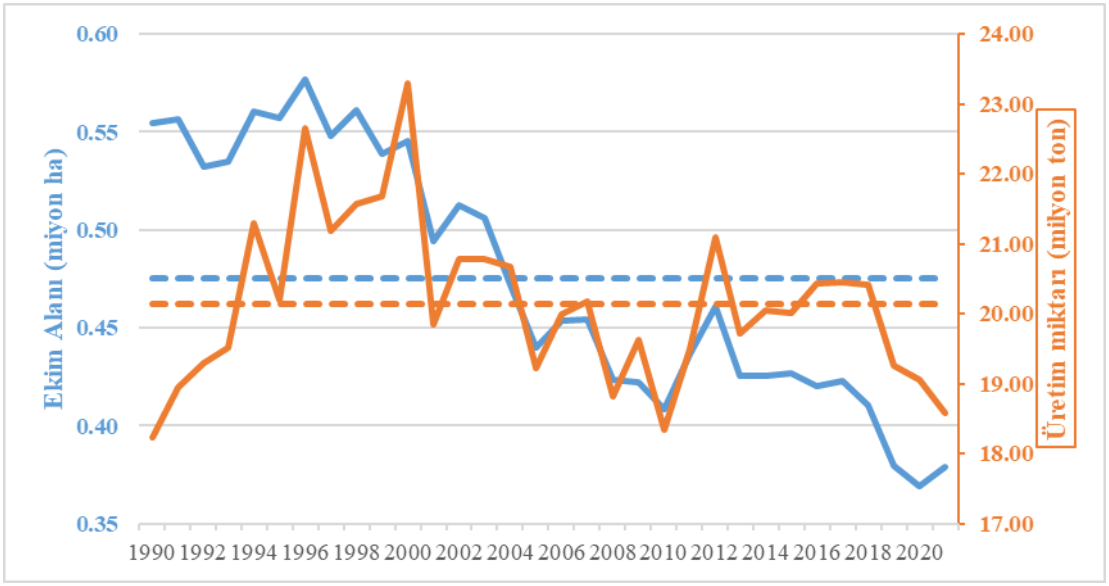
Ukrayna patates üretim miktarı 1992 yılında 20.3 milyon ton iken 2021 yılında yaklaşık % 5.3'lük artış ile 21.4 milyon tona ulaşmıştır (Şekil 7). Patates üretimi bakımından dünya üretiminin %7.3 'ünü karşılarken 2021 yılında %5.7'sine denk gelmektedir. Üretimde önemli azalmanın gerçekleştiği yıllar ise sırası ile 1994 (-%23.4), 1999(-%17.4), 2001(-%12.6),2015(-12.0) ve 2019(-%9.9). Azalma yanında önemli artış gözlenen yıllar ise sırası ile 1996(%25.0), 2000(%55.9),2003(%11.0), 2004(%12.5) ve 2011(%29.6).



Şekil 8. Ukrayna patates verimi (ton/ha) değişim (1990-2021) grafiği

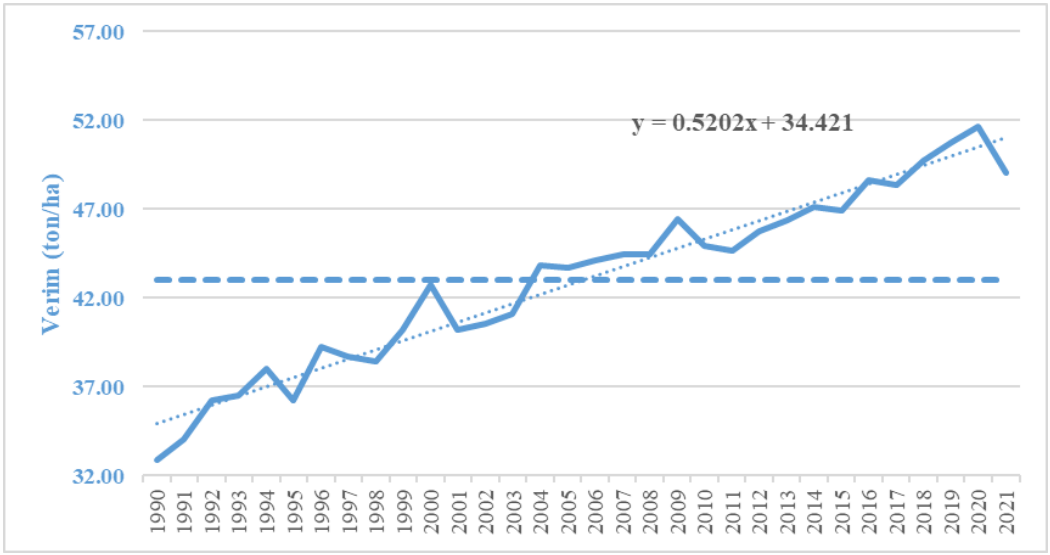
Ukrayna patates verimi 1992 yılında 11.9 ton/ha iken 2021 yılında 16.64 ton/ha olarak gerçekleşmiştir. En düşük verim 1999 yılında 8.2 ton/ha iken en yüksek verim ise 2014 yılında 17.6 ton/ha'dır (Şekil 8).

Amerika Birleşik Devletleri (ABD), patates ekim alanında önemli düzeyde azalma eğilimi gözlenmiş ve 1990 yılında 554.7 bin hektar iken 2021 yılında 378,7 bin hektara düşmüştür (Şekil 9). Patates ekim alanındaki daralma son 32 yılda -%31.7 olarak gerçekleşmiştir. Patates ekim alanı bakımından ABD dünya patates ekim alanının 1990 yılında %3.1'ini karşılarken 2021 yılında bu oran %2.1'e düşmüştür. En yüksek düşüş oranları 1997(-%5.1), 2001(-%9.4), 2004(-%6.7),2005(-%6.8), 2008(-%6.7), 2013(-%7.7) ve 2019(-%7.6) yıllarında gözlenmiştir.



Şekil 9. ABD patates ekim alanı (milyon ha) ve üretim miktarı (milyon ton) değişimi (1990-2021)

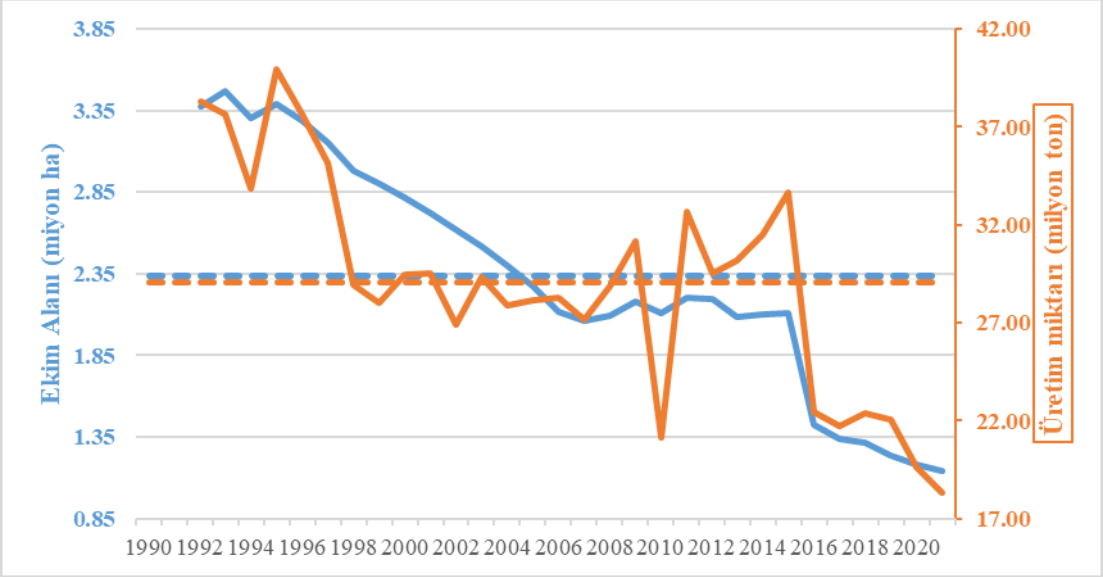
ABD patates üretim miktarı ise 1990 yılında 18.2 milyon ton iken 20221 yılında %1.9'luk artış ile 18.5 milyon ton olarak gerçekleşmiştir (Şekil 9). ABD patates üretim miktarı bakımından dünya üretiminin 1990 yılında %6.8'ini karşılarken, 2021 yılında ise %4.9'nu karşılamaktadır. Üretim miktarı 2010 yılına kadar azalma eğilimi gözlenirken 2010-2018 arasında artı ve 2018 sonrası yine azalma eğilimi göstermiştir. En önemli üretim düşüşleri 1995(-%5.2), 2001(-%14.8), 2005(-%7.0), 2008(-%6.7), 2010(-%6.5), 2013(-%6.5) ve 2019(-%5.7) yıllarında gerçekleşmiştir.



Şekil 10. ABD patates verimi (ton/ha) değişim (1990-2021) grafiği

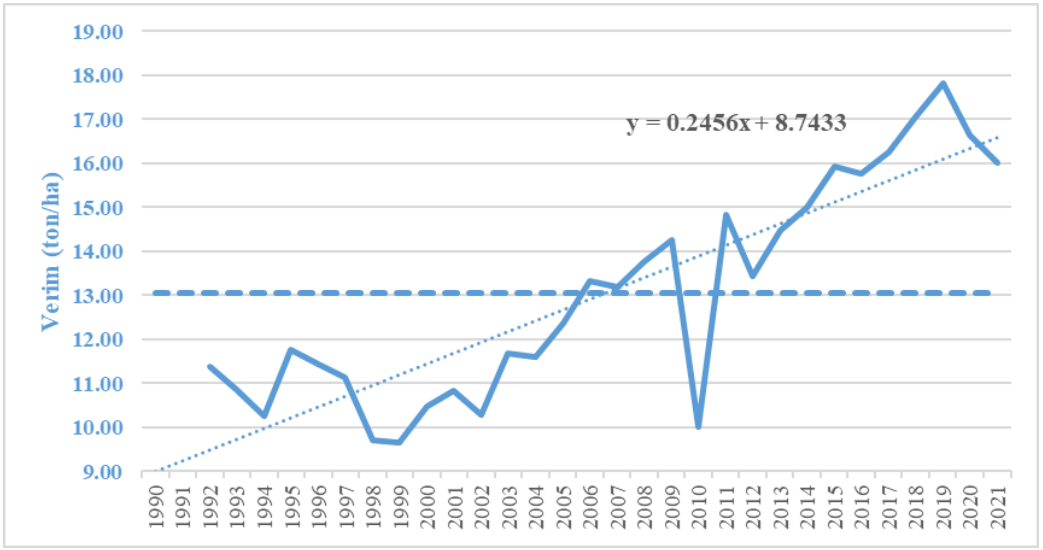
ABD patates verimi 1990 yılında 32.9 ton/ha iken 2021 yılında %49.2'lik atış ile 49.7 ton/ha ulaşmıştır (Şekil 10). En yüksek verim ise 2020 yılında 51.6 ton/ha olarak gerçekleşmiştir. ABD patates verim eğim grafi incelendiğinde yıllık ortalama verim artışı 520 kg/ha şeklinde gerçekleşmiştir.

Rusya patates ekim alanı 1992 yılında 3.37 milyon hektar iken 2021 yılında 1.14 milyon hektara gerilemiştir (Şekil 11). Son 30 yılda Rusya'da patates ekim alanı -%66.1 oranında azalma göstermiştir. Rusya patates ekim alanında önemli azalmalar 1992-2007 ve 2015-2021 arasında geçekleşmiştir. En önemli düşüş ise 2016 yılında -%32.5 düzeyinde gerçekleşmiştir.



Şekil 11. Rusya patates ekim alanı (milyon ha) ve üretim miktarı (milyon ton) değişimi (1990-2021)

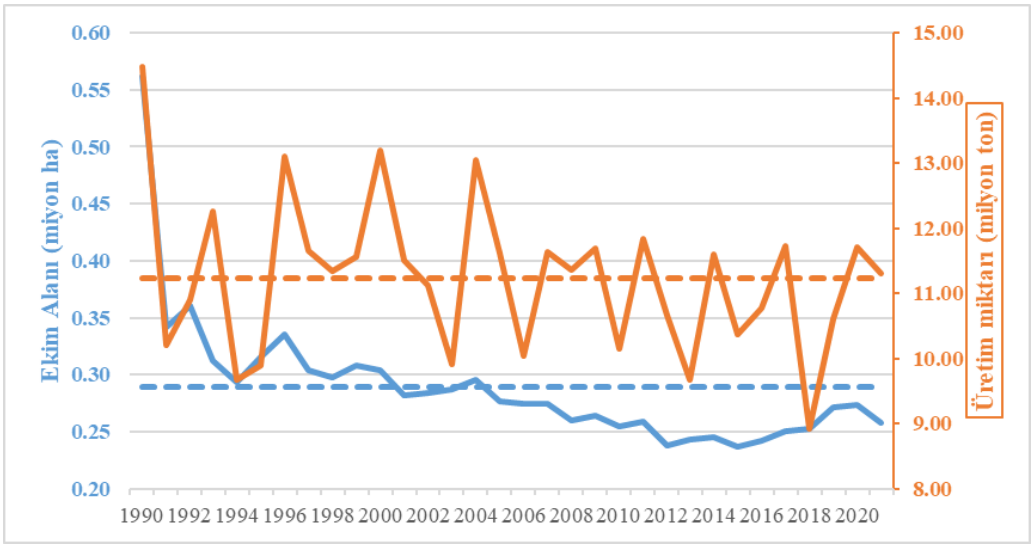
Ekim alanındaki daralmayla paralel olarak Rusya'da patates üretimi de azalma eğilimi göstermiştir. Rusya'da patates üretimi 1992 yılında 38.3 milyon ton iken 2021 yılında yaklaşık %52.3 düzeyinde azalmayla18.3 milyon tona gerilemiştir (Şekil 11). Üretimde düzenli azalmaya karşın 2010(-%32.1) ve 2016 (-%33.2) yıllarında önemli düzeyde ekstrem azalma gözlenmiştir. Azalmaya ilişkin 2016 yılında ekim alanında da önemli azalma üretimdeki azalmayı açıklarken 2010 yılındaki azalma verimin %40 düzeyinde azalmasından kaynaklanmaktadır.



Şekil 12. Rusya patates verimi (ton/ha) değişim (1990-2021) grafiği

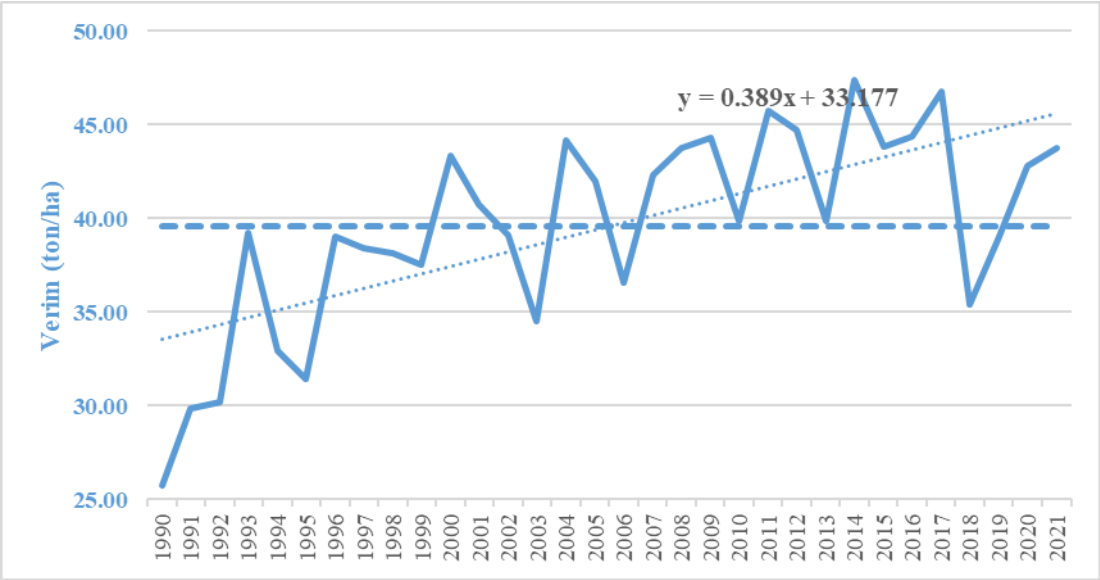
Rusya patates verimi 1992 yılında 11.37 ton/ha iken 2021 yılında %40.9 düzeyinde artış ile 16.64 ton/ha düzeyine ulaşmıştır (Şekil 12). 2010 yılındaki ekstrem verim düşü dışında Rusya'da genelde verim artış yönündedir. Eğilim grafine göre yıllık ortalama artış oranı ise son 30 yılda 246 kg/ha olarak hesaplanmıştır.

Almanya patates ekim alanı 1990 yılında 561bin hektar iken 2021 yılında 258 bin hektara gerilemiştir. Ekim alnı azalması 1991 yılında -%39.1 düzeyinde 1993 yılında -%13.5 düzeyinde gerilemesiyle birlikte 300 bin hektar düzeyine düşmüştür (Şekil 13). Almanya dünya patates ekim alanının 1990 yılında %3.2'sini karşılarken 2021 yılında bu oran %1.4'e düşmüştür.



Şekil 13. Almanya patates ekim alanı (milyon ha) ve üretim miktarı (milyon ton) değişimi (1990-2021)

Almanya patates üretimi 1990 yılında 14.5 milyon ton iken 2021 yılında 11.3 milyon tona gerilemiştir (Şekil 13). Ekim alanındaki yüksek düşüşler benzer şekilde üretim miktarında olumsuz yansımıştır. 1991 yılında -%29.5, 1994 yılında -%21.1 ve 2018 yılında -%23.9 düzeyinde sert düşüşler gözlenmiştir.



Şekil 14. Almanya patates verimi (ton/ha) değişim (1990-2021) grafiği

Sert düşüşler yanında önemli artılarda 1993 yılında %12.5, 1996 yılında %32.3, 2000 yılında %14.0, 2004 yılında %31.5, 2007 ve 2011 yıllarında %16.7, 2014 yılında %20.0 ve 2019 yılında %18.8 düzeyinde artışlar gözlenmiştir. Almanya patates üretimi tüm bu belirsiz üretim artışına rağmen son 32 yılda %21.8 düzeyinde atış göstermektedir.

Almanya patates verimi yönünden 1990 yılında 25.8 ton/ha iken 2021 yılında 43.8 ton/ha ulaşmıştır (Şekil 14). Verim eğim grafiğine göre yıllık ortalama 389 kg/ha artış gözlenmektedir.

3. SONUÇ VE ÖNERİLER

Patates tarımının 1990-2021 yılları arasında araştırıldığı bu çalışmada patates ekim alanında son 32 yılda %2.7 artış gözlenirken üretimde ise aynı periyotta %41.0 düzeyinde artış gerçekleşmiştir. Patates tarım alnındaki önemli artış ivmeleri 1992 (%4.5), 1999 (%4.4) ve 2020 (%7.4) yıllarında gerçekleşirken düşüşler ise 2006 yılında -%5.4 ve 2019 yılında -%4.1 olarak gerçekleşmiştir. Patates üretim miktarı 1990 yılında 266.8 milyon ton iken 1991 yılında önemli bir düşüşle son 32 yılın en düşük üretimi olan 260.0 milyon tona gerilemiş fakat düzenli

artış eğilimi ile 2021 yılında 376.1 milyon tona ulaşmıştır. Üretim miktarında önemli artış ivmeleri 1992 (%8.6), 1993 (%9.2), 1995 (%5.6), 1996 (%8.9), 2000 (%9.0), 2004 (%6.7) ve 2011 (%12.3) yıllarında gerçekleşirken, düşüş eğilimi ise 1994 yılında -%11.3 ve 2001 yılında -%5.4 olarak gerçekleşmiştir. Her iki düşüş dönemlerinde ekim alanında önemli düzeyde azalmanın da üretimdeki düşüşte etkili olduğu görülmektedir. Ekim alanı ve üretim arasında korelasyon incelendiğinde ise negatif yönlü ve istatistiksel anlamda önemli olmayan ilişki tespit edilmiştir. Patates verimi 1990 yılında 15 ton/ha iken 2021 yılında 20.78 ton/ha ulaşmıştır. Dünyada en yüksek verim 22.38 ton/ha olarak 2019 yılında gerçekleşirken en düşük verim ise 14.4 ton/ha ile 1991 yılı olmuştur. Verim eğim grafiğine göre yıllık ortalama 240 kg/ha olarak hesaplanmıştır. Ekim alanı patates tarımının önemli üreticisi olan ülkelerde genelde azalma eğiliminde olmasına karşın birim alanda verim artışı ile birlikte üretim miktarında artış devam etmektedir. Patates yemeklik taze veya işlenmiş ürünler ve tohumluk ticareti açısından dünyada önemli pazarı olan bir üründür. Tarım alanlarında iklim değişikliğinin olumsuz etkileri yanında özellikle hastalık ve zararlıları yönünden olumsuz etkiler artacaktır. Bununla birlikte sertifikalı ve farklı gelişme dönemlerine sahip verimli çeşitlerin ıslahı ile bu olumsuz etkilerin azaltılabilir.

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DÜNYA ŞEKER PANCARI TARIMINDA RİSKLER VE EĞİLİMLER

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Özet
En temel gıda maddelerinden birisi olan şeker, 18. yüzyılın sonuna kadar sadece şeker kamışından üretilmiştir. 19. yüzyılda Avrupa'da yeni bir hammadde olarak şeker pancarı tarımı ve şeker pancarından şeker üretimi başlamıştır. Yer aldığı coğrafya gereği Türkiye, Avrupa Birliği, Rusya, Ukrayna gibi ülkeler pancardan; ABD, Japonya, Çin gibi ülkeler hem pancardan hem kamıştan; Brezilya, Hindistan, Meksika, Pakistan, Tayland ve Avustralya gibi ülkeler kamıştan şeker üretmektedir. Dünyada Şekerin yaklaşık %79'u şeker kamışından ve %21 ise şeker pancarından elde edilmektedir. Dünyada üretim fazlaları ve stoklar şeker piyasasını olumsuz etkilemektedir. Şeker pancarının dünyada sınırlı alanda tarımının yapılıyor olması ve tarım alanlarında rekabet gücündeki düşüşler önemli riskleri oluşturmaktadır. Diğer yandan tatlandırıcılar ve alternatif ara madde veya tamamlayıcı maddelerde şeker piyasasını önemli düzeyde etkilemektedir. Dünyada şeker pancarı tarım alanlarında önemli azalma gözlenirken üretimde ise dalgalı seyir gözlenmektedir.
Anahtar Kelimeler: şeker, *Beta vulgaris* L., risk, değişimler

RISKS AND TRENDS IN WORLD SUGAR BEET FARMING

Abstract
Sugar, one of the most basic foodstuffs, was produced only from sugar cane until the end of the 18th century. In the 19th century, sugar beet cultivation as a new raw material and sugar production from sugar beets started in Europe. Due to its geography, countries such as Turkey, the European Union, Russia and Ukraine consume beet; Countries such as the USA, Japan and China produce both beet and cane; Countries such as Brazil, India, Mexico, Pakistan, Thailand and Australia produce sugar from cane. Approximately 79% of the sugar in the world is obtained from sugar cane and 21% from sugar beets. Overproduction and stocks in the world negatively affect the sugar market. The fact that sugar beet is cultivated in a limited area in the world and the decrease in competitiveness in agricultural areas pose important risks. On the other hand, sweeteners and alternative intermediates or complementary substances significantly affect the sugar market. While there is a significant decrease in sugar beet agricultural areas in the world, a fluctuating trend is observed in production.
Keywords: sugar, Beta vulgaris L., risk, changes

1. GİRİŞ

İnsan beslenmesinde özel bir yeri olan şeker, tarih boyunca önemli bir besin maddesi olmuştur. Şeker üretiminin tarihi çok eskilere dayanmakla birlikte özellikle 1900'lü yıllarda Avrupa'da yaygınlaşarak tercih edilen bir gıda maddesi haline gelmiştir. Uluslararası ticaretteki önemi artan şeker Avrupa ülkelerinin kendi ülke ve kolonilerinde şeker üretimi ve işlenmesiyle ilgili faaliyetlere büyük ölçekli yatırımlar yapması şekerin ekonomide önemli bir yer edinmesini sağlamıştır. Halihazırda yüzden fazla ülkede üretilen şeker hammaddelerinin işlenmesiyle toplumun önemli bir ihtiyacı karşılanmaktadır (Kıymaz,2001). Dünyada şeker önceleri sadece şeker kamışından üretilebiliyorken, Avrupa'da savaşların ardından yaşanan açlık ve kıtlığın ardından yeni bir hammaddenin ortaya çıkmasıyla şeker pancarından da üretilmeye başlandı. Günümüzde birbiriyle rekabet halinde olan ve iki farklı hammaddeden elde edilebildiği için iki farklı maliyet yapısına sahip olan ancak kamıştan elde edilenin maliyetinin diğerinden daha düşük olduğu iki farklı şekerden bahsetmek mümkündür. Yer aldığı coğrafya gereği Türkiye, Avrupa Birliği, Rusya, Ukrayna gibi ülkeler pancardan; ABD, Japonya, Çin gibi ülkeler hem pancardan hem kamıştan; Brezilya, Hindistan, Meksika, Pakistan, Tayland ve Avustralya gibi ülkeler kamıştan şeker üretmektedir. Dünyada Şekerin yaklaşık %79'u şeker kamışından ve %21 ise şeker pancarından elde edilmektedir. Pancar şekeri, kamış şekerinden daha pahalı üretilmesine rağmen, gelişmiş ülkelerin gıda güvenliği, üretici gelirleri ve tarımsal ekonomi politikaları ve öncelikle gıda güvenliği politikaları ve tarımsal ekonomi politikaları açısından tarihsel gelişimi içerisinde özel yeri olan bir politika ürünü olmuştur. Avrupa Birliği dünya çapında tüketilen pancar şekerinin yaklaşık %50'sini üretiyor ve bu da onu dünyanın en büyük pancar şekeri üreticisi yapıyor. Ancak pancar şekeri dünya şeker üretiminin yalnızca %21'ini oluşturmaktadır; geri kalanı şeker kamışından üretilmektedir. AB dünyanın üçüncü büyük şeker üreticisidir. Dünyadaki üretim fazlalıkları ve stoklar şeker piyasalarını olumsuz etkiliyor. Öte yandan alternatif tatlandırıcıların belirli kullanım alanları olmasına rağmen tamamlayıcı ara ürün veya doğrudan şeker alternatifi olabilmeleri nedeniyle şekerle rekabet etmekte ve dolayısıyla şeker pazarındaki dengeleri tehdit etmekte ve üretimleri yaygınlaşarak yüksek miktarlara ulaşmaktadır.

Dünyada şeker sektöründe korumaların azaltılmasıyla ortaya çıkacak daha serbest bir ticaret ortamında, kamış şekeri üreten ülkeler karşısında şeker pancarı şekeri üreten ülkelerin rekabet şansı yaratması gerekmektedir. Bunun için, ülkelerin arz talep dengesini koruyarak, şeker

pancarı çiftçisinin desteklendiği ve yatırım faaliyetlerinde yeni teknolojilerle yan ürünlerin piyasada daha fazla değerlendirileceği politikaların geliştirilmesi gerektiği düşünülmektedir. Ayrıca iklim değişikliği çevre sorunları yanında su varlığı ve kalitesi, hastalık ve zararlıların kontrolü verimli çeşit ıslahı önem kazanmaktadır.

2. DÜNYADA ŞEKER ÜRETİMİ VE TÜKETİMİ

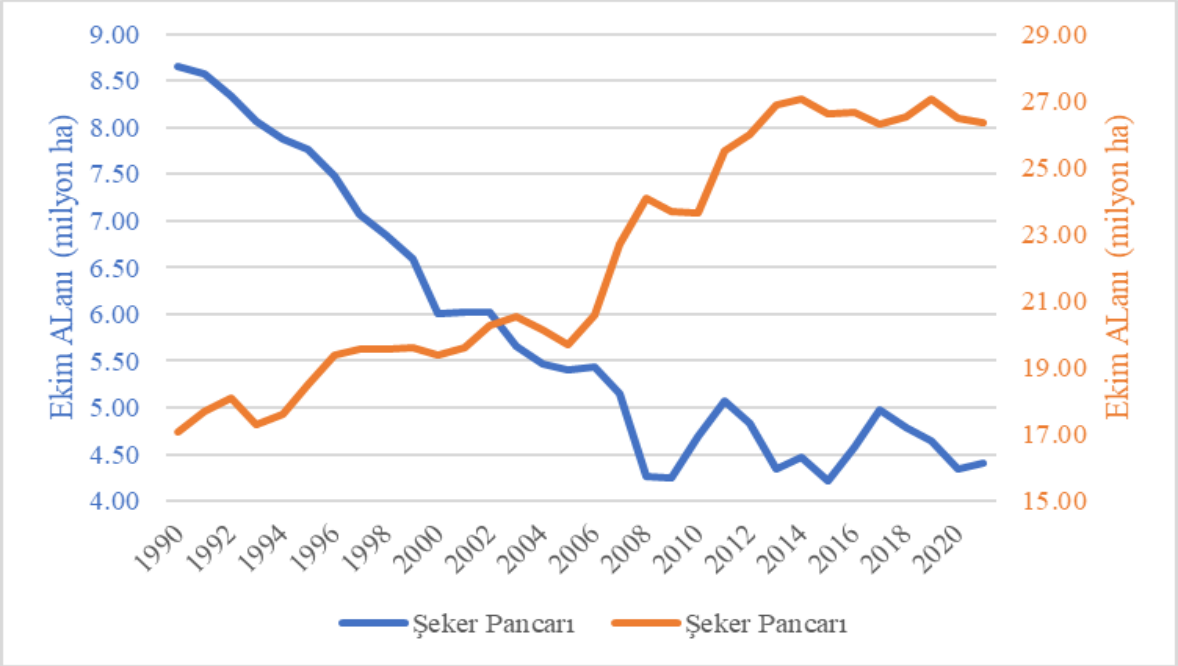
Dünyada şeker üretimi son on yılda 166-183 milyon ton aralığında değişmekte olup bunun yaklaşık %95-98 tüketilmekte olup stok durumu oluşmamaktadır. Dünyada önemli şeker üreticileri Tablo 1'de verilmiştir. Dünya şeker üretiminde en yüksek payı 38.05 milyon ton şeker üretimiyle Brezilya olurken aynı zamanda dünya şeker üretiminin %21.5'ini üretmektedir. Hindistan ise 32 milyon ton şeker üretimiyle en büyük 2. Şeker üreticisi konumundadır. Avrupa Birliği ise 14.9 milyon ton ile dünya şekerinin %8.4'nü karşılamaktadır (Tablo 1).

Tablo 1. 2022 yılında önemli şeker üretici ülkeler ve üretim oranları (USDA,2023)

Ülkeler	Toplam üretim (milyon ton)	Dünya üretimdeki payı (%)
Brezilya	38.05	21.5
Hindistan	32.00	18.1
Avrupa Birliği	14.90	8.4
Tayland	11.04	6.2
Çin	9.00	5.1
Amerika Birleşik Devletleri	8.42	4.7
Rusya	7.18	4.1
Pakistan	6.86	3.9
Meksika	5.71	3.2
Avustralya	4.20	2.4
Türkiye	3.00	1.7
Diğer	36.91	20.8

Şeker üretiminin yanında dünyada en önemli tüketici ülkelerin aynı zamanda üretim açısından da önde olan ülkeler olduğunu görülmektedir. En büyük şeker tüketicisi ülkelerin başında Hindistan, AB, Çin, ABD, Brezilya, Endonezya, Pakistan, Rusya, Meksika ve Mısır gelirken, Doğu Asya'nın en yüksek seviyede şeker tüketen kıta olduğu görülmektedir. Türkiye ise 2021/22 sezonunda yaklaşık 2.9 milyon ton tüketim ile dünyada 11. sırada yer almaktadır (Anonim, 2023a). Şeker ticareti yönünden değerlendirildiğinde ithalatta Çin, Endonezya, ABD,

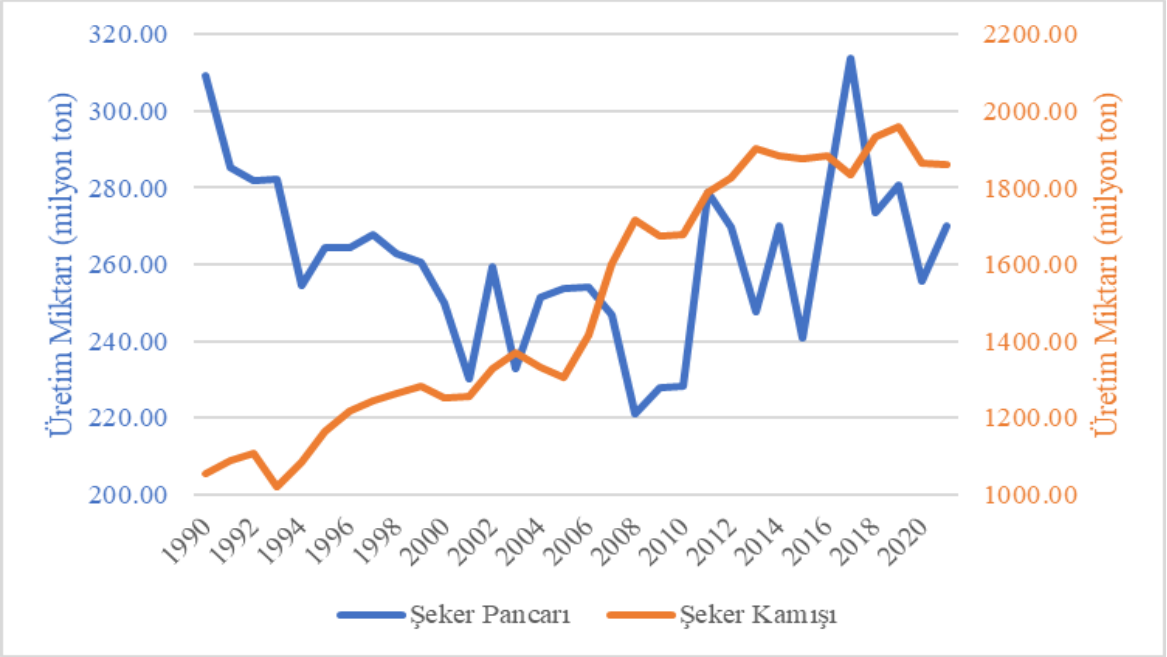
Cezayir, Bangladeş ve AB şeklinde sıralanırken ihracatta ise Brezilya, Tayland, Hindistan, Avustralya, Guatemala ve Meksika şeklinde sıralanmaktadır.



Şekil 1. Dünya Şeker pancarı ve Şeker kamışı ekim alanı değişimi (1990-2021)

Son yıllarda şeker üretimindeki artış çoğunluklu olarak şeker kamışı üretiminden kaynaklanmaktadır. Özellikle Brezilya, Tayland, Avustralya ve Güney Afrika şeker kamışı üretimi artışına bağlı olarak şeker kamışı şeker oranı da artmaktadır. Şeker pancarında şeker üretimi son dönemlerde azalmaktadır. 2021/22 döneminde % 79,1 olan kamış şekerinin payı 2022/23 döneminde % 80,1'e yükselerek son yılların en yüksek seviyesine ulaşmıştır.

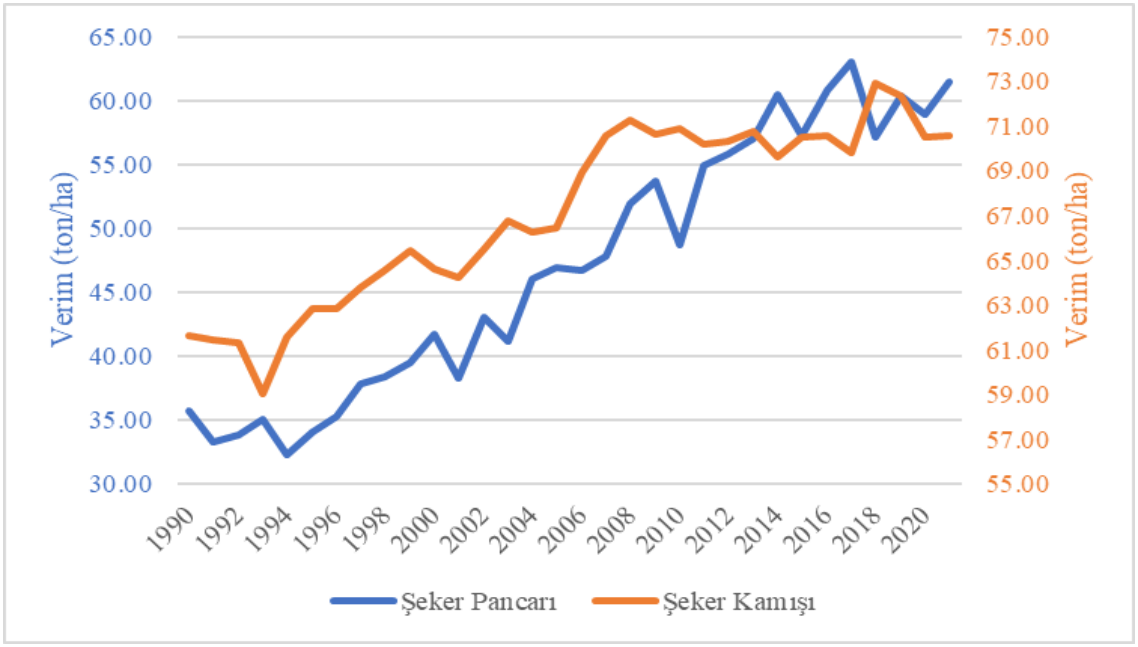
Şeker pancarı ekim alanı 1990 yılında 8.66 milyon hektar iken 2021 yılında -%49.18 oranında azalma ile 4.40 milyon hektara gerilemiştir (Şekil 1). Şeker pancarının son 32 yıldaki önemli düzeyde azalmasına karşın 2008 yılından itibaren bu azalma eğilimi yataya dönmüştür. Şeker kamışı ekim alanı ise şeker pancarının tam tersi yönde artış eğilimi sergilemiştir. Şeker kamışı ekim alanı 1990 yılında 17.1 milyon hektar iken 2021 yılında %54.28'lik artış ile 26.35 milyon hektara ulaşmıştır. Şeker kamışı ve şeker pancarının ekim alanları toplamının şeker pancarı ekim alanına oranlandığında 1990 yılında şeker pancarının payının %33.64 olduğu hesaplanırken 2021 yılında bu oranın %14.31 gerilediği hesaplanmıştır.



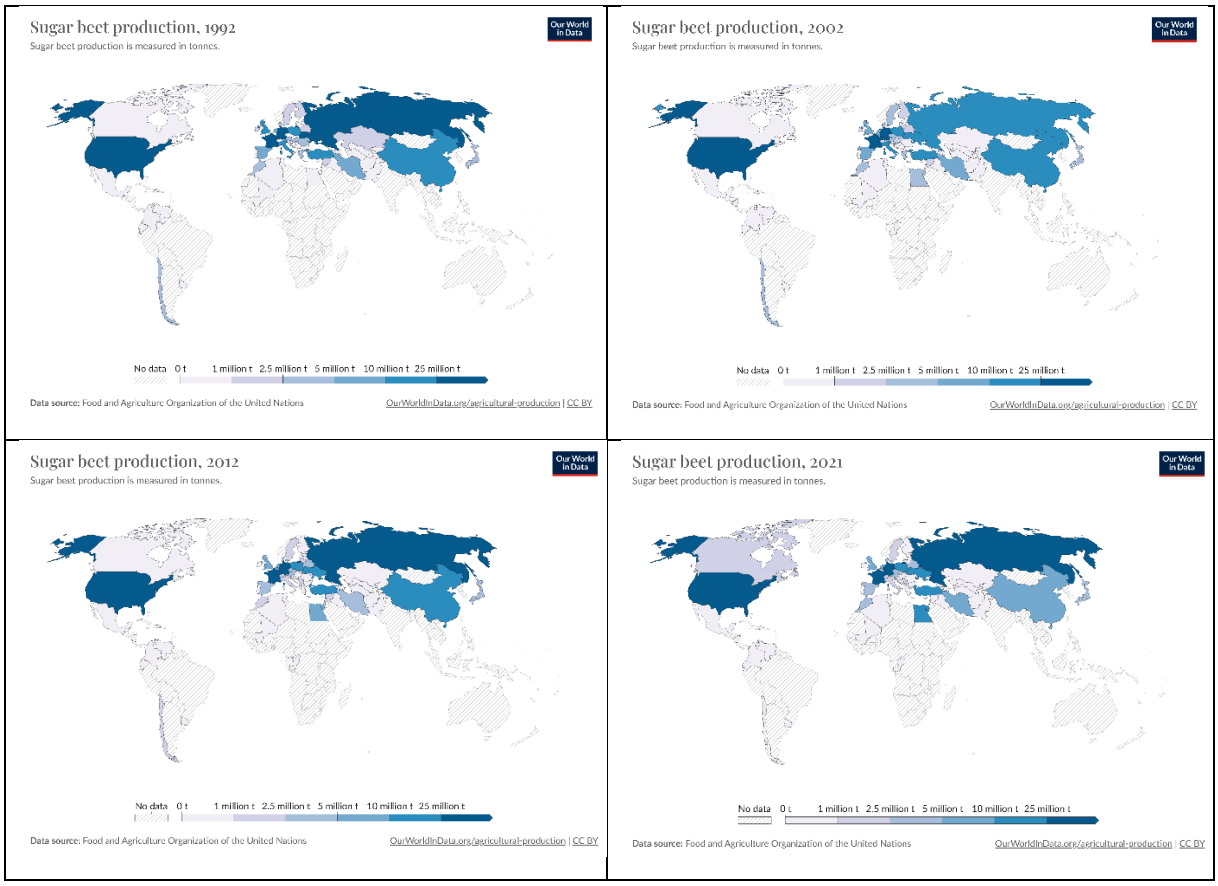
Şekil 2. Dünya şeker pancarı ve şeker kamışı üretim miktarı değişim grafiği (1990-2021)

Şeker pancarının dünya genelinde üretim miktarı incelendiğinde 1990 yılında 309.19 milyon ton iken 2021 yılında -%12.62 oranında düşerek 270.16 milyon ton gerilemiştir (Şekil 2). Şeker pancarı üretiminde son 32 yılın en düşük değeri ise 2008 yılında 221.10 milyon ton olarak elde edilmiştir. Dünyada şeker pancarı ekim alanı ve üretimde önemli azalmanın 2008 yılında gerçekleşmesinde hem Amerika hem de Avrupa'da ekim alanı ve üretim miktarı önemli düzeyde azalmasından kaynaklanmaktadır. Şeker kamışı üretimi incelendiğinde 1990 yılında 1053.0 milyon ton üretim sağlanırken 2021 yılında üretim %76.58 düzeyinde artış ile 1859.4 milyon tona ulaşmıştır. Şeker pancarı ve şeker kamışı üretiminin toplamına göre şeker pancarı üretimi oranlandığında 1990 yılında şeker pancarı oranı %22.70 düzeyinde iken 2021 yılında bu oran %12.69'a gerilemiştir.

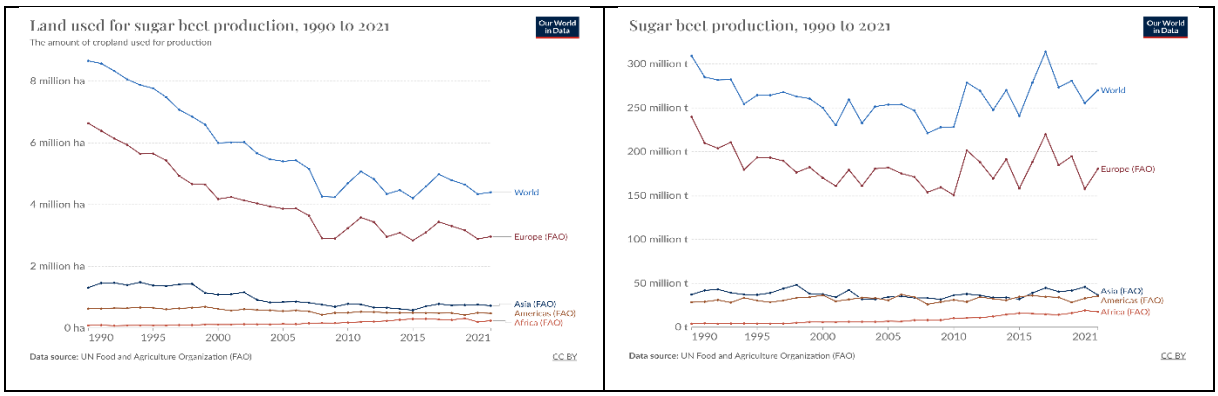
Şeker pancarı verimi 1990 yılında 35.71 ton/ha iken 2021 yılında %71.95 oranında artış ile 61.41 ton/ha olarak gerçekleşmiştir. Şeker kamışı verimi 1990 yılında 61.65 ton/ha iken 2021 yılında %14.46 oranında artış ile 70.57 ton/ha olarak gerçekleşmiştir (Şekil 3). Şeker pancarında verimli ve şeker oranı yüksek çeşitlerin geliştirilmesi ile verimde önemli artışlar sağlanmıştır.



Şekil 3. Dünya şeker pancarı ve şeker kamışı verimi değişim grafiği (1990-2021)

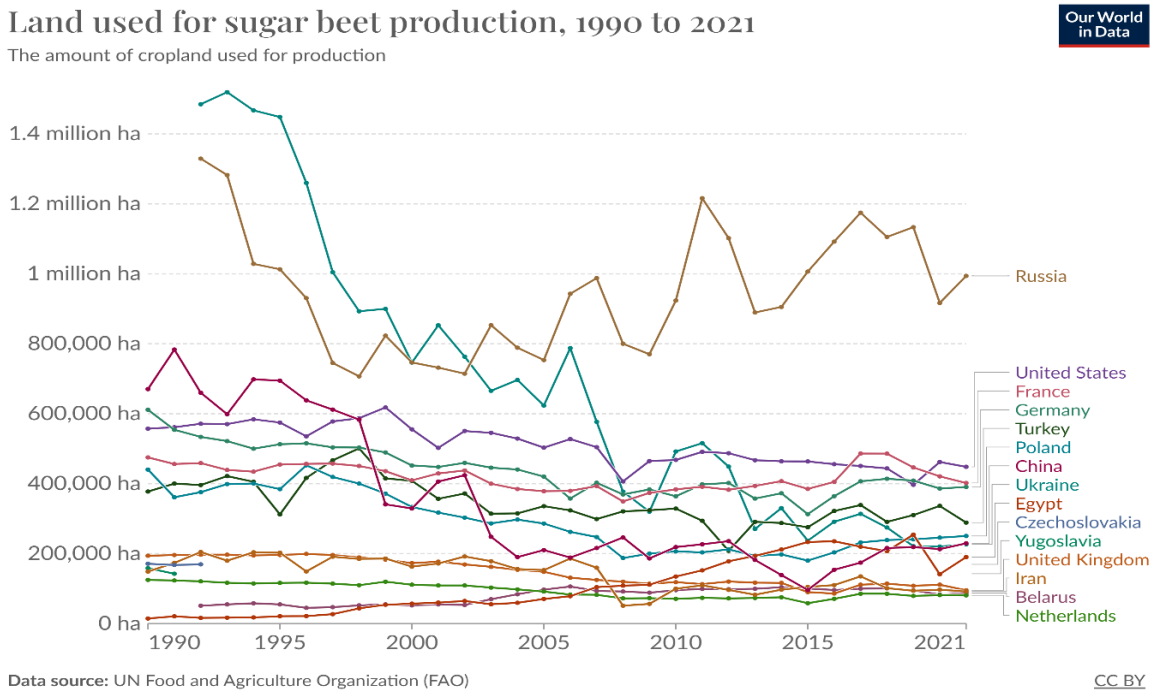


Şekil 4. Dünya şeker pancarı ekim alanları (1990-2021)



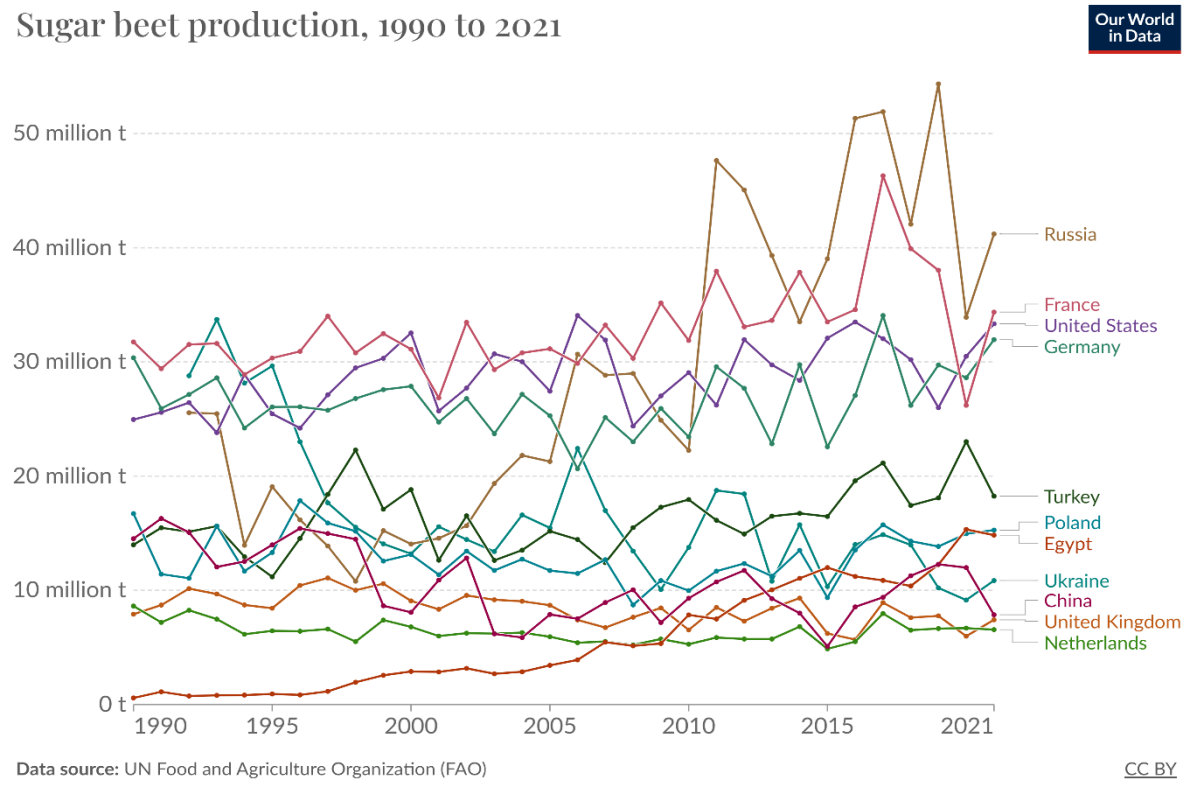
Şekil 5. Dünya ve Avrupa kıtası şeker pancarı ekim alanları karşılaştırması (1990-2021)

Şeker pancarı tarım alanı 1990 yılında 8.66 milyon hektardan 2021 yılında %49.18 oranında azalarak 4.4 milyon hektara düşmüştür. Avrupa kıtasında 1990 yılında 6.64 milyon hektar ekim alanı 2021 yılında %55.42 oranında azalarak 2.96 milyon hektara gerilemiştir. Dünya şeker pancarı ekim alanı değişimi Avrupa şeker pancarı ekim alanı grafiğine benzer bir azalma eğrisi gözlenmektedir (Şekil 5). Benzer durum üretim miktarı içinde geçerlidir. Avrupa kıtası dünya şeker pancarı üretiminin 2/3'sini karşıladığından şeker pancarının geleceğinde önemli etkiye sahiptir. Şeker pancarı üretim miktarındaki azalma 1990-2021 yılları arasında dünyada -%12.63 iken Avrupa'da ise -%24.68'dir.



Şekil 6. Şeker pancarı tarımı yapan bazı ülkelerin ekim alanları değişimi (1990-2021)

Şeker pancarı tarımında ekim alanı bakımından 1992 yılında sırasıyla Ukrayna (1.49 mil. ha), Rusya (1.33 mil. ha), Çin (660 bin ha) ve ABD (571.2 bin ha) yer alırken Ukrayna 2008 yılında -%74.7 azalarak 377.2 bin hektara gerilemiştir. Ukrayna'nın 2021 yılında şeker pancarı ekim alanı 226,6 bin ha gerilemiştir. Rusya ekim alanı 1992 yılında 1.33 milyon hektar iken 1998 yılında -%46.94 azalarak 707,0 bin ha gerilemiş fakat 1998 yılına göre %40.57 artarak 2021 yılında 993.83 bin ha ulaşmıştır. Yine 1990 yıllarda 670,3 bin ha ekim alanı sahip Çin 2004 yılında -%71,66 oranında azalarak 189.99 bin ha düşmüştür (Şekil 6). Şeker pancarında 1992 yılına göre en önemli düşüş gösteren ülkeler sırasıyla Ukrayna (-1,26 milyon ha), Çin (-460.7 bin ha), Rusya (-335.4 bin ha) ve Almanya (-142.95 bin ha) yer alırken Mısır ise 173.91 bin ha şeker pancarı tarım alanını artırmıştır. Dünyada Mısırdan sonra şeker pancarı tarım alanını artıran diğer ülkeler ise sırasıyla Belarus (+36.00 bin ha), Türkmenistan (+17.28 bin ha) ve Irak (+5.5 bin ha).



Şekil 7.Şeker pancarı üretimi yapan önemli ülkelerin üretim miktarı değişimi (1990-2021)

Şeker pancarının üretim miktarı dikkate alındığında 1990 yılında en önemli üretim Sovyetler Birliği ülkeleri birlikte yer aldığından 82.9 milyon ton üretimle ilk sırada yer alıyordu. Fransa

31.7 milyon ton ile toplam üretimin yaklaşık %10.27 ile 2. sıra yer almıştır. Almanya 30.4, ABD 24.9, Polonya 16.7 milyon ton üretimle sıralamada yer almıştır. 2021 yılında dünya üretimi 270.16 milyon tona gerilerken Rusya %13.3'lük pay ile 41.2 milyon ton üretim sağlamıştır. Rusya'yı sırasıyla Fransa 34,4, ABD 33,3, Almaya 31,9 ve Türkiye 18,3 milyon ton üretim sağlamışlardır. Üretim miktarındaki değişimlerin 1992 ile 2021 yıllarına göre değerlendirildiğinde dünya üretiminde -%4.1 gerileme hesaplanırken İtalya'da -%89,7, Ukrayna -%62.3, Çin'de -%47.9, İngiltere'de -%26.9, Hollanda'da-%20.55 ve İran'da -%14.3 düzeyinde düşüş gözlenmiştir. Üretimdeki artışlara bakıldığında Mısır %1893.0, Rusya%61.3, Polonya %38.2, ABD %26.1, Türkiye %20.65, Almanya%17.7 ve Fransa %9.0 olarak gerçekleşmiştir.

3. SONUÇ VE ÖNERİLER

İnsan beslenmesinde özel bir yeri olan şeker, tüketimi nüfus artışına bağlı olarak artmaktadır. Gelişmiş ülkelerde şekerin kullanımının azaltılması ve sağlıklı yaşam uygulamaları nedeniyle bu ülkelerde şeker tüketimi azalırken özellikle az gelişmiş Asya ve Afrika ülkelerinde talep artmaktadır. Genel olarak arz talep dengesinin sağlandığı şeker piyasasında pandemi döneminde üretimde azalma ve tüketim artışı biraz dengeleri bozsa da Brezilya'da şeker üretimin artması ile denge tekrar sağlanacaktır. Özellikle şeker kamışı üretiminin artması taleplerin karşılanmasında etkilidir. Şeker kamışının çok yıllık olması, tropik ve subtropik bölgelerde yetişmesi ve maliyetlerin az olması şekeri alındıktan sonra geriye kalan sapların fabrikalarda enerjide kullanılması gibi birçok nedenlerle daha ucuz şeker oluşumunu sağlamaktadır. Şeker pancarı AB ülkeleri, Rusya, ABD, Türkiye, Mısır, Çin, ve Ukrayna başta olmak önemli tarım alanlarını oluştururken son 30 yılda ekim alanlarında daralma gözlenmektedir. Şeker pancarının tarım istekleri dikkate alındığında özellikle yağışın yetersiz olduğu bölgelerde sulama ile üretimin yapılması nedeniyle maliyetli ve meşakkatli olmaktadır. Son yıllarda iklim değişikliğinin olumsuz etkileri nedeniyle artan kuraklık stresi, yağış rejim değişikliği, dolu ve sel baskınları gibi olumsuz meteorolojik hadiselerin artması nedeniyle üretim alanlarında önemli azalmalara neden olmaktadır. Ayrıca uzun süreli ve münavebe uygulanmayan tarım alanları başta olmak üzere yaygınlaşan hastalık ve zararlılar olumsuz etkilerini artırmaktadır.

Dünyada sadece mısırdan üretilen nişasta kökenli tüm şuruplara glukoz dahil mısır şurubu, fruktoz içeren şuruplara HFCS (High Fructose Corn Syrup - Yüksek Fruktozlu Mısır Şurubu)

denilmektedir. Nişasta kökenli fruktoz içeren şuruplardan yaklaşık %42 fruktoz, %53 glukoz içerenler HFCS-42; yaklaşık %55 fruktoz, %41 glukoz içerenler HFCS-55 olarak adlandırılmaktadır. Bunlardan HFCS-55, pancardan elde edilen sakarozun ikamesi olarak kabul edilmektedir. HFCS-42 genellikle unlu mamuller ve gıda üretiminde, HFCS-55 ise çoğunlukla hazır içecek üretiminde tatlandırıcı olarak kullanılmaktadır. Düşük kalorili alternatif şeker arayışları ve özellikle Yüksek Fruktozlu Mısır Şurubunun (HFCS) üretimi kullanımı sınırlı düzeyde devam etmektedir.

Küresel ekonomi, yüksek enflasyon üretim maliyetleri ve tüketici davranışı önemli ölçüde şeker kullanımını etkilemiştir.

Avrupa Birliğinin Ortak Tarım Politikaları ve kota uygulamaları ile şeker pancarında önemli düzeyde artış sağlanırken ihracatçı konumdan net ithalatçı konumuna yerleşmiştir. Avrupa'da kurulu olan şeker sanayinin korunması ayrıca önem kazanmaktadır.

Dünyada şeker sektöründe korumaların azaltılmasıyla ortaya çıkacak daha serbest bir ticaret ortamında, kamış şekeri üreten ülkeler karşısında şeker pancarı şekeri üreten ülkelerin rekabet şansı yaratması gerekmektedir. Bunun için, ülkelerin arz talep dengesini koruyarak, şeker pancarı çiftçisinin desteklendiği ve yatırım faaliyetlerinde yeni teknolojilerle yan ürünlerin piyasada daha fazla değerlendirileceği politikaların geliştirilmesi gerektiği düşünülmektedir.

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Özet
Dünyada olduğu gibi Türkiye'de de suyun en fazla kullanıldığı sektör tarımdır. Basınçlı sulama yöntemlerinin, geleneksel sulama yöntemlerine oranla daha fazla su tasarrufu sağladığı bilinen bir gerçektir. Bununla birlikte, gün geçtikçe artan dünya nüfusuna bağlı olarak kıt ve vazgeçilmez kaynak olan suya olan talep de artmaktadır. Bu nedenle çiftçiler su kullanımı konusunda bilinçlendirilmeli ve arazilerine en uygun sulama yöntemini kullanılmaya ikna edilerek gelecek nesillere daha yaşanılabilir bir dünya bırakmasına katkı sağlanmalıdır. Sulama miktarını ve sulama zamanını azaltmayı, suyun kök bölgesinin altına sızmasını minimum seviyeye düşürmeyi ve sulamadan sonra suyun buharlaşmasını azaltmayı hedefleyen yöntemlerden bir tanesi de kesikli damla sulama yöntemidir. Özellikle bitki yetiştirme ortamına ilk sulama suyundan itibaren kademeli olarak uygulanması ile, daha sonra uygulanacak olan sulamalarda suyun toprakta daha hızlı emilimi sağlanmaktadır. Toprağa ekilen tohumun çimlenmesi için yüksek derecede toprak nemi sağlamak, kesikli damla sulama tekniğinin uygulanmasının bir diğer nedenidir. Kesikli damla sulama teknolojisi, verimi artırma, kaliteyi iyileştirme, su tasarrufu sağlama ve damlatıcıların tıkanmasını azaltma gibi konularda olumlu etkileri olduğu için tüm dünyada uygulanmaktadır. Sık sulamalar sayesinde, toprakta su hareketi ve kökler tarafından alınması için arzu edilen koşulları sağlanabilmektedir. Kesikli damla sulama yöntemi ile sulama sağlandığında büyük ölçüde su tasarrufu sağlanmaktadır. Bitki kök bölgesinin altına sızan su minimum seviyeye düşürüldüğünde yapılacak olan sulama aralıkları artar ve sudan tasarruf edildiği gibi zamandan da tasarrufu hedeflenmektedir. Kesikli damla sulama yönteminin birçok avantajı bulunmaktadır. Bitki toprak üstü organları ıslatılmadığından bitki hastalık ve zararlılarının gelişmesi önlenmektedir. Yabancı ot gelişimi daha az miktarda oluşmaktadır. Bu çalışmada kesikli damla sulama yönteminin kullanım alanları, avantaj ve dezavantajları hakkında bilgi verilmiştir. Bunun yanında Dünyada ve Türkiye'de yapılan çalışmalar değerlendirilmiş, kesikli damla sulama uygulamalarının kuraklıkla mücadelede kullanım olanakları incelenmiştir.
Anahtar Kelimeler: kesikli sulama, damla sulama, su tasarrufu

PULSE DRIP IRRIGATION APPLICATIONS IN COMBATING DROUGHT

Abstract
Agricultural sector is the dominant consumer of fresh water in Turkey, as in the world.. Moreover, due to the increasing world population, demand for water, a scarce and indispensable resource, is also increasing. It is a known fact that pressurized irrigation methods save more water than traditional irrigation methods. For this reason, farmers should be made aware of water management and should be persuaded to use the most suitable irrigation method for their lands, thus contributing to leaving a more livable world for future generations. One of the methods that aims to reduce the amount of irrigation and irrigation time, minimize the leakage of water under the root zone, and reduce the evaporation of water after irrigation is the pulse drip irrigation method. Especially by gradually applying water to the plant growing environment from the first irrigation water, faster absorption of water into the soil is ensured in subsequent irrigations. Providing a high degree of soil moisture for germinating the seed planted in the soil is another reason for applying the pulse drip irrigation technique. Pulse drip irrigation technology is applied worldwide as it has positive effects on increasing efficiency, improving quality, saving water, and reducing clogging of drippers. It is applied all over the world because it has positive effects on issues. Thanks to frequent irrigation, the desired conditions for water movement in the soil and uptake by the roots can be achieved. When irrigation is provided with the pulse drip irrigation method, significant water savings are achieved. When the water leaking under the plant root area is reduced to a minimum level, the irrigation intervals are increased, and it is aimed to save time and water. The pulse drip irrigation method has many advantages. Since the aboveground organs of the plant are not wetted, the development of plant diseases and pests is prevented. Weed growth occurs in less quantity. In this study, information about the usage areas, advantages, and disadvantages of the pulse drip irrigation method is given. In addition, studies conducted worldwide and in Turkey were evaluated, and the possibilities of using pulse drip irrigation applications in combating drought were examined.
Keywords: pulse irrigation, drip irrigation, water saving

1. GİRİŞ

Gün geçtikçe artan dünya nüfusuna bağlı olarak vazgeçilmez kaynak olan suya talep de artmaktadır. Bu durum beraberinde su sorununu gündeme getirmiştir.Suyun aşırı kullanımı, su kaynaklarının azalmasına hatta yok olmasına neden olmaktadır. Su kaynaklarının korunması için su kullanımında tasarruf yapılmalıdır.

Dünya'da ve Türkiye'de en fazla su kullanımı tarım sektöründedir. Tarımsal sulamada su tasarrufu, kaynaktan alınan suyun en az kayıpla bitki kök bölgesine ulaşması ve depolanması ile mümkündür. Suyun kaynaktan alındığı andan bitkiye verilinceye kadar geçen süreçte uygulanan yöntemlere bağlı olarak çeşitli kayıplar söz konusudur. Özellikle su iletim ve dağıtımının açık kanal ve kanaletlerle yapıldığı durumlarda su kaybı daha fazla iken, borulu su dağıtım şebekelerinde sadece sürtünmeden kaynaklanan kayıplar söz konusudur (Bayramoğlu ve Ağızan, 2018).

Çiftçiler tarafından bilinçsizce yapılan tarımsal sulamalar su kaynaklarının azalmasına neden olmaktadır. Bu nedenle su tasarrufu konusunda çiftçiler bilinçlendirilmeli ve sahip oldukları araziler ile su kaynaklarına uygun sulama yöntemini kullanmaya teşvik edilmelidir (Bayramoğlu ve Ağızan, 2018).

Tarımsal sulama ile beklenen optimum verim artışını sağlayabilmek için suyun toprağa en ekonomik ve tekniğine uygun bir şekilde verilmesi esastır. Bunu sağlamak için de; sulama yapılacak arazinin toprak özellikleri, sulama suyunun miktarı ve kalitesi, topografik durum, arazinin büyüklüğü ve şekli, bitki türü, iklim özellikleri, sulama giderleri bölgenin sosyal ve kültürel özellikleri dikkate alınarak sulama yönteminin seçilmesi gerekir. Tarımsal sulamalarda su toprağa değişik yöntem ve sistemlerle verilebilmektedir.

2. KESİKLİ SULAMANIN AMACI

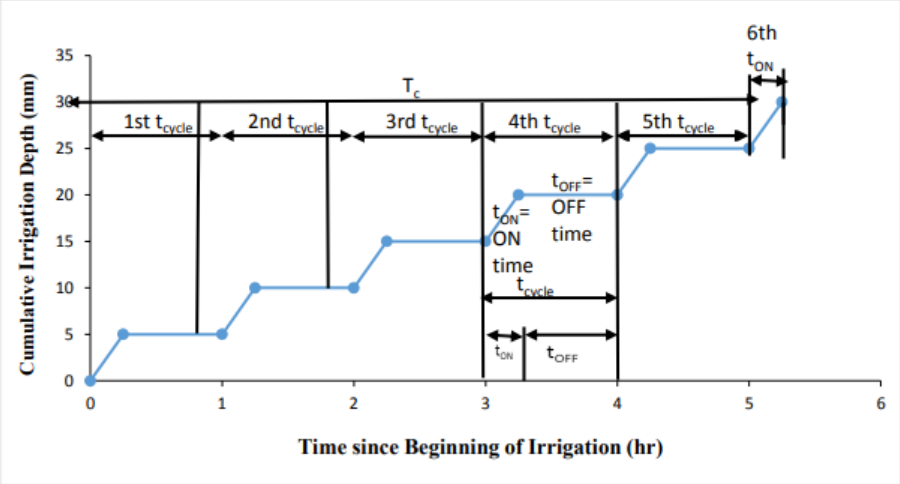
Kesikli sulama sistemi, sulama miktarını ve sulama zamanını azaltmayı, suyun kök bölgesinin altına sızmasını minimum seviyeye düşürmeyi ve sulamadan sonra suyun buharlaşmasını azaltmayı hedeflemektedir. Sulama suyunun kademeli olarak uygulanması, ortama ilk suyu sağlayarak toprağın nemlendirilmesi ve daha sonra uygulanacak olan sulamalarda suyun toprakta daha hızlı emilimini sağlamaktadır (Eid vd., 2013). Kesikli sulama yöntemi, verim, kalite, su tasarrufu, maliyet azaltmayı vb. hedefleyen bir yöntemdir.

3. KESİKLİ DAMLA SULAMANIN ARAZİYE UYGULANMASI

Kesikli damla sulama, gerekli sulama suyu miktarı (Di) uygulanana kadar kesik döngüsünün AÇIK ve KAPALI süresinin sürekli olarak tekrarlandığı sulamadır. Her döngüde sulama uygulamasına açık kaldığı süre boyunca (t_{ON}) devam edilecek ve kapalı kaldığı süre boyunca (t_{OFF}) dinlenme yapılacaktır. Bu döngüler, sulama sezonu boyunca, her sulamada sulama süresi (T_c) boyunca tekrarlanacaktır.

Kesikli damla sulama uygulaması; sulama aralığı boyunca su bulunma durumu, günlük mevcut su, sulama derinliği, sulama aralığı, su pompalama / iletme / tedarik kapasitesi, mevcut güç kaynağının bir gün içindeki süresi gibi bilgilere bağlı olarak yapılmaktadır.

Tasarımda; belirli bir sulama aralığı boyunca sulanacak alan, bir günde sulanacak alan, bir vardiyada sulanacak alan, selenoid valf / vardiya sayısı, kesikli sulamanın zaman bileşenleri (açık kalma zamanı, kapalı kalma zamanı, döngü süresi, bir vardiyadaki toplam sulama süresi, bir sulamadaki döngü sayısı) gibi bilgiler kullanılmaktadır (Şekil 1).



Şekil 1. Kesikli Damla sulama kavramı (Kaynak: Rank and Vishnu, 2021)

Pratikte, sulama uygulamaları arasındaki süre, toprağın doymamış hidrolik iletkenliğine ve bitki köklerinin su alımına bağlı olan topraktaki suyun hareketine göre belirlenmektedir (El-Mogly et al, 2012).

4. KESİKLİ DAMLA SULAMANIN AVANTAJLARI

Kesikli sulamanın avantajları şu şekilde sıralanabilir (Anonim, 2023);

- Ağır bünyeli topraklarda yüzey akış azalır.
- Kumlu topraklarda daha az yıkanma veya su kaybı meydana gelir.
- Sığ topraklarda ve tepelik alanlarda su daha verimli uygulanabilir.

- Ağaç altı mini yağmurlama ve sisleme uygulamalarında sıcaklık kontrolü amacıyla kullanılabilir.
- Seralarda yetiştirme kaplarının boyutları, çok düşük deşarj oranları nedeniyle azalabilmektedir.
- Bitki toprak üstü organları ıslatılmadığından bitki hastalık ve zararlılarının gelişmesi önlenir.
- Yabancı ot gelişimi daha azdır.
- Elektrik tüketimi azalmakta, kullanılan pompaların da ömrü uzamaktadır.

5. KESİKLİ DAMLA SULAMANIN DEZAVANTAJLARI

Kesikli sulamanın aşağıda belirtilen bazı dezavantajları bulunmaktadır (Anonim, 2023);

- Önceden var olan bir sulama sistemine kesikli sulama uygulaması için gerekli materyallerin alınması ve bakımlarının yapılması için ek bir maliyet gerekmektedir.
- Sistemin verimli bir şekilde çalışması için belli oranda basınç ihtiyacı söz konusudur.
- Basınçlı su kaynağının bütünlüğünün korunması kritik öneme sahiptir. Boru hatlarındaki sızıntılar, sulama periyotlarının uzun sürmesi nedeniyle önemli maliyetlere neden olabilir.
- Toprakta tuz birikmesini önlemek için sulama döngülerine çok dikkat edilmelidir. Yetersiz sulama, su buharlaştıkça geride tuz kalıntıları kalmasına ve toprak neminin ihtiyaçtan çok daha az olmasına sebep olabilir.
- Dinlenme sırasında suyun sistemde geri çekilmesine izin verilirse parselde eş su dağılımı sağlanamamış olur. Bu nedenle sızıntıyı engellemek için bazı cihazların kullanılması veya sistem boyunca her bir su dağıtım noktasına çek valf konulması gerekmektedir. Bu da ek bütçe gerektirir (Anonim, 2023).

6. KESİKLİ DAMLA SULAMA UYGULAMASI KULLANILARAK YAPILAN ÇALIŞMALAR

Mısır'da 2006 – 2007 yıllarında yapılan bir çalışmada, organik olarak yetiştirilen patateste kesikli sulamanın su tasarrufu ve verime olan etkilerini araştırmışlardır. Bu amaçla topraktaki nem dağılımı, uygulama verimliliği, bitki verimi ve su kullanım etkinliği değerleri Çizelge 1'de incelenmiştir. Elde edilen sonuçlar, kesinti sayısının arttırılmasının patates verimi, uygulama verimi ve su kullanım etkinliğini arttırdığını ortaya çıkarmıştır (Bakeer et al. 2009).

Çizelge 1. Patates kesikli damla sulama uygulaması

Çalışma	Bitki	Yöntem	Uygulama	Verilen Toplam Su (mm)	Verim (kg/da)	WUE (kg/m^3)	IWUE (kg/m^3)
Bakeer et al, 2009	Patates(Organik)	Topraküstü Damla Sulama: Sürekli (CDI) + Kesikli (%100, %75, %50 kısıtlı sulama)	%100	742.38	Sürekli:1035 Kesikli (4): 1548	Sürekli: 1.40 Kesikli (4): 2.08	Sürekli: 4.35 Kesikli (4): 6.50
			%75	580.71	Sürekli:843 Kesikli (4): 1512	Sürekli: 1.45 Kesikli (4): 2.60	Sürekli: 3.54 Kesikli (4): 6.35
			%50	418.81	Sürekli:574 Kesikli (4): 371	Sürekli: 1.37 Kesikli (4): 0.89	Sürekli: 2.41 Kesikli (4): 1.56
		Toprakaltı Damla Sulama Sürekli (CDI) + Kesikli (%100, %75, %50 kısıtlı sulama	%100	742.38	Sürekli:1119 Kesikli (4): 1564	Sürekli: 1.51 Kesikli (4): 2.11	Sürekli: 4.70 Kesikli (4): 6.57
			%75	580.71	Sürekli:926 Kesikli (4):1522	Sürekli:1.59 Kesikli (4): 2.62	Sürekli: 3.89 Kesikli (4): 6.39
			%50	418.81	Sürekli: 619 Kesikli (4): 417	Sürekli: 1.48 Kesikli (4): 0.99	Sürekli: 2.60 Kesikli (4): 1.75

Mısır'da toprak altı damla sulama sistemiyle sulanan yeşil fasulyede (*Phaselous vulgaris L.*) kesikli sulamanın tarla koşullarında yapılan bir çalışmada, verim ve besin elementleri üzerine etkileri değerlendirilmiştir. Çalışmada, sulama suyu ihtiyacının bir kerede uygulandığı T1'den, dört kesik kullanılarak uygulandığı T4'e kadar değişen kesik sayısına dayalı dört farklı sulama uygulaması karşılaştırılmıştır (El-Mogy et al., 2012). Elde edilen veriler su kullanımı, mevsimsel sulama, verim, su kullanım etkinliği, sulama suyu kullanım etkinliği, vejetatif büyümeye etkisi ve besin elementleri içeriği açısından değerlendirilmiştir.

Deneme sonuçlarına göre, her sulamada daha yüksek kesik sayısının (üç veya dört kez), verim ve besin konsantrasyonu üzerinde önemli etkiye sahip olduğu gözlenmiştir. Bu nedenle her sulamada 3-4 kesikle sulama suyu uygulanması tavsiye edilmiştir. Çizelge 2 incelendiğinde bitkinin ihtiyaç duyduğu oranlarda kesikli sulama ve besin maddeleri uygulanarak, optimum üretime ulaşmak için gereken gübre miktarının azaltılabileceği sonucu ortaya çıkmıştır.

Çizelge 2. Yeşil fasulye kesikli damla sulama uygulaması

Çalışma	Bitki	Yöntem	Uygulama	Verilen Toplam Su (mm)	Verim (kg/da)	WUE (kg/m^3)	IWUE (kg/m^3)
El-Mogy et al, 2012	Yeşil Fasulye	Sürekli (T1) + Kesikli (T2,T3,T4)	1. YIL				
			T1	382.00	900	0.046	0.038
			T2	370.00	941	0.051	0.043
			T3	356.00	1029	0.060	0.050
			T4	344.00	1150	0.071	0.059
			2. YIL				
			T1	390.00	967	0.044	0.037
			T2	378.00	952	0.049	0.041
			T3	363.00	1031	0.058	0.048
			T4	351.00	1126	0.069	0.057

Mısır' da soya fasulyesinin veriminin arttırılması ve iyileştirilmesi için kesikli damla sulama ve malçlama türlerinin etkisini incelemek amacıyla 2010-2011 yıllarında bir çalışma yürütülmüştür. Kök bölgesindeki toprak nem dağılımı, soya bitkisinin gelişim özellikleri, verimi, kullanım etkinliği, yağ içeriği ve verimi, protein içeriği ve verimi parametreleri incelenmiştir. Sulama suyu kullanım etkinliği üzerindeki etkisine yönelik istatiksel analiz sonuçlarına göre, sulama gereksinimlerinin plastik malç kullanılarak günde 8 kesik uygulanmasının en iyi sonuçları verdiği Çizelge 3'te olduğu gibi bildirilmiştir.

Bu koşullar altında en yüksek verim, kalite özellikleri ve sulama suyu kullanım etkinliği 8 kesik uygulanarak gerçekleşmiştir. Kök bölgesindeki toprak nem dağılımından ve ıslanan toprak hacmine bağlı olarak plastik malç kullanımı toprak yüzeyindeki buharlaşma sürecini azaltır, dolayısıyla kök bölgesindeki yabancı ot büyümesinin azalmasına ek olarak tuz birikimini azaltır (Eid et al, 2013).

Çizelge 3. Soya fasulyesi kesikli damla sulama uygulaması

Çalışma	Bitki	Yöntem	Uygulama	Verilen Toplam Su (mm)	Verim (kg/m)	WUE (kg/m^3)	IWUE (kg/m^3)
Eid et al, 2013	Soya Fasülyesi	Sürekli	Kontrol Parseli	805.95	268.94	-	0.33
			Organik Malç	805.95	333.20	-	0.40
			Plastik Malç	805.95	364.14	-	0.43
		Kesikli(4)	Kontrol Parseli	805.95	364.14	-	0.43
			Organik Malç	805.95	397.46	-	0.50
			Plastik Malç	805.95	428.40	-	0.50
		Kesikli (8)	Kontrol Parseli	805.95	214.20	-	0.30
			Organik Malç	805.95	411.74	-	0.50
			Plastik Malç	805.95	523.60	-	0.63
		Kesikli(12)	Kontrol Parseli	805.95	173.74	-	0.20
			Organik Malç	805.95	245.14	-	0.30
			Plastik Malç	805.95	309.40	-	0.40

Malatya Kayısı Araştırma İstasyonu Müdürlüğünde adaptasyonu yapılan bazı böğürtlen çeşitlerinin sürekli (iki sulama arasında tüketilen su miktarının bir defada verilmesi) ve kesikli (iki sulama arasında tüketilen su miktarının sulama süresi boyunca dört defada verilmesi) damla sulama yöntemlerinde su verim ilişkileri değerlendirilmiş ve kalite parametreleri Çizelge 4'te gösterilmiştir.

Çalışmada, kesikli damla sulamanın su tasarrufu sağlayıp, su ve gübre kullanım etkinliğini arttırdığı sonucuna varılmıştır. Yöntemin toprak su içeriği değişimine (azlığına) tepkisi yüksek olan böğürtlen çeşitleri için de uygulanabilir potansiyele sahip olduğu bulunmuştur (Şakar Erdoğan, 2014).

Çizelge 4. Böğürtlen kesikli damla sulama uygulaması

Çalışma	Bitki	Yöntem	Uygulama	Verilen Toplam Su (mm)	Verim (kg/da)	WUE (kg/m^3)	IWUE (kg/m^3)
Şakar Erdoğan,2014	Böğürtlen	Sürekli (T1) + Kesikli (T2,T3,T4)	Kesikli Sulama				
			Bursa 1	404.97	509000	1.14	1.26
			Chester	493.53	502000	0.93	1.02
			Jumbo	355.45	641000	1.66	1.80
			Sürekli Sulama				
			Bursa 1	723.31	572000	0.72	0.79
			Chester	588.07	691000	1.06	1.18
			Jumbo	589.99	348000	0.53	0.59

Ankara'da silajlık mısır bitkisinde toprakaltı damla sulamada kesikli sulama uygulamalarının toprakta su dağılımına etkisinin araştırıldığı bir çalışmada, toprakta yarayışlı suyun %30'u tüketildiğinde toprak nemini tarla kapasitesine çıkarmak için gerekli sulama suyu tek seferde (F0), 1, 2 ve 3 kesintiyle (F1, F2, F3) uygulanmıştır. Araştırma sonucunda kesikli sulamanın toprakta sürekli sulamaya oranla daha yüksek su seviyesi oluşturduğu Çizelge 5'te görülmüştür. Sonuç olarak, kesikli sulamanın toprakta su dağılımını arttırdığı, iki sulama arasındaki kesinti süresinin fazla olduğu durumda daha iyi sonuçlar elde edildiği görülmüştür (Gültekin, 2021).

Çizelge 5. Silajlık mısır kesikli damla sulama uygulaması

Çalışma	Bitki	Yöntem	Uygulama	Verilen Toplam Su (mm)	Verim (kg/da)	WUE (kg/m^3)	IWUE (kg/m^3)
Gültekin, 2021	Silajlık Mısır (2 yıllık ortalama)	Sürekli (F0) + Kesikli (F2,F3,F4)	F0	446.45	8065	14.75	18.10
			F1	394.75	8769	18.15	22.20
			F2	405.85	8704	17.55	21.50
			F3	414.60	8365	16.45	20.20

7. SONUÇ VE ÖNERİLER

Tarımda bilinçsiz su kullanımı en büyük sorunlardan birisi haline gelmektedir. Gelecek nesilleri düşünerek su kullanımında insanları bilinçlendirmek gerekmektedir. Verim kaybı fazla olmadığı sürece yüzey sulama yöntemlerinden kaçınılmalıdır. Kesikli damla sulama yönteminde, damlatıcıların tıkanması azaldığı gibi su tasarrufu sağlanmakta elektrik tüketiminde azalmalar görülmekte ve verimi arttırmada oldukça etkilidir.

Yapılan çalışmalar göz önüne alındığında, kesikli sulama yönteminin akış hızını arttırmaya yönelik bir çalışma olduğu görülmektedir. Bununla birlikte, kısıtlı sulama uygulamalarının zorunlu olduğu durumlarda yapılacak kısıntının çok fazla olmasının bazı bitkilerde verimde düşüşe neden olduğu gözlenmiştir. Bu durum kısıtlı sulama uygulamalarının kesikli damla sulamada kullanılmasının zorunlu olduğu hallerde verilen kısıt miktarının dikkatli seçilmesi, hatta bu alanda çalışmaların yapılarak kısıt miktarının belirlenmesi gerekliliğini ortaya koymaktadır.

Yapılan çalışmalar genel olarak değerlendirildiğinde, kesikli sulamanın verime olumlu etkisi olduğu görülmüştür. Aynı şekilde su uygulama randımanı da sürekli sulamaya oranla kesikli sulamada artış göstermiştir.

Buradan da anlaşılacağı gibi kesikli olarak sulama uygulamasında verilen suyun daha etkin bir şekilde kullanıldığı anlaşılmaktadır. Bu durum özellikle kuraklıkla mücadelede kesikli sulama uygulamalarının kullanılabileceğini göstermektedir.

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BİTKİSEL EKSTRAKTLARIN BÜYÜKBAŞ HAYVANLARDA GÖRÜLEN MASTİTİS HASTALIĞINA VE KANSERLE MÜCADELEDE ETKİNİRLİĞİ

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Özet
Büyükbaş hayvanlarda süt verimini, süt kalitesini ve yağ oranının düşmesine sebep olan etkenlerin başında mastitis (meme başı iltihabı) gelir. Mastitis; bakteri, virüs, mantar, ve nonspesifik etkenlerin sebep olduğu meme başı yangını hastalığıdır. Güvenli gıda üretiminde süt her aşamada temizlik ve hijyen konuları ile gündemini korur. Mikroorganizmalara önlem alınmadığı sürece süte geçmekte ve süt kalitesinde düşüşe sebebiyet vermektedir. Yüksek bakteri oranına sahip sütler ya çok ucuza alınmakta ya da kullanılmamaktadır. Sütlerde ki bakteri oranını yok etmek ya da en aza indirmek için genellikle kimyasal solüsyonlar antibiyotikler ya da merhemler tercih edilmektedir. Kullanılan bu yöntemler sütte tat değişimi, sütte acılaşma ve küfümsü, çürük bir tadın algılanmasına yol açar, bunun yanında kullanılan antibiyotiklere karşı zaman içerisinde bakterilerin direnç göstermesi de en büyük dezavantajlardan biridir. Ayrıca iyi bir dezenfektanın sadece bakteri öldürme değil aynı zamanda meme başı derisini kuruma, tahriş, yara ve kötü hava koşullarına karşı da koruma sağlaması gerekmektedir bu yüzden piyasadaki dezenfektanların birkaç ekstraktın karışım halinde kullanıldığı anlaşılmaktadır. Birçok bitki özleri içeren çeşitli antiseptik dezenfektan arayışına gidilmiştir. Her yıl mastitis hastalığı yüzünden Türkiye de yaklaşık 50 milyon TL lik ekonomik kayıp yaşanmaktadır. Bu nedenle hastalığın tanımlanması ve hastalıktan korunma yöntemlerinin geliştirilmesi çok önemlidir. Bu sektörde kullanılan antibiyotikler, merhemler ve ilaçlı solüsyonlara alternatif yöntemler amaçlanmaktadır. Ayrıca bitkisel tedavilerin kanserle savaşta son yıllarda oldukça olumlu etkileri görülebilmektedir. Tıbbi bitkiler kansere yakalanma riskini en aza indirir. Hastalığın farklı organlara sıçrama yeni metastaz durumuna önlem almakta etkilidirler. Kanser hastalarında tamamlayıcı tıp olarak adlandırılan bitkisel destekli tedavi yöntemleri kemoterapi yönteminin oluşturduğu nefes darlığı, kusma, anemi gibi yan etkilerin etkisini azaltmaktadır. Tedaviye destek olma immün sistemi güçlendirme ve yaşam kalitesini artırmaya yönelik tamamlayıcı bir terapi olarak hastalara bir umut ışığı olmaktadır.
Anahtar Kelimeler: Süt, Mastitis, Bitkisel Solüsyon, Kanser, Bakteri

THE EFFECTIVENESS OF HERBAL EXTRACTS IN THE FIGHT AGAINST MASTITIS DISEASE AND CANCER IN CATTLE

ABSTRACT

Mastitis (inflammation of the nipple) is one of the factors that cause milk yield, milk quality and fat ratio to decrease in cattle. Mastitis; It is a nipple fire disease caused by bacteria, viruses, fungi, and nonspecific factors. In safe food production, milk maintains its agenda with cleaning and hygiene issues at every stage. As long as precautions are not taken against microorganisms, it passes into the milk and causes a decrease in milk quality. Milk with a high bacterial content is either bought very cheaply or not used. Chemical solutions, antibiotics or ointments are generally preferred to destroy or minimize the rate of bacteria in milk. These methods used lead to a change in taste in milk, bitterness in milk and the perception of a moldy and rotten taste, as well as the resistance of bacteria to the antibiotics used over time. In addition, a good disinfectant should not only kill bacteria, but also protect the nipple skin against drying, irritation, wounds and bad weather conditions, so it is understood that disinfectants on the market are used in a mixture of several extracts. Various antiseptic disinfectants containing many plant extracts have been sought. Every year, due to mastitis, approximately 50 million TL of economic loss is experienced in Turkey. For this reason, it is very important to identify the disease and develop methods of prevention from the disease. Alternative methods to antibiotics, ointments and medicated solutions used in this sector are aimed. In addition, herbal treatments have had very positive effects in the fight against cancer in recent years. Medicinal plants minimize the risk of developing cancer. They are effective in preventing the spread of the disease to different organs, new metastases. Herbal assisted treatment methods called complementary medicine in cancer patients reduce the effect of side effects such as shortness of breath, vomiting and anemia caused by the chemotherapy method. It is a beacon of hope for patients as a complementary therapy to support treatment, strengthen the immune system and improve the quality of life.

Keyword: Milk, Mastitis, Herbal Solution, Cancer, Bacteria

GİRİŞ

Süt, yaşayan her canlının ihtiyacı olan en önemli protein kaynağıdır. içerisinde protein, besin maddeleri, karbonhidrat, Süt şekeri, Eser elementler, vitaminler, mineraller ve enzimler bünyesinde dengeli ve yeterli miktarda bulundurur. fizyolojik yönden yüksek besin değerine sahip olan sütün kusursuzca içilebilmesi için onun sağlıklı, iyi beslenmiş hayvanlardan elde edilmiş olması ve tüketiciye kadar giden yolda zararlı etkilerden mümkün olduğunca korunması gerekir. Sütler normal şartlarda ve hijyenik kurallara uyarak hazırlansa bile, belli başlı sayıda mikroorganizma barındıran bilmektedir. Hijyenik şartlara ne kadar uyulursa uyulsun mililitrede 20000' lere varan mikroorganizma sayıları normal kabul edilmektedir. Fakat bu sayıyı aşan değerler sütün çeşitli kaynaklardan kontamine (mikroorganizma ulaşımı) olduğunu göstermektedir. (Roberson, 1998)

Kontamine kaynaklı hastalıklardan, süt endüstrisinde en sık karşılaşılan MASTİTİS hastalığıdır. Mastitis, yalın anlamı ile meme başı iltihabıdır. Meme bezleri hücrelerinin veya bağı dokusunun veya her ikisinin iltihaplanmasıyla kendini göstermektedir. Bakteri, virüs, mantar ve nonspesifik etkenler sebepleri olarak sıralanmaktadır. Araştırmalarda mastitis etkeni olarak yaklaşık 200 bakteri türü, virüs mantar ve yosunlar tespit edilmiştir. Bakteri türleri arasında Staphylococus, Aureus ve Escherichia Coli en sık rastlanan mikroorganizmalardır. Mikroorganizmalara önlem alınmadığı sürece süte geçmekte ve süt kalitesinde düşüşe sebebiyet vermektedir. Yüksek bakteri oranına sahip sütler ise ya çok ucuza satılmakta ya da kullanılmamaktadır. Mastitis teşhisinde süt memelerinin klinik muayenesi (inspeksiyon, palpasyon) yöntemleri sütün muayenesinde ise;

1-Fiziksel muayene yöntemleri
2-Kimyasal muayene yöntemler
3-Bakteriyolojik muayene yöntemler
4- Sitolojik muayene yöntemleri

Kullanılır. Sütün muayenesi denildiğinde aklımıza SHS (Somatik hücre sayısı; hayvancılığın gelişmiş olduğu ülkelerde ve ülkemizde de sütün kalitesinin değerlendirilmesinde ve meme sağlığı üzerinde kriter olarak kabul edilmektedir. Araştırmalar ve yapılan analizlerde somatik hücre sayısının artması ile süt veriminin azaldığı

tespit edilmiştir.(Göncü S, Özkütük, Hay üret, 2002) (Leitner G., Shoshani E. 2000; 47:581) mastitis hastalığı akut (ilerleyen) subakut (kronik nitelik kazanmamış) veya kronik (süregelen, devamlı) bir seyir izleyebilmektedir. Bu şartlarda süt verimi düşer, renkte değişim olur ve tüketim için istenmeyen sonuçlar elde edilir. Büyük ekonomik kayıplara yol açar. Hijyenik olmayan ahırlar, ani ısı değişimleri, sıkışık barınaklar, kullanılan dezenfektanlar mastitise sebep olarak sıralanmaktadır. Mastitis ile mücadelede antibiyotiklerin kullanımı kaçınılmazdır. Ancak direnç gösteren bakteriler sebebiyle mastitis, sağaltımı oldukça zor bir hastalık olarak süt endüstrisinin önemli bir problemi olarak görülmektedir.(Baser ,KHC,2008,Özek T, Tümen G.,1993)

Mastitisle Mücadelede Bitkisel Yöntemler

Mastitisle mücadelede; sütteki bakteri oranını yok etmek veya en aza indirmek için sağım öncesi ve sonrası solüsyonlar oldukça sık kullanılmaktadır.(Zukali ve Ark.;2011) Kullanılan kimyasal kökenli solüsyonlar majör patojen enfeksiyonlarını azaltırken, sütte kalıntı riskini artırmaktadır.(Galton ve Ark.;1986) Kullanılan antibiyotikli kremler ve antibiyotik solüsyonları yağlı ve sulu formda bulunurlar. Ancak bu formda yaralı bölgeye tam tutunamadıkları için tedavinin meme içine ulaşmasına bir etkileri yoktur. AB ülkelerinde sütte kalıntıya sebep oldukları için bu tür solüsyonların kullanımına ciddi kısıtlamalar getirilmiştir. (Karakök,2007) Çünkü; dünyada güvenli gıda üretiminde kabul edilen genel ilke, sağlıklı, dengeli sürdürülebilir üretim ve sağlıklı gıda temini açısından risk içermemesidir. Bu sebeple alternatif solüsyon arayışları oldukça hız kazanmıştır.(İpçok ve Ark.,2017)

Bitkilerin antimikrobiyal aktiviteleri göz önünde bulundurularak kimyasal yöntemlere alternatif yöntemler geliştirme amaç olarak karşımıza çıkmaktadır. Ülkemiz tedavi amaçlı kullanılan bir çok bitkinin büyük çoğunluğunun gen merkezidir. Ayrıca nadir bulunur endemik türlerin bulunduğu coğrafi bölgeler içermektedir.(Faydaoğlu,2013)Tedavi amaçlı kullanılan bitkilerin 20.000 civarında olduğu tahmin edilmekte ve antimikrobiyal etkileri tespit edilmektedir. Alternatif dezenfektan madde olarak bitkilerin bu özelliklerinin kullanılması amacıyla çeşitli çalışmalarda denemelere tabi tutulmuş bitkiler ve elde edilen sonuçları vardır. İneklerde sağım sonrası ve öncesi meme başı daldırma solüsyonlarının uygulanmasıyla meme başı bakteri sayısının oldukça azaldığı tespit edilmektedir.

Kanserle Mücadelede Bitkisel Destekli Tedavi

Kanser**;** dünyada ölüm nedenleri arasında ikinci sırada yer alan ve en sık görülen önemli toplumsal sağlık sorunlarından biri olarak karşımıza çıkmaktadır. Dünyada olduğu gibi maalesef son yıllarda ülkemizde de oldukça önemli bir sağlık sorunudur. Kanser tedavisinde, kemoterapi, radyoterapi kemik iliği transplantasyonu gibi yöntemleri sıkça kullanılmaktadır. Kemoterapi çoğalan hücrelere karşı seçici öldürücü etkileri olan doğal, sentetik kimyasal hormonlarla yapılan bir tedavi şeklidir.(Baykara O. 2016) ancak kemoterapinin tedavi etkilerinin yanı sıra bulantı-kusma, mukozit , diyare, nefes darlığı, uykusuzluk, ağrı, halsizlik, anemi, yorgunluk, hematolojik, cilt ve göz ile ilgili istenmeyen birçok semptoma neden olmaktadır.(Seven M., Akyüz A., 2013) görülen bu semptomlar hastaları fizyolojik, psikolojik ve sosyal yönden etkilemektedir.

Bu dönemde tedaviye destek olma, immün sistemi güçlendirme ve yaşam kalitesini artırmaya yönelik farmakolojik yöntemlere destek amacıyla tamamlayıcı terapi yöntemlerine de başvurulmaktadır. (Arslan M., Özdemir L., 2015)

Kanser hastalarında tamamlayıcı terapi kullanım oranlarına bakıldığında dünyada %7,00- 84,0 iken ülkemizde bu oran %36-70,0 aralığındadır. (Yel P., Karadakovan A., 2020) ulusal sağlık istatistikleri merkezi tarafından yapılan bir araştırmada en çok kullanılan tamamlayıcı tıp formlarının sistemin ve mineral kullanılmayan doğal ürünlerin uygulanması olduğu sonucuna ulaşılmıştır. Kanser hastalarında tamamlayıcı tıp kullanan kişilerin yaşının daha genç, daha yüksek eğitim seviyesine sahip, yüksek gelirli, daha iyi sağlık bilincine sahip olanların yararlandıkları belirtilmektedir. (Arslan G., Yücel Ş.Ç., 2016)

Alternatif Bitkisel Dezenfektanımız ve İçerdiği Bitkiler

Hastalıklara karşı korunmada kimyasalların riskleri ve yani etkileri nedeniyle doğal ürünlere yönelim son yıllarda oldukça artmıştır bu amaçla birçok bitki farmakolojik ve mikrobiyolojik yönden araştırılmaktadır bitkilerin antimikrobiyal aktiviteleri göz önünde bulundurularak, mikro organizmalara karşı yan etkileri en az düzeye indirebilecek, güvenli gıda üretimini destekleyecek alternatif dezenfektan solüsyonu geliştirme, amaçlanmıştır. Tamamlayıcı tıp yöntemlerine destekleme amacıyla da kanser hücreleri üzerinde etkinirliliği üzerinde çeşitli laboratuvar çalışmaları yapılmaktadır.

Moringa (Moringa Oleifera): İnsan hayatında uzun bir geçmişe sahip olan moringa ağacı tüm kısımlarında (kök, gövde ,dal, yaprak, çiçek, legümen ve tohum) içerdiği sekonder matabolitleri, besin değeri içerdiği besin değerleri ile tarımda ve endüstride oldukça değer kazanarak geniş çapta kullanılmaktadır. Bitkinin yaprak ve tohum kısımları fitokimyasallar açısından oldukça zengindir. Proteinler, lipitler ,karbonhidratlar, Flavonoit, fenolik asit , amino asit ve yağ asitleri gibi 90'dan fazla besin maddesi taşır. İçerdiği fitokimyasallar sebebiyle antioksidan, anti mikrobiyal, antikanser, kardiyo vasküler riskleri önleyici etkileri ispatlanmıştır. (Kou, X, Li, B,J.B. Drake, J.M. ,Chen , N. 2018)

Plantago Lanceolata (Sinirli Ot): Plantaginaceae ailesinden olan plantago lanceolata, tıb alanında yaprakların tamamına yakını veya türlerinin polar ekstraktları kullanılarak fitoterapi alanında sindirim ve solunum sistemindeki kanser ile alakalı problemlerin ve ağrıların giderilmesinde kullanılmaktadır. Bunun yanı sıra deri ve enfeksiyon hastalıklarının tedavisinde de kullanılmaktadır .(Samuelsen A.B.,2000)Sinirli ot bitkisi türlerinin yaprak kısımlarında bulunan biyolojik aktif glikozitler, flavonoidler, polisakkaritler, musilaj etkili arabino halaktan ve vitaminlerden dolayı günümüzde tıbbi amaçla birçok alanda kullanılmaktadır. Önemli bir biyolojik ajan olan iridoid glikozitler bitkinin yaprak kısımlarında bulunmaktadır. Antioksidan ve antimikrobiyal özellikleri ile süperoksit dismutaz ve glutatyon -S- tranferaz enzim aktiviteleri yanında Fe, Zn, ve Cu yapısında bulunmaktadır. Aucubin maddesinin yara iyileştirici, antibakteriyel mast hücrelerinde inhibe edici etkisi belirlenmiştir. Taze bitkiden elde edilen maseratlar, sıvı ekstraktları ve şurupları ağız ve boğaz iltihabı tedavisinde ve iltihablı cilt için de kullanılmaktadır.(Koçak M. S.,2011)

Kuzu Kulağı (Rumex Acetosa): Rumex türünün 200 kadar türü bulunmaktadır.Ülkemizde ise 6 tanesi endemik olmak üzere 25 türü yetişmektedir.(Davis,1988)Antioksidan özelliği sayesinde vücuttaki hücresel savunmaları destekler ve hüce bileşenlerinin oksidatif hasarlarını önlemeye yardımcı olurlar.Sahip olduğu antioksidatif özelliklerinin biyoalınablirlik derecesi oldukça yüksektir. Rumex türleri Antrokinon bakımından zengin bitkilerdir. Emodin tipi Antrokinonları içermektedir. Emodin, krizofanol, fiskiyon ile bunların heterozitleridir. Kuvvet verici, laksatif etkileri görülmektedir. Ateş düşürücü, Lan temizleyici olarak kullanıldığı , cilt hastalıklarına karşı faydalı olduğu ifade edilmektedir. (Çakılcioğlu ve Turkoğlu, 2010, Kaval ve Ark. 2014)

Civan Perçemi (Achillea Millefolium): Latincede 'bin bir yaprak' anlamına gelir. Bilinen en eski kullanıma sahip tıbbi bitkilerden biridir.Bitkiden elde edilen uçucu yağında praazulen adı verilen kimyasalı içerdiği bilinmektedir. Mamedov vd. 2004'de Rusya ve Orta Asya'dan toplanan tıbbi bitki materyallerinin üzerinde yaptıkları bir çalışmada, A. millefolium'un toprak üstü kısımlarından hazırlanan farmasötik preparatlar ile A. santolina'nın çiçeklerinden hazırlanan galenik ve uçucu yağ preparatlarının derideki yaralar, iltihaplanmalar ve alerjik döküntüler ile dermatit tedavisinde kullanıldıklarını kaydetmişlerdir. Geleneksel tıpta kanamayı durdurucu etkisinden dolayı kullanımı gerçekleşmiştir.(Gualtiero Simonetti,(1990) Bulundurduğu yağlar, flavonoidler , tanenler, ve diğer bileşenler nedeniyle anti-inflamatuar antiseptik özelliklere sahiptir.Yapısında achilleine, apigenin, azulen , inülin, menthol, gibi kimyasal yapılar bulundurur. Antibakteriyel özelliği mevcuttur oksidatif stres indeksi orta düzeyde bir antroksiden aktivitesine sahiptir.

SONUÇ VE BULGULAR:

Süt sığırcılığı ağında tedavi ve ürün kaybıyla yetiştiricilere büyük ekonomik zarar veren mastitis hastalığından korunmak ve kanser hastalığında fitoterapi tedavi amaçlı alternatif bir yöntem olması amacıyla bitkisel yöntemlere yönelim son yıllarda ve günümüzde oldukça önem kazanmaktadır. Hastalıklara karşı korunmada kullanılan kimyasal yöntemlerin riskleri ve yan etkileri yaygın olarak bilinmektedir bu nedenlerden dolayı bitkisel ürünlere yönelimin artmasıyla bitkisel pozisyonumuzu geliştirmeyi amaçlamış bulunuyoruz. Elimizdeki bitkisel ekstrakt solüsyonun muzun bakteriler üzerindeki antimikrobiyal etkisini belirlemek ve kanser hücreleri üzerindeki etkilerini gözlemlemek amacıyla laboratuvar çalışmaları yapılmıştır. Bitkisel solüsyonumuzun etkinirliliğini gözlemlemek amacıyla Escherichia Coli ve stophylococcus Aureus bakterileri üzerinde pıhtılaşma pozitif stafilokokların numaralandırılması için yatağa yöntem olan Baird-Parker Agar ortamını kullanma tekniği ile Beta- glukoronidaz pozitif Escherichia Coli sayımı yöntemi uygulanmıştır. Yine hazırlanan solisyonu stotoksit aktivite çalışmaları karaciğer kanser hücre hattına karşı invitro olarak 48 saat için test çalışılmıştır. Hücreler hazırlanan solisyonu farklı konsantrasyonlarına maruz bırakılmış ve absorbans ölçümleri karşılaştırılmıştır. HepG2 hücre hattına karşı stotoksit etkisi test edilmiştir. Kanserli

karaciğer hücreleri üzerinde toksit etkisi olduğu görülmüştür. Yapılan labaratuar analizleri sonucunda elde edilen bitkisel solisyonun bakteriler üzerindeki antimikrobiyal etkinirliliği kanıtlanmıştır. Daha ileri boyutta çalışmalarımız halen devam etmektedir.

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IĞDIR ŞALAK KAVUNUNUN BAZI MORFOLOJİK VE FİZYOLOJİK ÖZELLİKLERİNİN BELİRLENMESİ

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Özet
Kavun üretiminde lider ülkelerden olan Türkiye, yaklaşık 1.8 milyon ton ile Dünyada ikinci sırada yer almakta ve toplam üretimin %6.55'ini karşılamaktadır. Türkiye kavunun gen merkezleri arasında olmasının yanı sıra yüksek tüketici talebi ve yüksek ihracat gibi nedenlerle farklı tüketim amaçlarına uygun olarak kullanılan birçok hibrit, açık tozlanan ve yerel çeşit bulunmaktadır. Şalak kavunu da bu yerel genotipler arasında olup, Aras Vadisinde konumlanan Iğdır ekolojik koşullarında uzun yıllardan beri üretilmekte ve pazarda yer bulmaktadır. İç piyasada yoğun talep oluşturan bu yerel kavun çeşidi çevre illere de pazarlanmaktadır. Araştırmamızda bölgede yoğun olarak tüketilen Şalak kavunu 8 farklı bölgeden alınan örneklerle bitkisel özelliklerinin ortaya konulması amaçlanmıştır. Bitki ve kök boyu, gövde çapı, bitki ve kök yaş ağırlığı, meyve ağırlığı, meyve uzunluğu ve çapı, bitki başına meyve sayısı ve verim, meyve eti ve kabuğu kalınlığı, yaprakta klorofil içeriği, meyvede pH, SÇKM, titre edilebilir asit miktarı, toplam şeker ve C vitamini içerikleri belirlenmiştir. 8 bölgenin ortalamasına göre sırasıyla bitki ve kök boyu 164.30 ve 50.13 cm, gövde çapı 1.83 cm, bitki ve kök yaş ağırlığı 417.76 ve 60.53 g, meyve ağırlığı 4316.80 g, meyve uzunluğu ve çapı 42.66 ve 24.57 cm, bitki başına meyve sayısı ve verim 3.12 adet ve 13523.41 g, meyve eti ve kabuğu kalınlığı 1.79 ve 0.38 cm, klorofil miktarı 113.12 SPAD, meyvede pH 4.97, SÇKM %7.83, titre edilebilir asitlik 2.06 mval/100 ml, toplam şeker içeriği 11.24 mg/g ve C vitamini içeriği 21.14 mg/100 g olarak belirlenmiştir. Araştırma bulgularına göre Şalak kavunu genotipinin literatür kaynakları ile karşılaştırıldığında geniş taç yapısına sahip, oldukça iri meyveli, sulu, lezzetli ancak muhafazaya dayanıksız meyve yapısına sahip olduğu belirlenmiştir. Şalak kavununun mevcut özellikleri ile ıslah çalışmalarında materyal olarak kullanılabileceği ve ayrıca uzak bölgelere ihracatı için muhafaza yöntemlerinin geliştirilmesi gerektiği düşünülmektedir.
Anahtar kelimeler: *Cucumis melo,* Genetik çeşitlilik, Iğdır ovası, Köy popülasyonu, Şalak kavunu

DETERMINATION OF SOME MORPHOLOGICAL AND PHYSIOLOGICAL CHARACTERISTICS OF IĞDIR ŞALAK MELON

Abstract
Türkiye, one of the leading countries in melon production, ranks second in the world with approximately 1.8 million tons and accounts for 6.55% of the total production. In addition to Türkiye being among the melon gene centers, there are many hybrid, open-pollinated and local varieties used for different consumption purposes due to such as high consumer demand and high exports. Şalak melon is among these local genotypes and has been produced and found in the local market for many years in the ecological conditions of Iğdır, located in the Aras Valley. This local melon variety, which creates high demand in the domestic market, is also marketed to surrounding provinces. In our research, it was aimed to reveal the morphological properties of Şalak melon, which is consumed extensively in the region, with samples taken from 8 different regions. Plant and root height, stem diameter, plant and root fresh weight, fruit weight, fruit length and diameter, number of fruits and yield per plant, fruit flesh and peel thickness, chlorophyll content in the leaf, pH, SSC, titratable acid amount, total sugar and vitamin C contents in the fruit were determined. According to the average of 8 regions, it was determined as plant and root length are 164.30 and 50.13 cm, stem diameter is 1.83 cm, plant and root fresh weight is 417.76 and 60.53 g, fruit weight is 4316.80 g, fruit length and diameter are 42.66 and 24.57 cm, number of fruits per plant and yield are 3.12 pieces and 13523.41 g, fruit flesh and peel thickness 1.79 and 0.38 cm, chlorophyll amount 113.12 SPAD, fruit pH 4.97, SSC 7.83%, titratable acidity 2.06 mval/100 ml, total sugar content 11.24 mg/g and vitamin C content 21.14 mg/100 g. According to the research findings, when compared to the literature sources, the Şalak melon genotype was determined to have a wide crown structure, rather large fruit, juicy, delicious but not preservable fruit structure. It is thought that Şalak melon can be used as a material in breeding studies with its existing characteristics and preservation methods should also be developed for export to remote areas.
Keywords: *Cucumis melo*, Genetic diversity, Iğdır plain, local genotype, Şalak melon

1. INTRODUCTION

Türkiye is the origin and gene center for many species, and this is considered an indicator of having rich genetic resources (Karaağaç and Balkaya, 2017). One of the reasons for this high plant diversity is that it has different climatic conditions that vary from region to region (Taşcı, 2016). Local varieties emerge as a result of natural selection and generally have high quality characteristics because they are adapted to the region where they are grown (Kaşka, 2019). A lot of work has been done to collect and identify the genetic materials of the melon species in Turkey and to reveal their various characteristics (Sarı vd., 2005; Eşiyok vd., 2005; Sensoy vd., 2007; Şensoy ve Şahin, 2012; Erdoğan, 2016; Dal vd., 2017; Ermiş ve Aras, 2017; Tatar ve Şensoy, 2020; Yakupoğlu ve Çoban, 2022). Melon (*Cucumis melo* L.), a member of the Cucurbitaceae family, is one of the most grown vegetable species in Türkiye and in the world. Türkiye, one of the leading countries in melon production, ranks second in the world with approximately 1.8 million tons and meets approximately 6.55% of the total production (TUIK, 2023). In addition to Türkiye being among the melon gene centers, there are many hybrid, open-pollinated and local varieties used for different consumption purposes due to reasons such as high consumer demand and high exports. Although the homeland of melon is known as Asia, wild melon varieties have been identified in Eastern Anatolia, the Caucasus, Iran, Afghanistan and Turkestan, and their spread throughout the world took place from these regions (Anonymous, 2017). The region producing the most melon in Türkiye is the Central Anatolia Region with 41%. This region is followed by the Aegean (27%), Southeastern Anatolia (15%), Mediterranean (7%), Marmara (5%), Eastern Anatolia (4%) and Black Sea Region (1%) (Şensoy, 2005). Due to its ecological and topographic conditions, Iğdır is among the largest micro-climatic regions in Türkiye. In addition to commercially sold hybrid and open-pollinated varieties, local genotypes grown in the region for years play a major role in Iğdır plain plant production. Many of these local genotypes cannot be produced with the desired yield and quality outside the ecological conditions of the Iğdır plain, which makes these genotypes unique.

When we look at the plant production statistics of Iğdır province, melon is at the forefront among vegetables with a production of 17,902 tons in an area of approximately 7,343 decares (TUIK 2023). While half of this vegetable production was provided by Şalak melon in the past,

this ratio has decreased considerably today. Şalak melon, which has a long vegetation life and very large fruits, also has high sugar and water content. Due to its high water content and thin shell, its storage life is short and its road resistance is poor. In this study, it was aimed to reveal some vegetative characterization features of the Şalak melon genotype grown in the Iğdır plain and to examine it at the morphological and physiological level in order to be a pioneer in future breeding and conservation studies.

2. MATERIAL AND METHODS

2.1 Material

Şalak melon samples used in the research were collected in 8 different regions within the borders of Melekli town of Iğdır center. Morphological observations were carried out in the field in August 2021, coinciding with the harvest period of melons (Figure 1). Determination of fruit characteristics was carried out at Iğdır University, Faculty of Agriculture, Vegetable and Seed Physiology Laboratory (Table 1).



Figure 1. Şalak melon sampling areas in the Iğdır plain

2.2 Methods

2.2.1 Morphological characterization

Plant height (PH) and root length (RL) measurements were made with the help of a digital caliper. 5 plants from each region were measured and their averages were calculated in cm. The stem height of the plants from the root collar to the growing tip of the plant on the main stem

was measured as plant height, and the root length was measured by taking into account the part where nearly 90% of the root was concentrated downwards from the soil distance.

The stem diameter (SD) was measured from the middle of the 10th and 11th internodes with the help of a digital caliper. Stem diameter is determined as mm. Plant (PW) and root (RW) fresh weight is calculated as the fresh weight of the plant from the distance above the soil, and the part below the root collar is calculated as the fresh weight of the root. The plant was cut from the root neck and the above-ground and under-ground parts were weighed on a scale with a sensitivity of 0.0001 g and expressed in g. Mean fruit length (FL) was measured in mm with the help of a digital caliper on the vertical axis from the middle points of three randomly selected fruits from all fruits harvested in each growing area, and their average was taken. Mean fruit diameter (FD) was measured in mm with the help of a digital caliper on the horizontal axis from the middle points of three randomly selected fruits from all fruits harvested in each growing area, and their average was taken. Mean fruit weight (FW), 3 randomly selected fruits from all fruits harvested in each growing area, were weighed with the help of a scale and their average was taken as g.

Table 1. List of morphological and physiological characters with abbreviations recorded for 8 location of Şalak melon

Character	**Abbreviation**
Plant length (cm)	PL
Root length (cm)	RL
Stem diameter (cm)	SD
Plant fresh weight (g)	PW
Root fresh weight (g)	RW
Yield per plant	YP
Mean fruit weight (g)	FW
Mean fruits number of plant (unit)	FNP
Mean fruit length (cm)	FL
Mean fruit diameter (cm)	FD
Fruit flesh thickness (cm)	FFT
Fruit peel thickness (cm)	FPT
Leaf chlorophyll content (SPAD)	LCC
Soluable solid content (%)	SSC
pH	pH
Titratable acid amount (mval/100 ml)	TA
Total sugar (mg/g)	TS
Vitamin C content (mg/100 g)	VitC

The number of fruits per plant (FP) and yield (YP) were calculated by first counting the fruits harvested from 3 plants from each region to determine the number of fruits per plant, then weighing them and taking their average.

Fruit flesh thickness (FFT), the distance between the outer shell thickness and the core cavity in harvested fruits, was measured in cm with a digital caliper.

Fruit peel thickness (FPT), the distance between the end of the fruit flesh and the fruit surface in the harvested fruits, was measured in mm with a digital caliper.

2.2.2 Physiological Analyzes

The amount of water-soluble solids (SSC) in fruit was determined by a refractometer. Results are expressed as %.

Fruit juice pH value (pH) was obtained as a result of measurements made with a hand-held WTW pH meter probe immersed in the filter. The amount of titratable acid (TA) was determined by adding 10 ml of pure water to 5 ml of the sample taken from the filter and titrating with 0.1 N NaOH solution until a pH value of 8.01 was obtained. The titratable acid value was calculated based on the amount of NaOH consumed and expressed as mval/100 ml (Karaçalı, 1993; Altunlu, 2011). The amount of chlorophyll (CC) was determined in plant leaves with a chlorophyll meter (SPAD-502^{+}, Konica Minolta Sensing, Inc., Japan).

Total sugar (TS) was calculated spectrophotometrically in mg/g according to the method of Gao et al. (1999). Ascorbic acid (VitC), 0.25 g fruit sample was extracted with 10 ml 6% trichloroacetic acid, 4 ml of the extract was mixed with 2 ml 2% dinitrophenylhydrazine (acid medium) and 1 drop of 10% thiourea (acid medium) was added to it. dissolved in 70% ethyl alcohol) was added. Mixing 15 min after boiling in a water bath and cooling to room temperature, 5 ml of 80% (v/v) H_2SO_4 at 0 °C was added to the sample and then the absorbance was determined at 530 nm. The concentration of ascorbic acid was calculated from the standard curve (Mokherjee and Choudhuri, 1983).

2.2.3 Statistical analysis

Analysis of variance was applied to the data obtained from the study with the SPSS (SPSS Inc. PASW Statistics version 26) package program on the computer. Differences between the averages were determined by the DUNCAN test with a 5% significance level.

3. RESULTS AND DISCUSSION

In this study, fruit shape were investigated as ovate (ananas type). The predominant colour of the fruit rind in melon genotypes has been identified pale yellow. Shape of fruit at pistil scarof melon genotypes was investigated as circular. Also, fruit flesh color was investigated creamy-yellow.

In researching the plant characteristics of Şalak melon, firstly the plant and root length were examined. In the observations made in 8 different regions, it was determined that PL varied between 181.21 cm and 143.14 cm, the highest PL was calculated in region 1, and the lowest was calculated in regions 2 and 3. RL varied between 60.61 cm and 42.87 cm. The highest RL was detected in region 5, and the lowest was detected in regions 2 and 3. The average PL and RL values of the regions are 164.30 cm and 50.13 cm. It was determined that the stem diameters of the plants were between 1.89 cm and 1.74 cm, and the average SD was 1.83 cm. The highest SD was calculated in region 4, and the lowest was calculated in region 2 (Table 2).

Table 2. PL, RL, SD, PW, RW and YP measurements of Şalak melon genotypes in different regions

Location	PL	RL	SD	PW	RW	YP
1	181.21 a	55.66 b	1.88 a	402.12 d	60.72 b	16088.36 a
2	143.14 e	42.87 e	1.74 e	436.29 a	66.23 ab	11754.91 d
3	145.89 e	44.16 e	1.76 de	441.09 a	54.92 c	12565.05 c
4	166.33 d	48.93 cd	1.89 a	403.50 d	57.29 bc	15353.78 b
5	172.58 b	60.61 a	1.83 bc	396.25 d	69.17 a	15454.10 b
6	165.60 d	50.90 c	1.79 c-e	426.34 ab	52.24 c	11814.29 d
7	170.22 bc	47.50 d	1.87 ab	421.62 ab	58.48 bc	12595.47 c
8	169.54 c	50.39 c	1.85 a-c	414.86 c	65.15 ab	12561.28 c
Mean	164.30	50.13	1.83	417.76	60.53	13523.41

*: The values expressed with different letters in each column are statistically different from each other at the 5% significance level.

Considering the fresh weights of plants vegetative parts and roots, the average PW and RW according to regions were determined as 417.76 g and 60.53 g. Statistically, the highest PW was determined in regions 2 and 3 with 441.09 g and 436.29 g, respectively, and the lowest was determined in regions 4, 1 and 5 with 403.50 g, 402.12 g and 396.25 g, respectively. Statistically, the highest RW was calculated in region 5 with 69.17 g, and the lowest was calculated in regions 3 and 6 with 54.92 g and 52.24 g, respectively (Table 2).

Yield per plant is an important data in our research, it varied between 16088.36 g and 11754.91 g according to regions, and the average stood out as 13523.41 g. The highest YP was determined in region 1, and the lowest was determined in regions 2 and 6 (Table 2).

In addition to plant measurements, some fruit characteristics were also calculated in our research. It was observed that the mean fruit weight, which is one of them, varied between 4615.20 g and 4158.19 g. Statistically, the highest FW was detected in region 1 and the lowest in region 6. When the number of fruits per plant was examined, it was seen that the average number of fruits was 3.12 and varied between 3.26 and 2.92 depending on the region. The highest FNP was found in regions 1, 7 and 8, and the lowest was found in region 2 (Table 3).

Table 3. FW, FNP, FL, FD, FFT and FPT measurements of Şalak melon genotypes in different regions

Location	FW	FNP	FL	FD	FFT	FPT
1	4615.20 a	3.24 a	42.32 c	26.19 b	1.45 e	0.44 a
2	3951.77 e	2.92 d	40.90 d	20.98 e	1.90 ab	0.32 d
3	4309.88 c	3.16 b	38.51 e	22.64 d	1.82 c	0.37 c
4	4539.44 ab	3.12 b	41.75 cd	27.55 a	1.80 c	0.42 ab
5	4424.14 b	3.00 c	45.04 ab	23.61 cd	1.84 bc	0.40 b
6	4158.19 d	3.00 c	44.13 b	25.87 b	1.69 d	0.41 ab
7	4302.13 c	3.26 a	45.57 a	24.95 c	1.88 ab	0.36 c
8	4233.62 cd	3.26 a	43.06 bc	24.73 c	1.94 a	0.34 cd
Mean	4316.80	3.12	42.66	24.57	1.79	0.38

*: The values expressed with different letters in each column are statistically different from each other at the 5% significance level.

It was observed that the average fruit length and diameter of Şalak melons were 42.66 cm and 24.57 cm depending on the region. Statistically, the highest FL was determined in region 7 and the lowest in region 3, while the highest FD was determined in region 4 and the lowest was determined in region 2 (Table 3).

Fruit flesh and fruit peel thickness were measured as 1.79 cm and 0.38 on average depending on the region. FFT varied between 1.94 - 1.45 cm, and FPT varied between 0.44 - 0.32 cm. Statistically, the highest FFT was calculated in region 8 and the lowest was calculated in region 1. The highest FPT was detected in region 1 and the lowest in region 2 (Table 3).

Table 4. LCC, SCC, pH, TA, TS and VitC values of Şalak melon genotypes in different regions

Location	LCC	SCC	pH	TA	TS	VitC
1	117.51 a	7.91 a	4.98 ab	2.06 c	11.55 ab	20.13 d
2	110.36 d	7.77 d	4.99 a	1.99 d	12.13 a	19.88 d
3	111.52 cd	7.79 cd	4.94 cd	1.96 e	10.96 bc	19.15 de
4	115.08 b	7.86 b	4.93 d	2.18 a	11.35 b	25.24 a
5	114.89 b	7.85 b	4.96 bc	2.02 d	11.08 bc	21.60 c
6	112.38 c	7.80 c	4.99 a	2.05 c	10.83 bc	18.55 e
7	111.77 c	7.81 c	4.95 c	2.10 b	10.49 c	21.23 c
8	111.44 cd	7.85 b	4.98 ab	2.15 a	11.54 ab	23.36 b
Mean	113.12	7.83	4.97	2.06	11.24	21.14

*: The values expressed with different letters in each column are statistically different from each other at the 5% significance level.

In the chlorophyll measurements made in melon leaves, it was calculated that the values varied between 117.51 and 110.36 SPAD, and the average chlorophyll amount according to the regions was 113.12 SPAD. The highest LCC was determined in region 1 and the lowest in region 2 (Table 4). It has been observed that the amount of water-soluble solids, which is one of the important measurements made in fruits, varies between 7.91 and 7.77%, with an average of 7.83%. Statistically, the highest SCC was calculated in region 1 and the lowest in region 2 (Table 4). It was determined that the average pH value of observed Şalak melons was 4.97 and varied between 4.99 and 4.93 depending on the region. Statistically, the highest pH was calculated in regions 2 and 6, and the lowest was calculated in region 4 (Table 4). It was observed that titratable acidity amounts were 2.06 mval/100 ml on average and varied between 2.18 mval/100 ml, and 1.96 mval/100 ml depending on the region. The highest TA values were found in regions 4 and 8, and the lowest were found in region 3 (Table 4). It was observed that the average reducing and non-reducing sugar content was 11.24 mg/g, varying between 12.13 mg/g and 10.49 mg/g depending on the region. Statistically, the highest TS was determined in region 2 and the lowest in region 7 (Table 4). It was calculated that the average vitamin C content of fruits is 21.14 mg/100 g, and depending on the region, it is 25.24 mg/100 g and 18.55 mg/100 g. Statistically, it was determined that the highest VitC content was found in the samples grown in region 4 and the lowest in the samples grown in region 6 (Table 4). Master thesis of Bahçıvançı (2017), they stated that in the summer local melon genotypes grown in Diyarbakır region was calculated between plant height 2.04-1.43 m, fruit weight 4375-703 g, fruit length 32.23-12.55 cm, fruit diameter 21.18-12.63 cm, fruit shell thickness 2.13-0.43 cm, and SSC 26.26-21.61%. Dal et al. (2017) reported that in the local melon genotypes they examined, plant height was 77.31 cm, stem diameter was 4.58 mm, mean fruit weight was 673.29 g, fruit flesh

thickness was 8.06 mm, fruit shell thickness was 12.66 mm, fruit SSC was 3.81% and pH was 2.98. Yakupoğlu and Çoban (2022) in their study on the local genotype of Bağrıbütün, reported that the mean fruit length was 13.95 cm, fruit width was 11.94 cm, fruit weight was 922 g, fruit SSC was 11.92%, titratable acidity was 1.16 g/100 g, pH was 6.5, total sugar was 13.54 mg/g, and vitamin C content was 15.52 g/100 g. When the research findings are compared with literature sources, it is seen that Şalak melon genotype has bigger vegetative development. In terms of its main fruit characteristics, it has been observed that it has very large fruits, is rich in vitamin C, does not have much acidity, has a high sugar content, but has a thin fruit flesh. Zhukovsky (1933) reported that Anatolia has a great genotype richness in melon, watermelon and squash. As a matter of fact, Şalak melon genotypes are a part of this richness. The fact that the plant has large and juicy fruits and is rich in vitamin C and total sugar content makes this genotype very valuable. However, when thin flesh is combined with high fruit juice content, it creates major problems, especially in shelf life and roadworthiness. In order for this valuable genotype not to be lost and to be passed on to future generations, it is of great importance to eliminate its negative characteristics through both cultural and breeding studies.

4. CONCLUSION

A wide variation in the parameters examined was observed in Şalak melon genotype plants grown by producers in 8 different regions. These differences seen in plant vegetative parts and fruits may result from the ecological conditions in which the plants were grown, the growing conditions, or the maturity of the fruit at harvest. Apart from this, another possibility is the possibility of mixing commercial varieties in the region with the same type of melon genotypes that have recently arrived via Nakhchivan (Azarbaijan) and Iran. In general, according to the parameters examined, region 1 showed superiority in terms of the examined features. It is thought that it would be more accurate to grow with seeds obtained from this region for similar vegetal characteristics and desired fruit quality. It is of great importance to preserve in gene banks Şalak melon genotypes, which are determined to have large fruits, abundant juiciness, and high vitamin C and sugar content. It is also important to obtain a geographical indication in order to increase its awareness. In order to prevent this genotype from disappearing, it is of great importance to encourage its cultivation by local producers. Finally, in order to sell Şalak

melon both within Turkey and to different parts of the world, preservation methods must be developed or breeding studies must be carried out to increase fruit strength.

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IĞDIR SÜPER DOMATES YEREL GENOTİPİ TOHUMLARINDA BAZI MORFOLOJİK, CANLILIK VE FİZYOLOJİK ÖZELLİKLERİNİN BELİRLENMESİ

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Özet
Dünyada ve Türkiye'de en fazla üretilen sebzelerin başında domates gelmektedir. Türkiye yoğun ve farklı amaçlara yönelik domates üretimi nedeniyle çok sayıda hibrit, açık tozlanan ve köy popülasyonu çeşide sahiptir. Özellikle köy popülasyonu tohumları ıslah çalışmalarında genetik çeşitlilik sağlaması açısından büyük önem taşımaktadır. Bu araştırmada Iğdır ovasının farklı bölgelerinden hasat edilen Süper Domates yerel genotipine ait tohumların morfolojik özellikleri, çimlenme oranları ve çimlenme sırasında sahip oldukları bazı fizyolojik özelliklerin ortaya konması amaçlanmıştır. Araştırmada meyve başına tohum, bin tohum ağırlığı, 1 gramdaki tohum sayısı, toplam ve normal çimlenme oranları, ortalama çimlenme zamanları, tohum eni, tohum boyu, tohum alanı, tohum şekli, Katalaz ve Polifenol oksidaz aktiviteleri ile H_2O_2 içerikleri belirlenmiştir. Bölgelerin ortalamaları dikkate alındığında meyve başına tohum 249 adet, bin tohum ağırlığı 2.98 g, bir gramdaki tohum sayısı 335 adet, toplam ve normal çimlenme oranları %90.6 ve %79.7, ortalama çimlenme zamanı 2.52 gün, tohum boyu ve eni 5.43 ve 3.79 mm, tohum alanı 18.06 mm^2, tohum şekli oval olarak belirlenmiştir. Katalaz ve Polifenol oksidaz aktiviteleri sırasıyla 0.488 ve 163.13 µmol min^{-1} g^{-1} YA olarak H_2O_2 içeriği ise 141.05 µM g^{-1} YA olarak belirlenmiştir. Araştırma bulguları literatür kaynaklarıyla karşılaştırıldığında Süper domateste meyve başına tohum sayısının yüksek olduğu, tohumlarının nispeten küçük, canlılık oranlarının ve sağlıklı fide elde edilebilme oranının yüksek olduğu, antioksidan kapasitesinin oldukça yüksek olduğu görülmüştür. Bu nedenle ıslah çalışmalarında kolaylıkla kullanılma potansiyellerinin olduğu düşünülmektedir.
Anahtar kelimeler: Biyoçeşitlilik, *Lycopersicon esculentum*, Süper domates, tohum canlılığı, tohum fizyolojisi, yerel genotipler

DETERMINATION OF SOME MORPHOLOGICAL, VIABILITY AND PHYSIOLOGICAL CHARACTERISTICS OF IĞDIR SÜPER TOMATO LOCAL GENOTYPE SEEDS

Abstract

Tomato is one of the most produced vegetables in Türkiye and in the world. Türkiye has many hybrid, open-pollinated and village population varieties due to intensive tomato production for different purposes. Especially local genotype seeds are of great importance in terms of providing genetic diversity in breeding studies. In this research, it was aimed to reveal the morphological characteristics, germination rates and some physiological characteristics of the seeds of the Süper Tomato local genotype harvested from different regions of the Iğdır plain. In the research, seeds per fruit, thousand seed weight, number of seeds per gram, total and normal germination rates, mean germination times, seed width, seed length, seed area, seed shape, Catalase and Polyphenol oxidase activities and H_2O_2 contents were determined. Considering the averages of the regions, it was determined that seeds per fruit are 249, thousand seed weight is 2.98 g, number of seeds per gram is 335, total and normal germination rates are 90.6% and 79.7%, mean germination time is 2.52 days, seed length and width are 5.43 and 3.79 mm, seed area is 18.06 mm^2 and its seed shape is oval. Catalase and Polyphenol oxidase activities were determined as 0.488 and 163.13 µmol min^{-1} g^{-1} FW, respectively, and H_2O_2 content was determined as 141.05 µM g^{-1} FW. When the research findings were compared with literature sources, it was seen that the number of seeds per fruit in Süper tomato was high, the seeds were relatively small, the viability rates and the rate of obtaining healthy seedlings were high, and the antioxidant capacity was quite high. For this reason, it is thought that they have the potential to be easily used in breeding studies.

Keywords: Biodiversity, *Lycopersicon esculentum*, Süper tomato, seed viability, seed physiology, local genotypes

1. INTRODUCTION

It is thought that the tomato was first cultivated by indigenous tribes living in Mexico or Peru, from where it spread to Europe in the 16th century, to North America in the 18th century and then to the whole world, and it entered Türkiye in the early 1900s (Güvenç, 2017; Kaya et al., 2018). Hundreds of different tomato varieties and types, consumed fresh and processed, are grown worldwide today. There are many wild species of tomato. These wild species, which are relatives of the cultivated tomato, show wide diversity as the altitude increases above sea level and constitute an important gene pool (Sönmez and Ellialtıoğlu, 2014).

Tomato (So*lanum lycopersicum* L.), a member of the Solanaceae family, is one of the most cultivated vegetables in the world and in Türkiye (Oğuz, 2010). In 2021, 189.13 million tons of tomatoes were produced worldwide in a total area of 5.06 million hectares (FAO, 2023). Türkiye ranks 3rd in the world with 13.10 million tons of tomato production in an area of 158719 ha (TUIK, 2023). Although Türkiye is not within the gene center of the tomato, it has a wide genetic diversity. This diversity arises from hybrid varieties, open-pollinated varieties and local genotypes.

Considering that biodiversity includes both wild and cultivated species and varieties within these species; Biodiversity includes the gene resources that make up the world genetic heritage (Dal et al., 2017). Türkiye is one of the countries with the highest genetic resources and genetic diversity. Detecting, collecting and preserving the diversity in plant genetic resources is extremely important for the sustainability of plant diversity. Since the same plant species creates very variable variations within itself through varieties and genotypes, it is very important to protect plant genetic resources and to determine the varieties that will represent the widest variation (Gross et al., 2006, Karagöz et al., 2010; Karataş et al., 2017). In other words, in order to effectively benefit from genetic resources, it is necessary to investigate the diversity in plant genetic resources (Che et al., 2003; Bode et al., 2013).

Local genotypes mostly emerged by selecting individuals with high quality characteristics and in harmony with the region, by continuing selection in successive generations and by continuing breeding in selected individuals and by the effect of natural selection (Dal et al., 2017). Local

varieties are extremely important because they are essential in breeding studies and can be hybridized with cultivated varieties (Eser et al., 2005). In the characterization of plant genetic resources, morphological and agronomic observations and measurements are widely used by plant breeders. Today, genotypes of many plant species are collected, identified, and as a result of the identifications, similar ones are eliminated and core collections are created to be used in breeding studies. It is very important for breeders to know the material they will work with genotypes, determination of morphological characteristics such as flowers, fruits, leaves, branches and seeds; phenological characteristics such as germination, emergence, flowering and maturation time, and agricultural characteristics such as plant height, number of branches, biological efficiency and grain yield (Madakbaş and Ergin, 2011). Of course, observations at the physiological and molecular level with modern techniques make great contributions to the classification of varieties. Iğdır province is among the largest micro-climatic regions in Türkiye due to its low altitude and high temperature. It contains many species and varieties in both culture and wild flora. When we look at the plant production statistics of Iğdır province, tomato fruit ranks first among edible vegetables with a production of 35217 tons in an area of approximately 8915 decares (TUIK 2023). Approximately 1/3 of this tomato production is covered by the local genotype called Süper tomato, which has been grown intensively in the region for many years. Süper tomato genotype, which is a large tomato (beef) type, has a high flavor and aroma. However, as with many products of the plain, their storage and road resistance are quite limited due to the high water content of the fruits. In this case, the cultivation of this species is decreasing day by day. In this study, it was aimed to examine the seed characteristics of the Süper tomato genotype grown in the Iğdır plain at the morphological, physiological and viability level in order to be a pioneer in the characterization and breeding studies that can be carried out in the following years.

2. MATERIAL and METHODS

2.1 Material

The examination of the Süper tomato samples began in Jun-July 2021 and 2022, in the middle of harvest season. Samples were marked in 32 different regions, and measurements were made by measuring at least 5 different plant and their averages in each location (Fig. 1). The tests were conducted at the Vegetable and Seed Physiology Laboratory at Iğdır University.

2.2 Method

Harvested tomato fruits were subjected to seed extraction by fermentation method. The fruits were cut into pieces with the help of a knife and filled into containers filled with 50% water. The fruits were crushed in water and the upper part of the container was covered with parafilm to make it hermetic condition and kept in the dark at room temperature for 24 hours. Then, the seeds that sank to the bottom of the water were filtered and washed again. Finally, the filtered seeds were dried for 72 hours in a shaded and airy place to receive air from the bottom and top. Dried seeds were stored at +4 ºC until used. All parameters examined are given in table 1.

2.2.1 Morphological characterization

While saving the seeds from the fruits, 5 replications were counted from each region and the average was calculated. The number of thousand seeds was determined by randomly weighing 100 seeds in 5 replicates from the seeds taken from each region and proportioning them to 1000 seeds. The number of seeds per gram was determined by weighing, counting and proportioning 1 g of seeds in 5 replicates.

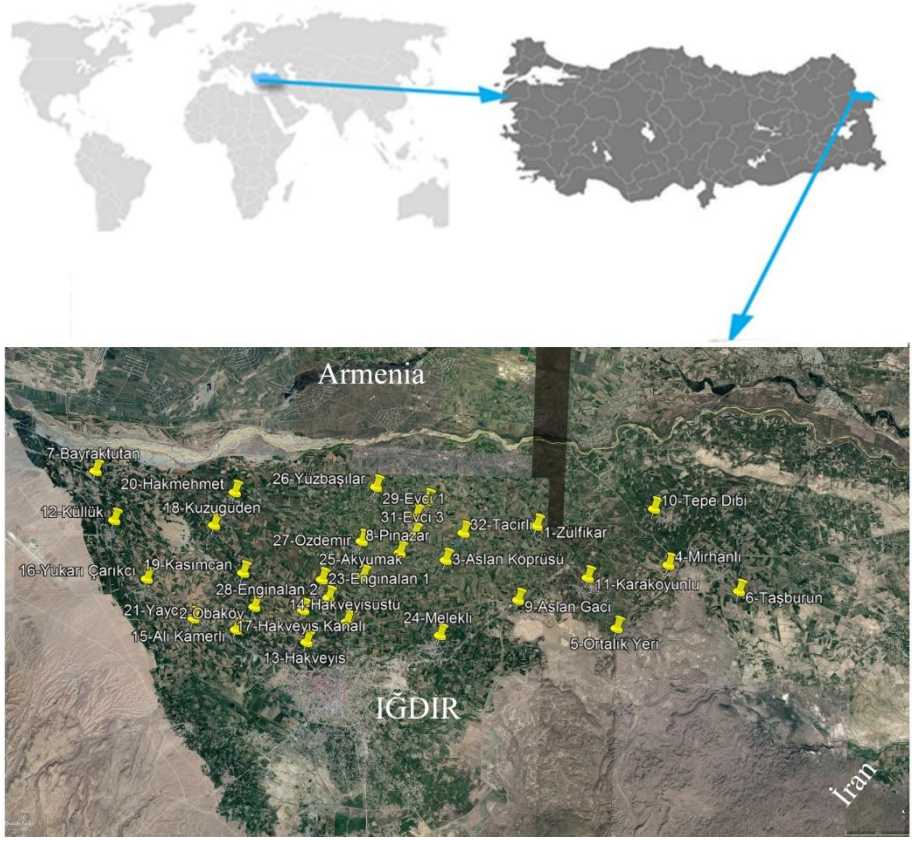


Figure 1. Observed locations to evaluate plants belonging to süper tomato genotypes

Width (SW) and length (SL) measurements of seeds were calculated with the help of a digital caliper for 10 seeds in 3 replicates in samples collected from each region and expressed in mm. Seed area (SA) was calculated as width x length and expressed in mm^2.

2.2.2 Germination test

The seeds were germinated as 3x50 seeds between paper at 25 °C for 14 days and the germination rate was determined as a percentage. Seeds showing a radicula (rootlet) 2 mm long were considered germinated. At the end of the 14th day, seeds showing appropriate hypocotyl, cotyledon and root structure were used to determine the normal germination rate (ISTA, 2017). During the seed germination test, daily counts were made and the mean germination time (MGT) was determined. The MGT was calculated with the help of the following formula, based on the groups with total germination above 50% (Demir et al., 2008);

$$MGT = \frac{\Sigma n \times D}{\Sigma n}$$

Table 1. List of morphological and physiological characters with abbreviations recorded for 32 location of tomato

Character	Abbreviation
Number of seeds per fruit (unit)	NSF
Thousand seed weight (g)	TSW
Number of seeds per gram (g)	NSG
Seed width (mm)	SW
Seed length (mm)	SL
Seed area (mm^2)	SA
Total germination percentage (%)	TG
Normal germination percentage (%)	NG
Mean germination time (day)	MGT
Catalase activity (µmol min^{-1} g^{-1} FW)	CAT
Polyphenol oxidase activity (µmol min^{-1} g^{-1} FW)	PPO
Hydrogen peroxide content (µM g^{-1} FW)	H_2O_2

2.2.3 Physiological Analyzes

H_2O_2 content, 0.5 g seeds were firstly homogenized in an ice bath with 5 ml of 0.1% (w:v) TCA. Then, the homogenate was centrifuged for 15 min at 10000 *g*. After centrifuge, 0.5 ml

süpernatant was mixed with the 0.5 ml 10 mM KH_2PO_4 buffer (pH 7.0) including 1 ml 1M KI. After recording the absorbances at 390 nm, the relevant H_2O_2 content was quantified using standard curve (Sergiev et al., 1997). To determine the change in enzyme activities, 0.25 g of seed sample was crushed in liquid nitrogen in porcelain mortars. It was homogenized with 5 ml cold buffer (0.1 M Na_2HPO_4 Ph 7.5), 0.5 Mm Na-EDTA and 1 mM Ascorbic acid. After the homogenized samples were centrifuged at 18000 *g* for 30 min at 4 °C, the obtained samples were kept at room temperature for 1 hour. CAT activity was immediately determined in a portion of the resulting homogenate, and the extract was kept at -20 °C until used for PPO activity determination (Jebara et al., 2005).

Catalase (CAT; EC 1.11.1.6) activity was determined based on the disappearance of H_2O_2 at 240 nm. In this enzyme analysis, 2.5 ml 0.05 M KH_2PO_4 (pH 7.0), 1.5 Mm H_2O_2 and 0.2 ml enzyme extract were added to the reaction medium with a final volume of 1 ml. Enzyme activation evaluation, the change in absorbance within 1 min for 1 mg protein was determined as 40 Mm cm^{-1} at a wavelength of 240 nm (Jebara et al., 2005). Polyphenol Oxidase (PPO; E.C.1.14.18.1) activity was determined spectrophotometrically by measuring the increase in absorbance at 496 nm for 4-methyl catechol and at 500 nm for all other substrates (Espin et al., 1995). While measuring the enzyme activity, the final volume of the reaction mixture was prepared as 1 ml by adding 0.1 ml enzyme + 0.1 ml substrate (100 mM) + 0.1ml MBTH (10 mM) + 0.02 ml DMF + 0.068 ml buffer (50 mM) solution. The reaction mixture without enzyme solution was also used as a blank. One unit of PPO activity; It was determined as the amount of enzyme that causes an increase in absorbance of 0.001 in 1 min in 1 ml of reaction mixture (Kolcuoğlu, 2012). Statistical analyzes were performed using the SPSS 26 package program. DUNCAN multiple comparison method was used to determine the differences of the examined parameters according to regions.

3. RESULTS and DISCUSSION

It was determined that Süper tomato seeds were oval shaped, light yellow in color and densely hairy. In the measurements made on the samples collected from the areas where Süper tomato local genotypes were grown in the Iğdır plain, it was determined that there were statistical differences between the number of seeds per fruit, thousand seed weight and the amount of

seeds per gram. It was determined that the number of seeds per fruit varied between 326 and 199, with the highest NSF in region 16 and the lowest in regions 3, 10 and 15 (Table 2).

Table 2. NSF (unit), TSW (g) and NSG (unit) in Süper tomato seeds by regions

Location	NSF	TSW	NSG	Location	NSF	TSW	NSG
1	269 d	2.56 fg	349 cd	**17**	230 h	3.22 cd	314 e
2	303 b	2.47 g	325 de	**18**	234 h	3.07 d	321 de
3	202 k	3.43 c	307 ef	**19**	263 e	3.15 cd	313 e
4	218 i	3.16 cd	325 de	**20**	261 e	3.01 d	288 f
5	255 f	2.51 g	367 c	**21**	245 fg	2.65 f	296 f
6	326 a	2.93 e	416 a	**22**	254 f	3.36 c	299 ef
7	242 g	2.90 e	351 cd	**23**	274 cd	3.78 b	387 b
8	236 a	2.56 fg	326 de	**24**	248 fg	3.16 cd	395 b
9	207 j	2.47 g	303 ef	**25**	230 h	2.69 f	278 g
10	201 k	2.76 ef	318 e	**26**	219 i	2.79 ef	289 f
11	216 i	2.73 ef	336 d	**27**	231 h	2.66 f	346 cd
12	293 bc	3.05 d	329 de	**28**	251 f	3.12 cd	370 c
13	288 c	2.62 f	407 a	**29**	263 e	3.32 c	328 de
14	307 b	3.95 a	342 d	**30**	284 c	3.03 d	340 d
15	199 k	2.77 ef	310 e	**31**	259 ef	3.83 b	357 cd
16	208 j	2.81 ef	316 e	**32**	252 f	2.91 e	371 c

*: The values expressed with different letters in each column are statistically different from each other at the 5% significance level.

Thousand seed weights varied between 3.95 g and 2.47 g. Statistically, the highest TSW was calculated in the samples taken from regions 14 and the lowest was calculated in the samples taken from regions 2, 5 and 9. When the number of seeds per gram was examined, it was determined that it varied between 416 and 278 according to regions, the highest NSG was determined in the samples taken from regions 6 and 13, and the lowest was determined in the samples taken from region 25 (Table 2).

When the seed lengths were examined from the observations made to determine the physical properties of the seeds, it was seen that they varied between 5.88 and 4.88 mm depending on the region. It was determined that the highest SL was in the samples taken from regions 17 and 23, and the lowest was in the sample 27 (Table 3).

It was observed that the seed width varied between 4.36 mm and 3.28 mm depending on the region. The highest SW was determined in the samples taken from regions 7, 10, 14 and 23,

and the lowest was determined in the samples 9 and 24. It has been revealed that seed areas vary between 21.41 mm^2 and 14.47 mm^2. The highest SA was measured in sample 23, and the lowest was measured in samples 22 and 27 (Table 3).

Table 3. SL (mm), SW (mm) and SA (mm^2) in Süper tomato seeds by regions

Location	SL	SW	SA	Location	SL	SW	SA
1	5.74 ab	3.41 e	16.58 j	**17**	5.85 a	4.12 b	20.02 cd
2	5.56 c-e	3.56 de	17.48 h	**18**	5.74 ab	4.22 ab	20.43 bc
3	5.44 e	4.27 ab	20.67 b	**19**	5.30 ef	3.61 d	16.09 jk
4	5.29 ef	3.72 cd	20.01 cd	**20**	5.17 f	3.74 cd	18.20 g
5	5.72 b	3.57 de	17.45 h	**21**	5.50 de	3.63 d	15.54 k
6	5.18 f	3.56 de	18.75 f	**22**	4.89 h	3.37 ef	14.49 l
7	5.39 e	4.36 a	19.77 de	**23**	5.88 a	4.32 a	21.41 a
8	5.29 ef	3.87 c	17.38 h	**24**	5.39 e	3.28 f	15.36 k
9	5.13 fg	3.28 f	14.92 kl	**25**	5.54 c-e	3.63 d	18.37 g
10	5.54 c-e	4.36 a	20.06 cd	**26**	5.74 ab	3.43 e	16.57 j
11	5.40 e	4.18 ab	19.62 de	**27**	4.88 h	3.36 ef	14.47 l
12	5.78 ab	4.05 bc	17.35 h	**28**	5.59 cd	3.63 d	18.34 g
13	5.58 cd	3.66 d	18.38 g	**29**	5.41 e	3.38 ef	20.58 bc
14	5.14 fg	4.35 a	20.06 cd	**30**	5.63 c	4.24 ab	20.29 c
15	5.26 ef	4.23 ab	19.48 e	**31**	5.09 g	3.52 de	15.96 jk
16	5.55 c-e	3.52 de	16.60 j	**32**	5.23 f	3.95 bc	17.28 i

*: The values expressed with different letters in each column are statistically different from each other at the 5% significance level.

It was observed that the viability rates of Süper tomato samples collected from the Iğdır plain differed according to the regions. It was calculated that total germination rates varied between 100.0 and 74.7%, while normal germination rates varied between 92.0 and 61.3%. The highest TG was determined in the samples taken from regions 4, 12 and 13, and the lowest was determined in the sample 20. Statistically, the highest NG was seen in sample 5 with 92.0%, and the lowest was seen in sample 32 (Table 4).

Table 4. Viability rates (%) and mean germination times (day) in Süper tomato seeds by regions

Location	TG	NG	MGT	Location	TG	NG	MGT
1	86.0 f	74.7 h	2.4 ef	**17**	90.7 de	80.7 e-g	2.4 ef
2	97.3 a-c	82.7 e	2.6 de	**18**	80.0 g	77.3 gh	2.0 h
3	98.7 ab	87.3 b-d	2.6 de	**19**	78.7 gh	77.3 gh	2.1 gh
4	100.0 a	78.7 g	2.2 f-h	**20**	74.7 i	62.7 jk	2.9 c
5	94.7 c	92.0 a	2.6 de	**21**	88.0 e	82.7 e	2.4 ef
6	86.0 f	81.3 ef	2.8 cd	**22**	93.3 cd	89.3 b	2.7 c-e
7	90.7 de	84.0 d	2.6 de	**23**	88.0 e	64.0 j	2.9 c
8	86.0 f	82.7 e	2.8 cd	**24**	98.7 ab	84.0 d	2.1 gh
9	77.3 g-i	74.7 h	2.7 c-e	**25**	94.7 c	83.3 de	2.2 f-h
10	93.3 cd	86.7 cd	2.9 c	**26**	90.7 de	89.3 b	2.1 gh
11	98.7 ab	86.7 cd	2.4 ef	**27**	98.7 ab	88.7 bc	2.0 h
12	100.0 a	88.7 bc	2.1 gh	**28**	92.0 d	64.0 j	3.2 b
13	100.0 a	87.3 b-d	2.0 h	**29**	78.7 gh	77.3 gh	3.2 b
14	86.0 de	77.3 gh	2.2 f-h	**30**	76.7 hi	69.3 i	2.5 d-f
15	98.7 ab	88.7 bc	2.0 h	**31**	97.3 a-c	68.0 i	3.6 a
16	96.0 bc	89.3 b	2.4 ef	**32**	90.7 de	61.3 k	3.1 bc

*: The values expressed with different letters in each column are statistically different from each other at the 5% significance level.

Fast germination of seeds is an indicator of vigour, and one of the most basic determination tests is the calculation of the mean germination time. It was found that MGT varies between 3.6 days and 2.0 days depending on the region. Statistically, the highest MGT was detected in sample 31, and the lowest was detected in samples 13, 15, 18 and 27 (Table 4).

It has been observed that antioxidant enzyme activities in Süper tomato seeds vary from region to region, similar to physical properties. It was observed that catalase activities varied between 0.566 µmol min^{-1} g^{-1} FW and 0.329 µmol min^{-1} g^{-1} FW, and polyphenol oxidase activities varied between 199.5 µmol min^{-1} g^{-1} FW and 133.2 µmol min^{-1} g^{-1} FW. Statistically, the highest CAT activity was calculated in sample 19, and the lowest was calculated in sample 1. When PPO activities were examined, statistically the highest was detected in sample 30, and the lowest was detected in sample 3 (Table 5).

Table 5. Antioxidant enzyme activity (µmol min^{-1} g^{-1} FW) and Hydrogen peroxide content (µM g^{-1} FW) in Süper tomato seeds by regions

Location	CAT	PPO	H_2O_2	Location	CAT	PPO	H_2O_2
1	0.329 i	147.3 g	147.2 cd	**17**	0.481e	170.3 d	128.5 e-g
2	0.457 f	155.9 f	156.4 bc	**18**	0.459 f	181.6 c	123.1 h
3	0.513cd	133.2 i	156.9 bc	**19**	0.566 a	171.1 d	131.6 ef
4	0.479 e	137.6 h	123.3 h	**20**	0.472 ef	166.7 de	130.5 ef
5	0.483 e	148.9 g	120.0 i	**21**	0.470 ef	150.2 fg	136.3 e
6	0.480 f	175.5 cd	167.9 b	**22**	0.533 bc	157.6 ef	146.8 cd
7	0.399 h	186.5 bc	162.9 b	**23**	0.542 b	151.9 fg	156.7 bc
8	0.421 g	145.0 gh	166.8 b	**24**	0.506 cd	165.9 de	155.5 bc
9	0.495 d	180.1 c	119.1 i	**25**	0.482 e	162.0 d-f	194.5 a
10	0.526 c	188.2 b	127.2 gh	**26**	0.492 de	167.1 de	130.2 ef
11	0.507 cd	191.6 b	121.5 hi	**27**	0.512 cd	170.5 d	132.1 ef
12	0.499 d	159.9 ef	130.6 ef	**28**	0.519 cd	154.23 f	140.8 d
13	0.495 d	160.5 ef	134.3 e	**29**	0.477 e	188.63 b	124.1 h
14	0.488 de	138.4 h	149.1 c	**30**	0.483 e	199.5 a	129.0 e-g
15	0.557 ab	138.9 h	158.0 bc	**31**	0.479 e	167.05 de	120.4 i
16	0.521 c	144.4 gh	140.7 d	**32**	0.485 e	163.9 d-f	151.6 c

*: The values expressed with different letters in each column are statistically different from each other at the 5% significance level.

When the H_2O_2 contents, which are one of the most important factors in determining the level of disintegration of the cell structure, were examined, it was seen that it varied between 194.5 µM g^{-1} FW and 119.1 µM g^{-1} FW depending on the regions. Statistically, the highest H_2O_2 content was determined in sample 25, and the lowest was determined in samples 5, 9 and 31 (Table 5).

Many studies have been carried out to reveal the vegetative morphological, physiological and molecular characteristics of tomato local genotypes (Bhatia et al., 2004; Oğuz, 2010; Sönmez et al., 205; Kurt, 2019; Akbaba and Özden, 2023). However, research on seed characteristics in local genotypes is quite limited. Yakupoğlu and Çoban (2022) calculated seed width, length, thickness and thousand-seed weight in their study on local melon genotypes. In tomato, Chime et al. (2017), in their study where they examined the vegetative and fruit characteristics of local tomato varieties as well as the morphological characteristics of the seeds, reported that the seeds were oval and light yellow in color. In their study, Akbaba and Özden (2023) reported that in the Süper tomato genotype, under normal conditions, the total and normal germination rates were determined as 86.7% and 76.7%, respectively, and the mean germination time was 6.5 days. They reported that viability rates decreased further in saline conditions, but viability rates

and germination rates could increase significantly with the application of some endophytic bacteria to seeds. Our research has shown that Süper tomato seeds, especially taken from some regions, have high viability, fast germination vigour, and high antioxidant capacity. When compared to our research findings, this shows that tomato seeds may vary depending on the period in which they were taken, the region, and the ecological characteristics of the period in which they were grown. Hihg antioxidant capacity, the large size, and hairy structure of süper tomato seeds may indicate that they may be resistant to stress conditions. Because especially hairiness can be considered a sign of the wildness of the species.

4. CONCLUSION

A wide variation in the parameters examined was observed in the Süper tomato genotype seeds collected from 32 different regions. These differences seen in the seeds may be due to the soil characteristics in which the plants are grown, the maturity of the fruit at harvest, or cultivation techniques. However, another possibility is that it may lose its original quality in some regions because they have been grown together with hybrid and open-pollinated varieties in the same region for many years. According to the parameters examined in general, it was observed that the viability and development parameters were the highest in the seeds obtained from regions 12, 13, 15, 24, 26 and 27.

Plant genetic resources are of great importance for agricultural sustainability and the continuity of human nutrition. For this reason, more detailed studies, as well as seed characteristics, need to be carried out on the Süper tomato species. According to the results obtained, it is of great importance to preserve the seeds of this genotype in gene banks and other relevant institutions.

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SASON'DA ÇİLEK ÜRETİMİ VE YEREL KALKINMAYA ETKİLERİNİN DEĞERLENDİRİLMESİ[1]

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ÖZET
Farklı sosyoekonomik gelişme dinamiklerine sahip ülkelerde bu dinamikleri göz önünde bulundurmaksızın uygulanan kalkınma politikaları, bir yandan ülkelerin gelişmişlik düzeyleri arasındaki farkın açılmasına diğer taraftan da kalkınmanın daha çok ekonomik boyutunu referans alarak sosyal boyutunun geri planda kalmasına neden olmuştur. 1970'li yıllarda yaşanan krizin etkileriyle, geleneksel kalkınma politikalarının başarıları sorgulanmaya ve bu kalkınma politikaları bölgesel ve yerel potansiyele odaklanan bir yaklaşıma evrilmeye başlamıştır. Türkiye'de bölgesel/yerel kalkınma politikaları, 2000'li yıllardaki tarımsal reform ve yeniden yapılanmaya yönelik adımlarla ivme kazanabilmiştir. Tarımsal reform ve yeniden yapılanma için atılan adımlarda, Uluslararası Para Fonu, Dünya Bankası ve Dünya Ticaret Örgütü ile yapılan anlaşmaların yanı sıra Helsinki Zirvesi'nde Türkiye'nin Avrupa Birliği üyeliğine aday ülke olduğunun resmi olarak açıklanmasının önemli etkileri bulunmaktadır. 2001 yılında, Doğu ve Güneydoğu Anadolu Bölgesi'nde yer alan ve aralarında Batman'ın da bulunduğu 11 ilde, üretimi kotaya tabi olan tütün üretiminden vazgeçen üreticilerin Alternatif Ürün Programı çerçevesinde desteklenmesine karar verilmiştir. Batman Tarım İl Müdürlüğü'nün çileği tütüne alternatif bir ürün olarak belirlemesiyle Sason ilçesinde çilek üreticiliği 2000'li yıllarda hayata geçmiştir. 2006-2007 yılında İl Özel İdare Müdürlüğü koordinatörlüğü ve bütçesiyle 15 dekarlık alanda başlayan çilek üretimi, Güneydoğu Anadolu Projesi (GAP) kapsamındaki Diyarbakır Batman Siirt Kalkınma Projesi ile desteklenerek 2011-2015 yılları arasında yaygınlaşmıştır. Bu çalışmada, Sason'da çilek üretimi faaliyetlerinin yerel kalkınmaya etkilerinin 11 çilek üreticisi ve 1 eski sivil toplum kuruluşu yöneticisiyle yapılan görüşmelerden elde edilen bilgilerin nitel araştırma yöntemi ile analiz edilerek ortaya konulması amaçlanmıştır. Elde edilen bulgular, çilek üretim faaliyetlerinin ilçenin sosyoekonomik gelişmişlik düzeyini ve refahını arttırıcı etkilerinin olduğunu işaret etmekle birlikte, üretim ve pazarlama sürecinde karşılaşılan sorunların sürdürülebilir kalkınmayı ve verimliliği olumsuz etkilediğini göstermiştir.
Anahtar Kelimeler: Sason, Çilek Üretimi, Yerel Kalkınma, Sürdürülebilir Kalkınma

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EVALUATION OF STRAWBERRY PRODUCTION IN SASON AND ITS EFFECTS ON LOCAL DEVELOPMENT

ABSTRACT
Development policies implemented in countries with different socioeconomic development dynamics without taking these dynamics into account have, on the one hand, widened the gap between the development levels of the countries, and on the other hand, caused the social dimension to remain in the background, taking the economic dimension of development as a reference. With the effects of the crisis in the 1970s, the success of traditional development policies began to be questioned and these development policies began to evolve into an approach focusing on regional and local potential. Regional/local development policies in Turkey were able to gain momentum with the steps towards agricultural reform and restructuring in the 2000s. In the steps taken for agricultural reform and restructuring, the agreements made with the International Monetary Fund, the World Bank and the World Trade Organization, as well as the official declaration of Turkey as a candidate country for European Union membership at the Helsinki Summit, have important effects. In 2001, it was decided to support producers who gave up tobacco production, whose production was subject to quota, in 11 provinces of the Eastern and Southeastern Anatolia Region, including Batman, within the framework of the Alternative Product Program. Strawberry production began in the Sason district in the 2000s, when the Batman Provincial Directorate of Agriculture identified strawberries as an alternative product to tobacco. Strawberry production, which started in 2006-2007 in an area of 15 decares with the coordination and budget of the Special Provincial Administration Directorate, was supported by the Diyarbakır Batman Siirt Development Project within the scope of the Southeastern Anatolia Project (GAP) and became widespread between 2011-2015. In this study, it was aimed to reveal the effects of strawberry production activities on local development in Sason by analyzing the information obtained from interviews with 11 strawberry producers and 1 former non-governmental organization manager by using qualitative research method. The findings indicate that strawberry production activities have increasing effects on the socioeconomic development level and welfare of the district, but also show that the problems encountered in the production and marketing process negatively affect sustainable development and productivity.
Keywords: Sason, Strawberry Production, Local Development, Sustainable Development

1. GİRİŞ

Ülkelerin ulaşmaya çalıştığı çok boyutlu bir 'hedef' olan kalkınma, ekonomik, sosyal ve kurumsal göstergelerdeki olumlu gelişmeleri kapsayan bir 'süreç'tir (Mıhçı, 1996, s. 5). İktisadi literatür incelendiğinde, kalkınma kavramının tanımı ve kapsamının farklı dönemlerde, içinde bulunulan dönemdeki gelişmelere göre şekillendiği görülmektedir. Sanayi Devrimi'nin ardından yaşanan gelişmelerin ülkeler arasındaki refah düzeyi farklılıklarını derinleştirmesi nedeniyle, 1970'li yıllardan önce daha çok sanayileşme, modernleşme, büyüme ve sermaye birikimi gibi iktisadi hedefler üzerinde durulmuştur. Bu bağlamda, söz konusu dönemde kalkınma daha çok iktisadi boyutuyla ele alınan bir kavram iken yoksulluk ve işsizlik gibi kavramların ihmal edilmesinin bir sonucu olarak kalkınma yolunda arzu edilen seviyeye ulaşılamaması, 1970'li yıllardan sonra kalkınma kavramında bir dönüşüm yaşanmasına sebep olmuştur. Ayrıca dış şokların etkisi ile yaşanan iktisadi daralmalar da kalkınma iktisadının bakış açısının değişmesine ve bunun sonucunda kalkınma iktisadının odağında olan sanayileşme ve büyüme gibi konulara olan ilginin kalkınmanın sosyoekonomik boyutlarına kaymasına yol açmıştır.

1970'lerde dış şoklarla başlayan süreç, sosyal, ekonomik ve siyasal değişimler ortaya çıkarmasının yanı sıra 'bölge' kavramının da yeni bir boyut kazanmasına neden olmuştur. Bu açından, 1970'li yıllar bölgesel kalkınma anlayışından yerel kalkınma anlayışına geçişin temellerinin atıldığı bir dönem olarak değerlendirilebilir. 1970'li yıllardan önce uygulanan bölgesel kalkınma politikaları 1970'li yıllarla birlikte yerini, yörenin kendi olanakları ve potansiyeli ile kalkınabilme yetkinliğini ön plana çıkaran yerel kalkınma politikalarına bırakmaya başlamıştır. Yatırımların yüksek kâr getirebilecek belirli sektörlere ve ekonomik faaliyetlere yoğunlaşmasına neden olan yukarıdan aşağıya geleneksel kalkınma perspektifinin kalkınmada yetersiz kalması, çok aktörlü katılımı savunan ve belirlenen bölgelerde kalıcı iyileşmelere odaklanan yerel kalkınma perspektifinin politika yapıcılar için bir seçenek olarak ortaya çıkmasına yol açmıştır.

Geçmişten gelen merkeziyetçi bir yönetim anlayışının hâkim olması nedeniyle, Türkiye'de geleneksel kalkınma yaklaşımının yerel kalkınma yaklaşımına evrilmesi uzun ve aşamalı bir süreç içinde gerçekleşmiştir. Bu geçiş sürecinde, Türkiye'nin Avrupa Birliği'ne (AB) aday ülke olarak açıklanmasının ve Uluslararası Para Fonu (IMF), Dünya Bankası (WB) ve Dünya Ticaret Örgütü (DTÖ) gibi uluslararası kuruluş ve örgütlerle yaptığı anlaşmaların Türkiye'deki tarım

politikalarında reform ve yeniden yapılanma adımlarını hızlandırmasının önemli etkileri olmuştur.

Türkiye'de yerel kalkınma perspektifinde uygulamaya konulan örneklerden biri, Batman'ın Sason ilçesindeki çilek üretim faaliyetleridir. Sason'da yerel halkın en önemli geçim kaynağı olan tütün üretimine kota uygulanmasının ardından, çilek yetiştiriciliği alternatif bir tarımsal faaliyet olarak belirlenmiş ve ilçedeki çilek üretimi %100 hibe desteğiyle 2007 yılında 15 dönümlük arazide 4 aileyle sınırlı olacak şekilde başlamıştır. İlk çilek projesi başarılı olunca çilek üretimi kısa sürede ilçe geneline yayılmış ve yerel halkın temel geçim kaynağı olmuştur. Bu çalışmanın amacı, görece geri kalmış bir ilçe olan Sason'da bir yerel kalkınma uygulaması örneği olarak hayata geçirilen çilek üretim faaliyetlerinin yerel kalkınma politikalarının hedefleri üzerindeki etkilerini incelemektir. Bu bağlamda, Sason'daki çilek yetiştiriciliği faaliyetlerinin, yerel kalkınma politikalarının temel hedefleri olan bölgenin sosyoekonomik kalkınmasına, bölgede yoksulluğun azaltılmasına, verimlilik artışına ve sürdürülebilirlik çabalarına olan etkilerinin ortaya konulması amaçlanmıştır.

2. YEREL KALKINMA

Kalkınma kavramı gibi yerel kalkınma kavramının da iktisatçıların üzerinde görüş birliğine vardığı net bir tanımı bulunmamaktadır. İktisat literatüründe yerel kalkınmanın tanımlandığı kesin bir teorik modelin var olmaması ve ayrıca yerel ekonomik kalkınma ile ilgili strateji ve planların temel motivasyonlarının birer taklit ve deneyimin ötesine geçememesi, geniş çevrelerce genel kabul gören bir tanımının ortaya çıkmasının önünde engel teşkil etmiştir (Rodríguez-Pose, 2001, s. 8). Bununla birlikte, Uluslararası Çalışma Örgütüne göre yerel ekonomik kalkınma; bölgede mevcut olan yerel kaynakları ve küresel düzeyde avantajı beraberinde getiren bölgesel rekabet avantajını kullanarak başarılı işler ortaya çıkarmak ve ekonomik faaliyetleri harekete geçirmek amacıyla, kalkınması planlanan belirli bir bölgedeki özel sektör ve kamu sektörü arasında işbirliği faaliyetlerini teşvik eden çok aktörlü bir kalkınma sürecidir (van Boekel ve van Logtestijn, 2002, s. 5).

1970'te başlayan kriz; üretimin örgütlenmesinde, üretim faktörlerinin dağılımı ve işleyişinde, yönetimde ve ideolojik boyutta önemli etkilere yol açmış, bölgeler de bu dönemde kavramların dönüşümünden etkilenmiştir. Bu bağlamda 1970'li yıllardaki kalkınma anlayışında 'bölge'den daha küçük bir yerleşim birimini ifade eden 'yerel'e odaklanan bir yönelim ortaya çıkmıştır. Özetle makro düzeydeki kalkınma yaklaşımının mikro bir perspektife evriminde önce bölgesel,

1970'li yıllardan sonra ise kendi imkânları, kaynakları ve potansiyeli ile kendi kalkınma sürecini besleyen yerel kalkınma dinamikleri dikkate alınmaya başlanmıştır (Eraydın, 2004). Yerel kalkınma politikalarına artan ilginin temel nedeni, geleneksel kalkınma politikalarının uygulandığı dönemdeki kalkınma deneyimlerinin sonuçlarından yola çıkılarak bu politikaların güvenilirlik ve yeterliliğinin sorgulanmaya başlanmasıdır. Geleneksel kalkınma politikaları pratikte yetersiz kalırken yerel kalkınmanın uygulanabilirliğine yönelik girişimlere ilişkin başarılı örnek sayısının giderek artması, bu iki kalkınma perspektifi arasındaki temel farklılıklarla açıklanabilmektedir (Çetin, 2007, s. 5).

Rodriguez-Pose'ye (2001) göre, geleneksel kalkınma yaklaşımında kalkınma stratejilerinin uygulanması ile ilgili verilecek kararlarda yerel aktörlerin katılımına çok gerek duyulmazken yerelin sahip olduğu potansiyeli kalkınmada bir rekabet avantajı olarak değerlendiren yerel kalkınma yaklaşımında yerel aktörlerin katılımı büyük önem taşımaktadır. Geleneksel kalkınma yaklaşımında kalkınmaya yönelik politikalarla ilgili kararlar genellikle bakanlıklar ve merkezi hükümet tarafından alınıp uygulanırken yerel kalkınma yaklaşımında yerel aktörlerin kalkınma sürecine katılımı merkezi hükümet ve yerel aktörler arasındaki dikey ve yatay koordinasyonla sağlanmaktadır. Geleneksel kalkınma yaklaşımında ekonomik kalkınmayı sağlamak için daha çok sanayi gibi yüksek kâr getiren sektörlere yatırım yapma eğilimi söz konusu iken yerel kalkınma yaklaşımında her bölge/yörenin koşulları, imkânları ve sahip olduğu potansiyel belirlenip göz önünde bulundurularak bölge/yöre ile ilgili bir kalkınma stratejisi oluşturmak suretiyle bölge/yörede ekonomik kalkınmanın sağlanması amaçlanmaktadır. Son olarak, geleneksel kalkınma yaklaşımında herhangi bir bölge/yörenin yatırım açısından bir cazibe merkezi haline getirilmesi için teşvik paketlerine ve sübvansiyonlara başvurma eğilimi söz konusu iken yerel kalkınma yaklaşımında yatırımların bölge/yöreye yönelmesini sağlamak için bölge/yöredeki temel koşulların iyileştirilmesine odaklanılmaktadır

3. TÜRKİYE'DE TARIMIN GELİŞİMİ VE KALKINMADAKİ ÖNEMİ

Türkiye tarımının gelişim süreci kuruluş dönemi, planlı dönem, 1980-2000 dönemi ve 2000 yılından günümüze kadar geçen dönem olmak üzere dört dönem üzerinden incelenebilir. Cumhuriyet'in ilk yıllarında, 13 milyona yakın nüfusun sadece %10'u okuma yazma bilen kesimden oluşurken nüfusun %90'ı ise kırsal bölgelerde yaşamakta ve geçimini tarımla idame ettirmektedir. Tarımsal üretim bu dönemde genel olarak teknolojiden yoksun bir şekilde, ilkel

ve geleneksel yöntemlerle gerçekleştirilmiştir (Dernek, 2006). İlk dört planlı dönemin ortak özellikleri ise eskisinden farklı yeni bir strateji ve düzenleme inşa etmek yerine zaten var olan üretim yapısından hareket ederek planlama yapılması, ekonomik büyümenin her planın en temel amacı olması, tarımdan ziyade ağırlığın sanayi sektörüne yönelik olması yani sanayi sektöründe büyümenin asıl öncelik olması ve her plan döneminde o döneme özel yeni planlar üretmekten ziyade planların uzun bir dönem için oluşturulan stratejilerin birer parçası olmalarıdır (Kepenek ve Yentürk, 2001). Dolayısıyla bu dönemde kalkınmadan çok büyümeye, tarım sektöründen çok sanayi sektörüne odaklı bir strateji benimsendiğini söylemek yanlış olmayacaktır. Bununla birlikte, Cumhuriyetin kuruluşundan 1980'lere kadar Türkiye'de tarım sektörü üretimin lokomotif sektörü olmuştur. Söz konusu dönemde devletin korumacı ve yerli kaynaklara bağlı sanayileşme politikaları, tarım sektörüne daha fazla önem verilmesini gerektirmiştir. Bu sebeple devlet tarımsal üretimin arttırılması ve tarım üreticilerinin yaşadığı sorunların çözümü için tarım sektörüne olan desteği arttırmıştır. Nüfusun çok büyük bir kesiminin geçim kaynağı olan tarımın bu dönemde milli hasılaya, ihracata ve istihdama önemli katkıları olmuştur (Narin, 2008). 1980'li yıllarda Türkiye'de liberal politikaların uygulanmaya başlamasıyla birlikte tarım sektörüne olan ilgi her geçen gün azalmış ve bu nedenle 1980'li yıllardan itibaren tarım sektörünün milli hasıla, ihracat ve istihdam içindeki payı azalmaya başlamıştır.

İktisat literatüründe 2000'li yıllarda Türkiye'deki tarım politikalarının belirlenmesinde AB, IMF, WB ve DTÖ gibi uluslararası birlik, kuruluş ve örgütlerle imzalanan anlaşmalar ve onların bir parçası olma yolunda atılan adımların getirdiği yükümlülüklerin önemli etkilerinin olduğu belirtilmektedir (Narin, 2011; Tahsin, 2001; Yavuz, 2005). Türkiye'nin IMF'e sunduğu 9 Aralık 1999 tarihli Niyet Mektubu'nda uygulayacağını belirttiği tarım politikaları, DTÖ'ye katılımın getirdiği ve bu örgütün Nihai Senedi'ne bağlı olarak ortaya çıkan yükümlülükler ve AB Katılım Ortaklığı Belgesi'ne uyum kapsamında Ulusal Program'da yer verilen tarımsal politikalar, bu dönemde Türkiye'deki tarımsal reform ve yeniden yapılanma sürecinin çerçevesini oluşturmaktadır. Türkiye'nin 2000'li yıllarda tarım politikaları konusunda hayata geçirdiği önemli gelişmeler; çiftçiyi desteklemek adına uygulanan ihracat sübvansiyonları ile girdi ve fiyat desteklerinin uluslararası kuruluşlarla imzalanan anlaşmalar çerçevesinde sınırlandırılması ve buna alternatif olarak doğrudan gelir destekleme politikalarının hayata geçirilmesidir (Tahsin, 2001, s. 75)

4. BATMAN'IN SASON İLÇESİNDE ÇİLEK ÜRETİMİ

Batman'ın kuzeyinde bulunan ve dağlık bir alanda kurulmuş olan Sason ilçesi, ilçede Doğu Anadolu'nun karasal ve yer yer Akdeniz Bölgesi'nin ılıman ikliminin hâkim olması nedeniyle karışık bir iklim yapısına sahiptir. Sason'da sene boyunca ortalama yağış miktarı 98 kg/m² civarında olup tarım arazileri oldukça engebeli olduğu için tarım makinalarının kullanımına çok elverişli değildir (Demir Kaya ve diğerleri, 2016, s. 1918). Bu durum, Sason'da yetiştirilebilecek tarımsal ürün çeşidinin sınırlı olmasına neden olmaktadır.

Son yıllarda Sason'daki üreticilerin yaygın olarak yetiştirdiği tarımsal ürünlerden biri de çilektir. Sason'da çilek yetiştiriciliği, 2000'li yıllarda Sasonlu tarım üreticilerinin en önemli geçim kaynağı olan tütün üretimine kota getirilmesi ve üreticilerin bundan ekonomik olarak olumsuz etkilenmesiyle başlamıştır. 2001 yılında Doğu ve Güneydoğu Anadolu Bölgesi'ndeki Batman dâhil on bir ilde tütün üretiminden vazgeçerek alternatif ürünlerin üretimine yönelen üreticilerin Alternatif Ürün Programı kapsamında desteklenmesine yönelik kararın alınmasının ardından, Batman Tarım İl Müdürlüğü çileği tütüne alternatif bir ürün olarak belirlemiştir. 2006-2007 yıllarında İl Özel İdare Müdürlüğü koordinatörlüğü ve bütçesiyle 15 dekarlık alanda başlayan çilek üretimi, Güneydoğu Anadolu Projesi (GAP) kapsamındaki Diyarbakır Batman Siirt Kalkınma Projesi ile desteklenerek 2011-2015 yılları arasında yaygınlaşmıştır (Batman İl Tarım ve Orman Müdürlüğü, t.y.). Bu açıdan Sason'daki çilek üretim faaliyetlerinin, tütüne kota getirilmesi nedeniyle üreticilerin ekonomik kayıplarının telafi edilmesine yönelik destek ve teşvikleri içeren 'bölgesel' bir tarım politikası kararının, yerel aktörlerin koordinasyonu ve belirlediği doğru alternatif ürün ile bir 'yerel' kalkınma uygulaması örneğine dönüşmesiyle başladığı söylenebilir. Sason'daki çilek üretimi sağlanan destekler ve iyi kalitede ürün elde edilmesi ile yaygınlaşmış ve 2021 yılında 'Sason Çileği', Batman Ticaret ve Sanayi Odası Başkanlığının girişimleriyle Coğrafi İşaret Tescil Belgesi almıştır (T.C. Tarım ve Orman Bakanlığı Batman İl Tarım ve Orman Müdürlüğü, 2021).

5. AMAÇ VE YÖNTEM

Çalışmanın bu başlığı altında çalışmanın amacı ve örneklemi ile verilerin toplanma süreci ve analizine ilişkin bilgiler sunulmaktadır.

5.1. ÇALIŞMANIN AMACI

Bu çalışmanın amacı, bir yerel kalkınma uygulaması örneği olan Sason'da çilek yetiştiriciliği faaliyetlerinin yerel kalkınma politikalarının hedeflerine katkısını tespit etmektir. Bu bağlamda,

Sason'daki çilek üretim faaliyetlerinin ilçenin sosyoekonomik kalkınmasına, ilçede yoksulluğun azaltılmasına, verimlilik artışına ve sürdürülebilirlik çabalarına olan etkilerinin ortaya konulması amaçlanmıştır. Ayrıca çalışmada çilek üretim faaliyetlerinin verimlilik ve sürdürülebilirliğini olumsuz etkileyen faktörler ile üreticilerin üretimde verimliliğin artması ve üretimin sürdürülebilirliğinin sağlanmasına yönelik talep ve beklentilerinin neler olduğu da belirlenmeye çalışılmıştır.

5.2. ÖRNEKLEM

Araştırmanın örneklemini 11 çilek üreticisi ve 1 eski sivil toplum kuruluşu yöneticisi olmak üzere toplam 12 katılımcı oluşturmaktadır. Araştırmaya dâhil edilen katılımcılar K1, K2, K3, …. şeklinde kodlanmıştır. Katılımcılara ait demografik bilgiler Tablo 1'de gösterilmiştir. Tablo 1'de görüldüğü üzere araştırmanın örneklemi 10 erkek ve 2 kadın katılımcıdan oluşmaktadır. Katılımcılardan sekizi Demetevler Mahallesi'nde, ikisi Karameşe Köyü'nde, biri Kelhasan Köyü'nde, biri de Sason'un merkezinde ikamet etmektedir.

Tablo 1. Katılımcıların Demografik Bilgileri

Katılımcıların Demografik Bilgileri					
Katılımcı Kodu	***Cinsiyeti***	***Yaşı***	***Köyü/Mahallesi***	***Mesleği***	***Kaç Yıldır Tarımla Uğraşıyor?***
K1	Erkek	35	Demetevler Mahallesi	Çilek Üreticisi	4
K2	Erkek	30	Demetevler Mahallesi	Çilek Üreticisi	8
K3	Erkek	34	Demetevler Mahallesi	Çilek Üreticisi	10
K4	Erkek	41	Demetevler Mahallesi	Çilek Üreticisi	16
K5	Erkek	30	Demetevler Mahallesi	Çilek Üreticisi	8
K6	Erkek	38	Demetevler Mahallesi	Çilek Üreticisi	5
K7	Erkek	27	Demetevler Mahallesi	Çilek Üreticisi	3
K8	Erkek	26	Kelhasan Köyü	Çilek Üreticisi	9
K9	Erkek	47	Sason Merkez	Eski Sektörel Sivil Toplum Kuruluşu Yöneticisi	4 (Faaliyeti sonlandırdı)
K10	Kadın	52	Demetevler Mahallesi	Çilek Üreticisi	8
K11	Kadın	30	Karameşe Köyü	Çilek Üreticisi	15
K12	Erkek	35	Karameşe Köyü	Çilek Üreticisi	25

5.3. VERİLERİN TOPLANMASI

Araştırma verileri çevrimiçi yöntemlerle toplanmıştır. Yarı yapılandırılmış derinlemesine görüşme formunda 10 soru yer almakla birlikte, daha derinlemesine bilgiye ihtiyaç duyulması durumunda katılımcılara yönlendirilen soru sayısı arttırılmıştır. Görüşmelerin başlangıç tarihi

15 Ağustos 2023 olup 19 Ağustos 2023 tarihinde son görüşme gerçekleştirilmiştir. Görüşmeler en az 24, en fazla 58 dakika sürmüştür.

5.4. VERİLERİN ANALİZİ

Araştırma nitel araştırma tasarımına göre yapılandırılmıştır. Nitel veri analizi sürecinde öncelikle katılımcılarla gerçekleştirilen görüşmelerden elde edilen ham ve kaydedilmiş veri seti, deşifre edilmiş ve yazıya geçirilmiştir. Yazıya dökülerek çözümlenen veri seti, ayrıntılı olarak incelenmiş ve çalışmanın amacı çerçevesinde kodlar oluşturulmuştur. Oluşturulan kodlardan yola çıkılarak ulaşılan kategoriler üzerinden araştırmanın bulguları ortaya konulmaya çalışılmıştır.

6. BULGULAR

Bu başlık altında öncelikle Batman'ın Sason ilçesinde yaygınlaşan çilek üretim faaliyetlerinin ilçedeki işgücü hareketliliğine, ilçe ekonomisine, ilçenin refah seviyesine ve toplumsal cinsiyet eşitliği kapsamında kadın katılımına olan etkileri değerlendirilmektedir. Ardından, Sason'daki üreticilerin karşılaştıkları ve çilek üretim faaliyetlerinin verimliliği ve sürdürülebilirliği önünde engel oluşturan/oluşturabilecek faktörler tespit edilmiştir. Son olarak, çilek üreticilerinin üretim faaliyetlerini gerçekleştirirken karşılaştıkları sorunlarla başa çıkabilmelerine yönelik talep ve beklentilerine yer verilmiştir.

6.1. ÇİLEK ÜRETİM FAALİYETLERİNİN İLÇEDEKİ İŞGÜCÜ HAREKETLİLİĞİNE ETKİLERİ

Yerel kalkınma politikalarının önemli amaçlarından biri, bölge dışına göçe neden olan itici faktörleri azaltmak ve var olan itici faktörler nedeniyle bölgeyi terk eden yerel halk için tersine göçü oluşturacak çekici faktörler ortaya çıkarmak suretiyle bölgenin işgücü arzının azalmasının önüne geçmektir. Yerel halkının yaşadığı bölgeden göç etmesine sebep olabilecek farklı faktörler bulunmakla birlikte, ekonomik sebepler bu faktörlerin arasında belki de en önemlisidir. Bölgede işsizliğin ciddi bir ekonomik sorun olması, bölge dışına göçü hızlandırmaktadır. Yerel halkının iş bulma olanaklarını arttırıcı etkiler ortaya çıkarabilecek bir yerel kalkınma politikası, başarılı olması durumunda, bölge dışına göçlerin azalmasını ve daha önce iş bulamamak gibi ekonomik nedenlerle göç eden yerel halkın bölgelerine geri dönmesini sağlayacaktır.

Yapılan görüşmelerde katılımcıların değerlendirmelerinden hareketle, ilçede meydana gelen işgücü hareketleri **göç** kategorisi altında bir araya getirilmiştir. Katılımcı değerlendirmeleri incelendiğinde, her 4 katılımcıdan 3'ünün Sason'daki çilek üretim faaliyetlerinin ilçedeki işgücü hareketliliğine etkisinin 'ilçe dışına göçü azaltıcı' yönde, her 3 katılımcıdan 2'sinin ise 'tersine göçü artırıcı' yönde olduğu şeklinde değerlendirmeler yaptığı görülmüştür. Dolayısıyla katılımcılar arasında çilek üretim faaliyetlerinin ilçedeki işgücü hareketliliğine olumlu etkileri olduğuna dair yaygın bir kanı olduğunu söylemek mümkündür. Tablo 2'de çilek üretim faaliyetlerinin ilçedeki işgücü hareketliliğine etkisine ilişkin örnek katılımcı ifadelerine yer verilmektedir.

Tablo 2. Çilek Üretim Faaliyetlerinin İlçedeki İşgücü Hareketliliğine Etkisine İlişkin Örnek Katılımcı İfadeleri

Katılımcı Kodu	İfade	Yerel Kalkınmaya Etkisi
K2	"Önceden bölgeden Trabzon'a, Ordu'ya, Samsun'a ve Düzce'ye mevsimlik işler için çalışmaya gidenler oluyordu ayrıca tekstil işleri için de köyden çalışmak için göç edenler oluyordu… Şu anda insanlar tekstilde asgari ücretle çalışacağıma kendi köyümde çalışayım diyor… Yani şu anda başka şehre gideyim, Sason'dan taşınayım şeklinde düşünen pek kimse kalmadı..."	**İlçe dışına göçü azaltıcı etki**
K5	"Yani şimdi Sason'da çilek üretimi başladıktan sonra yani 2007 yılında göç azaldı… Çilek bölgede göçü durdurdu"	
K1	"Ben Ankara'da çalışıyordum. Ben sırf çilek üretimi için Ankara'yı bırakıp geldim şu anda Ankara'da olsaydım 32-33 bin lira maaş alıyor olacaktım. Ama burada mesela aylığım 6 bin geliyor ama kendi işim olduğu için kafam rahat…"	**Tersine göçü artırıcı etki**
K9	"...1994-2004 yılları arasındaki boşluk nedeniyle köylerden İstanbul'a büyük bir göç oldu. Ama çilek üretiminden sonra köye dönüşler başladı. İşsizlik oranına bayağı bir etkisi oldu…"	

Katılımcı değerlendirmelerinin analiziyle elde edilen bulgulara göre, ilçede yaygınlaşan çilek üretimi, ilçe halkı için istihdam sağlayıcı bir faaliyet olması nedeniyle, bir taraftan ilçe dışına göçü azaltırken diğer taraftan gelir elde etmek amacıyla tekstil üretiminde ya da mevsimlik tarım işlerinde çalışmak amacıyla ilçe dışına göç eden yerel halkın ilçeye geri dönüşü açısından çekici bir faktör oluşturmuştur. Son dönemde şehirde yaşamak için katlanılması gereken maliyetlerin artması, ilçe dışına göçü engelleyen ve tersine göçü hızlandıran bir diğer faktördür. Çilek üretiminde çalışma imkânına sahip olan yerel halk, yevmiye karşılığı ya da asgari ücretle çalışıyor/çalışacak olsa bile, çilek üretiminin sağladığı istihdam fırsatı ile ilçede kalmayı/ilçeye geri dönmeyi tercih etmektedir. Devletin desteklediği bir faaliyet olan çilek üretiminin yaygınlaşması, yalnızca çilek üretiminde ücret karşılığı çalışma imkânı elde eden kişiler için

değil, ilçede toprak sahibi olmasına rağmen başka şehirde ücret karşılığı çalışmak için ilçeden ayrılanlar için de tersine göç oluşturucu bir unsur olmuştur.

6.2. ÇİLEK ÜRETİM FAALİYETLERİNİN İLÇE EKONOMİSİNE ETKİLERİ

Yerel kalkınma politikalarının öncelikli hedeflerinden biri, kalkınması istenen görece geri kalmış bölgelerde istihdam olanakları ve iş fırsatları oluşturmaktır. Bölgede kendi işini kuranlar aynı zamanda yerel halk için de istihdam olanakları sağlamaktadır. Her iki durumda da yerel halkın elde edeceği gelir ile yapacağı harcamalar bölge ekonomisinin gelişmesine katkı sağlama potansiyeline sahiptir. Bununla bağlantılı olarak, araştırma bulgularının bu başlığı **istihdam ve girişimcilik fırsatları** kategorisi altında birleştirilmiştir.

Sason'daki çilek üretim faaliyetinin ilçedeki **istihdama** olan etkilerine yönelik değerlendirmelerinde katılımcılardan 7/12'sinin 'kadın istihdamı' ve 5/12'sinin 'genç istihdamı'; **girişimcilik fırsatlarına** olan etkilerine yönelik değerlendirmelerinde ise her 4 katılımcıdan 1'inin 'kendi işinin sahibi/patronu olma' ve 'ilçede iş imkânı yaratma' maddelerine dikkat çektiği görülmüştür. Tablo 3'te Sason'daki çilek üretim faaliyetlerinin ilçe ekonomisine etkisine ilişkin örnek katılımcı ifadeleri sunulmaktadır.

Tablo 3. Sason'daki Çilek Üretim Faaliyetlerinin İlçe Ekonomisine Etkisine İlişkin Örnek Katılımcı İfadeleri

Katılımcı Kodu	İfade	Yerel Kalkınmaya Etkisi	
K2	"…Bugün çilek işinin genelini kadın yürütüyor, kadın tarlada daha çok çalışıyor. Bugün temel ihtiyaçlarını eşine veya babasından istemeden gelip çilek işinde çalışıp kendisi karşılayabiliyor. Bu da bir çeşit istihdamdır…"	**Kadın ve genç istihdamı**	**İstihdam olanaklarını yaratması**
K11	"Burada yazın köyün gençleri gidip başka yerlerde mevsimlik işlerde çalışırlardı ama bölgede çilek yetiştiriciliğinin yaygınlaşmasıyla birlikte gençler burada da belirli yevmiye karşılığı hasat zamanı iş bulabiliyorlar…"		
K9	"...Çünkü sadece çilek üretimi yapan insan değil, orada yevmiyeyle çalışan insanlara da bir desteği oldu. İşte çilek tarlası olan kişinin işgücü evde yoksa bunu dışardan getirdiği işçilerle yapıyor…"	**Kendi işinin sahibi/patronu olma ve ilçede iş imkânı yaratma**	**Girişimcilik fırsatları yaratması**
K8	"…Yani şimdi mesela bizim bahçeye çilek işçisi olarak gelen insanlar şu anda çilek bahçesi sahibi olmuş. Yani bu da tekstile veya şuraya buraya 115 gitmelerine engel oldu. Kendileri üretip kendileri satıyor…"		

Analiz sonucu elde edilen bulgulara göre, yerel kalkınma politikasının temel hedeflerinden biri olan gelişmemiş bölgelerde girişimcilik ve istihdam imkânlarının oluşturulması, Sason'da çilek üretim faaliyetleri neticesinde gerçekleşmiştir. Yerel halk hem çilek bahçelerini kendileri kurup işletmekte hem de ilçede yaşayanları belirli bir yevmiye karşılığında kendi işlettikleri çilek

bahçelerinde istihdam etmektedirler. Küçük bir alanda çilek yetiştiriciliğine başlayanlar, zamanla faaliyetlerini hızlandırarak yerel halka ek istihdam imkânı sağlamışlardır. Önceki dönemlerde çilek bahçelerinde çalışanların bir kısmı da kendi çilek bahçelerini oluşturmuştur. Çilek üretimi özellikle çilek bahçelerinde çalışan gençler ve kadınlar için bir gelir kaynağı olmuştur. Ancak çilek üretiminde gerçekleşen istihdamın, çoğunlukla gündelik olması ve kayıtlı bir istihdam türü olmaması nedeniyle çilek üretiminin oluşturduğu istihdam imkânının resmî istatistiklere tam olarak yansıması mümkün görülmemektedir.

6.3. ÇİLEK ÜRETİM FAALİYETLERİNİN İLÇENİN REFAH SEVİYESİNE ETKİLERİ

Yerel kalkınma politikalarının bir başka önemli hedefi, gelişmemiş bölgelerin refah seviyesinde artış sağlamaktır. Yerel kalkınma politikalarında amaç yalnızca gelişmemiş bir bölgeyi ekonomik olarak kalkındırmak değil, aynı zamanda bölgenin sosyoekonomik olarak gelişmesini de sağlamaktır. Bu nedenle, Sason'daki çilek üretim faaliyetinin ilçenin sosyoekonomik gelişme düzeyine olan etkilerine ilişkin araştırma bulguları, **refah seviyesinde artış** kategorisi altında incelenmektedir.

Tüm katılımcıların çilek üretiminin ilçenin refah seviyesine olan etkilerine yönelik değerlendirmelerinde özellikle 'ekonomik kazancın artışı' maddesini vurguladıkları görülmüştür. Katılımcıların 5/12'si çilek üretiminin ilçenin refah seviyesine olan katkısını 'ev/araba alma/yenileme'; görüşmeye katılan her 4 katılımcıdan 1'i ise 'nakit para sağlama' maddesi üzerinden değerlendirmiştir. Az sayıda katılımcı ise çilek yetiştiriciliği faaliyetinin 'bilinç ve eğitim düzeyi artışı'na katkı sağladığını belirtmiştir. Sason'daki çilek üretim faaliyetlerinin ilçenin refah seviyesine etkisine ilişkin örnek katılımcı ifadeleri Tablo 4'te sunulmaktadır.

Tablo 4. Çilek Üretim Faaliyetlerinin İlçenin Refah Seviyesine Etkisine İlişkin Örnek Katılımcı İfadeleri

Katılımcı Kodu	İfade	Yerel Kalkınmaya Etkisi	
K3	"…Tekel olayından sonra artık çekilmiyordu tütün işi... Çilek gelince biz biraz toparlandık, iyiydi yani bizim için. Hemen hemen herkesin çileği vardı mahallede, iyiydi yani bir kazancı vardı…"	**Ekonomik kazancın artışı**	**Refah seviyesinde artış sağlaması**
K10	"Tabii ki de insanların ekonomik durumu şimdi daha iyi. Bizim için çilek bir geçim kaynağı yani. Biz bayanlar mesela hiç para görmüyorduk, çilek ektikten sonra işim de oldu, param da oldu, yani öncesine göre çok daha iyi durumdayız."		
K5	"...Köylerde eskiden toplamda 1-2 araba varken şu an hemen hemen her kapıda bir araba var. Çilek üretimi yapan herkesin kapısının önünde bir araç var. Bu tütün döneminde yoktu. Sason'da çilek üretimini yapanların refah seviyesi yükseldi."	**Ev/araba yenileme**	
K1	"… Walla hocam size şöyle söyleyeyim, ben beş yıl öncesine bakarsam ve şimdiki duruma bakarsam büyük bir istihdam sağlandı. Batman merkezden Sason merkezine gelene kadar eski evler vardı, şu anda hepsi yenilendi."		
K2	"...Bugün biri bir yere gitmek istediğinde parası yoksa gidip 15-20 kilo çilek koparıp, çilekleri satarak rahat bir kafayla istediği bir yere gidebiliyor. Çilek işinde sıcak para olduğu için parasız kalmıyorsunuz. Çilek işi yapan herkeste sıcak para akışı oluyor."	**Nakit para sağlaması**	
K7	"… Çilek hasadı Mayıs ayında başlıyor Aralık ayına kadar sürüyor. Çilek topluyorsunuz, çilek hasadını yaptıktan sonra paranız hemen elinize geçiyor ve bu parayı bir şekilde değerlendirebiliyorsunuz. Çilek üretiminde elinize günlük paranın geçmesi çok önemli.		
K11	"...Ama bölgedeki çilek projelerinin bu bölgeye inanılmaz katkıları oldu, doğum oranlarına kadar etkilediğini söyleyebilirim, çünkü ekonomik düzey arttıkça bilinç de artıyor, e bilinç artınca doğal olarak bu kadınların hem ekonomik olarak hem de sosyal hak olarak biraz daha dik durmasını sağlıyor..."	**Bilinç ve eğitim seviyesinin artması**	
K8	"...Bu çilek üreticiliği işi okuma seviyesinde de artış olmasını sağladı, insanlar daha önce maddi açıdan sıkıntı yaşadığı için ve geçinemedikleri için eğitime çok para ayıramıyorlardı ama şu an böyle değil. Çileğin eğitime de faydası oldu."		

Analiz sonucu elde edilen bulgular, bir yerel kalkınma uygulaması örneği olarak ilçede başlayan çilek üretim faaliyetinin ilçenin refah düzeyinde artış sağladığını işaret etmektedir. Tütüne kota gelmesi ile gelir kaybı yaşayan üreticiler, çilek üretimine geçmeleriyle birlikte (yakın zamana kadar) tütün ürettikleri döneme göre daha iyi bir kazanç elde ettiklerini ifade etmişlerdir. Bu kazanç artışı, çiftçilerin ev/araba sahibi olmalarına ve/veya bunları yenilemelerine olanak sağlamıştır. Artan kazancın üreticilere yaşadıkları evleri yenileme imkânı sağlamasını yalnızca refah artışının ekonomik boyutu ile değerlendirmek eksik bir değerlendirme olacaktır. Zira görece daha sağlıklı bir ortamda barınma imkânı sağlama etkisi de göz önünde bulundurulduğunda burada sosyoekonomik bir gelişmeden bahsedilebilir. Tütün üretiminde ekim döneminden hasat zamanına kadar tarımsal üretim kaynaklı nakit paraya

erişimi mümkün olmayan üreticiler, çilek üretiminin daha sık aralıklarla nakit paraya erişim sağlamasını refahlarında artış sağlayan bir durum olarak değerlendirmiştir. Ancak son dönemde maliyetlerindeki artış, bu görece iyi refah düzeyinde düşüşler gerçekleşmiştir. Katılımcılardan bir kısmı ise ekonomik imkânlarındaki artışın beraberinde eğitim imkânlarındaki artışı getirdiğine ve bilinç düzeyini arttırdığına yönelik değerlendirmeler yapmışlardır.

6.4. ÇİLEK ÜRETİM FAALİYETLERİNİN TOPLUMSAL CİNSİYET EŞİTLİĞİNE ETKİLERİ

Kadının cinsiyeti nedeniyle herhangi bir ayrımcılığa uğramaksızın toplumda aktif bir rol üstlenebilmesinin önündeki engellerin kaldırılması, kalkınma politikalarının odağındaki önemli bir hedeftir. Kadınların sosyal ve ekonomik olarak kırılganlıklarının erkeklere göre yüksek olması nedeniyle, yerel kalkınma politikalarında özellikle desteklenmesi ve kadının iş ve eğitim hayatına katılımının teşvik edilmesi, kadının güçlenmesini sağlayarak toplumsal cinsiyet eşitliğinin azaltılmasına katkı sağlama potansiyeline sahiptir. Bu doğrultuda, katılımcıların Sason'daki çilek üretim faaliyetlerinin toplumsal cinsiyet eşitliğine etkilerine ilişkin değerlendirmeleri, **kadın katılımı** kategorisi altında bir araya getirilmiştir.

Görüşmeye katılan tüm katılımcılar, çilek üretim faaliyetlerinin kadın katılımına olan etkilerine yönelik değerlendirmelerinde 'kadının aile gelirinden faydalanması' maddesini özellikle vurgulamışlardır. Katılımcılardan 7/12'sinin değerlendirmelerinde ise 'kadınlar için iş imkânı sağlaması' ve 'devlet desteklerinde kadına öncelik' maddelerinin ön plana çıktığı gözlemlenmiştir. Tablo 5'te Sason'daki çilek üretim faaliyetlerinin toplumsal cinsiyet eşitliğine etkilerine ilişkin örnek katılımcı ifadelerine yer verilmiştir.

Tablo 5. Çilek Üretim Faaliyetlerinin Toplumsal Cinsiyet Eşitliğine Etkilerine İlişkin Örnek Katılımcı İfadeleri

Katılımcı Kodu	İfade	Yerel Kalkınmaya Etkisi	
K1	"... Mesela ben birkaç sene önce 4,5 liraya sattığım çilekle eşime altın dahi alabiliyordum. Herkes gelir artınca eşiyle paylaşıyor. Kadın da artan gelirden faydalanıyor…"	**Kadının aile gelirinden faydalanması**	**Kadın katılımını arttırması**
K4	"Biz erkekler ve kadınlar tarlada birlikte çalışıyoruz bu yüzden elde edilen gelirden kadın da yararlanıyor tabii ki. Biz kadınlarımızı kesinlikle eksik bırakmıyoruz. Şimdi gelip görsen bizden daha lüks giyiniyorlar. Ben merkeze her gidişimde eşim benden daha fazla harcıyor..."		
K3	"Daha çok kadınlar çalışıyor çilek işinde. Kadınlar gelip günlük belirli bir yevmiye karşılığında çalışıyor. Kadına da maddi olarak bir katkısı oluyor çileğin."	**Kadınlar için iş imkânı sağlaması**	
K5	"Tabii ki de istihdam arttı, yani çalışanlar resmi olarak işçi görünmeseler de kayıt dışı işçi sayısında artış meydana geldi. Daha çok kadınlar ve çocuklar için bir iş imkânı oldu bölgede."		
K8	"Ya genelde hibe ve destek durumlarında öncelik kadına tanınıyor. Çünkü kadının işgücüne katılımı erkeklere nazaran çok fazla olmadığı için devlet de bunun farkında olarak kadınlara biraz daha fazla öncelik tanıyabiliyor…"	**Devlet desteklerinde kadına öncelik verilmesi**	
K2	"...Kadınlara daha çok öncelik tanıyor ve daha fazla kolaylık sağlıyor devlet. Bizim ülkenin sisteminde kadın sürekli ikinci planda tutulduğu için ister istemez kadın katılımın artmasına yönelik bir teşvik var."		

Analiz sonucunda elde edilen bulgulara göre, ilçedeki çilek üretim faaliyetlerinin 'kadının aile gelirinden faydalanması'nın yanı sıra bölgede yaratılan iş imkânıyla 'kadınların bireysel gelir elde etmelerini' sağlayarak kadının ekonomik olarak güçlenmesine katkı sağladığı görülmektedir. Katılımcı değerlendirmeleri incelendiğinde, kadının aile gelirinden faydalanma düzeyindeki artışın kendi emeğinin, diğer bir deyişle ücretsiz aile işçiliğinin bir karşılığı olarak ortaya çıktığını söylemek yanlış olmayacaktır. Çilek bahçelerinde kadının ücretli istihdamı, kendisi için bireysel gelir sağlayıcı bir faaliyet olsa da bu istihdamın büyük ölçüde kayıt dışı olması bir sorun olarak göze çarpmaktadır. Ayrıca net bir bilgiye sahip olmamalarına rağmen, katılımcılar arasında devlet desteklerinde 'kadın üreticilere öncelik verildiği' görüşü hâkimdir. Bu kanaat, hanenin çilek üretiminin devlet desteklerinden yararlanma olasılığını arttıracağı düşüncesiyle erkeklerin hanedeki kadınların girişimciliğini desteklemesini sağlayacak olumlu etkiler de ortaya çıkarabilecektir.

6.5. ÇİLEK ÜRETİM FAALİYETLERİNDE VERİMLİLİĞİ VE SÜRDÜRÜLEBİLİRLİĞİ OLUMSUZ ETKİLEYEN FAKTÖRLER

Kalkınma kavramının zaman içinde kapsamının genişlemesiyle sürdürülebilirliğin sağlamasının da kalkınma sürecindeki önemi vurgulanmaya başlamıştır. Sürdürülebilirlik için bir taraftan mevcut kaynakların etkin kullanılması diğer taraftan da bu kaynakların niteliklerinin iyileştirilmesi gerekmektedir. Dolayısıyla verimlilik artışının sürdürülebilirlik için olmazsa olmaz bir unsur olduğu söylenebilir. Yerel kalkınma bağlamında verimliliği arttırmaya yönelik çaba, yerel kaynakların mümkün olduğunca etkili bir biçimde kullanılması amacını taşımaktadır. Yerel kalkınmada sürdürülebilirlik politikaları ise yerel kalkınma sürecinde doğal kaynakların sürdürülebilir bir biçimde kullanılması ve çevresel faktörlerin yerel kalkınma sürecindeki olumsuz etkilerinin göz önünde bulundurulması yaklaşımına dayanmaktadır. Dolayısıyla, yerel kaynaklara dayalı bir gelişme modeli olan yerel kalkınma yaklaşımında, verimli ve sürdürülebilir bir üretim gerçekleştirilmesinin önünde engel oluşturan faktörleri kavramak ve bu faktörlerin ortadan kaldırılması için gerekli tedbirleri almak önem arz etmektedir. Bu doğrultuda, çalışmanın bu başlığı altında Sason'daki çilek üreticilerinin üretim faaliyetlerinin verimliliğini ve sürdürülebilirliğini olumsuz etkileyen faktörler belirlenmeye çalışılmıştır. Katılımcıların değerlendirmeleri göz önünde bulundurularak Sason'da çilek üretim sürecinde üreticilerin karşı karşıya kaldığı ve üretimin verimliliğini ve sürdürülebilirliğini olumsuz etkileyen faktörler **çilek üretimi konusunda düşük bilgi düzeyi ve profesyonellerden bilgi edinmedeki güçlükler, ürünleri muhafaza etme ve depolamada karşılaşılan güçlükler, maliyetlerin yüksekliği, pazarlama zorlukları ve ilçede etkili bir tarım kooperatifinin olmaması** kategorileri altında toplanmıştır.

Görüşme yapılan her 6 katılımcıdan 5'i değerlendirmelerinde, Sason'daki üreticilerin üretim konusundaki 'düşük bilgi düzeyi'nin sürdürülebilirlik ve verimlilik odaklı tarımsal üretim çabalarını önünde bir engel teşkil ettiğini vurgularken her 2 katılımcıdan 1'i çilek üretimi sürecinde üreticilerin ihtiyaç duydukları bilgiye 'diğer üreticilere danışma' ve 'deneme yanılma' yöntemi ile ulaşmaya çalıştıklarını belirtmiştir. Ayrıca görüşmeye katılan tüm katılımcılar 'ilçede soğuk hava deposu olmaması'nı üretim sürecinde sürdürülebilirlik ve verimlilik odaklı tarımsal üretim çabalarını olumsuz etkileyen bir faktör olarak değerlendirmiştir. Her 3 katılımcıdan 2'sine göre 'pazara erişim' sorunları, her 4 katılımcıdan 1'ine göre 'yakıt pahalılığı', her 4 katılımcıdan 3'üne göre ise pazarlama ve satış konularında

çiftçiyle birlikte hareket edebilecek ve çiftçinin ihtiyaçlarını gözetecek 'etkili bir tarım kooperatifinin olmaması' üretimdeki verimliliği ve sürdürülebilirliği olumsuz etkilemektedir. Tablo 6'da üreticilerin çilek üretim faaliyetlerinde verimliliği ve sürdürülebilirliği sağlamada karşılaştıkları zorluklara ilişkin örnek katılımcı ifadelerine yer verilmiştir.

Tablo 6. Üreticilerin Çilek Üretim Faaliyetlerinde Verimliliği ve Sürdürülebilirliği Sağlamada Karşılaştıkları Zorluklara İlişkin Örnek Katılımcı İfadeleri

Katılımcı Kodu	İfade	Verimliliğin ve Sürdürülebilirliğin Sağlanmasında Karşılaşılan Zorluklar
K4	"Bazıları biliyor ama %90'ı bilmiyor. Kafalarına göre hareket ediyorlar yani, bazıları komşusuna soruyor öyle böyle bir şekilde öğrenmeye çalışıyorlar ama çoğu bilmiyor. Yani deneme yanılma yöntemi ile bir şekilde öğreniyorlar bu işi."	**Çilek üretimi konusunda düşük bilgi düzeyi ve profesyonellerden bilgi edinmedeki güçlükler**
K9	"Bence bilgileri hiç yok. Herkes kafasına göre üretim yapıyor ve maalesef tarlalar çok kötü durumda şu an… Bizimkiler maalesef kafalarına göre çilek üretimini yapıyor. Tarlada çok çeşitli ilaçlar kullanıyorlar tam olarak bilmedikleri için, bu şekilde zaten tarla mahvolduğu için tarlanın verimliliğini de çok kötü etkiliyor."	
K8	"Bence çiftçilerin sulama ve gübreleme konusunda çok fazla bilgileri yok... Toprak analizi mesela çok önemli, çok çiftçi gördüm mesela bahçeye çilek ekmiştir ama o toprak verimsiz olduğu için o toprakta çilek üretilememiştir o adam o masrafın hepsini boşa yapmıştır... Çiftçi herhangi bir verim almadığı için bu çiftçi için büyük bir maliyete neden oluyor..."	
K1	"...Yani zaten çilek günlük satılıyor. Çilek sabah toplandı mı akşama kadar zaten kararıyor... Bu yüzden bölgeye bir soğuk hava deposunun sağlanması şart."	**Ürünleri muhafaza etme ve depolamada karşılaşılan güçlükler**
K9	"...Yani çoğu çilek şu anda çürüme aşamasında soğuk hava deposu olmadığı için, koparıldığı ilk gün satılmazsa ikinci gün çilek zaten telef oluyor."	
K8	"Artan maliyetler çiftçinin ürününü pazara ulaştırmasında baya sıkıntı yaratıyor şu anda, baktığımızda yakıtın yüksek fiyatlara ulaşması çiftçinin 128 çileğini komisyonculara vermesine neden oluyor bu da aslında zarar etmesine sebep oluyor."	**Maliyetlerin yüksekliği**
K12	"...Pazara ulaştırma konusunda yakıt fiyatları çok yüksek olduğu için maalesef araya aracılar koymak zorunda kalıyoruz ve bu da bizim kârımızı düşürüyor…"	
K6	"Müşteriye ulaşmak zor, çilek üreticisi her zaman tedirgin oluyor, çünkü kesin bir alıcı yok. O şüphe içinde daima tedirgin oluyor…"	**Pazarlama zorlukları**
K10	"Pazara ulaştırma konusunda sıkıntı yaşıyoruz herkesin aracı olmadığı için. Mesela biz en çok yaz aylarında sıkıntı yaşıyoruz…"	
K6	"... Bazen en kaliteli ürün 20 liraya giderken, daha kötü bir ürün 30 liraya gidebiliyor. İşte bir kooperatif olsaydı bunlara sahip çıkardı, bir fiyat düzenlemesi yapardı. Çileğin raf ömrü çok kısa olduğu için çiftçi de diyor tarlada kalacağına 15 liraya vereyim fakat bu sefer kendisi zarar ediyor."	**Çilek üretimi sürecinde etkili bir tarım kooperatifinin olmaması**
K7	"Güçlü bir kooperatife çok fazla ihtiyaç duyuyoruz. Çünkü çilek gibi tarımsal ürünler pazarlamada serbest piyasanın insafına kalırsa burada komisyoncu biraz vicdansız olabiliyor…"	

Nitel veri analizi sonuçlarına göre özellikle gübreleme, sulama ve ilaçlama konusundaki bilgi eksiklikleri, toprak yapısının bozulmasına ve kirlenmesine yol açarak hem çevreyi hem de

üretimin verimlilik ve sürdürülebilirliğini olumsuz etkilemektedir. Sahip olduğu ayırt edici özellikleri ile coğrafi işaret almış bir ürün olan Sason çileğinin toprakta oluşabilecek bozulma ve kirlenmeler nedeniyle zamanla bu ayırt edici özelliklerini kaybetmesi de üretimin verimliliği ve sürdürülebilirliği açısından bir risk faktörü oluşturmaktadır. Bu açıdan, üretim sürecindeki bilgi eksiklikleri ve profesyonellerden bilgi almadaki güçlükler, verimli ve sürdürülebilir üretimi olumsuz etkileyen en önemli faktörlerden biridir.

Çilek niteliği gereği zaten hassas bir meyve iken katılımcılar Sason'da yetiştirilen çilek türünün hasadın ardından daha hızlı bozulma özelliği taşıdığını belirtmişlerdir. Daha önce kiralanan bir soğuk hava deposunda ürünlerini saklama imkânı bulan üreticiler, bu imkânı kaybetmeleriyle depolama ve ürünlerini muhafaza etme konusunda ciddi sıkıntılar yaşamakta ve ürünlerini bozulmadan satabilmek için ederinin altında fiyat önermektedir. Çileğin depolanması ve pazarlanmasında yaşanan problemler mevcut üretimden önemli ölçüde fire verilmesine de neden olmaktadır. Yakıt fiyatları ve diğer maliyet unsurlarının artması üretim maliyetlerini artırırken, depolama ve pazarlamada yaşanan güçlükler verimliliği düşürmekte, bu da üreticilerin çilek üretim faaliyetlerinden elde ettiği geliri olumsuz etkilemektedir.

2021 yılında kuruluşu tamamlanan ve çilek fiyatındaki istikrarı sağlayarak üreticinin daha dengeli bir gelir elde etmesine ilişkin fonksiyonları yerine getirmeyi amaçlayan Sason Çilek Üreticileri Birliği bölgede örgüt bilincinin olmaması ve üreticilerin bazı etik dışı davranışları nedeniyle kısa bir sürede etkinliğini yitirmiştir. Üreticiler birlik ve kooperatif ifadelerini üretim ve pazarlama sürecinde kendilerine aktif destek sağlayabilecek örgütlü bir yapıyı belirtmek üzere birbirinin yerine kullanmakla birlikte, üretici birliğinin etkinliğini yitirmesine neden olan süreç göz önünde bulundurulduğunda, yerel halkın üretim ve pazarlama sürecinde karşılaştıkları zorlukları kolektif bir şekilde kendi kendilerine aşabilecek potansiyellerini kullanamadıkları da söylenebilir.

6.6. ÇİLEK ÜRETİCİLERİN TALEP VE BEKLENTİLERİ

Genel olarak kalkınma politikalarında devlet destekleri, en önemli politika aracı olarak görülmektedir. Devlet desteklerinin yerel kalkınma politikaları açısından önemi ise politika uygulamasının erken aşamalarında destekler aracılığıyla bölge halkının üretim yapmaya teşvik edilmesidir. Bu erken aşamada kalkınması planlanan bölgede üretimin teşvik edilmesiyle, bölgedeki yerel imkân ve potansiyel yerel aktörlerin katkısıyla harekete geçirilmektedir. Ancak yerel kalkınma yaklaşımı, ilerleyen aşamalarda kalkınma sürecinin temel dinamiğinin bu

harekete geçirilen imkân ve potansiyeller olmasını amaçlamaktadır. Bu nedenle, bölgesel bir tarım politikasının bölgedeki yerel aktörlerin katkısıyla bir yerel kalkınma uygulamasına dönüşmesiyle başlayan ve Diyarbakır Batman Siirt Kalkınma Projesi ile desteklenerek yaygınlaşan Sason çileği yetiştiriciliğinin yerel kalkınma yaklaşımına uygun ve başarılı bir kalkınma modeli olarak değerlendirilebilmesi için, kalkınma sürecinde karşılaşılan zorlukların aşılmasında devletin parasal desteklerinden ziyade mevcut imkân ve potansiyelleri iyileştirme fonksiyonunun öne çıkması gerekmektedir.

Bununla birlikte, görüşme yapılan katılımcıların 7/12'si özellikle son dönemde artan maliyetler nedeniyle karşılaştıkları güçlükleri aşabilmek için 'hibe miktarının arttırılması' beklentisi içindedir. Her 6 katılımcıdan 5'i 'eğitim verilmesi'ni, 'profesyonel desteği sağlanması'nı ve 'saha araştırmasının yapılması'nı talep etmektedir. Katılımcılardan 5/12'si ise çileğin hassas ve çabuk bozulabilen doğal yapısı nedeniyle ürünü depolama ve muhafaza etme sürecindeki zorlukları aşabilmek için ilçede 'soğuk hava deposu/çilek işleme tesisi/çilek fabrikası'na ihtiyaç olduğunu belirtmiştir. Sason'daki çilek üreticilerinin talep ve beklentilerine ilişkin örnek katılımcı ifadeleri Tablo 7'de sunulmaktadır.

Tablo 7. Çilek Üreticilerinin Talep ve Beklentilerine İlişkin Örnek Katılımcı İfadeleri

Katılımcı Kodu	İfade	Üreticilerin Talep ve Beklentileri
K3	"...Mesela destekler de artmalı, yani mesela %50 destek çok iyi olur bizim için. 2 dönümlük destek kurtarmaz çiftçiyi yani en azından 8-10 dönümlük bir destek iyi olurdu bizim için…"	**Hibe miktarının arttırılması**
K12	"Hibe desteği artmalı... Yani kesinlikle hibe desteği artmalı ve bölgede en yakın zamanda bilimsel tarım yapılmalı."	
K4	"...Tarımdan sorumlu yetkililer sadece ÇKS zamanı geldiğinde ÇKS işlemini yapıyorlar. Ben onlardan kesinlikle memnun değilim, çünkü tek bir gün olsun çiftçinin arazide durumunu görmek için geldikleri yok… Çileği hastalık vursa veya şu bu gelip ilgilenmiyorlar..."	**Saha araştırmalarının yapılması ve profesyonel desteği**
K2	"...Tarlaya zaten gelmiyorlar. Destekleme zaten yok en azından devletin ziraat mühendislerini tarlaya sahip çıkmaları ve çiftçiye yardımcı olmaları yönünde harekete geçirmesi gerekiyor..."	
K2	"Tesis, tesis kurulmadığı müddetçe ve işlemesi burada yapılmadığı sürece hiçbir yere çiftçi olarak biz varamayız. Reçeli, pestili, kurutması ve soğuk hava deposu yapılmadığı sürece hiçbir şekilde ileriye dönük projeler çıkmaz artık…"	**Soğuk hava deposu/çilek işleme tesisi /çilek reçel fabrikasının kurulması**
K6	"...Yapılması gereken diğer şeyler ise mesela fabrika kurulacak, çiftçinin ürettiği çileklerin bahçede kalmaması ve çürümemesi için bölgede çilekle ilgili farklı iş kolları kurulmalı. Bu şekilde hem devlet kazanır hem de çiftçi."	

Sason'da çilek üretim faaliyetleri %100 hibe desteği ile başlamıştır ve Diyarbakır Batman Siirt Kalkınma Projesi kapsamında desteklendiği dönemde de destekler aynı hibe oranıyla devam etmiştir. Nitel veri analizi ile ulaşılan bilgilere göre, bu hibelerin bir kısmı çilek bahçelerinin

kurulumuna yönelik olduğundan, çilek bahçesinin kurulumunun ardından hibe destekleri yalnızca üretimi kapsayacak şekilde 2 dönüm için %70 oranında uygulanmaktadır. Yerel kalkınma yaklaşımında bölgenin kalkınmasını kendi imkân ve potansiyelleriyle devam ettirmek esastır. Ancak üreticiler son dönemde yaşanan enflasyonist ortamda maliyetlerinin artması nedeniyle hibe miktarının arttırılması beklentisi içine girmişlerdir.

Katılımcıların önemli bir kısmının eğitim/profesyonel desteğinin artması ve saha araştırması yapılması yönündeki taleplerinin ise yerel kalkınma yaklaşımına uygun talepler olduğunu söylemek yanlış olmayacaktır. Zira yerel kalkınma yaklaşımında karşılaşılan güçlüklerin aşılmasında esas olan öncelikli olarak imkân ve potansiyelin iyileştirilmesini sağlamaktır. Genel olarak Sasonlu üreticilerin çilek üretim faaliyetlerinin kendilerine sağladığı sosyoekonomik faydanın farkında olduğu ve bu faaliyetlerini sürdürebilmeyi arzu ettikleri söylenebilir. Ancak deneme-yanılma yoluyla ya da birbirlerine danışarak çilek üretimi gerçekleştiren üreticilerin uygulamalarının doğruluğu konusunda bazı endişeleri bulunmaktadır. Bu endişeleri giderecek şekilde eğitim verilmesi, profesyonel desteği sağlanması ve toprak analizi yapılması var olan imkân ve potansiyeli iyileştirecek unsurlardır.

Üreticilerin soğuk hava deposu, çilek işleme tesisi ve çilek reçel fabrikasının kurulması yönündeki taleplerinin karşılanması durumunda üreticiler devlet desteklerine daha az ihtiyaç duyabilirler. Zira üreticiler bir taraftan hassas bir ürün olan çileği depolama ve muhafaza etme konusunda karşılaştıkları zorluklar nedeniyle üretimlerinden fire vermekte, diğer taraftan ürünlerini bozulmadan satabilmek için fiyatını düşürmektedir. Bu ise üreticiler açısından bir gelir kaybını beraberinde getirmektedir. Ürünleri soğuk hava deposunda saklama imkânı sağlanması fire ve düşük fiyat kaynaklı gelir kaybını ortadan kaldırabilecektir. İlçede çilek talebinin sürekliliğini sağlayacak ve üreticilerin ürünlerini bozulmadan satabilecekleri bir çilek işleme tesisi/çilek fabrikası ise yalnızca çilek üreticileri için değil ilçede çilek üretim faaliyetiyle uğraşmayan yerel halk için de kalkınmayı arttırıcı bir unsur olabilecektir. Tarımsal üretime odaklı bir yerel kalkınma uygulaması olan Sason çileği yetiştiriciliğinin harekete geçirdiği potansiyelin sanayi sektörünün gelişmesi için bir fırsat olarak değerlendirilmesi durumunda, bu tür işletmeler yalnızca çilek üreticilerinin karşı karşıya kaldıkları sorunlarla başa çıkabilmesi çerçevesinde değil yerel halkın istihdam edilmesi gibi ek unsurlarla da kalkınma sürecine katkı sağlayabilecektir.

7. SONUÇ VE DEĞERLENDİRME

Kalkınmanın bir hedef olmanın ötesinde bir süreç olduğu ve yerel kalkınma yaklaşımının teorik temellerden ziyade deneyimlere dayalı olarak ortaya çıktığı gerçeği göz önünde bulundurulduğunda, yerel kalkınma uygulamalarında kalkınması amaçlanan bölgedeki halkın süreç içindeki deneyimlerinin ortaya konulması önem arz etmektedir. Bu çalışma, bölgesel bir tarımsal politika kararının yerel aktörlerin katkısıyla yerel bir kalkınma uygulaması örneğine evrilmesiyle başlayan Sason'da çilek üretim faaliyetlerinin ilçenin kalkınmasına olan etkilerini, çilek üreticilerinin deneyimlerini göz önünde bulundurarak değerlendirmeyi amaçlamıştır. 12 katılımcıdan elde edilen bilgiler ve nitel veri analizi yöntemleri kullanılarak yapılan analiz ve değerlendirmeler doğrultusunda, Sason'da bir yerel kalkınma uygulaması örneği olarak başlayan çilek üretim faaliyetlerinin ilçenin ekonomisine, refah düzeyine, ilçedeki işgücü hareketlerine ve toplumsal cinsiyet eşitliği kapsamında kadın katılımına olumlu katkılar sağladığını söylemek mümkündür. Bununla birlikte, kalkınma kavramı dönemin ihtiyaçlarına göre şekillenen bir kavramdır ve son dönemlerde kalkınmanın sürdürülebilirliğinin önemine yapılan vurgu daha da güçlenmiştir. Sürdürülebilirliğe yerel kalkınma yaklaşımı açısından bakıldığında, yerel kalkınma sürecinin temel dinamiklerini oluşturan yerel imkân, kaynak ve potansiyelin gelecekte de devam edebilmesi için, verimlilik ve sürdürülebilirlik önünde engel teşkil edilebilecek faktörlerin belirlenerek bunların ortadan kaldırılması ve mevcut imkân, kaynak ve potansiyelin iyileştirilmesi gerekmektedir. Bu amaçla, katılımcıların deneyimlerine dayalı olarak sağladığı bilgilerin analiz edilmesiyle, Sason'daki çilek üreticilerinin üretimlerini verimli ve sürdürülebilir bir şekilde gerçekleştirmelerini olumsuz etkileyen faktörler belirlenmeye çalışılmış ve bu faktörler çilek üretimi konusunda düşük bilgi düzeyi ve profesyonellerden bilgi edinmedeki güçlükler, ürünleri muhafaza etme ve depolamada karşılaşılan güçlükler, maliyetlerin yüksekliği, pazarlama zorlukları ve ilçede etkili bir tarım kooperatifinin olmaması şeklinde beş kategori altında toplanmıştır. Üretim sürecinde üreticilerin karşı karşıya kaldığı güçlüklerin verimlik ve sürdürülebilirliğe olumsuz etkilerinin azaltılması yönünde atılan adımlar, üreticilerin ve yerel halkın gelecekte de kalkınma deneyimlerinin devam edebilmesini mümkün kılacaktır. Ancak atılacak adımların devlet teşviklerine dayalı olarak değil, yerel kalkınma yaklaşımına uygun bir şekilde mevcut imkân, kaynak ve potansiyelin iyileştirilmesi temelinde şekillenmesi gerekmektedir. Bu bağlamda Sasonlu çilek üreticilerinin eğitim ve profesyonel desteği sağlanması, saha araştırması ve toprak

analizi yapılması, soğuk hava deposu/çilek işleme tesisi/çilek fabrikası gibi işletmelerle tarımsal üretimden sanayi sektörüne ileri bağlantıların kurulması gibi yerel kalkınma yaklaşımına uygun taleplerini karşılayabilecek adımlara yerel kalkınma politikalarında yer verilmesi önem arz etmektedir.

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ÖZET
Bu derleme, aronyanın kimyasal bileşimini araştırmaya, besin değerini değerlendirmeye ve sunabileceği potansiyel sağlık etkilerini ayırt etmeye odaklanarak aronyanın çok yönlü yönlerini araştırmak için yola çıkmıştır. Bu çalışma, aronyanın kapsamlı bir şekilde incelenmesi yoluyla, sağlık ve beslenmenin geliştirilmesinde değerli bir kaynak olma potansiyeline ışık tutmayı amaçlamıştır. Az bilinen aronya meyvesi (chokeberry, *Aronia melanocarpa*), son derece ilginç iki fenolik fitokimyasal olan prosiyanidin ve antosiyaninlerin en zengin bitki kaynaklarından biridir. Aronyanın kuru madde, kül, protein, yağ ve diyet lifi içerikleri sırasıyla %15,6-28,8, %0,44-0,58, %0,7, %0,14, %5,6'dır (yaş ağırlık, fw). Aronya meyvelerinin pH değeri 3.3 ile 3.7 arasında değişmektedir ve meyveler organik asit olarak yüksek miktarda l-Malik asit ve sitrik asit içermektedir. Aronya meyveleri vitaminler (C (%1.3-27.0 fw), B kompleksi ve K) ve mineraller (K, Ca, Na, vb.) bakımından zengindir. Meyvenin bileşimi, çeşit, gübreleme, meyve olgunluğu, hasat zamanı ve habitat/konum dahil olmak üzere bir dizi değişkenden etkilenmektedir. Aronyada bulunan fenolik kimyasallar (prosiyanidinler, antosiyaninler ve fenolik asitler) muhtemelen en önemli bileşendir ve terapötik faydalarının çoğunun kaynağıdır. Aronyanın toplam fenolik madde içeriği 2010 ile 6902 mg/100g (fw) arasında değişmektedir. Aronya meyvelerinde bulunan başlıca uçucu bileşenler, benzaldehit siyanohidrin, hidrosiyanik asit ve benzaldehittir. Ek olarak, benzil alkol, 2-feniletanol, fenilasetaldehit, salisilaldehit, asetofenon, 2-hidroksiasetofenon, 4-metoksiasetofenon, fenol, 2-metoksi fenol ve metil benzoat gibi çeşitli benzen türevleri de aroma bileşikleri olarak tanımlanmıştır. Aronya meyvesi antioksidan, anti-proliferatif veya koruyucu, antimutajenik, hepatoprotektif, kardiyoprotektif ve antidiyabetik özellikleri göstermektedir. Ayrıca, literatürde aronya (*Aronia melanocarpa)* meyvelerinin zararlı veya istenmeyen etkilerine ilişkin herhangi bir bilgi bulunmamaktadır. Tüketici tercihleri sağlık konusunda daha bilinçli seçimlere yöneldiğinden, aronya içeren gıda ürünlerinin yaygınlaşması bu büyüyen trendle mükemmel bir uyum içindedir. Sağlık açısından sayısız potansiyel faydasıyla aronya, besleyici ve lezzetli meyvelerin seçimi konusunda tüketicilerin seçeneklerini zenginleştirmeye hazırdır.
Anahtar Kelimeler: Aronya, Fenoller, Prosiyanidinler, Antosiyaninler, Antioksidan

CHOKEBERRY: NUTRITION VALUES AND POTENTIAL HEALTH EFFECTS

ABSTRACT
This review set out to delve into the multifaceted aspects of aronia, with a primary focus on investigating its chemical composition, evaluating its nutritional value, and discerning the potential health effects it may offer. Through a thorough examination of aronia, this study sought to shed light on its potential as a valuable resource in promoting health and nutrition. The lesser-known berry fruit chokeberry (*Aronia melanocarpa*) is one of the richest plant sources of procyanidins and anthocyanins, two extremely interesting phenolic phytochemicals. The dry matter, ash, protein, fat, and dietary fiber contents of aronia are 15.6-28.8%, 0.44-0.58%, 0.7%, 0.14%, 5.6% (fresh weight, fw), respectively. The pH value of aronia berries range between 3.3 and 3.7, and it includes high amount of l-Malic acid and citric acid as organic acids. Aronia berries are rich in vitamins (C (1.3-27.0% fw), B complex and K) and minerals (K, Ca, Na, etc.). The composition is influenced by a number of variables, including cultivar, fertilization, berry maturity, harvest time, and habitat/location. The phenolic chemicals (procyanidins, anthocyanins and phenolic acids) found in aronia are possibly the most significant component and the source of many of its therapeutic benefits. The total phenolic content of aronia ranges between 2010 and 6902 mg/100g (fw). The primary volatile components found in aronia berries included benzaldehyde cyanohydrin, hydrocyanic acid, and benzaldehyde. Additionally, various benzene derivatives have been identified as aromatic compounds, such as benzyl alcohol, 2-phenylethanol, phenylacetaldehyde, salicylaldehyde, acetophenone, 2-hydroxyacetophenone, 4-methoxyacetophenone, phenol, 2-methoxyphenol, and methyl benzoate. Antioxidant, anti-proliferative or protective, antimutagenic, hepatoprotective, cardioprotective, and antidiabetic properties are all displayed by aronia In addition, the literature contains no information regarding the harmful or undesired effects of *Aronia melanocarpa* berries. As consumer preferences lean more towards health-conscious choices, the expansion of Aronia offerings aligns perfectly with this growing trend. Aronia, with its numerous potential health benefits, stands poised to enrich consumers' options when it comes to selecting nutritious and flavorful berry fruits.
Keywords: Aronia, Phenols, Procyanidins, Anthocyanins, Antioxidant

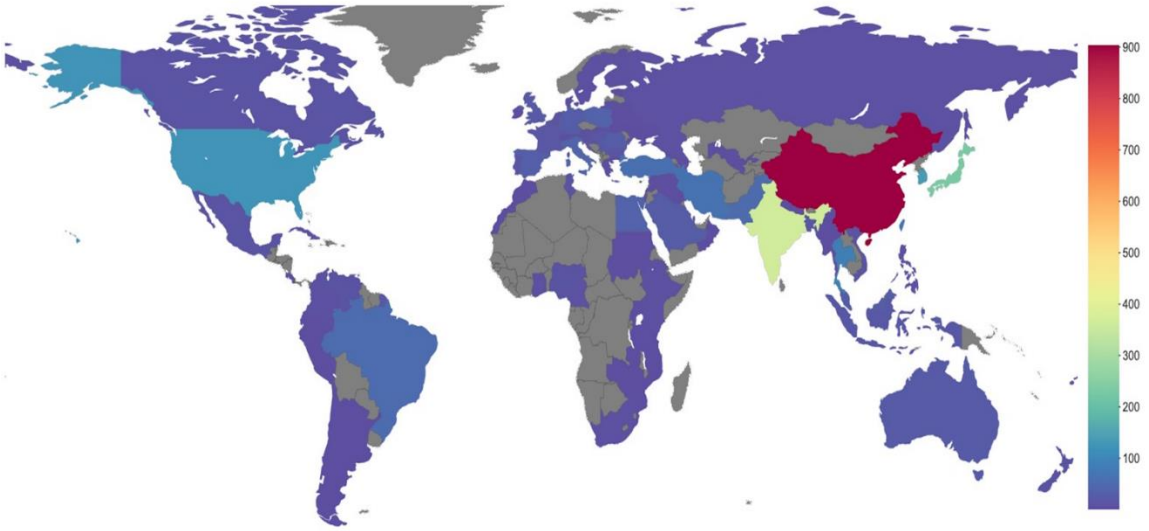
1. GİRİŞ

Aronya (*Aronia melanocarpa*), Kuzey Amerika'ya özgü bir bitki olup, yaklaşık olarak bir yüzyıl önce Avrupa'ya getirilmiştir. Bu bitki, *Rosaceae* familyasına ait bir çalı türüdür ve özellikle *A. melanocarpa* alt türü, meyve üretimi için kullanılmaktadır. Taze ve işlenmemiş aronya meyvesi acı tadından dolayı nadiren tüketilmektedir. Ancak aronyanın elma, armut veya üzüm gibi diğer meyvelerle harmanlanmasıyla yapılan meyve suları daha fazla tüketilmektedir (Ara, 2002). Aronyanın yenilebilir kısımları genellikle küçük, koyu renkli ve vişne benzeri meyvelerdir. Aronya, gıda endüstrisinde meyve suyu, sos, reçel, meyve çayı ve besin takviyesi üretiminde kullanılmaktadır (C. Chrubasik ve ark., 2010; Scott ve ark., 2007).

Aronya meyvesi yalnızca gıda olarak değil aynı zamanda bitkisel ilaç olarak da kullanılmaktadır. Aronya meyvesi yüksek oranlarda vitaminler, mineraller, polifenol ve antosiyanin gibi biyoaktif bileşenleri içerdiği için farmakolojik olarak fayda sağlamaktadır (Jurikova ve ark., 2017).

Aronya meyvelerinde bulunan fenolik bileşikler, sağlık üzerinde olumlu etkileri bulunan güçlü antioksidatif özellikler sunmaktadır. Bu bileşenler insan vücudunda antidiyabetik, anti-enfektif, antimutajenik, kardiyokoruyucu, gastrokoruyucu ve hepatokoruyucu etki göstermektedir. Aronya meyvelerinde bulunan fenolik bileşiklerin çeşitliliği, bu meyvenin sağlık üzerinde olumlu etkiler gösterme potansiyelini artırmaktadır (Kokotkiewicz ve ark., 2010).

Son zamanlarda, tüketicilerin beslenme ve sağlık alanlarındaki ilgilerinin artmasıyla birlikte aronya meyvesiyle ilgili yapılan araştırmalar, hızla artmaktadır. Aronya meyvesi ile ilgili en çok yayın yapan ülkeler sırasıyla Polonya (392), Amerika (188) ve Çin (111)'dir (Şekil 1). İnsan sağlığını geliştirici birçok özelliğinin yanı sıra çok karmaşık moleküller arası etkileşimler nedeniyle aronya meyvesinde bulunan bileşikler ve bunların yararları hakkında daha fazla çalışmaya ihtiyaç duyulmaktadır. Bu çalışmanın amacı, *Aronia melanocarpa* meyvelerinin, kimyasal bileşimini ve besin profilini gözden geçirerek sağlığa yararlı özelliklerini vurgulamaktır.



Şekil 1. Aronya ile Yapılan Yayınların Ülkelere Göre Dağılımı

2. GELİŞME

2.1. Besin Değerleri

Aronya meyvesinin besin öğeleri, bitkinin yetiştiği toprak özellikleri, kullanılan gübreler, meyvelerin olgunlaşma süreci, hasat zamanı ve bitkinin yetiştiği habitat gibi faktörlere bağlı olarak değişmektedir (Skupien ve Oszmianski, 2007). Aronya meyvelerinin kimyasal bileşimi Tablo 1'de verilmiştir. Diğer meyvelere kıyasla aronya yüksek miktarda sorbitol ve polifenol içermektedir (Wawer, 2010).

2.1.1. Diyet Lifi

Meyveler ortalama olarak 5.62 g/100 g (taze ağırlık) diyet lifi içermektedir (Tanaka ve Tanaka, 2001). Aronyadan elde edilen diyet lifi tozları mikrokristalin selüloz, pektinler, ligninler, kitin benzeri polimerler ve yoğunlaştırılmış tanenler içermektedir. Bu bağlamda aronya posası preparatlarının yüksek miktarda selüloz, hemiselüloz ve lignin içeren iyi bir diyet lifi kaynağı olduğu söylenebilir (Nawirska ve Kwaśniewska, 2005).

2.1.2. Organik Asitler

Aronya meyvelerinin içerdiği organik asitlerin toplam içeriği (taze ağırlığın % 1-1.5) diğer meyvelerle karşılaştırıldığında nispeten daha düşük konsantrasyonda olduğu belirtilmiştir.

Aronya meyvesinde en çok bulunan organik asitler ise L-malik asit ve sitrik asittir (Tanaka ve Tanaka, 2001).

2.1.3. Şeker

Aronyanın şeker içeriğinin yaklaşık olarak %16–18 arasında olduğu tespit edilmiştir. Yapılan çalışmalar incelendiğinde, glikoz ve fruktoz toplamının 13-17.6 g/100 g taze ağırlık arasında olduğu belirlenmiş, sakkaroz ise tespit edilememiştir (Seidemann, 1993; Strigl ve ark., 1995). Taze sıkılmış meyve suyunda glikoz (30–60 g/L; ortalama: 41 g/L) ve fruktoz (28 – 58 g/L, ortalama: 38 g/L) tespit edilmiştir (Ara, 2002). Sorbitol, diyet gıdalarında sıklıkla kullanılan bir şeker ikamesidir ve laksatif etki göstermektedir Grembecka ve ark., 2015). Enzimatik olarak belirlenen ortalama sorbitol miktarı, taze sıkılmış meyve suyunda 80 g/L, pastörize meyve suyunda ise 56 g/L seviyesinde bulunmuştur (Kapçı, 2013). Aronyanın sorbitol miktarının, test edilen diğer meyve ve yemişler arasında en yüksek konsantrasyona sahip olduğu bulunmuştur.

2.1.4. Yağ

Aronyanın toplam yağ içeriği 0.14 g/100g taze ağırlık olarak bulunmuştur. Aronya meyvesinin tohumunda, sterol ve fosfolipid gibi lipitler önemli miktarda bulunur (Sidor and Gramza-Michałowska, 2019). Geriye kalan lipitler esas olarak posada olup, çoklu doymamış yağ asitleri toplam yağ asitlerinin; %90.49'unu, doymuş yağ asitleri ise %9.51'ini oluşturmaktadır. Farklı yağ asitleri türleri arasında, linoleik (C18:2) %43.43 ve oleik asitler (C18:1) %16.38 oranlarında bulunmaktadır (Sidor and Gramza-Michałowska, 2019). Aronya meyvesinin lipit içeriği düşük olmakla birlikte, modern işleme teknolojilerinin uygulanmasıyla aronya tohumlarından ve posadan lipitlerin geri kazanılması sağlanabilir ve yüksek oranda doymamış yağ asitleri içeren yeni tohum yağı kaynakları geliştirilebilir.

2.1.5. Protein

Diğer meyvelere benzer şekilde, aronya meyvesinin protein ve amino asit içeriği nispeten düşüktür (700 mg/100 g taze ağırlık ve 4.900 ila 24.000 mg/100 g kuru ağırlık). Aronya meyvesi hem esansiyel hem de esansiyel olmayan amino asitleri içermektedir. Treonin (0,033 - 0,39 mg/100 g taze ağırlık) ve serin (0,023 I-0,39 mg/100 g taze ağırlık) aronya meyvesinde yüksek konsantrasyonda bulunan aminoasitlerdir (Sidor ve Gramza-Michałowska, 2019).

2.1.6. Vitamin ve Mineraller

Aronya meyvesi A, C ve E vitaminlerini içermektedir. Toplam karotenoidler (α-, β- ve ζ-karotenler dahil) aronya meyvesi suyunda 97.8 µg/L'ye kadar çıkabilmektedir (Oprea ve ark,

2014). Meyve sularının mineral içeriği 300 - 640 mg/100 mL arasında değişmektedir (Kapçı ve ark., 2013). Makro ve mikro elementlerin analizi Tablo 1'de özetlenmiştir. Aronya meyvesinin suyu yüksek miktarlarda potasyum ve çinko içermektedir.

Tablo 1. Aronya Meyvesinin Kimyasal Bileşimi (Ara, 2002)

Bileşenler	**Taze Aronya Meyvesi (g/L)**
Bağıl Yoğunluk	1.081
Kuru Madde %	19.5 °Brix
pH	3.6
Glukoz	41
Fruktoz	38
Glukoz+Fruktoz	79
Sukroz	TE
Sorbitol	80
Diyet Lifi	İz (Strigl ve ark.,1995)
Pektin	3.7 g/kg (Fan-Yung ve Rechits, 1977)
Yağ	TE
Protein	TE
Organik Asitler	
l-Malik asit	9.0
Tartarik asit	TE
Sitrik asit	500 mg/L
İzositrik asit	65 mg/L
Şikimik asit	80 mg/L
Suksinik asit	1.5
Vitaminler	
Vitamin C	200 mg/L
Folat µg/L	TE
Vitamin B1	500 µg/L
Vitamin B2	600 µg/L
Vitamin B6	550 µg/L
Niasin	3400 µg/L
Pantotenik asit	2200 µg/L
Tokoferol	TE
Vitamin K	TE
Mineraller	
Kül	6.4; 4.6 (Lehmann, 1990)
Na, mg/L	5
K, mg/L	2850
Ca, mg/L	150
Mg, mg/L	140
Fe, mg/L	4 (2-8)
Zn mg/L	1.3 (0.8-2.5)
I µg/L	TE
Fitokimyasallar	
Karotenoidler	TE
β-Carotene	TE
β-Cryptoxanthin	TE
Amigdalin	57.5 mg/kg (Lehmann, 1990)

TE: Tespit edilemedi.

2.2. Biyoaktif Bileşikler

Yapılan çalışmalara göre, aronya antioksidan olarak sınıflandırılan polifenoller, antosiyaninler ve prosiyanidinler gibi sağlığa yararlı biyoaktif bileşikler açısından zengindir (Pliszka ve ark., 2008; Oszmiański ve Lachowicz, 2016). Aronyanın biyolojik aktivitesi, antosiyaninler, flavonoller, proantosiyanidinler ve fenolik asitlerden oluşan polifenollerin zengin kaynaklarına sahip olmasından kaynaklanmaktadır. Ayrıca aronya meyveleri az miktarda benzaldehit, siyanohidrin, hidrosiyanik asit ve benzaldehit gibi uçucu bileşikler ve bunların türevlerini de içermektedir (Zaurov ve ark., 2013).

2.2.1. Polifenoller

Aronya, üzüm, çeşitli sebzeler ve birçok meyve türü, kimyasal olarak çok sayıda hidroksil grubundan oluşan aromatik halkalara sahip olan kompozitler olarak sınıflandırılan polifenoller bakımından oldukça zengindir (Kähkönen ve ark., 2001). Bu grup, fenolik halka yoluyla birbirinden farklılık gösterebilen çok sayıda fenolik kompozit alt grubunu içermektedir. Flavonoidler, fenolik asitler, basit fenoller, stilbenler ve lignanlar polifenollerin ana gruplarıdır. Aronya meyvelerindeki birincil polifenoller arasında antosiyaninler, proantosiyanidinler, flavonoller ve fenolik asitler bulunmaktadır (Tsao, 2010). Aronya meyvesinin toplam polifenolleri 1.0 - 3.6 g/100 g taze ağırlık aralığında değişmektedir.

2.2.2. Flavonoller

Aronya meyvesinde bulunan en önemli flavanol grubu prosiyanidinlerdir. Tanelerin kuru ağırlığına göre prosiyanidin miktarları %0.66 - %5.18 arasında değişmektedir. Çeşitli flavan-3-ol alt birimleri polimerik (-)- epikateşinlerin yapısını oluşturmaktadır. Aronya meyvesi ayrıca serbest epikateşin içerir; ancak konsantrasyonu polimerik prosiyanidinlere (%0.015 kuru ağırlık) kıyasla genellikle daha düşüktür (Pascual-Teresa ve ark., 2010; Gąsiorowski ve ark., 1997).

2.2.3. Flavonoidler

Flavonoidler, üç karbonlu bir köprü (C_6-C_3-C_6) ile birbirine bağlanan iki aromatik halka içeren polifenolik bileşiklerdir. Antioksidan, antimikrobiyal, antikanser, antidiyabetik ve kalp koruyucu gibi çok sayıda farmakolojik etki göstermektedirler. Flavonoller, flavonlar, flavan-3-oller, antosiyanidinler, flavanonlar, izoflavonlar, dihidroflavonol ve flavan-3,4-dioller flavonoidlerin önemli alt sınıflarından bazılarıdır. Flavonoidlerin her alt sınıfı önemli kimyasal

özelliklere sahiptir (Andersen ve ark.,2006; Crozier ve ark., 2009). Aronya meyvesinin renginden flavonoid sınıfındaki bileşikler sorumludur.

2.2.4. Antosiyaninler

Antosiyaninler, aronya meyvesinde bulunan ikinci en büyük fenolik bileşik grubudur. Konsantrasyonları kuru ağırlıkta %0.60 - %2.00 arasında değişmektedir (Benvenuti, ve ark., 2004). Siyanidin glikozitlerin (yani 3-galaktosid, 3-glukozit, 3-arabinosid ve 3-ksilosit) bir karışımı bulunmuştur ve siyanidin 3-galaktosid, aronyanın ana bileşeni olarak kabul edilmektedir (Tablo 2) (Zafra-Stone ve ark.,2007). Aronyada az miktarda pelargonidin türevleri, 3-O-galaktosid ve 3-O-arabinosid de bulunmaktadır. Birçok meyve ve sebzenin farklı renkleri bu bileşikten kaynaklanmaktadır (Minkiewicz ve ark., 2004).

Tablo 2. Aronya Meyvesinde Bulunan Biyoaktif Bileşikler

Fenolik Bileşen	**Aronya Meyvesi mg/100g**	**Referans**
Prosiyanidinler (toplam)	5182 (KA)	Oszmiański ve Wojdylo, 2005
	3992 (KA)	Mayer-Miebach ve ark., 2008
	664 (TA)	Wu ve ark., 2004
Antosiyaninler (toplam)	307-631(TA)	Seidemann, 1993
	1480 (TA)	Wu ve ark., 2004
	770-970 (KA)	Strigl ve ark., 1995
	1959 (KA)	Oszmiański ve Wojdylo, 2005
Cy-3-arabinosid	146 (TA)	Slimestad ve ark.,2005
Cy-3-galaktoz	315 (TA)	Slimestad ve ark.,2005
Cy-3-glukozit	10 (TA)	Slimestad ve ark.,2005
Cy-3-ksilosid	47 (TA)	Slimestad ve ark.,2005
Pel-3-arabinosid	2.3	Wu ve ark., 2004
Pel-3-galaktoz	iz	Wu ve ark., 2004
Flavonoller		
Quer türevleri (toplam olarak)	>71 (TA)	Zheng ve Wang, 2003
-Quer-3-galaktoz	30.2 (TA)	Zheng ve Wang, 2003
- Quer-3-glikozit	27.3 (TA)	Zheng ve Wang, 2003
- Quer-3-rutinosid	15 (KA)	Oszmiański ve Wojdylo, 2005
-Diğer Quer türevleri	27 (KA)	Oszmiański ve Wojdylo, 2005
(--)-Epikateşin	15.4 (KA)	Oszmiański ve Wojdylo, 2005
Klorogenik asit	302 (KA)	Oszmiański ve Wojdylo, 2005
Neoklorogenik asit	291 (KA)	Oszmiański ve Wojdylo, 2005

TA: Taze Ağırlık; KA: Kuru Ağırlık

3. Aronya Meyvesinin Potansiyel Sağlık Etkileri

Aronya gıda katkı maddesi ve tedavi edici madde olarak uzuzn zamandır kullanılmaktadır. Aronya çeşitlerinde bulunan antosiyaninler gibi doğal polifenoller, antimutajenik ve lipit düşürücü gibi birçok farmakolojik özelliğe sahiptir. Ayrıca, aronya meyvesi kardiyovasküler hastalık riskini azaltabilen biyoaktif bileşiklere sahiptir. Bu nedenle, araştırmacılar, aronya meyvesinin sağlık açısından faydaları konusunda kapsamlı çalışmalar yürütmektedir

(Bermúdez-Soto ve Tomás-Barberán, 2004; Valcheva-Kuzmanova ve ark., 2007). Ayrıca aronya meyve özleri için herhangi bir toksisite tespit edilmemiş olması kullanımının güvenli olduğunu göstermektedir (Ahles ve ark.,2020). Aronya meyvesinin farmakolojik etkileri Tablo 3'te gösterilmiştir.

Tablo 3. Aronyanın farmakolojik etkileri

Farmakolojik Etki	**Preperat**	**Gözlemler**	**Referans**
Antimutajenik	Kuru ekstrat	Benzo[a]piren ve 2-aminoflorene karşı aktivite	Denev ve ark., 2012
Anti-tümor	Kuru ekstrat	DNA zincirinin kırılması Kolon kanserini engelleme	Pool-Zobel ve ark., 1999
Kardiyokoruyucu	Antosiyanin ekstratı	LDL-c oksidasyonu azaltma, artan adiponekpektin seviyeleri	Naruszewicz ve ark.,2003
Antidiyabetik	Meyve suyu	Kanda glukoz seviyesinin düşmesi	Lala ve ark., 2006
Antiinflamatuar	Kuru ekstrat	Antiinflamatuar etki	Ohgami ve ark., 2005
Santral sinir sistemi	Meyve suyu	Kaygı benzeri durumun gelişmesini ve hafızanın bozulmasını önleme	Todorova ve ark., 2019
Hipolipidemi	Meyve suyu	Yüksek yağlı diyetle beslenen sıçanlarda obezite ve inflamasyonu önleme	Jiao ve ark., 2021
Hepatik fibrosis	Antosiyanin ekstratı	Hepatik fibrozu azaltma potansiyeli	Yang ve ark.,2020

3.1. Antimutajenik ve Antikanser Etki

Diğer meyveler gibi aronya meyvesi de insan ve hayvanlarda anti-tümör etki gösteren polifenoller içermektedir. Aronya özütü, SK-Hep1 karaciğer kanser hücrelerinin büyümesini, göçünü ve istilasını önlemektedir (Thi and Hwang, 2018). Ayrıca aronya ekstraktı metastaza sebep olan proteazların (MMP-2/9, MT-1 MMP) ekspresyonunu inhibe etmektedir. Yapılan bir çalışmada, fermente aronya suyundan izole edilen katekolun kanser kök hücrelerini inhibe ettiği sonucuna varılmıştır (Choi et al., 2018). Katekol, kanser kök hücrelerinin oluşumunu inhibe

ederek, kanser hücrelerinin hayatta kalmasını artıran IL-6 üretimini azaltmıştır. Böylece, aronya bileşenleri in vitro olarak birçok şekilde kanser mekanizmasını engelleyebilmektedir.

Yapılan in vitro çalışmalarda, antosiyanin ekstraktına 24 saatlik maruz kalma sonrasında normal hücrelerin büyümesini etkilemeden, insan HT-29 kolon kanseri hücrelerinin büyümesini %60 oranında inhibe ettiğini bildirmişlerdir. *Aronya melanocarpa* ekstraktı, benzer konsantrasyonda antosiyanin içeren üzüm ve yaban mersini gibi meyvelerle karşılaştırıldığında, kanser hücrelerinin büyümesini daha fazla inhibe ettiği görülmüştür (Malik Malik ve ark., 2003).

3.2. Antidiyabetik Etki

Yapılan in vivo çalışmalar aronya tüketiminin insülin direncini azalttığını bildirmiştir. Kemirgenlerde aronya suyu konsantresi tüketimi, insülin direnci ile iltihaplanma arasında bir ilişki olan adiponektinin plazma düzeylerini artırmaktadır (Baum ve ark., 2016). Aronya suyu tüketimi ayrıca diyabetik farelerde bağırsak glukozidaz aktivitesini azalttı ve DPP IV aktivitesini arttırdı (Yamane et al., 2016). Tip 2 diyabetli yetişkinlere aronya suyu verilmesi ile, açlık kan şekeri ve glikozillenmiş hemoglobin (HbA1c) seviyelerinde azalma ve glisemik indeksi düşürdüğü bildirilmiştir (Milutinović et al., 2019).

3.3. Kardiyovasküler Hastalıklar

Kardiyovasküler hastalıklar ABD' de önde gelen ölüm nedenidir (Centers for Disease Control and Prevention, 2020). Kötü beslenme, düşük fiziksel aktivite, aşırı alkol ve sigara kullanımı kardiyovasküler hastalık riskini artırabilir. Kan basıncı seviyesinin ve vücut yağlanma miktarının artması, LDL kolesterol ile yüksek inflamasyon oluşması ve oksidatif stres gibi nedenler kardiyovasküler hastalık riskini artırmaktadır. Aronya meyvesi tozu, ekstraktı ve suyunun tüketilmesi farelerde diyet kaynaklı obezitede kilo alımını, lipid dismetabolizmasını ve inflamasyonu engellemektedir (Bhaswant et al., 2017; Jeong and Kim, 2019).

Aronya meyvesi tüketimi, insan müdahale çalışmalarında kardiyovasküler hastalık riskiyle ilişkili biyobelirteçleri iyileştirmektedir. Örneğin, aronya ekstraktı (116 mg) ve tozu (12 mg) tüketimi, sağlıklı erkeklerde vasküler fonksiyonun bir belirteci olan akış aracılı dilatasyonu iyileştirmiştir (Istas et al., 2019). 300 mL/gün aronya suyu ve 3 g/gün aronya tozu tüketimi, hafif yüksek hipertansiyonu olan yetişkinlerde sistolik/diyastolik kan basıncını düşürmüştür ancak serum lipitlerinde bir değişiklik olmamıştır (Loo et al., 2016).

Aronya ekstraktı, daha önce sigara içen sağlıklı kişilerde toplam ve LDL kolesterolü azaltmış ve bu değişiklikler, peonidin-3-galaktosid, siyanidin-3-galaktosid ve 3-(4 hidroksifenil) propiyonik asidin idrarla atılımındaki artışla ilişkilendirilmiştir (Xie et al., 2017). Yapılan çalışmalar sonucunda Aronya tüketiminin HDL kolestrolü arttırdığı saptanmıştır (Rahmani et al., 2019).

3.4. Antiinflamatuar Etki

Aronya meyvesinin anti-inflamatuar özellikleri, diyabet, kardiyovasküler hastalıklar ve bağışıklık sistemi ile ilgili kronik problemler gibi kronik hastalıkların gelişiminin önlenmesiyle ilgilidir (Jurikova ve ark., 2017). Siklooksijenazlar (COX'ler) ve indüklenebilir nitrik oksit sentaz (iNOS), birçok inflamatuar hastalığın ilerlemesiyle pro-inflamatuar enzimlerdir (Li ve ark., 2017). Aronya meyvesinin anti-inflamatuar mekanizması, nitrojen oksit sentaz (iNOS) ve siklooksijenaz (COX-2) ekspresyonunun doğrudan inhibisyonu ve ayrıca proinflamatuar faktörlerin azaltılması ile ilgilidir. Aronya meyvesi ekstraktları, nitrik oksit, prostaglandin (E2) ve tümör nekroz faktörü-α üretimini inhibe ederek antiinflamatuar aktivite göstermektedir (Ohgami ve ark., 2005).

3.5. Antioksidan Etki

Oksidatif hasar genellikle radikal oluşumu ile antioksidan savunma arasındaki denge bozulduğunda meydana gelmektedir ve oksidatif stres olarak tanımlanmaktadır (Ehlenfeldt, ve ark., 2001). Kalp hastalıkları, felç, Alzheimer ve Parkinson hastalığı gibi çeşitli hastalıkların gelişiminde önemli bir faktördür (Denev ve ark., 2012). Çeşitli antioksidanlar oksidatif stresi azaltır ve spesifik substratların oksidasyonunu geciktirir veya engeller (Ehlenfeldt, ve ark., 2001). Yapılan çalışmalar, aronya meyvesinin antioksidan kapasitesinin diğer meyvelerden önemli ölçüde daha yüksek olduğunu göstermektedir (Denev ve ark., 2012). Çalışmalarda antioksidan kapasitesinin göstergesi olarak oksijen radikal absorbans kapasitesi (ORAC) değerleri kullanılmaktadır ve aronya meyvesinin ORAC değerleri yaban mersini, siyah kuş üzümü ve kızılcıktan oldukça yüksek bulunmuştur. Aronya polifenoller, C, E vitaminleri, Cu ve Zn açısından zengindir. Bu bileşenlerin varlığı Aronya meyvesinin antioksidan kapasitesinni arttırmaktadır (Seeram ve ark., 2008).

3.6. Karaciğer Koruyucu Etki

CCl_4, sitokrom P450'yi son derece reaktif triklorometil serbest radikallerine metabolize ederek karaciğer hasarına neden olmaktadır. Aronya suyu, farelerde CCl_4 maruziyeti sonucu oluşan

karaciğer hasarını hafifletmektedir. Bu sayede hepatoprotektif etkiler göstermektedir (Valcheva-Kuzmanova ve ark., 2004). CCl_3 radikalleri oksijenle reaksiyona girdiğinde lipid peroksidasyonu başlatır ve bu durum hücre ölümüne yol açar. Farelerde yapılan deneylerde Aronya suyunun, lipid peroksidasyonunu önlediği görülmüştür (Valcheva-Kuzmanova ve ark., 2005).

3.7. Nörokoruyucu Etki

Kemirgenlerde yapılan deneyler aronya tüketiminin nöroprotektif etkilerini desteklemektedir. Kültürlenmiş hipokampal ve mikroglial hücrelere uygulandığında aronya oksidatif stresi ve inflamasyonu azaltmaktadır (Lee ve ark., 2018). Yaşlı sıçanlarda aronya suyu tüketimi sinir liflerini arttırmaktadır. Aronya takviyesinin, sıçanlarda hafıza bozukluğunu düzelttiği ve motor becerilerini geliştirdiği gözlemlenmiştir (Daskalova ve ark., 2019). Ayrıca aronya suyu tüketimi yetişkin sıçanlarda kaygı benzeri davranışları azaltmaktadır (Tomić ve ark., 2016).

SONUÇ

Günümüzde kalp-damar hastalıkları, enfeksiyonlar, kanser, diyabet, obezite ve nörolojik bozukluklar insan sağlığını bozan önemli sorunlardır. Bu hastalıkların tümüne, hücre apoptozuna ve patogenezlerinin ilerlemesine yol açan, oksidatif stre neden olmaktadır. Bu nedenle antioksidanlar, normal hücrelere zarar veren serbest radikallerin üretimini önlemeleri nedeniyle insan sağlığını desteklemede önemli etkenlerdir. Antioksidanların enfeksiyonların kontrolüne yardımcı olabileceği ve bunun da diğer hastalıkların tedavisi üzerinde olumlu etkiler gösterdiği bilinmektedir. Birçok ülkede kolaylıkla yetiştirilebilen aronya meyvesi güçlü antioksidan aktivite göstermektedir ve bu nedenle kanserin, kardiyovasküler hastalıkların, diyabetin, obezitenin ve nörolojik bozukluklarının önlenmesi ve olası tedavisinde potansiyel olarak faydalı olduğu bulunmuştur. Aronya meyveleri, antosiyaninler ve diğer biyoaktif polifenoller açısından en zengin bitki kaynaklarından biridir. Ancak, tadının ekşiliği ve burukluğu nedeniyle diyette yeterince kullanılmamaktadır. Bununla birlikte, aronya meyveleri ve bileşenlerinin oksidatif stresle ilişkili hastalıkların önlenmesi ve tedavisinde yararlı etkiler sağladığı gösterilmiş olmasına rağmen, bugüne kadar yapılan klinik çalışmalarda gözlemlenen etkinliklerinin zayıf olduğu görünmektedir. Bu sebeple, aronya meyveleri üzerine yapılacak gelecekteki araştırmalar, mevcut fenolik ve diğer bileşenlerin dozlarının optimize edilmesinin yanı sıra yeni formülasyonların geliştirilmesine, yeni aktif bileşiklerin izole edilmesi ve bunların sentetik modifikasyonlarına odaklanabilir. Bu nedenle, aronya meyvelerinin

antidiyabetik ve anti-enfektif aktiviteleri ve kalp hastalığı üzerindeki potansiyel terapötik etkileri için daha ayrıntılı mekanik çalışmalar, bu meyvelerin insan sağlığının geliştirilmesinde yararlı ajanlar olarak geliştirilmesini destekleyebilmektedir.

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DUT YAPRAKLARININ İNSAN SAĞLIĞI ÜZERİNDEKİ FARMAKOLOJİK ETKİLERİ

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ÖZET
Moraceae (Dutgiller) familyasından gelen dut bitkisinin *Morus alba, Morus nigra* ve *Morus rubra* şeklinde olmak üzere üç farklı türü mevcuttur. İpek böceğinin başlıca ve tek besin kaynaklarından olan dut yaprakları içerdiği biyoaktif bileşenler, mineraller, vitaminler ve yağlar nedeniyle birçok araştırmada incelenmiştir. Bu bileşenler arasında flavonol, antosiyanin, fenolik asitler, alkaloitler, potasyum, kalsiyum, sodyum, magnezyum, B_1 vitamini, folik asit, linoleik asit, palmitik asit, oleik asit ve melatonin bulunmaktadır. Dut yaprakları protein (%13.40-19.40), kalsiyum (1.70-3.90 g/100g), potasyum (1.20-3.90 g/100g) ve vitamin C (0.97-1.49 mg/g) bileşenleri bakımından oldukça zengindir. Biyoaktif bileşenler açısından zengin olan dut yapraklarının toplam fenolik ve flavonoid değerleri sırasıyla 16.21–24.37 mg GAE/g ve 26.41–31.28 mg QE/g aralıklarında değişmektedir. Yapılan *in vitro* ve *in vivo* araştırmalarda dut yaprağı ekstraktları insan vücudu üzerinde, antioksidatif, hipoglisemik, hipolipidemik, anti-obezite, antiinflamatuar ve antikanser aktiviteleri gibi çeşitli farmakolojik etkiler göstermektedir. Bu yararlı etkiler; α-glukosidaz ve α -amilaz enzimlerinin inhibisyonu, köpük hücre oluşumunun azaltılması, yağ sentezinin inhibisyonu, NF-κB aktivitesinin baskılanması ve apoptozun başlatılması ile bağlantılıdır. Diğer taraftan güçlü antioksidatif aktiviteden sorumlu fenolik bileşikler, özellikle flavonoidler, fenolik asitler ve alkaloidler farmakolojik etkilere aracılık etmede önemli bir rol oynamaktadır. Ayrıca, geleneksel bitkisel ilaç olarak tüketilen dut yaprakları; vücut bağışıklığını güçlendirmek, kan şekeri ve tansiyonu düşürmek gibi hastalıkların tedavisinde de kullanılmaktadır. Ancak dut yapraklarının farmakolojik etkilerinin incelendiği *in vitro* araştırmalar daha yaygınken *in vivo* araştırmalar sınırlı sayıdadır. Bu derlemede, dut yapraklarının *in vitro* ve *in vivo* farmakolojik özellikleri ile sağlık üzerine etkileri incelenmiştir.
Anahtar Kelimeler: Dut yaprağı, Biyoaktif bileşikler, Farmakolojik özellikler

PHARMACOLOGICAL EFFECTS OF MULLBERRY LEAVES ON HUMAN HEALTH

ABSTRACT

There are three different species of the mulberry plant from the Moraceae family, *Morus alba*, *Morus nigra* and *Morus rubra*. Mulberry leaves, one of the main and only food sources of the silkworm, have been studied in many researches due to the bioactive components, minerals, vitamins and oils they contain. These components include flavonol, anthocyanin, phenolic acids, alkaloids, potassium, calcium, sodium, magnesium, vitamin B_1, folic acid, linoleic acid, palmitic acid, oleic acid and melatonin. Mulberry leaves are rich in protein (13.40-19.40%), calcium (1.70-3.90 g/100g), potassium (1.20-3.90 g/100g), and vitamin C (0.97-1.49 mg/g). The total phenolic and flavonoid values of mulberry leaves, which are rich in bioactive compounds, vary in the ranges of 16.21–24.37 mg GAE/g and 26.41–31.28 mg QE/g, respectively. In *in vitro* and *in vivo* studies, mulberry leaf extracts show various pharmacological effects on the human body, such as antioxidative, hypoglycemic, hypolipidemic, anti-obesity, anti-inflammatory and anticancer activities. These beneficial effects are linked to inhibition of α-glucosidase and α-amylase enzymes, reduction of foam cell formation, inhibition of lipid synthesis, suppression of NF-κB activity and induction of apoptosis. On the other hand, phenolic compounds responsible for potent antioxidative activity, especially flavonoids, phenolic acids and alkaloids, play an important role in mediating pharmacological effects. In addition, mulberry leaves, which are consumed as traditional herbal medicine; It is also used in the treatment of diseases such as strengthening body immunity, lowering blood sugar and blood pressure. However, while *in vitro* studies examining the pharmacological effects of mulberry leaves are more common, *in vivo* studies are limited. In this review, *in vitro* and *in vivo* pharmacological properties and health effects of mulberry leaves were examined.

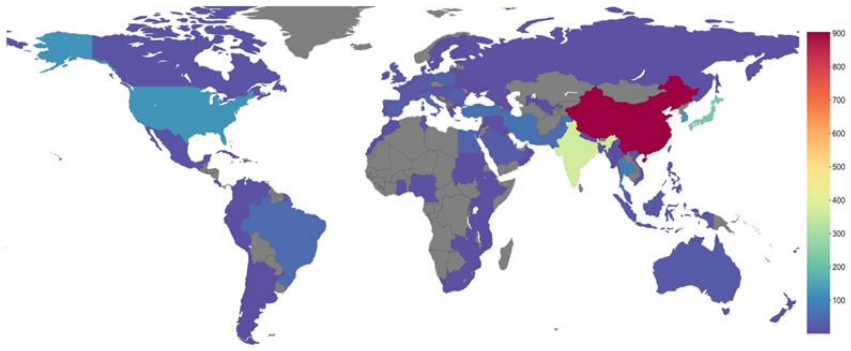
Keywords: Mulberry leaf, Bioactive compounds, Pharmacological properties

1. GİRİŞ

Eski dönemlerden beri insanlar ihtiyaçlarını karşılamak için bitkisel kaynakları kullanmaktadır. Bitkiler, içeriklerinin zengin olmasından dolayı gıda, ilaç ve kozmetik gibi birçok alanda kullanılmaktadır. Birçok bitki, çeşitli hastalıkların önlenmesi ve tedavisinde fonksiyonel gıdalar ve alternatif ilaçlar şeklinde yaygın olarak kullanılmaktadır. Bitkiler, birçok biyoaktif bileşiğin potansiyel kaynakları olarak kabul edilmektedir. Tıbbi bitkilerin güvenilirliği ve etkinliği, uzun geleneksel kullanımla ve bilimsel araştırmalarla doğrulanmaktadır. Ayrıca, tedavi amaçlı kullanılan bitkilerin, günümüzde güncel kullanılan ilaçlara göre erişilebiliriliği daha kolay ve maliyeti düşüktür. Tüm bu nedenlerden dolayı, günümüzde şifalı olarak nitelendirilen tıbbi bitkiler, birinci basamak sağlık sisteminin önemli bir bileşeni haline gelmiştir. Beyaz dut *(Morus alba),* karadut *(M. nigra)* ve kırmızı dut *(M. rubra*), Morus cinsine ait bilinen türler arasında yer almaktadır (Yigit ve ark., 2010).

Dünya çapında tropikal, subtropikal ve ılıman bölgelerde yetişen farklı dut türleri bulunmaktadır. Ancak bunun büyük çoğunluğu Çin, Japonya, Kore ve Hindistan gibi Asya ülkelerinde yetişmektedir (Sanchez 2000). Mükemmel bir besin içeriğine sahip ve yüksek oranlarda fitokimyasal madde içeren dut meyvesi, fonksiyonel gıda olarak kabul görmüştür (Srivastava ve ark., 2006). Taze dut meyvesi; meyve suyu, reçel ve jöle gibi pek çok gıdanın üretiminde kullanılmaktadır (Yiğit ve ark., 2010). Dut meyvesi gibi oldukça lezzetli bulunan dut yaprakları da birçok endüstri kolunda kullanılmaktadır (Srivastava ve ark., 2006). Öncelikle, dut yaprakları ipek böceğinin (Bombyx mori) tek besin maddesi olduğu için ipekböceği yetiştiriciliği endüstrisinde çok önemli bir rol oynamaktadır (Rohela et al. 2020). Aynı zamanda dut yapraklarının süt üretimi üzerindeki olumlu etkisinden dolayı süt hayvanlarının beslenmesinde yem endüstrisinde kullanılmaktadır (Gupta ve ark., 2005). Dut yapraklarından elde edilen tozlar, ekstraktlar ve kapsüller gibi ürünler günümüzde vücut ağırlığını ve kan şekerini kontrol etmeye yönelik ticari fonksiyonel gıdalar ve diyet takviyeleri olarak kullanılmaktadır. Her geçen gün kullanımı giderek yaygınlaşan dut yaprakları ile ilgili yapılan araştırmalar artmaktadır. Dünya genelinde en çok yayın yapan ülkeler sırasıyla Çin (904), Hindistan (366) ve Japonya (229) şeklinde sıralanmakla birlikte ülkemizde dut yaprağı ile ilgili kayıtlı yayın sayısı 57'dir (Şekil 1). Yapılan çalışmalar sonucunda, dut yapraklarının antioksidanlar, fenolik bileşenler, flavonoidler ve polifenoller gibi bir dizi biyoaktif madde içerdiği saptanmıştır (Lee ve Choi., 2012). İçeriğindeki biyoaktif bileşikler sayesinde,

antioksidan, antidiyabetik, hipokolestrolemik, antikanser ve antiinflamatuar etki gibi birçok farmakolojik etkiye sahiptir (Devi ve ark., 2013). Tüm bu nedenlerden dolayı bu derlemede, dut yapraklarının *in vitro* ve *in vivo* farmakolojik özellikleri ile sağlık üzerine etkileri incelenmiştir.



Şekil 1. Dut Yaprağı ile Yapılan Yayınların Ülkelere Göre Dağılımı

2. GELİŞME

2.1. Besin Değeri

Yapılan çalışmalara göre, dut yapraklarının besin içerikleri , hasat koşullarına, türüne, genetik faktörlere, çevresel etmenlere ve ekolojik şartlara bağlı olarak değişkenlik göstermektedir. Dut yaprakları önemli düzeyde protein, karbonhidrat, yağ, vitamin, mineral ve lif içermektedir (Tablo 1). Dut yaprakları protein (%13.4-19.4), mineraller(1.7-3.9 g/100g kalsiyum, 1.2-3.9 g/100g potasyum), vitamin (0.97-1.49 mg/g askorbik asit) açısından oldukça zengindir (Tablo 1). Dut yapraklarında bulunan protein içeriği ve miktarı diğer yeşil yapraklı sebzelere göre oldukça yüksek ve zengindir (Gupta ve ark., 2005). Dut yaprakları, antosiyaninler, alkaloidler ve flavonoidler gibi birçok biyoaktif bileşik içermektedir. Biyoaktif bileşenler açısından zengin olan dut yapraklarının toplam fenolik ve flavonoid değerleri sırasıyla 16.21–24.37 mg GAE/g ve 26.41–31.28 mg QE/g aralıklarında değişmektedir (Flaczyk ve ark., 2013). Dut yapraklarının polifenol konsantrasyonları ise kuru ağırlığın %1.04-1.87mg'na denk gelmektedir (Lee ve Choi, 2012). Ayrıca , dut yapraklarında flavonoidler, alkaloidler (%6.4), fenolik asitler (%10.7) ve benzofuranlar (%17.9) dahil olmak üzere çok çeşitli fenolik bileşikler vardır. Özellikle, flavonoidler, toplam 140 fenolik bileşikten 81'ini oluşturan bileşikler olarak önemli bir rol oynamaktadırlar (Chan ve ark., 2020). Kurutulmuş dut yapraklarından ekstrakte edilen toplam

fenolik asit miktarı, 80.0 mg/100 g-184.3 mg/100 g aralıklarında değişmektedir (Memon ve ark., 2010). Toplam fenolik asitlerin ana kısmını oluşturan kafeoilkinik asitlerin içerikleri incelediğinde %60.5 -%67.2 aralığında (Memon ve ark., 2010) 5-kafeoilkinik asit (klorojenik asit) olduğu görülmektedir (Chan, ve ark., 2020). Dut yapraklarında bulunan ise flavonoidler kuwanonlar, moracinflavanlar, moragroller ve morkotinlerdir. Genel rutin, isoquercetin, kaempferol-3-O-rutinosid ve astragalin miktarları 4.34 mg/g ila 0.53 mg/g arasında değişmiştir (Hong ve ark., 2013). Ayrıca dut yaprakları hidroksistilbenlerden Resveratrol ve Oxyresveratrol içermektedir. Bu biyoaktif maddenin kardiyokoruyucu ve nöroprotektif etkisi bulunmaktadır. Dut yaprakları antosiyaninler açısından zengindir ve antioksidan aktivite göstermektedir (Bae ve Hyung, 2007).

Tablo 1. Dut yaprağının kimyasal kompozisyonu

Besin ögesi	**İçerik**	**Referans**
Ham protein	%13.40-19.4	Sanchez-Salcedo ve ark., 2017
Total karbonhidrat	%47.27–56.42	Adeduntan and Oyerinde 2010
Ham yağ	%4.24–6.57	Iqbal ve ark., 2012
Vitamin		
Vitamin C	0.97-1.49 mg/g	Iqbal ve ark., 2012
Mineraller		
Nitrojen	2.1–3.1 g/100 g	Sanchez-Salcedo ve ark., 2017
Fosfor	0.1–0.2 g/100 g	Sanchez-Salcedo ve ark., 2017
Potasyum	1.2–3.9 g/100 g	Sanchez-Salcedo ve ark., 2017
Kalsiyum	1.7–3.9 g/100 g	Sanchez-Salcedo ve ark., 2017
Sodyum	0.01 g/100 g	Sanchez-Salcedo ve ark., 2017
Magnezyum	0.5–1.4 g/100 g	Sanchez-Salcedo ve ark., 2017
Sülfür	0.2–0.3 g/100 g	Sanchez-Salcedo ve ark., 2017
Demir	119.3–241.8 mg/kg	Sanchez-Salcedo ve ark., 2017
Çinko	23.9–39.5 mg/kg	Sanchez-Salcedo ve ark., 2017
Manganez	35.8–90.5 mg/kg	Sanchez-Salcedo ve ark., 2017
Bor	253.5–825.3 mg/kg	Sanchez-Salcedo ve ark., 2017
Bakır	4.2–5.9 mg/kg	Sanchez-Salcedo ve ark., 2017
Molibden	0.8–2.3 mg/kg	Sanchez-Salcedo ve ark., 2017
Nikel	1.7–5.4 mg/kg	Sanchez-Salcedo ve ark., 2017
Kurşun	0.3–0.8 mg/kg	Sanchez-Salcedo ve ark., 2017
Karbon	37.4–41.4 g/100 g	Sanchez-Salcedo ve ark., 2017
Lityum	1.9–17.2 mg/kg	Sanchez-Salcedo ve ark., 2017
Titanyum	5.4–10.8 mg/kg	Sanchez-Salcedo ve ark., 2017
Organik Asitler		
Sitrik Asit	32.2–105.5 mg/100 g	Sanchez-Salcedo ve ark., 2017
Malik Asit	43.7–72.6 mg/100 g	Sanchez-Salcedo ve ark., 2017

2.2. Dut Yapraklarının Farmakolojik Özellikleri

Dut yaprakları ve dut yaprağından üretilen preperatlar; fenoller, polisakkaritler, steroidler, amino asitler, lignanlar ve uçucu maddeler gibi farmakolojik acıdan önem taşıyan biyoaktif bileşikleri içermektedir. Bu bileşikler sayesinde dut yaprakları antioksidan özellik, hipoglisemik etki, lipid metabolizması düzenlemesi, antikanser ve anti-inflamatuar etki gibi çeşitli farmakolojik faydalar sağlamaktadır (Afzal ve ark., 2021).

2.2.1. Antioksidan Etki

İn vitro ve *in vivo* yapılmış çok sayıda çalışma, dut yaprağı özlerinin fenolik polisakkaritler, albümin, morasin N gibi bileşiklere bağlı olarak güçlü antioksidan özelliklere sahip olduğunu göstermektedir (Sun ve ark., 2018). Ekstraktın antioksidan etkileri, reaktif oksijen türleri ve serbest radikaller üzerindeki güçlü temizleyici etkisinin yanı sıra ksantin oksidaz aktivitesini inhibe etme yeteneğinden kaynaklanmaktadır (Wan ve ark., 2018). Ayrıca diyabetin neden olduğu oksidatif hasara karşı ve hücreleri lipid peroksidasyonun neden olduğu hasara karşı korumaktadır (Choi ve ark., 2013).

2.2.2. Hipoglisemik Etki

Diyabet genel olarak yüksek kan şekeri seviyesi ve değişen insülin metabolizması ile karakterize edilen bir sendromdur (Butt ve ark., 2008). Duttan izole edilen 1-deoksinojirimisin (DNJ) ve türevleri, önemli α-glikozidaz inhibitör aktivitesine sahiptir ve bu sayede hem kan şekeri hem de insülin sekresyonunun tepkisini baskılayarak kan şekeri seviyesinin düşmesine neden olmaktadır (Sarikaphuti ve ark., 2013). 250 mg/kg ve 500 mg/kg dozlarında dut yaprağı ekstraktı, anti-diyabet aktivitesi nedeniyle anti-insülin direnci etkisi göstermiştir. Dut yapraklarının, diyabetin neden olduğu böbrek fonksiyon hasarını iyileştirerek (Gurukar ve Chilkunda, 2018) ve erken diyabetik retinopatiyi azaltarak, diyabet komplikasyonlarını azalttığı görülmüştür (Gurukar ve Chilkunda, 2018). Diyabetik insan ve farelerde yapılan araştırmaların sonuçları dutun kan şekeri seviyesini düşürdüğünü göstermektedir.

2.2.3. Hipokolestrolemi ve Antiaterojenik Etki

Hiperlipidemi, yüksek düzeyde serum trigliserit ve kolesterol ile karakterize lipid metabolizması bozukluğudur (Liu ve ark. 2009). Yüksek trigliserit ve kolesterol düzeylerinin ateroskleroz ve kroner kalp hastalığı için bir risk faktörü olduğu belirlenmiştir. Düşük yüksek yoğunluklu protein (HDL) ve düşük yoğunluklu lipoproteinin (LDL) oksidatif modifikasyonu, kroner arter hastalığının artmasıyla ilişkilidir (Liu ve ark., 2009). Yapılan çalışmalarda, dut

yaprağı özlerinin lipid düşürücü özelliklere sahip olduğunu ve potansiyel olarak hiperlipidemi ve kardiyovasküler (ateroskleroz ve koroner kalp hastalığı) hastalıklara karşı koruma sağladığını göstermektedir (Varghese ve Jibu Thomas, 2019; Metwally ve ark., 2019; Thaipitakwong ve ark., 2018). Yapılan araştırmaya göre, etanolik ekstrakt LDL kolesterolü, VLDL kolesterolü, trigliseritleri ve toplam kolesterol seviyelerini düşürürken HDL kolesterol seviyelerini yükseltmektedir (Varghese ve Jibu Thomas, 2019). Bu sayede dut yaprağı ekstraktı ateroskleroza karşı güçlü bir etki göstererek koruma sağlamakta ve köpük hücre (aterosklerotik lezyonlara özgü hücrelerdir) oluşumunu azaltmaktadır (Yang ve ark., 2011). Ekstraktta bulunan 1-DNJ ve fenolikler gibi bileşiklerin, bu etkilere sebep olduğu saptanmıştır (Yang ve ark.,2011; Wang ve ark., 2020).

2.2.4. Antiobezite Etki

Dut yaprakları, tüketilen yüksek yağlı diyetin neden olduğu kronik vücut ağırlığı artışını baskılamaktadır. Araştırma sonuçları, dut yapraklarıyla beslenen hayvanların kontrol grubuna göre daha düşük bir vücut ağırlığa sahip olduğunu göstermektedir. İç organ yağ dokularının ağırlığı ve vücut yağ kütlesinin de azaldığı saptanmıştır (Chang ve ark., 2016). Dut yaprakları, hücrelerdeki yağ damlacıklarının sayısı ve boyutunu azaltmasının yanı sıra adiposit sayısını da önemli ölçüde azaltmaktadır (Yang ve ark. 2014; Chang ve ark. 2016). Ayrıca, dut yapraklarının uzun süre tüketilmesinden sonra, anti-yağlanma sitokini olan dolaşımdaki adiponektin seviyesinde kademeli bir artış gözlenmiştir. Dut yaprakları, vücuttaki yağ kütlesini azaltmanın yanı sıra bağırsak florasını düzenleyerek de kilo azaltmada etkili olmaktadır (2019). Ek olarak, dut yaprağı polifenolleri ve lifi sinerjik etki göstererek kilo kaybına katkıda bulunmaktadır (Li, o ve Zou, 2019).

2.2.5. Antikanser Etki

Yang ve diğerleri (2012), dut yapraklarında bulunan polifenollerin, tümör hücrelerinin çoğalmasını, yayılmasını ve metastazını engelleyebileceğini rapor etmişlerdir. Ayrıca, hepatoselüler karsinom hücrelerinin ölümü, dut yaprağı polifenol ekstraktı ile sağlanmaktadır. Benzer şekilde, Fallah ve ark. (2018), İran'da dut yapraklarının kanser karşıtı bir ilaç olarak kullanılabileceğini bildirmişlerdir. Deneysel sonuçlar, dut yapraklarından elde edilen oksidatif flavonoidlerin, tümörlü bir sıçanın ömrünü uzatmada oldukça etkili olduğunu göstermiştir (Fallah ve ark., 2018).

2.2.6. Antiinflamatuar Etki

Dut yaprakları, makrofaj aktivasyonu kaynaklı inflamasyonda yer alan nükleer faktör (NF)-κB sinyal yolları aracılığıyla inflamatuar süreçleri baskılamaktadır (Chao ve ark., 2013; Parkve ark., 2013). Bu etkiler, indüklenebilir nitrik oksit sentaz (iNOS), siklooksijenaz-2 (COX-2), tümör nekroz faktörü-alfa (TNF-a), interlökin (IL)-1b ve IL-6 dahil olmak üzere proinflamatuar sitokinlerin azalmasından kaynaklanmaktadır (Park et al. 2013). TNF-α tarafından indüklenen monositlerin endotel hücrelere yapışması, dut yaprağı ekstresi ile önemli ölçüde azaltılmıştır. Ek olarak dut yaprakları, yüksek yağlı bir diyetin neden olduğu hepatik steatozun inhibisyonuna yol açan inflamatuar yanıtı ve otofaji sürecini iyileştirmektedir.

2.2.7. Karaciğer Hasarına Karşı Koruyucu Etki

Dut yaprakları, hepatoprotektif aktiviteye sahip flavonoidler, kumarin ve stilben içermektedir (Oh et al., 2002). Yapılan çalışmalarda dut yapraklarının, karbon tetraklorürün neden olduğu hepatotoksisiteye karşı hepatoprotektif potansiyele sahip olduğu bildirilmiştir (Hogade ve ark., 2010).

2.2.8. Nörolojik Hasarı Koruyucu Etki

Alzheimer, amiloid beta peptitlerinin beyinde oluşturduğu plaklarla ilişkili bir tür nörolojik hastalıktır. Yapılan çalışmalarda dut yapraklarının kaempferol -3-O-glukozit ve kaempferol -3-O-(6-malonil) glukozit içerdiği, tüketiminin beyinde peptit oluşumunu önlemeye yardımcı olduğu ve yaprağın metanol ekstresinin dopamin (D2) reseptörlerini bloke eden anti-dopaminerjik etkiye sahip olduğu gösterilmiştir (Yadav ve ark., 2008). Dut yaprağı ekstraktındaki oksiresveratrol (tirozinaz inhibitörü), nöroprotektif bir bileşen olarak görev yapmakta ve akut iskemik felci tedavi etmek için ilaçlarda kullanılmaktadır (Zhang ve Shi, 2012). Breuer ve ark. (2006), oksiresveratrolün kan-beyin bariyerini doğrudan geçerek beynin korumasında etkili bir madde olduğunu bildirmişlerdir.

3. SONUÇ

Bu derleme, dut yapraklarının birçok hastalığa karşı insan sağlığı üzerinde önemli farmakolojik etkileri olduğunu göstermektedir. *İn vitro* ve *in vivo* araştırmalarda dut yaprağı ekstraktları, insan vücudu üzerinde antioksidatif, hipoglisemik, hipolipidemik, anti-obezite, antiinflamatuar ve antikanser aktiviteleri gibi çeşitli farmakolojik etkiler göstermektedir. Dut yaprağında bulunan güçlü antioksidatif aktiviteden sorumlu fenolik bileşikler, özellikle flavonoidler, fenolik asitler ve alkaloidler farmakolojik etkilere aracılık etmede önemli bir rol oynamaktadır.

Yapılan deneylerin sonucunda dut yaprakları ve bunların ekstraktlarında bulunan biyoaktif bileşikler, çoklu oksidaz aktivitelerini, α-glukosidaz, α-amilazları ve yağ oluşumunu inhibe ederek, köpük hücrelerinin oluşumunu azaltarak, NF-κB aktivitesini azaltarak ve hücre apoptozunu indükleyerek insan vücudunda çeşitli farmakolojik etkilere sebep olmaktadır. Dut yaprakları üzerinde yapılmış *in vitro* çalışma sayısı fazla iken, *in vivo* çalışma sayısı azdır bu çalışmaların gelecekte arttırılması ile dut yapraklarının insan vücudu üzerindeki farmakolojik etkileri hakkında daha fazla bilgi sahibi olabiliriz.

Ülkemizde dut yaprakları, özellikle Akdeniz ve Ege bölgeleri gibi iklim koşullarına uygun bölgelerde yetiştirilmektedir. Dut yapraklarının yetiştirilmesinin desteklenmesi, yerel çiftçilere yeni gelir kaynakları sağlayabilir ve bu bitkinin potansiyelini tam olarak kullanma ve çeşitli sektörlerde daha fazla kullanımını teşvik etme fırsatı sunmaktadır. Dut yapraklarının yetiştirilmesi ve kullanılması, hem yerel hem de küresel düzeyde sağlık ve beslenme alanında olumlu etkiler göstermektedir. Bununla birlikte, bu süreçte sürdürülebilir tarım uygulamalarının ve yerel ekonominin desteklenmesi önemlidir.

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BAZI BİTKİ BÜYÜME DÜZENLEYİCİLERİNİN ARMUT VE ERİK ÇEŞİTLERİNDE ÇİMLENME VE POLEN TÜPÜ UZUNLUĞUNA ETKİLERİ

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ÖZET
Bu çalışma, bitki büyüme düzenleyicilerin 'October Sun' (*Prunus salicina* Lindl.) erik, 'Marguerite de Marillat' ve 'Williams' (*Pyrus communis* L.) armut çeşitlerinde polen çimlenmesi ve polen tüpü uzunluklarına etkilerini belirlemek için yapılmıştır. Araştırma kapsamında temin edilen çiçek örnekleri 2017 yılının ilkbahar sezonunda Çanakkale Onsekiz Mart Üniversitesi'ne ait Dardanos yerleşkesinde bulunan deneme ve araştırma bahçesinden toplanmıştır. Polen canlılığının tespitinde kullanılan iyotlu potasyum iyodür (IKI) solüsyonu, 10 ml damıtılmış su içinde 0.5 g iyot ve 1 g potasyum iyodürün çözünmesiyle elde edilmiştir. Armut ve erik polenlerinin ideal besin ortamını bulmak amacıyla besin ortamlarında bulunan sakkarozun miktarı %10, %15, %20 ve %25 olacak şekilde yapılan çimlendirme denemeleri neticesinde; çimlenmeyi en iyi %20 sakkarozun bulunduğu (+ %1 agar + 0.5 ppm borik asit) ortam desteklemiştir. 'October Sun' erik polenlerinde en yüksek çimlenme oranı kontrolde gözlemlenmiştir. Yapılan uygulamalar arasında en yüksek sonuç, 5 ppm IBA uygulamasından elde edilmiştir. Bununla birlikte, 5 ppm IBA uygulaması polen tüpü uzunluklarının 200 µm'den uzun olmasını sağladığı gözlemlenmiştir. 'Williams' armut polenlerinin en yüksek çimlenme oranı, 0.5 ppm EBR, 1 ppm BAP ve 10 ppm GA_3 uygulamalarında belirlenmiştir. Ayrıca, EBR uygulamalarının bu çeşide ait polen tüplerinin uzunluklarını daha çok arttırdığı gözlemlenmiştir. 25 ppm GA_3 ile IBA ve BAP'ın konsantrasyonu arttıkça polenlerin tüp uzunluğunu daha az arttırdığı belirlenmiştir. 'Marguerite de Marillat' armut polenlerinde çimlenme oranı %30'un altında kalmıştır. Kontrol uygulaması haricinde, 'Marguerite de Marillat' polen tüplerinin 50-200 µm arasında gelişimini destekleyen uygulamalar 0.5-1 ppm EBR, 5-10 ppm IBA ve 2 ppm BAP olmuştur. Polen tüpü uzunluğunu 200 µm'nin üzerine çıkaran bir uygulama gözlenmemiştir.
Anahtar Kelimeler: Büyüme Düzenleyicileri, Çimlenme Oranı, Polen Tüpü Uzaması, Erik, Armut

THE EFFECTS OF SOME PLANT GROWTH REGULATORS ON GERMINATION AND POLLEN TUBE LENGTH İN PLUM AND PEARS

ABSTRACT
This study was conducted to determine the effects of plant growth regulators on pollen germination and pollen tube lengths in 'October Sun' plum (*Prunus salicina* Lindl.) and 'Marguerite de Marillat' and 'Williams' pear (*Pyrus communis* L.) varieties. Flower samples obtained within the scope of the research were collected from the experimental and research orchard belonging to Çanakkale Onsekiz Mart University during the early spring season of 2017 at the Dardanos campus. The IKI (Iodine-Potassium Iodide) solution used for pollen viability assessment was prepared by adding 1 g of potassium iodide and 0.5 g of iodine to 10 ml of distilled water. In order to find the ideal nutrient medium for pear and plum pollens, germination experiments were conducted with varying amounts of sucrose in nutrient mediums, namely 10%, 15%, 20%, and 25%. The results revealed that the best germination occurred in the medium containing 20% sucrose, supplemented with 1% agar and 0.5 ppm boric acid. The highest germination rate for 'October Sun' plum pollens was observed in the control group. Among the applied treatments, the highest result was obtained from the 5 ppm IBA application. Additionally, it was observed that in the 'October Sun' variety, more pollen had pollen tubes longer than 200 µm, facilitated by the 5 ppm IBA application. The highest germination rate for 'Williams' pear pollens was determined in the 0.5 ppm EBR, 1 ppm BAP, and 10 ppm GA_3 applications. Additionally, it was observed that the application most increasing the pollen tube lengths for 'Williams' was EBR. It was determined that as the concentration of 25 ppm GA_3 and IBA and BAP increased, the tube length of pollen increased less. The germination rate for 'Marguerite de Marillat' pear pollens remained below 30%. Except for the control application, the treatments supporting the development of 'Marguerite de Marillat' pollen tubes in the range of 50-200 µm were 0.5-1 ppm EBR, 5-10 ppm IBA, and 2 ppm BAP.
Keywords: Plant Growth Regulators, Germination Ratio, Pollen Tube Length, Plum, Pear

1. GİRİŞ

Erik ve armut yetiştiriciliği Türkiye'de ekonomik olarak önemli bir tarım faaliyetidir. Ancak iklim değişiklikleri, hastalıklar ve tarım uygulamalarındaki değişiklikler, üretimde çeşitli zorluklar ortaya çıkarabilir. Ayrıca yetiştirilen türde döllenme ve meyve tutumunun yüksek olmasına ihtiyaç duyulmaktadır. Bir meyve türünde meyve tutumunun yüksek olmasında polenlerin miktarı, yapısı, canlılığı ve çimlenme oranı gibi özellikler etkili olmaktadır (Bolat ve Güleryüz, 1994; Altunbaş ve Engin, 2016).

Meyve oluşumu için gerekli olan tozlanma ve döllenme süreçlerinde polen ana unsurdur. Polen canlılığı bitkilerin üreme başarısını, genetik çeşitliliği, tohum ve meyve oluşumunu sağlayarak bitkilerin ekosistemdeki rolünü destekler. Bu nedenle, polen canlılığının çeşitli testler aracılığıyla araştırılması gereklidir (Çetin ve Soylu, 2006). Canlılık özelliği yüksek olan polenlerin çimlenme kabiliyetleri, ortamdaki sakkarozun hatta bitki büyümesini düzenleyici maddelerin miktarına ve çevresel koşullara (sıcaklık, nem vs.) bağlı olarak değişiklik gösterir.

Bitki büyüme düzenleyicileri ilk olarak tohumların çimlenmesi ve çeliklerin köklendirilmesi gibi süreçlerde kullanılırken, daha sonra bitki gelişimini teşvik etmek, çiçeklenmeyi düzenlemek, meyve oluşumunu artırmak ve çevresel streslere karşı direnci artırmak gibi amaçlarla kullanılmaya başlanmıştır. Ayrıca bitkilerin hastalıklara ve zararlılara karşı dayanıklılığını artırmak için de bu düzenleyiciler kullanılmaktadır (Aydoğdu ve Boyraz, 2005). Yapılan *in vitro* çalışmalarda bitki büyüme düzenleyicilerin etkileri tek başlarına ve çeşitli kombinasyonlar yapılarak gözlemlenmiştir.

Brassinosteroidler bitkilerin çeşitli büyüme ve gelişim süreçlerini düzenleyen bir grup bitki hormonudur. Bu bileşenler bitki büyümesini önemli ölçüde teşvik eden bitki büyüme düzenleyicileri olarak araştırmalarda önemli bir yer tutmaktadır (Engin ve Gökbayrak, 2022). Brassinosteroidlerin bu çeşitli fonksiyonları bitkilerin yaşamsal süreçlerini düzenlemede kilit bir rol oynadıklarını gösterir. Brassinosteroidler bitkilerin çeşitli büyüme aşamalarında çevresel streslere karşı adapte olmada ve genel sağlıklarını sürdürmede yardımcı olduğundan önemleri her geçen gün artmaktadır (Katel ve ark., 2022). Polen çimlenmesi bitkilerin üreme sürecinde

kritik bir adımdır. Brassinosteroidlerin genellikle bitki büyüme ve gelişimini düzenlediği bilindiğinden, bu hormonun spesifik olarak polen çimlenmesi ve polen tüpü gelişimi üzerinde de etkileri olabilir.

Sitokininler hücre bölünmesini ve genel büyümeyi uyarır. Polen tüpünün büyümesi ve polen çimlenmesi sırasında hücre bölünmesi önemli bir rol oynar. Bu nedenle, sitokininlerin uygun düzeyde olması polen çimlenmesini olumlu yönde etkileyebilir. Oksinler bitkilerde hücre büyümesi ve gelişmesini düzenleyen bir diğer önemli hormon grubudur. Polen tüpünün doğru bir şekilde büyümesi için oksinlerin düzenli bir şekilde mevcut olması önemlidir. Giberellinler çiçeklenme ve polen gelişimini etkileyen diğer önemli hormonlardır. Yeterli giberellin düzeyleri polen çimlenmesini teşvik edebilir (Kumlay ve Eryiğit, 2011)

Bu çalışmada kullanılan, 'Marguerite de Marillat' ve 'Williams' armut ile 'October Sun' erik çeşitlerinin polenleri *in vitro* koşullarda çimlendirilmiş ve ideal besin ortamı belirlenmiştir. Ayrıca, bitki büyüme düzenleyicilerinden 24-epibrassinolid (EBR), giberellik asit (GA_3), benzil aminopürin (BAP) ve indol bütirik asit (IBA) farklı konsantrasyonlarda besin ortamına eklenmiş ve bu maddelerin polen çimlenmesi ile polen tüpü gelişimi üzerindeki etkileri araştırılmıştır.

2. MATERYAL VE METOT

Araştırmanın uygulanabilmesi için gereken çiçek örnekleri Çanakkale Onsekiz Mart Üniversitesi'ne ait Dardanos yerleşkesinde bulunan deneme ve araştırma bahçesinden 2017 yılının ilkbahar döneminde toplanmıştır. Araştırmada 'Williams' ve 'Marguerite de Marillat' armut (*Pyrus communis* L.) ile 'October Sun' erik (*Prunus salicina* Lindl.) çeşitleri kullanılmıştır.

2.1. Polenlerin Elde Edilmesi

Farklı yükseklik ve yöndeki ağaç dallarından henüz açmamış veya açmak üzere olan çiçekler toplanarak, laboratuvarda anterler çiçek saplarından pens yardımıyla ayrılmıştır. Ayrılan

anterler bir kurulama kağıdı üzerine serilerek oda sıcaklığında 24 saat boyunca kurumaları için bekletilmiştir. Polen çimlendirme çalışması öncesinde polenler, ilk olarak 24 saat boyunca +4°C'de bekletilmiş, ardından petri kapları içinde 26±1°C'de iklim odasında 48 saat boyunca bekletilerek patlamaları sağlanmıştır.

2.2. Polen Canlılık Testi

Polen canlılığının belirlenmesinde kullanılan IKI solüsyonu, 1 g potasyum iyodür ve 0.5 g iyot 10 ml damıtılmış suya eklenerek oluşturulmuştur. Elde edilen solüsyon ile kahverengi renkte boyanan polenler canlı, sarı renkte ve saydam görünen polenler ise cansız olarak iki kategoriye ayrılmıştır (Bolat ve Pırlak, 1999). Her çeşit için IKI testinden 1 saat sonra yapılan sayımlar her bir lamda tesadüfi olarak seçilmiş 4 farklı bölgede en az 100 polenin sayılmasını içermiştir. Mikroskop altında (Olympus CX–41), farklı boyama gruplarına ait polenlerin oranları yüzde (%) olarak belirlenmiştir.

2.3. Besin Ortamındaki Sakkaroz Oranının Belirlenmesi

Polen çimlendirme testleri, Eti (1991) tarafından belirtilen *in vitro* koşullarda agar-petri yöntemiyle belirlenmiştir. İlk çimlendirme denemesi armut ve erik polenlerinin ideal besin ortamını belirlemek amacıyla besin ortamlarındaki sakkaroz oranları (%10, %15, %20, %25) değiştirilerek yapılmıştır.

2.4. Polen Çimlendirme Testleri

Besin ortamındaki ideal sakkaroz konsantrasyonu belirlendikten sonra mikropipet yardımıyla ortama bitki büyüme düzenleyici maddeler eklenmiştir. Brassinosteroid bileşiği olan 24-epibrassinolid (EBR) 0.5, 1 ve 2 ppm, giberellik asit (GA_3) 5, 10 ve 25 ppm, sitokinin bileşiği olan benzil aminopürin (BAP) 1, 2 ve 4 ppm ve son olarak bir oksin bileşiği olan indol bütirik asit (IBA) 5, 10 ve 25 ppm konsantrasyonları hazırlanarak ayrı ayrı besin ortamlarına eklenmişlerdir. Kontrol uygulamasının ortamı 100 ml saf suda 1 g agar ve 20 g sakkarozun çözdürülerek 0.5 ppm borik asit ilave edilmesinden oluşmuştur. Çubuk karıştırıcılar yardımı ile homojen dağılımları sağlanmıştır. Hazırlanan solüsyonlar petrilere yaklaşık 2 mm kalınlığında

ve boşluk kalmayacak şekilde dökülmüştür. Polenlerin ekimi resim fırçası kullanılarak besin ortamına homojen bir şekilde düşecek şekilde yapılmıştır. Ortam tam katılaşmadan önce petri kapaklarına saf su ile nemlendirilmiş iki kat filtre kağıdı ile kaplanmıştır. Hazırlanan petri kapları polenlerin çimlenmesi ve polen tüpü gelişimini izlemek amacıyla 26±1°C sıcaklıkta 24 saat boyunca karanlık bir odada muhafaza edilmiştir. Çimlenme süresince filtre kağıtları kurudukça, saf su ile nemlendirme işlemi gerçekleştirilmiştir. 24 saatlik çimlenme süresinin ardından, her petri kabında çimlenen polenler 10x büyütmeli bir mercek yardımıyla rastgele seçilmiş dört farklı bölgede en az 100 polen sayılarak, tespit edilmiştir. Çimlenen polenlerin oranları yüzde (%) olarak belirlenmiştir. Işık mikroskobunda (Olympus CX–41) 40x büyütmeli mercek ile LC Micro programı kullanılarak fotoğraflama işlemi gerçekleştirilmiştir.

2.5. Polen Tüpü uzunluğunun belirlenmesi

Polen ekimi işleminden 24 saat sonra, ışık mikroskobunun (Olympus CX-41) 40x büyütmeli merceği kullanılarak polen tüplerinin gelişimi belirlenmiştir. Polen tüpü uzunlukları 50 µm'den kısa, 50-200 µm arasında ve 200 µm'den uzun polen tüpleri olmak üzere üç farklı grupta sınıflandırılmış ve çimlenen polenlerin tamamında ölçüm yapılmıştır. Denemeler, dört farklı tekerrür üzerinde gerçekleştirilmiş ve elde edilen sonuçlar yüzde (%) olarak raporlanmıştır.

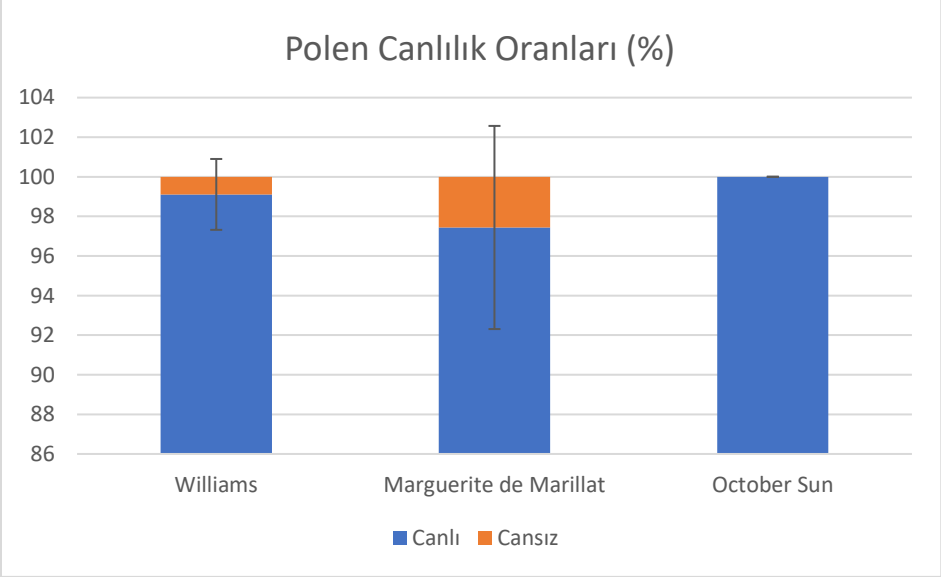
2.6. İstatistiksel Analizler

Besin ortamındaki sakkaroz ve çimlenme oranının tespiti deneme tesadüf parselleri desenine göre dört tekerrürlü yapılmıştır. Tekerrürlerde en az 100 adet polen sayılarak çimlenme oranları belirlenmiştir. Polen tüpü uzunluğunun tespitinde de tesadüf parselleri deseninde dört tekerrürlü bir düzen kullanılmış ve her bir tekerrürde tüm çimlenen polenlerin tüp uzunluğu ölçülerek belirlenmiştir.

Deneme sonuçları, Minitab istatistik programı (versiyon 16.1) kullanılarak varyans analizi ile değerlendirilmiş ve elde edilen verilere göre polen tüpü gelişimine olan etkileri hesaplanmıştır. Gruplar arasındaki farklılıklar ise $p \leq 0.05$ düzeyinde önemli kabul edilen Duncan çoklu karşılaştırma testi kullanılarak belirlenmiştir.

3. BULGULAR ve TARTIŞMA

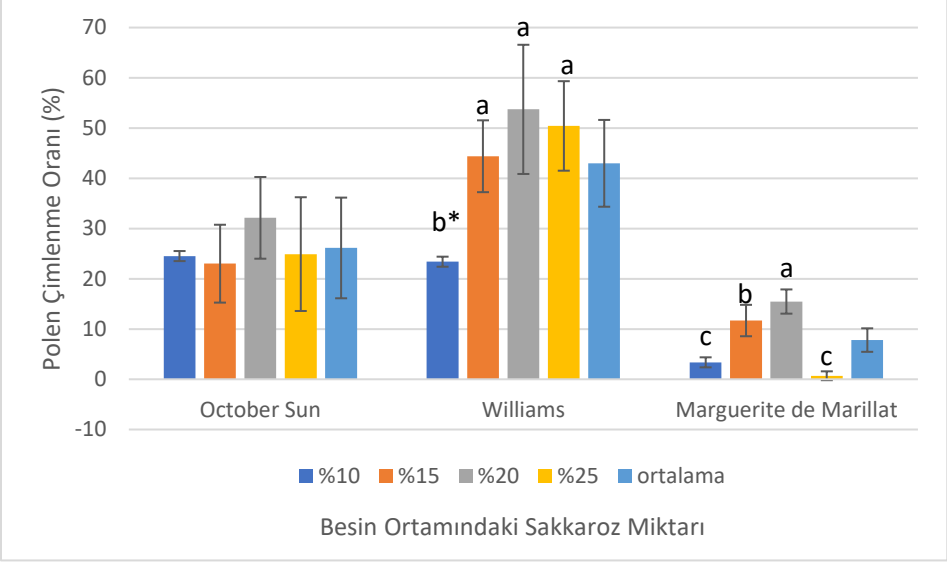
IKI testi sonuçlarına göre, 'October Sun' çeşidinde canlılık oranı %100, 'Williams' çeşidinde %99.01 ve 'Marguerite de Marillat' çeşidinde %97.44 olarak belirlenmiştir. Bu sonuçlar, her üç çeşidin de canlılık oranlarının oldukça yüksek olduğunu göstermektedir (Şekil 1). Benzer şekilde Binici ve Dalkılıç (2020) erik çeşitleri üzerinde hem IKI hem de TTC (Triphenyl Tetrazolium Chloride) canlılık testleri yapmış ve sonuçta IKI testinde canlılık oranları daha yüksek olmuştur.



Şekil 1. IKI testi ile belirlenen 'October Sun', 'Williams' ve 'Marguerite de Marillat' çeşitlerindeki polen canlılık oranları (%) (Hata Çubukları = ±Standart sapma)

Armut ve erik polenleri için en uygun çimlendirme ortamını bulmak amacıyla yapılan ilk deneme sonucunda polen çimlenmesi üzerinde besin ortamındaki sakkaroz oranının önemli olduğu gözlemlenmiştir ($p=0.01$). Armut polenlerinin çeşitli sakkaroz miktarlarına bağlı olarak polen çimlenme oranları önemli bulunurken, erik için bu fark önemsiz olarak belirlenmiştir ($p= 0.592$). Bu oranlar yüzde (%) olarak Şekil 2.'de verilmiştir. Sakkaroz miktarının artmasıyla birlikte, her iki çeşide ait polen çimlenme oranlarının arttığı ve en yüksek çimlenme oranına %20 sakkaroz içeriğinde ulaşıldığı tespit edilmiştir. Ancak, özellikle %25 sakkaroz miktarında 'Marguerite de Marillat' armut polenlerinin çimlenme oranının aniden düştüğü gözlemlenmiştir. Benzer bir eğilim, elma, erik ve vişne çeşitleri ile yapılan bir deneme için de rapor edilmiştir (Dorukoğlu ve Aslantaş, 2013). Bu denemede, sakkaroz konsantrasyonu arttıkça polen

çimlenme oranının arttığı, ancak artan konsantrasyonla beraber ani bir düşüş yaşandığı belirlenmiştir. Ayrıca, Binici ve Dalkılıç (2020) tarafından yapılan bir çalışmada Papaz eriği çeşidinde sırasıyla %15 ve %20 sakkaroz içeriği ortamlarında %34.15 ve %31.63 çimlenme oranları belirlenmiştir. Bu durum, araştırmacılar tarafından besin ortamındaki sakkaroz miktarının artmasıyla polenlerde osmotik basınç ve olası kuraklık stresinin artması olarak açıklanmıştır.



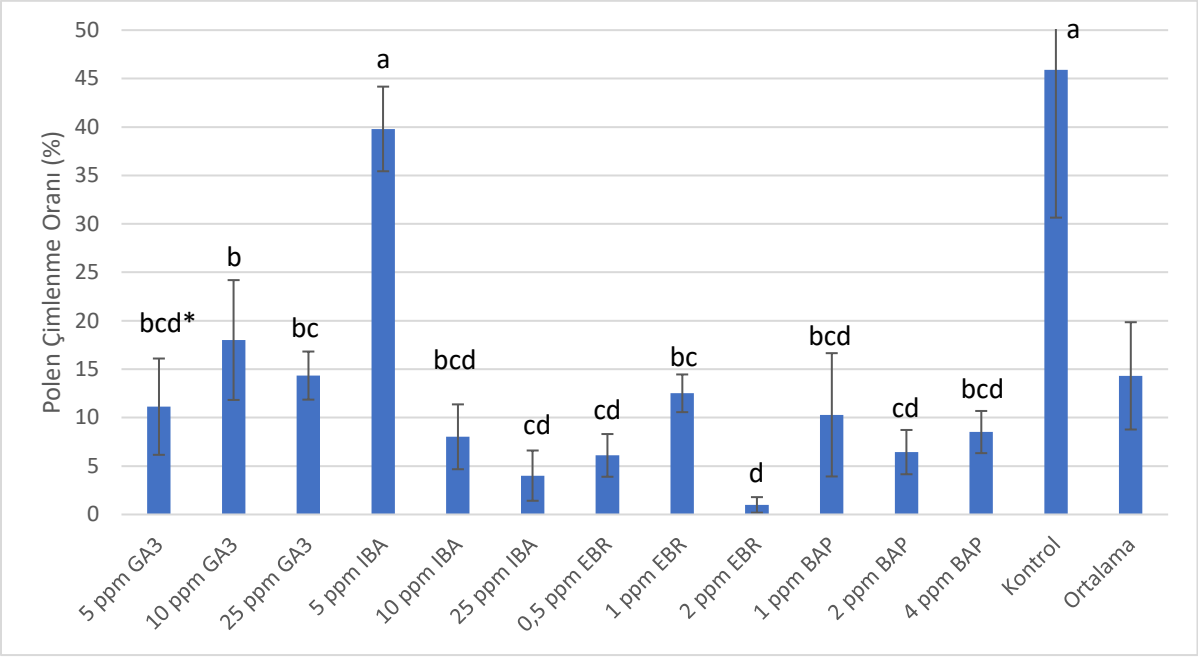
Şekil 2. 'October Sun' erik ile 'Williams' ve 'Marguerite de Marillat' armut çeşitlerine ait polenlerin farklı sakkaroz konsantrasyonlara sahip besin ortamındaki çimlenme oranları (%) *Farklı harfler gruplar arası farklılığı ifade eder. (Hata Çubukları = ±Standart sapma)

Deneme sonuçlarına göre, ideal besin ortamı olarak %20 sakkaroz konsantrasyonu olarak gözlemlenmiştir. Bu bulgu, daha önce Stanley erik çeşitleri için (Eti, 1991) ve armut çeşitleri için (Eti, 1996) yapılan çalışmalarla da desteklenmiştir. Polen çimlendirme denemesi sonucunda elde edilen veriler ile uygulama ve konsantrasyonların etkilerinin çeşitlere göre farklılık gösterdiği ve çeşitlerin çimlenme oranları üzerine etkili olduğu tespit edilmiştir (p=0.000).

3.1. 'October Sun' Erik Çeşidinde Çimlenme Oranı İle Polen Tüpü Uzunluğunun Tespiti

'October Sun' çeşidinde polen çimlendirme denemesi sonucunda farklı konsantrasyonlardaki büyüme düzenleyicilerin etkileri % olarak Şekil 3'te gösterilmiştir. En yüksek çimlenme oranları bitki büyüme düzenleyici kullanılmaksızın hazırlanan kontrol grubunda (%45.91) ve 5

ppm IBA uygulamasında (%39.80) tespit edilmiştir. En düşük çimlenme ise 2 ppm EBR uygulamasında bulunmuştur (%0.96). GA_3, IBA, EBR ve BAP uygulanan 'October Sun' polenlerinin çimlenme oranlarının kontrol uygulaması ile kıyaslandığında daha düşük olduğu görülmüştür.



Şekil 3. Farklı konsantrasyonlarda uygulanan büyüme düzenleyicilerin 'October Sun' erik polenlerindeki çimlenme oranı (%). *Farklı harfler gruplar arası farklılığı ifade eder. (Hata Çubukları = ±Standart Sapma)

GA_3 sonuçları içinde en iyi sonucu %18.01 çimlenme oranı ile 10 ppm GA_3 uygulamasının verdiği görülmektedir. GA_3 konsantrasyonu artınca (25 ppm) çimlenme oranı %14.34'e gerilemiştir. Kontrol uygulamasından sonra çimlenmeyi en fazla uyaran uygulama 5 ppm IBA olmuştur. IBA konsantrasyonları arttıkça, çimlenme oranlarını düşürerek olumsuz etkilere sebep olmuştur. EBR'nin artan konsantrasyonları başta çimlenmeyi teşvik ederken (1 ppm EBR; -%12.51), sonrasında çimlenme oranını düşürmüştür (2 ppm EBR; -%0.99). Nar çeşitleri ile yapılan bir çalışmada benzer şekilde GA_3 ve EBR uygulamaları çimlenme oranlarını artırırken, oksin bileşiği olan NAA (naftalen asetik asit)'in polen çimlenmesini azaltan bir etkisi olduğu gözlenmiştir (Engin ve ark., 2015). BAP uygulamaları içinde en uygun sonuç 1 ppm BAP (%10.29) konsantrasyonunda elde edilmiştir. Konsantrasyonun artmasıyla birlikte çimlenme oranında başta azalış (%6.44), ardından artış (%8.51) olduğu gözlemlenmiştir.

Polen tüpü uzunlukları, kısa olanlar (50 µm'den kısa), orta uzunluktakiler (50-200 µm arasında), ve uzun olanlar (200 µm'den uzun) olmak üzere üç kategoride incelenmiştir. Elde edilen sonuçlar yüzde olarak Çizelge 1'de sunulmuştur. 'October Sun' erik çeşidinde, polen tüpü uzunlukları genellikle 50 µm'den kısa ve 50-200 µm arasında değişim göstermektedir (Çizelge 1). Kontrol uygulamasında, Polen tüpü uzunlukları çoğunlukla %49.87 ile 50-200 µm arasında ölçülmüştür. %30.15 ise 50 µm'den kısa polen tüplerini temsil etmektedir.

Çizelge 1. 'October Sun' a ait polen tüplerinin *in vitro* şartlardaki uzunluk sınıflarına göre dağılımı (%)

Büyümeyi düzenleyici	Konsantrasyon (ppm)	>200 µm	<50-200> µm	<50 µm
EBR	0.5	2.78 cd*	6.70 f	90.53 a
	1	0.00 d	46.56 bcd	53.44 bc
	2	0.00 d	0.00 f	100.00 a
GA_3	5	0.00 d	17.75 ef	82.25 a
	10	15.79 bc	31.02 de	50.92 bcd
	25	11.05 bcd	59.00 abc	29.95 cde
BAP	1	7.04 bcd	46.71 bcd	46.25 bcde
	2	0.00 d	78.30 a	21.70 de
	4	4.17 cd	63.44 ab	32.39 cde
IBA	5	44.19 a	36.26 cde	19.55 e
	10	0.00 d	47.58 bcd	52.42 bc
	25	0.00 d	0.00 f	100.00 a
Kontrol	0	19.98 b	49.87 bcd	30.15 cde
Ortalama		8.08	37.17	52.66

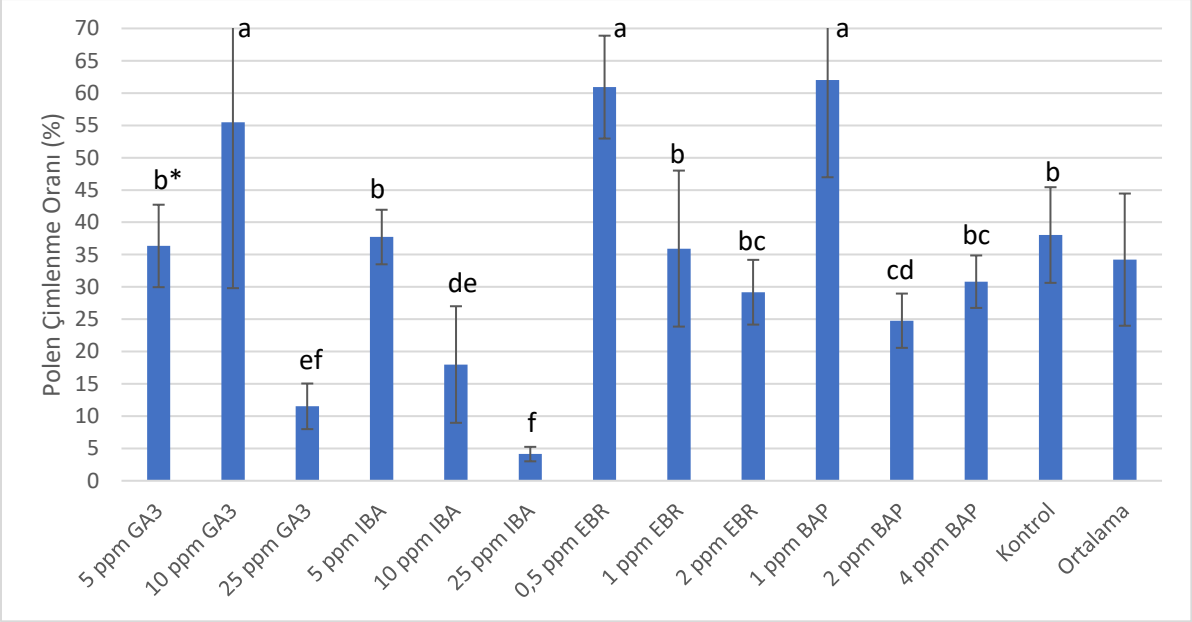
*Aynı sütundaki farklı harflerle gösterilen ortalamalar %5 düzeyinde farklıdır.

GA_3'ün artan konsantrasyonlarının 'October Sun' erik çeşidinde polen tüpü uzamasını arttırdığı gözlemlenmektedir. Bilhassa, 10 ppm GA_3 konsantrasyonunun, 200 µm'den uzun polen tüpü gelişimini diğer konsantrasyonlara göre daha etkili bir şekilde teşvik ettiği görülmüştür (%15.79). 5 ppm IBA uygulaması, diğer IBA konsantrasyonları ve diğer uygulamalar arasında en yüksek oranda (%44.19) 200 µm üzerinde polen tüpü uzunluğunu teşvik eden uygulama olmuştur. Ancak, 10 ppm ve 25 ppm IBA'nın 'October Sun' çeşidinde 200 µm'den uzun polen tüpü oluşumunu teşvik etmediği gözlemlenmiştir. 1 ppm EBR uygulamasında %12.51 çimlenme oranına ulaşılmasına rağmen, bu uygulamada 200 µm'in üzerinde polen tüpüne rastlanmamıştır. Diğer taraftan, %6.1 çimlenme oranına sahip olan 0.5 ppm EBR uygulamasında çimlenen polenlerin %2.78'i 200 µm'den uzun olarak belirlenmiştir. 2 ppm BAP

konsantrasyonu ise polen uzunluğu gelişimini desteklememiştir. Ancak, 1 ppm BAP (%7.04) ve 4 ppm BAP (%4.17) uygulamalarında 200 µm'den uzun polen tüpüne rastlanmıştır.

3.2. 'Williams' Armut Çeşidinde Çimlenme Oranı İle Polen Tüpü Uzunluğunun Tespiti

Büyüme düzenleyicilerin farklı konsantrasyonlardaki 'Williams' a ait polenlerin çimlenme oranlarına etkileri yüzde olarak Şekil 4'te gösterilmiştir. 'Williams' armut çeşidinde, en yüksek çimlenme oranları sırasıyla 1 ppm BAP uygulamasında (%62.00), 0.5 ppm EBR uygulamasında (%60.92) ve 10 ppm GA_3 uygulamasında (%55.46) gözlemlenmiştir. En düşük çimlenme oranı, 25 ppm IBA uygulamasında (%4.13) belirlenmiştir.



Şekil 4. Farklı konsantrasyonlarda uygulanan büyüme düzenleyicilerin 'Williams' armut polenlerindeki çimlenme oranı (%). *Farklı harfler gruplar arası farklılığı ifade eder. (Hata Çubukları = ±Standart Sapma)

Çimlenme oranı 10 ppm GA_3 (%55.46) konsantrasyonunda kontroldeki (%38.03) çimlenme oranından daha yüksektir, ancak 5 ppm GA_3 (%36.34) kontrolle benzerdir. 25 ppm GA_3 (%11.52) konsantrasyonu ise kontrolle karşılaştırıldığında düşük çimlenme oranına işaret etmektedir. IBA'nın konsantrasyonu arttıkça çimlenme oranı sırasıyla %37.72, %17.99 ve %4.13'e düşmüştür. 5 ppm IBA istatistiksel olarak kontrolle benzerken, 10 ve 25 ppm'lik konsantrasyonları kontrolle karşılaştırıldığında daha düşük çimlenme oranına sahiptir.

EBR uygulamasına odaklandığımızda, en iyi sonuç 0.5 ppm EBR konsantrasyonunda rastlanılmıştır (%60.92). 1 ppm EBR (%35.93) ile karşılaştırıldığında yakın bir sonuç elde edilmiş, ancak 2 ppm EBR (%29.18) kontrol grubunun gerisinde kalmıştır. Kocayemiş ile yapılan bir çalışmada, polenlerin çimlenmesini teşvik eden en iyi uygulamalar sırasıyla; 0.01 ile 0.001 ppm homobrassinolid (HBL), 0.001 ppm EBR, 25 ppm GA_3 ve 0.1 ppm EBR olarak belirlenmiştir (Gökbayrak ve ark., 2020). Çalışmamız, benzer şekilde GA_3'ün artan konsantrasyonlarında çimlenmenin azaldığını, EBR'nin ise GA_3 ile karşılaştırıldığında çimlenmeyi daha fazla teşvik ettiğini göstermektedir. Araştırmacılara göre, bu durumun polenlere uygulanan konsantrasyonla yakından ilişkili olduğu belirtilmiştir.

BAP'ın konsantrasyonu arttıkça çimlenme oranı başta azalırken sonrasında artmıştır. Özellikle 1 ppm BAP konsantrasyonu, %62'lik çimlenme oranıyla kontrol ve diğer uygulamalara kıyasla en yüksek çimlenme oranına sahiptir.

Çizelge 2. 'Williams' çeşidine ait polen tüplerinin *in vitro* şartlardaki uzunluk sınıflarına göre dağılımı (%)

Büyümeyi düzenleyici	Konsantrasyon (ppm)	>200 µm	<50-200> µm	<50 µm
EBR	0.5	100.00 a*	0.00 f	0.00 b
	1	93.31 a	6.69 ef	0.00 b
	2	95.17 a	4.83 ef	0.00 b
GA_3	5	67.70 b	28.69 cd	3.61 b
	10	94.17 a	5.83 ef	0.00 b
	25	0.00 d	95.00 a	5.00 b
BAP	1	51.04 c	48.96 bc	0.00 b
	2	0.00 d	63.12 b	36.88 a
	4	0.00 d	100.00 a	0.00 b
IBA	5	93.70 a	3.52 ef	2.78 b
	10	0.00 d	96.97 a	3.03 b
	25	0.00 d	100.00 a	0.00 b
Kontrol	0	68.38 b	24.76 de	6.86 b
Ortalama		51.04	44.49	4.74

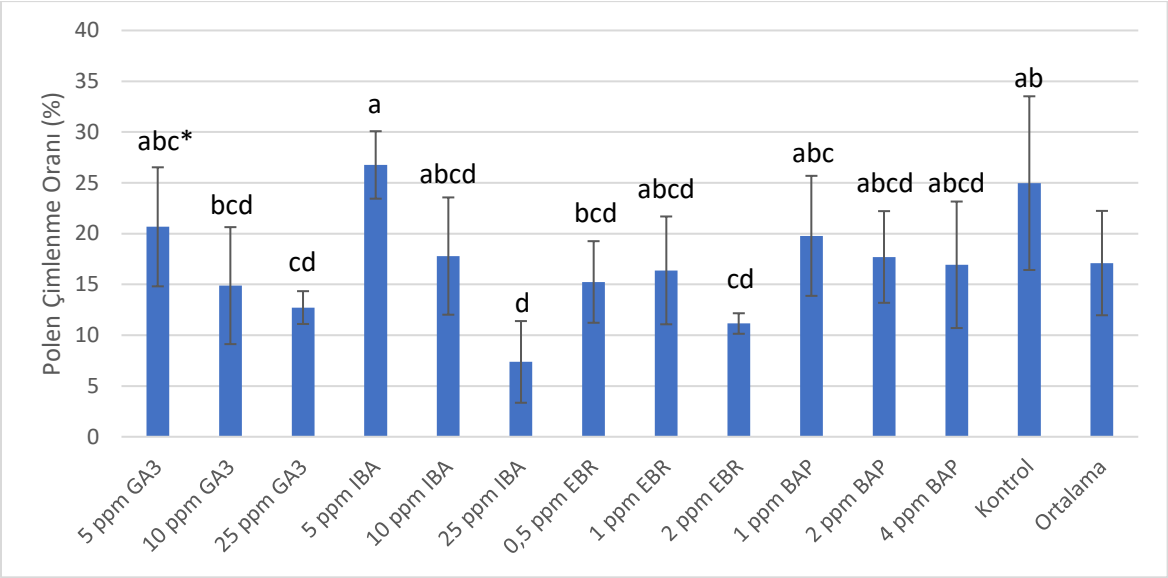
*Aynı sütundaki farklı harflerle gösterilen ortalamalar %5 düzeyinde farklıdır.

'Williams' armut çeşidindeki polen tüpü uzunlukları yüzdelik oranlarla Çizelge 2'de verilmiştir. 'Williams' armut çeşidinde GA_3'ün düşük konsantrasyonlu uygulamalarının polen

tüpü uzunluğunu 200 µm üzerine çıkardığı, ancak artan konsantrasyonların polen tüpü uzunluklarını 50-200 µm arasında sınırladığı gözlemlenmiştir. En etkili sonuç 10 ppm GA_3 uygulamasında (%94.17) elde edilmiştir. Aynı şekilde, IBA ve BAP uygulamalarının düşük konsantrasyonları da polen tüpü uzunluğunu olumlu yönde etkilemiştir. Örneğin, 5 ppm IBA uygulaması, çimlenen polenlerdeki polen tüplerinin %93.70'inin 200 µm'den uzun olmasını teşvik etmiştir. EBR'nin farklı konsantrasyonları da 'Williams' polen tüplerinin uzunluğunu artırmıştır 0.5 ppm EBR uygulaması (%100), 1 ppm EBR uygulaması (%93.31) ve 2 ppm EBR uygulaması (%95.17) ile, bu çeşide ait polen tüplerinin 200 µm'den uzun oluşumunu teşvik edilmiştir. Kontrol grubu bakıldığında, polen tüpü uzunluklarının 200 µm'nin üzerinde olduğu görülmüştür (%68.38). 'Williams' armut çeşidinde yapılan uygulamaların genel olarak polen tüpü uzamasını teşvik ettiği gözlemlenmiştir.

3.3. ‘Marguerite De Marillat’ Armut Çeşidinde Çimlenme Oranı İle Polen Tüpü Uzunluğunun Tespiti

'Marguerite de Marillat' çeşidinde ideal çimlenme oranları 5 ppm IBA uygulamasında (%26.76), kontrolde (%24.97), 5 ppm GA_3 uygulamasında (%20.67) ve 1 ppm BAP uygulamasında (%19.78) belirlenmiştir (Şekil 5). İstatistiki olarak diğer uygulamalara göre önemli olsalar dahi, ‘Marguerite de Marillat’ın polen çimlenme oranı %30’un altında kalmıştır. GA_3, IBA ve BAP uygulamalarının düşük konsantrasyonları polen çimlenmesine etkisi olmuş fakat konsantrasyonlar arttıkça çimlenme oranının düştüğü gözlenmiştir. Benzer bir sonucu Zhou ve Zhang (2010) armut üzerinde yaptıkları çalışmada düşük konsantrasyonlu GA_3 ‘ün çimlenme ve polen tüpü gelişimini pozitif etkilerken, konsantrasyon arttıkça bu gelişimin gerilediğini bildirmişlerdir.



Şekil 5. Farklı konsantrasyonlarda uygulanan büyüme düzenleyicilerin 'Marguerite de Marillat' polenlerindeki çimlenme oranı (%). *Farklı harfler gruplar arası farklılığı ifade eder. (Hata Çubukları = ±Standart Sapma)

EBR uygulamaları arasında en iyi sonuç %16.38 ile 1 ppm EBR olmuştur. Kontrol (%24.97) ile kıyaslandığında diğer uygulamaların çimlenme oranı kontrolden daha düşükken, 5 ppm IBA uygulamasının çimlenme oranı %26.76 ile yüksek bulunmuştur.

Armut çeşitlerinde, büyüme düzenleyicilerine olan tepkiler çeşide özgün bir şekilde görülmüştür. Özellikle EBR, 'Williams' çeşidinde etkili olmasına karşın, 'Marguerite de Marillat' çeşidinde bu etkinin kısıtlı ve özellikle yapılan uygulamanın dozuna bağlı olduğu gözlemlenmiştir. Bu durum, 'Marguerite de Marillat'ın triploid çeşit özelliklerinden kaynaklanabileceği gibi, iklim ve toprak şartları, ağacın yaş, bakım ve beslenmesi ile polenlerin ne zaman ve nasıl bir yöntem ile alındığıyla da ilişkili olabilir. Ayrıca, 'Marguerite de Marillat' ve 'October Sun' çeşitlerinin normal şartlarda da çimlenme oranının 'Williams' çeşidine göre düşük olduğu göz önüne alındığında, büyüme düzenleyicilerinin etkilerinin sınırlı kalabileceği bir durum ortaya çıkabilir. Gökbayrak ve Engin (2017)'in İtalya ve Cardinal üzüm çeşitlerinde yaptıkları çalışmada Bitki büyümeyi düzenleyicilerin etkilerinin genotipe bağlı olduğunu ve Cardinal çeşidinde belirgin farklar gözlenmediğini rapor etmiştir. 2016 yılında yaptıkları bir başka çalışmada ise, EBR, NAA ve GA_3'ün bazı sofralık üzüm çeşitlerinin in vitro polen çimlenmesi üzerine uyarıcı etkilerinin çeşitlere özgü olduğunu ve genel olarak GA_3'ün en çok

teşvik edici olduğunu, EBR'in ise zayıf etkilere sahip olduğunu gözlemlemişlerdir. (Gökbayrak ve Engin, 2016).

'Marguerite de Marillat' a ait polen tüpü uzunlukları Çizelge 3.'te incelenmiştir. 'Marguerite de Marillat' polenlerinde, GA_3'ün 5, 10 ve 25 ppm konsantrasyonları uzun polen tüpü gelişimini desteklememiştir. Ayrıca, IBA ve EBR düşük konsantrasyonda uygulandığında polen tüpü uzunluğunu artırdığı gözlenmiştir. Ancak, BAP'ın etkisi kararsızdır; 1 ppm ve 4 ppm konsantrasyonlarında 50-200 µm arasında bulunan tüp sayısını artırırken, 2 ppm konsantrasyonunda kısa polen tüplerinin oluştuğu gözlenmiştir. 5 ppm IBA (%92.11), 10 ppm IBA (%91.67), 0.5 ppm EBR (%95.24), 1 ppm EBR (%93) ve 2 ppm BAP (%95) uygulamalarının istatistiksel olarak anlamlı etkileri tespit edilmiştir. Bu uygulamaların çoğunlukla 50-200 µm aralığında polen tüpü uzamasını teşvik ettiği belirlenmiştir. 1 ppm BAP uygulamasında çimlenme oranı %19.78 olarak belirlenmiş olup, bu uygulamada çimlenen polenlerin sadece %5.83'ü 50 µm'den uzun ölçülmüştür. Diğer yandan, 2 ppm BAP uygulamasıyla elde edilen %17.7 çimlenme oranına sahip polenlerin %95'i 50-200 µm aralığında tespit edilmiştir. Bu durum, 2 ppm BAP konsantrasyonunun polen tüpü uzamasını daha etkili bir şekilde teşvik ettiğini göstermektedir.

Çizelge 3. 'Marguerite de Marillat'a ait polen tüplerinin *in vitro* şartlardaki uzunluk sınıflarına göre dağılımı (%)

Büyümeyi düzenleyici	Konsantrasyon (ppm)	>200 µm	<50-200> µm	<50 µm
EBR	0.5	0.00	95.24 a*	4.76 c
	1	0.00	93.00 a	7.00 c
	2	0.00	0.00 c	100.0 a
GA_3	5	0.00	6.62 c	93.38 a
	10	0.00	3.26 c	96.74 a
	25	0.00	0.00 c	100.00 a
BAP	1	0.00	5.83 c	94.17 a
	2	0.00	95.00 a	5.00 c
	4	0.00	7.02 c	92.98 a
IBA	5	0.00	92.11 a	7.89 c
	10	0.00	91.67 a	8.33 c
	25	0.00	9.40 c	90.60 a
Kontrol	0	0.00	62.46 b	53.17 b
Ortalama		0.00	43.20	58.00

*Aynı sütundaki farklı harflerle gösterilen ortalamalar %5 düzeyinde farklıdır.

4. SONUÇ VE ÖNERİLER

Bu araştırma, 'Williams', 'Marguerite de Marillat' ve 'October Sun' çeşitlerinin polen canlılıklarını, çimlenme yeteneklerini ve polen tüpü gelişimini belirlemeyi amaçlamaktadır. Bu sonuçlar, döllenme biyolojisi çalışmalarına önemli katkılarda bulunmayı hedeflemektedir.

Polen canlılığı sonuçlarına göre, üç çeşidin de canlılığı yüksek tespit edilmiş olmasına rağmen, polen çimlenme oranlarının düşük olmasının muhtemel nedeni yapılan IKI testinden kaynaklanabilir. Çünkü çimlenen her polenin canlı olmasına rağmen, canlılık testinde boyanan her polenin gerçekten canlı olmayabileceği bir durum söz konusu olabilir. İlerleyen çalışmalarda, diğer polen canlılık test yöntemlerinin de kullanılması ve sonuçların karşılaştırılması önemli olacaktır.

Bitki büyüme düzenleyicilerinin kullanımı genellikle bitki türüne, çevresel koşullara ve uygulama dozlarına bağlı olarak değişmektedir. Bitki büyüme düzenleyicilerinin polen çimlenmesi ve polen tüpü gelişimi üzerindeki etkilerini değerlendirmek için daha fazla bilimsel araştırmaya ihtiyaç vardır. Araştırmamızdaki *in vitro* sonuçları *in vivo* şartlara yansıtmak için arazi koşullarında uyarlanması faydalı olacaktır.

Not: Bu makale Ziraat Mühendisi Birsen Zeybek'in 'Yüksek Lisans' tezinden derlenmiştir.

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KIRSAL KALKINMADA COĞRAFİ İŞARETLİ ÜRÜNLERİN ROLÜ: KALECİK İLÇESİ ÖRNEĞİ

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ÖZET
Kırsal kalkınma, çoğunlukla tarımsal üretimle geçimini sağlayan halkın yeterli ve düzenli gelir elde etmesinin sağlanarak yaşam standardının belirli bir düzeye yükseltilmesini amaç edinen çalışmaların bütünüdür. Günümüzde, giderek artan yoksulluk, temiz ve sağlıklı gıdaya erişimde yaşanan sorunlar, kır-kent arasındaki eşitsizliklerin daha da derinleşmesi ve doğal kaynakların kirletilerek sürdürülebilirliklerinin tehlikeye girmesi kırsal alandaki üretim ve refah konularının önemini daha da arttırmaktadır. Kırsal kalkınma çalışmaları kapsamında, köyden kente olan göçleri önlemek amacıyla bir dizi sosyal ve ekonomik önlemler alınmakta ve bunlara ilişkin projeler gerçekleştirilmektedir. Coğrafi işaretli ve geleneksel ürünler de bu çalışmaların desteklenmesinde oldukça önemli olmuşlardır. Coğrafi işaretli ürünler belirli bir alana veya bölgeye özgü olarak kalite standardı ile birlikte birer marka haline getirilip üreticiye ve kırsal kalkınmaya destek olmaktadır. Bundan dolayı coğrafi işaretler bölgeler ve nihayetinde ülkeler için gelişmişlik açısından oldukça önemli bir rol oynamaktadır. Coğrafi işaret; belirgin bir niteliği, ünü veya diğer özellikleri bakımından kökenin bulunduğu yöre, alan, bölge veya ülke ile özdeşleşmiş ürünü gösteren işaret olarak tanımlanır. Kırsal alanda yaşayan halkın gelişme potansiyelini değerlendirmek amacıyla coğrafi işaretli ürünlerin ön plana çıkarılması kırsal kalkınma açısından önemli bir katkı sağlamaktadır. Coğrafi işaretli ürünler, kırsal turizmin de canlanmasında büyük rol oynamaktadırlar. Geleneksel ürünlerin ait olduğu bölgelere yurt içinden ve yurt dışından ziyaretçiler gelerek bölge ekonomisine katkı sağlamakta böylece hem bölgenin hem de ürünün tanıtımı gerçekleşmektedir. Ancak şu da unutulmamalıdır ki bir bölgeye ait coğrafi işaretli ürünleri belirlemek tek başına yeterli değildir. Önemli olan bu ürünlerin bölgedeki varlıklarının sürdürülebilirliğinin sağlanmasıdır. Bu çalışmada coğrafi işaretli ürünlere güzel bir örnek olan Ankara İli'nin Kalecik İlçesi'nde yetiştiriciliği yapılan Kalecik Karası üzümü ve yöreye özgü yapılışı ile orijinalliğini koruyan Cevizli Çöreği ele alınmıştır. Bu ürünlerin tarihçesi ve kırsal kalkınmadaki önemleri tartışılmıştır.
Anahtar Kelimeler: Kalecik, Kalecik Karası, Kalecik Cevizli Çöreği, Coğrafi İşaret, Kırsal Kalkınma

THE ROLE OF GEOGRAPHICAL INDICATION PRODUCTS IN RURAL DEVELOPMENT: THE CASE OF KALECIK DISTRICT

ABSTRACT
Rural development is a set of studies aiming to raise the standard of living to a certain level by ensuring that the people, who mostly make a living through agricultural production, earn sufficient and regular income. Today, increasing poverty, problems in access to clean and healthy food, deepening inequalities between rural and urban areas, pollution of natural resources and endangering their sustainability increase the importance of production and welfare in rural areas. Within the scope of rural development activities, a series of social and economic measures are taken and related projects are realised in order to prevent migration from rural to urban areas. Geographically marked and traditional products have also been very important in supporting these studies. Products with geographical indication are specific to a certain area or region, become a brand with a quality standard, and support the producer and rural development. Therefore, geographical indications play a very important role in terms of development for regions and ultimately for countries. Geographical indication is defined as a sign indicating a product identified with the region, area, region or country of origin in terms of a distinctive quality, reputation or other characteristics. In this study, Kalecik Karası grape grown in Kalecik District of Ankara Province, which is a good example of geographically marked products, and Cevizli Çöreği, which preserves its originality with its local speciality, are discussed. The history of these products and their importance in rural development are discussed. Bringing geographically marked products to the forefront in order to utilise the development potential of the people living in rural areas makes an important contribution to rural development. Geographically marked products also play a major role in the revival of rural tourism. Visitors from home and abroad come to the regions where traditional products belong and contribute to the regional economy, thus promoting both the region and the product. However, it should not be forgotten that it is not enough to identify the geographically marked products of a region alone. The important thing is to ensure the sustainability of the existence of these products in the region. In this study, Kalecik Karası grape grown in Kalecik District of Ankara Province, which is a good example of geographically marked products, and Cevizli Çöreği, which preserves its originality with its local speciality, are discussed. The history of these products and their importance in rural development are discussed.
Keywords: Kalecik, Kalecik Karası, Kalecik Walnut Doughnut, Geographical Indication, Rural Development

1. INTRODUCTION

Generally, the term of rural development refers to a policy area that primarily targets farmers and villagers and aims to achieve the goals of ensuring adequate and consistent income for agricultural businesses and enhancing the wellbeing of rural households. (Anonymous2018).

Rural development means creating new market opportunities with new products and services (Van Der Ploeg 2000).

Since the 1980s, rural development policies have undergone significant changes globally. The escalating poverty rates, development gap between rural and urban areas, and mounting environmental pressures due to population growth have raised the significance of rural development worldwide (Anonymous2018).

The development of rural areas is significant for both inhabitants of the region and urban dwellers. Due to the underdevelopment of rural regions, residents relocate to cities, resulting in irregular urbanization (Kayıkçı, 2009).

Geographical indication is a sign that identifies a product with its region, area or country of origin, regarding distinctive qualities, reputation, or other specific characteristics. This certification turns such products, specific to certain areas or regions, into brands while ensuring quality standards and supporting producer and rural development. Therefore, geographical indications are very important for countries (Anonymous2018, Anonymous2023a).

The mobilisation and sustainable implementation of economic development dynamics in rural areas have led to the emergence of geographically indicated products, which are a significant consideration for harmonisation with the EU. In our country, Industrial Property Law No. 6769 dated 22.12.2016 has provided legal infrastructure for the regulation of geographically marked products (Anonymous2018).

This study examines the "Kalecik Karası (Vitis vinifera L.)" grape cultivated in the Kalecik District of Ankara Province, which serves as a prime illustration of geographically marked products, along with the "Cevizli Çöreği (Walnut Doughnut)", which maintains its authenticity through its unique local speciality. The history and significance of these products in terms of rural development are examined.

2. MATERIAL and METHOD

2.1 Geographical Characteristics of Kalecik District

Kalecik District is located in the northeast of Ankara. The neighbours of the district are Kırıkkale Province, Çankırı Province and Çubuk, Akyurt and Elmadağ districts (Anonymous2017). Figure 1 shows the map of Kalecik District.

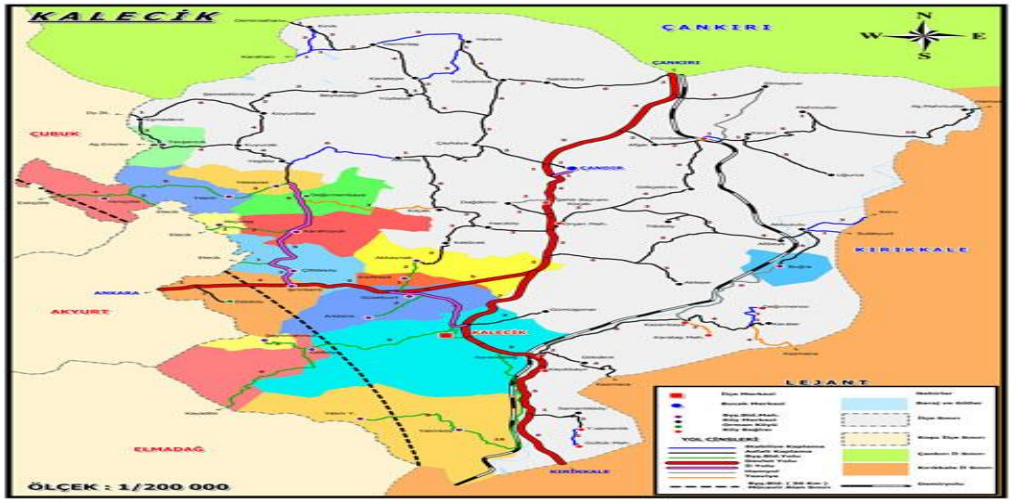


Figure 1. Map of Kalecik District (Anonymous2023b).

The area of the district is 1318 km² and the altitude is 725 metres. The district has a relatively hilly land structure. The Kızılırmak River passes through the southeast and northeast of the district. Since the altitude of the district is lower than its geography, it shows microclimate characteristics. The temperature difference between summer and winter seasons is high in the district. The average annual rainfall is 350-400 kg/m (Anonymous 2017).

The land area of Kalecik District is 131.800 hectares. Of this land, 42.31% is agricultural land, 22.59% is meadow and pasture, 7.12% is forested land and 27.98% is other land. Field crops are cultivated on 32505.7 hectares of the agricultural area, vegetable cultivation on 362 hectares, fruit cultivation on 3493.5 hectares and fallow area on 19404.1 hectares (Anonymous2017).

2.2 Geographical Indication Products of Kalecik District

2.2.1 Kalecik Çöreği (Kalecik Walnut Doughnut)

Kalecik's Walnut Doughnut has walnuts and allspice in it, and the dough is made in three layers. Each layer is brushed with oil, rolled into a spiral, and baked. In the district, the buns have been

served on holidays and special occasions since the past. On 07.10.2020, it was registered with the Turkish Patent and Trademark Office (Anonymous2023c).



Figure 2. Kalecik walnut doughnut (Anonymous2023d)



Figure 3. A Kalecik doughnut shop in Kalecik District.

2.2.2 "Kalecik Karası"

Grapes play a crucial role in agriculture in our country. During 2022, 3.6 million tons of grapes were harvested from 4.2 million decares of land, while Turkey exported 1.4 million tons of grapes in 2021/2022. Moreover, Türkiye contributed 31.3% of the total global raisin exports

during 2022 (Anonymous2022). There are important varieties in grape cultivation in our country. One of these varieties is *Kalecik Karası*. *Kalecik Karası* is a significant variety of wine grape grown in the Kalecik District of Ankara Province. Registered on 06.07.2007 by the Turkish Patent and Trademark Office (Anonymous2023e). According to historical records, *Kalecik Karası* has been cultivated in the region for an extended period. A substantial proportion of Kalecik District's soil is composed of brown, with a smaller quantity consisting of red-brown earth. The exclusive taste of *Kalecik Karası* emanates from the substantial amounts of calcium present in the soil where it is grown. The Kızılırmak River passing through near the district establishes a microclimate zone in the area. For the reasons mentioned, *Kalecik Karası* is amongst the essential ındustrial grape varieties in our country. In case this grape variety is grown in other regions, its distinct attributes are lost (Anonymous2023f).



Figure 4. A vineyard where Kalecik Karası is produced in Kalecik District.

3. CONCLUSION

Geographically marked products play a key role in the development of the region to which they belong. While these products contribute to the region in economic terms, they constitute a stepping stone in product-based industrialisation in the region and provide employment opportunities for the people of the region. In addition, geographically labelled products attract visitors to the region and increase the tourism potential of the region. As a matter of fact, this

situation in Kalecik District is as mentioned above. *Kalecik Karası*'s Festival' is organised every year in the district both to support and increase the production of *Kalecik Karası* and for advertising purposes. There are also agricultural production and industrial branches, especially viticulture, based on the grape grown in the region. Another geographically marked product, the Walnut Doughnut, has an increasing demand from the visitors coming to the region day by day. In the same way, this situation both provides an important income to the people of the region and increases the contribution of women in rural development.

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RISK ASSESSMENT OF HEAVY METALS CONCENTRATION IN WELL WATERS AROUND METAL RECYCLING INDUSTRIES OF IKORODU SOUTH WEST NIGERIA

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ABSTRACT
Assessment of heavy metals concentration of well waters (the major visible source of potable water and irrigation) was carried out to provide information on the rate of contamination/pollution caused by metals from recycling industries. Ten different well waters were collected and added together to make five samples, each representing an industry. Analysis was done using Atomic Absorption Spectrometer (AAS) while the interpretation of the analyzed results was carried out for the assessment of metal contents. Elemental composition results showed that the mean concentrations of the metals have concentrations higher than their permissible limits (PL) except Zn and Cd having concentrations (12.0 and 0.18 mg/kg) lower than their PL (30 and 0.5mg/kg respectively) The calculated contamination factor for the well water samples showed that Pb (60), Co (10,340), Cu (46,000), Fe (20), Ni (320), Mn (1000) are the metals that have highly contaminated the well waters in the area (CF>6). The Geo-accumulation index (Igeo) calculated showed that Pb, Co, Fe, and Ni are the metals that have been polluted the well waters with Co evenly having high degree of pollution across the well waters. These analyses showed that the well waters are contaminated and polluted with Pb, Co, Fe and Ni, therefore are not fit for usage. The habitants are hereby recommended to find alternative source of water farther away from this industrial area since the major source of these affected waters are from the soils and chemical spills from the industries which infiltrate and percolates down to the wells.
Keywords: Heavy metals, contamination, pollution, geo-accumulation, well water

INTRODUCTION

Heavy metals are principally referred as the metals which have high densities and atomic weights or atomic numbers (Li *et al.,* 2019). With the assumption that heaviness and toxicity are interrelated, heavy metals also include metalloids, such as arsenic, that are able to induce toxicity at low level of exposure (Duffus, 2002). Contamination may be recognized or not and may become an issue if the impure chemical is mixed with other chemicals or mixtures and causes additional chemical reactións. The additional chemical reactions can sometimes be beneficial, in which case the label 'contaminant is replaced with reactant or catalyst. Pollution is the introduction of contaminants into the natural environment that cause adverse change. Pollution can take the form of chemical substances or energy, such as noise, heat or light. Pollutants, the components of pollution, can be either foreign substances/energies or naturally occurring contaminants. Pollution is often classed as point source or non-point source pollution. In recent years, there has been an increasing ecological and global public health concern associated with environmental contamination by heavy metals. Heavy metals contamination can be observed in soil, water, air, e.t.c. (Zhang *et. al*., 2010). The composition and physical properties and chemical structure of each of the heavy metals are different. No doubt that the heavy metals are toxic as well as hazardous. They have harmful effects. Heavy metals are needed to be handled with care. Some heavy metals tend to be less reactive, whereas some are very reactive. These are thought to be toxic or highly destructive to the environment. Heavy metals mortify air, water, and soil quality and consequently cause health issues in plants, animals, people, etc. Some toxic elements are also regarded as beneficial, but only in small quantities for human health. These elements are vanadium, manganese, copper, iron, zinc, strontium, selenium, molybdenum etc. The deficiency of these metals is harmful and may increase susceptibility to heavy metal poisoning. Chronic level ingestion of heavy metals toxic or heavy metals has dangerous effects on human body, and the impacts are observable only after several years of exposure. (Zhang *et. al*., 2010).

Reported sources of heavy metals in the environment include geogenic, industrial, agricultural, pharmaceutical domestic effluents, and atmospheric sources (He *et al.,* 2005). Environmental pollution is very prominent in point source areas such as mining, foundries and smelters and other metal-based industrial operation. Although heavy metals are naturally occurring element that are found throughout the earth crust, most environmental contamination and human

exposure result from anthropogenic activities such as mining and smelting operation, industrial production, domestic and agricultural used metals and metal-containing compounds (Goyer, 2001). Heavy metals are significant environmental pollutants and their toxicity is a problem of increasing significance for ecological, evolutionary, nutritional and environmental reasons (Jaishankar *et al*., 2014)

In view of the inadequacy of the public water supply, the majority depend on self-supplied water through hand-dug wells and boreholes. These ground water sources are frequently harnessed indiscriminately and can be potentially polluted due to proximity to the industries established in the area. Several industries, including textiles, metal recycling, paint, breweries, bottling and plastic contribute substantially to the economy through employment and income generation, and there is rapid urban growth in the area. However, inadequate management of wastes generated from these industries poses a substantial threat to the environment and public health (Jaskelevicius *et al.,* 2009). These activities have resulted in serious environmental problems such as the contamination of both surface and ground water sources (Adebayo, 2010). In most cases, the untreated waste water effluents from these industries are released in water sources. They have considerable effect on both the surface and ground water in the region and consequently on the health of the inhabitants (Olayinka *et al.,* 2004). The toxic waste often accumulates through tropic level causing a deleterious biological effects (Kannan *et al.,* 2005) due to their non-degradable nature and long- time persistence in the environment. They contain a diverse range of chemicals, many of which have known hazardous properties (Gomez *et al*., 2008) and which have great effects on water quality in the immediate environs.

Water of inadequate quality has the potential to be a direct source of contamination and a vehicle for spreading localized contamination in the field, facility or transportation environments in the production of fresh produce crops (USDHHS, 2008). The increasing evidence of contamination of produce by industrial activities from irrigation water has been reviewed recently by Uyttendaele *et al*. (2015) and contamination events were identified where water is a risk factor in the production and harvesting of fresh produce. This necessitate the assessment of the heavy metals produced from these industries to check their effect on consumers and plants.

MATERIALS AND METHODS

Study Location

The field work was carried out within latitude 006°43'N and 006°44'N and longitude 003° 31'E and 003°37'E of Ikorodu area, Lagos state. The city has an area extent of 394km and population enumerated at 535,619 (2006 population censor). It has a tropical climate characterized by rainfall in the wet season April-October and a period of dry season October-May. Average temperature during raining season is 25°C and during dry season is 28°C. Several industries are located in this area (e.g Mayor Engineering African Steel, Phoenix Steel, Monarch Steel, African Foundry Metal, e.t.c) due to its proximity to Lagos metropolis, which is the most populated metropolis and commercial nerve center of Nigeria. The study location was concentrated mainly on metal industries which are located within an area covering about 6km. Materials used for the field work include Global Positioning system (GPS), nylon, soil auger, hand glove, field note book, sample bag, paper tape and marker.

Collection of Water Samples

Well water is the visible source of water used for irrigation and consumption in the area of study. Ten well water samples were collected around each metals recycling industry found in the area, the bottles were rinsed with the water samples and then filled up. These ten samples were later added together to make five samples, each representing one industry. Water samples were discounted to separate the particules from the water by using Whatman No.42 filter paper then later centrifuge to remove the settlement and then taken to the laboratory for elemental constituent analysis by using Atomic Absorption Spectrometer (AAS).

Determination of Contamination Factor

The contamination factor (CF) calculations were used to know the level of contamination of heavy metals in plants around the area of study and it's express as thus:

$$CF = \frac{Mean\ Concentration}{Background\ value} \qquad Eqn\ 1$$

(Hakanson *et al.*, 1980).

The contamination factor classification consists of four classes ranging from low contamination to very high contamination; low contamination (CF < 1), moderate

contamination (1≤CF<3), considerable contamination (3≤CF<6), and very high contamination (CF>6).

Determination of Geo-accumulation Index (Igeo)

The Geo accumulation index was used to assess the level of pollution in the soil around the study area. It is calculated by using the equation developed by (Muller, 1969) as used by Olatunji *et al.,* (2014) and it expressed as;

$$Igeo = Log2\frac{Cn}{1.5Bn} \qquad Eqn\ 2$$

Where Igeo is the Geo-accumulation Index, C_n is the concentration of metal, B_n is the background value obtain from each metals while 1.5 is the multiplication constant.

Geo-Accumulation Index Classification

According to Muller (1969), the geo-accumulation index classes consists of 7 ranges which include unpolluted (≤ 0), unpolluted to moderately polluted (0-1), moderately polluted (1-2), moderately polluted to strongly polluted (2-3), strongly polluted (3-4), strongly polluted to extremely polluted (4-5), and extremely polluted (>5).

Statistical Analysis

Data on metals content obtained from the AAS were analyzed for contamination and pollution factor. Pearson's Product Moment was also used to correlate the amount of metal in the water.

RESULTS AND DISCUSSION

The heavy metal concentration analysis is summarized below using statistical tools. The statistical table showed that with the exception of Zn and Cd, most of the detected metals have mean concentrations greater than their respective permissible limits (PL) in water. This showed that the well waters around the study area are contaminated and/or polluted by most of the heavy metals.

Table 1 **Summary of Heavy Metals Concentration**

METALS	RANGE (mg/kg)	MEAN±SD	PL (mg/kg)
Pb	1-10	6.0±4.1	0.1
Zn	0-60	12.0±26.8	30
Cd	0-0.3	0.18±0.1	0.5
Co	7-180	103.4±65.4	0.01*
Cu	0-45000	9200.0±20017.5	0.2
Fe	20-110	60.0±36.1	3.0
Ni	30-40	32.0±4.5	0.1*
Mn	0-1000	200.0±447.2	0.2

PL-WHO Permissible Limit for Water (*Mahmud *et al.*, 2016; Sankhla *et al*., 2021)

Pb has a range of 1-10mg/kg and this is higher when compared to 0.06-0.10mg/kg of Hussein *et al.*, (2013). Sources of Pb found in the area aside the metal recycling process are acid batteries, old plumbing system, waste incinerations, and combustion of leaded gasoline. Manganese also has a range of 0-1000mg/kg with the maximum value greater than the range (0.12-0.16mg/kg) of Hussein *et al.*, (2013). The sources of Mn fumes from exhaust pipes, welding activities, e.t.c. The cadmium range of 0-0.3mg/kg is lower when compared to the range of Cd (0.51-0.64mg/kg) by Ganiyu *et al*., (2021). Sources of Cd are excessive fertilization, sewage sludge incineration. The sources of Co in the area are chemical spills from some of the activities in the industries, emission of metal-laden dust particles from the metal recycling industries which settles on the soil and later percolates to the well water. The sources of Cu found in the study area include motor engine oils, copper IUDs, agricultural activities, domestic use of pesticides and automotive brake pads, while Nickel sources include coal combustion, incineration of wastes, smelting activities, traffic oil combustion, and vegetation. The approximate standard deviation value of Pb and Cd are close to their respective means, indicating that the sources of both Pb and Cd around the study area are uniform. Other heavy metals have standard deviation far from their respective means. This indicates that the sources of these metals are different and are indicative of the various human activities going on in the study area as at the time the field study was carried out.

Correlation Analysis

Pearson's coefficient analysis was used to measure the degree of correlation between the logarithms of the metal concentration data. The inter-elemental relationship of metals was obtained using Pearson's Correlation Coefficient. Correlation matrix table below reveals the relationship between elements in the water samples of the study area. In correlation analysis, strong and positive relationship occur between two parameters when the correlation value is greater than 0.5 (i.e. p = 0,5 and 0.99). When it is 1, it shows that perfect relationship exists between the two parameters. However, when it is positive but less than 0.5 (i.e. p = 0-0.499), the relationship between the two parameters are said to be weak. Where a negative sign appears before a value it implies no relationship exists between these the two metals.

Table 2 Correlation Matrices for Well Water

Elements	Pb	Zn	Cd	Co	Cu	Fe	Ni	Mn
Pb	1	-0.69	0.23	-0.80	-0.70	0.26	0.55	-0.69
Zn		1	0.51	0.66	0.94**	0.16	-0.25	0.92**
Cd			1	0.10	0.50	0.27	0.51	0.51
Co				1	0.67	-0.63	0.06	0.67
Cu					1	0.14	-0.26	0.97**
Fe						1	-0.47	0.16
Ni							1	-0.25
Mn								1

In the correlation matrixes table for well water samples above, strong and positive relationship occur between Zn/Co (0.66), Zn/Cu (0.94), Zn/Mn (0.92), Cu/Mn (0.97), Co/Cu (0.67), Co/Mn (0.67). These imply simultaneous increment or reduction of the concentration of these metals with each other indicating same anthropogenic sources or same degree of effect by these sources. Also positive but weak relationships exist between Pb/Cd (0.23), Pb/Fe (0.26), Zn/Fe (0.16), Cd/Co (0.10), Cd/Fe (0.27), Co/Ni (0.06), Cu/Fe (0.14), Fe/Mn (0.16) indicating gradual increment of the concentration simultaneously between the two metals considered. Negative relationship exist between Pb/Zn (-0.69), Pb/Co (- 0.80), Pb/Cu (-0.70), Pb/Mn (-0.69), Zn/Ni (-0.25), Co/Fe (-0.63), Cu/Ni (-0.26), Fe/Ni (-0.47), Ni/Mn (-0.25). This implies that there is reverse increment or reduction of concentration between the two metals, that is as one is

increasing, the other is decreasing and vice-versa, indicating different source of anthropogenic influences.

Contamination Factor of Heavy Metals

The calculated contamination factor (CF) is shown below. This was used to determine the degree of contamination each metal had on the well waters around the study area.

Table 3 Contamination Factor Analysis

Metals	Means (mg/kg)	Background value (PL)	Contamination Factor
Pb	6.0	0.1	60
Zn	12.0	30	0.4
Cd	0.18	0.5	0.36
Co	103.4	0.01	10,340
Cu	9200.0	0.2	46,000
Fe	60.0	3.0	20
Ni	32.0	0.1	320
Mn	200.0	0.2	1,000

The CF table showed that the well waters are highly contaminated ($cf \geq 6$) with most of the heavy metals detected except Zn and Cd ($cf \leq 1$). This is consequent when the means of the heavy metals are considered showing greater values than their respective permissible limit except Zn and Cd. The CFs of Pb, Cu and Ni (60, 46,000 and 320 respectively) are higher when compared with the highest values of Ogbaran and Uguru *et al.*, 2021 (36, 5.33 and 50 respectively). The very high rate of CF for Pb, Cu, Co, Ni, and Mn may be due to the huge number of presence of waste incineration, automobile workshops (which produces high quantity of acid batteries, combustion of leaded gasoline and motor engine oils spills), traffic congestion (which produces traffic oil combustion and fumes from exhaust pipes) and the smelting activities going on in the area of study. However the CFs of Zn and Cd are smaller when compared with the highest values of CFs for Zn and Cd (7.71 and 70 respectively) of the same work (Ogbaran and Uguru *et al.*, 2021).

Table 4 Geo-accumulation Indices of Heavy Metals

Metals	W1	W2	W3	W4	W5	Range	PL
Pb	1	1.48	1.77	2	2	1-2	0.1
Zn	0.30	0	0	0	0	0	30
Cd	-0.22	0	-0.70	-0.22	-0.40	≤ 0	0.5
Co	4.26	4.15	3.90	4.04	2.85	2-5	0.01
Cu	5.35	3.70	0	0	0	0-6	0.2
Fe	1.37	0.82	1.37	1	1.56	0-2	3.0
Ni	2.48	2.48	2.48	2.60	2.48	2-3	0.1
Mn	3.70	0	0	0	0	0-4	0.2

Keys:

W1 Well waters collected in location 1

W2 Well waters collected in location 2

W3 Well waters collected in location 3

W4 Well water collected in location 4

W5 Well water collected in location 5

PL WHO Permissible Limit

The calculated geo-accumulation index showed that the Pb, Co, Fe, and Ni are the heavy metals that have significant concentration enough to pollute the well waters in all the locations of the study area. Zn and Cd unpolluted the water in all the locations, indicating that these waters are free from zinc and cadmium as at the time the field work was carried out. Manganese is strongly polluted (3.70) in the well water in location 1 and not polluted in other well waters of the study area because of the closeness of the industry in location 1 to some welding workshops where additional Mn are produce by their activities. This has shown that even though Mn is highly contaminated in all well water, only the well water in location 1 is polluted with it. Lead and Iron are moderately polluted in all the well waters except the Fe in location 2 that is just tending towards having moderate pollution in the well water.

Considering all the well waters collected, cobalt (Co) is the only metal with even high degree of pollution across the well waters. While it has strongly polluted the well waters in location 3

(3.90) and 5 (2.85), strong to extreme pollution of it to the well waters is observed in the other locations. The even high degree of cobalt pollution of the well water is due to the high usage of chemicals by the various industries in the area which spills to the soils and later percolate to the subsurface waters and also the dusts produced from these industries. The highest pollution degree is found in well water in location 1 which has copper (Cu) being the pollutant with the greatest value of 5.35 indicating extreme pollution. This is due to the high concentration of copper produced in the metal recycling industries and the automobile workshops found around this industry in location 1.

CONCLUSION

Heavy metals in the well waters around metal recycling industries and surroundings were analyzed to check their potential risk on the habitants consuming these well waters and plants. The concentration analysis revealed that most of the elements have high concentrations in the well waters across the industrial area except for Zn and Cd. These high concentrations however did not depict their level of contamination and pollution across all the well waters. While the contamination factor calculated reveal same effect as the concentration analysis done, that is leaving just Zn and Cd as the only metals with non-significant contamination effect, the geo-accumulation index analysis (which is used to show the level of pollution of each metal on well waters) showed that only Pb, Co, Fe, and Ni have polluted all the well waters present evenly in the area. Co has the highest evenly distributed pollution index across the wells while Cu has the highest pollution index (location 1 well water) but not evenly distributed as it only pollute the wells in location 1 and 2.

Considering the effect of these heavy metals and the WHO permissible limits for consumption of water, it can be concluded that these well waters around the industries are unsafe for consumption and usage as irrigation for plants can also cause damage to the plants. The habitants are hereby recommended to have a relocation thought farther away from these industries so as to be safe from these heavy metal laden pollutants. Doing an Environment Impact Assessment (EIA) will help to provide a suitable environment for the habitants which will be free from the direct impacts of these industries.

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MERCİMEK BİTKİSİNDE FİTOPATOLOJİK AÇIDAN ZARAR OLUŞTURAN TOPRAK KÖKENLİ ÖNEMLİ FUNGAL HASTALIKLAR

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ÖZET

Ülkemizdeki mercimek (*Lens culinaris* Medik.) tarımı; insan gıdası olarak farklı kullanım alanlarına sahiptir. Ayrıca yıllara göre değişen oranlarda ihraç edilmekte ve önemli miktarda döviz kazandırmaktadır. Dünyadaki mercimek üretimi, gelişimi ve verimini etkileyen en önemli unsurlardan birisi biyotik faktörlerdir. Mercimek bitkisi fungus, bakteri, virüs, nematod ve bitki parazitlerinin neden olduğu birçok hastalıktan etkilenmektedir. Ülkemizde mercimek üretiminin gerçekleştirildiği bölgelerde, mercimek tarımını kısıtlayan en önemli faktör solgunluk, kök ve kök boğazı çürüklüğü etmenlerinin de içinde bulunduğu toprak kökenli patojenlerdir. Mercimekte hastalığa neden olan fungal etmenlerden *Fusarium avenaceum* (Fr.) Sacc.'un kök çürüklüğüne, *F. culmorum* (W.G. Smith) Sacc. ve *F. acuminatum* Ell. & Ev.'un kök boğazı çürüklüğü ve solgunluğa; *F. solani* (Mart.) Appel&Wollenw. Emend. Snyd. & Hans. kök çürüklüğüne; *F. redolens* Wollenw. [Syn:*F. oxysporum* var. *redolens* (Wr.) Gordon] ise kök ve kökboğazı çürüklüğüne ve solgunluğa neden olduğu kaydedilmiştir. Ayrıca toprak kökenli patojenler arasında; *Sclerotium rolfsii*, *Rhizoctonia bataticola, Rhizoctonia solani, Pythium ultimum*. gibi fungal hastalık etmenleri yer almaktadır. Yapılan bu derleme kapsamında; mercimek bitkisinde fitopatolojik açıdan zarara neden olan toprak kökenli önemli fungal hastalık etmenlerinin biyolojisi, epidemiyolojisi ve mücadelesi yer almaktadır.

Anahtar kelimeler: *Fusarium spp.,* Mercimek, *Sclerotium* spp.*, Pythium spp., Rhizoctonia spp.*

IMPORTANT SOIL-BORNE FUNGAL DISEASES THAT CAUSE PHYTOPATHOLOGICAL DAMAGE IN LENTIL PLANTS

ABSTRACT

Lentil (*Lens culinaris* Medik.) culture in our country has different uses as human food. In addition, it is exported at rates varying from year to year and brings a significant amount of foreign currency. One of the most important factors affecting lentil production, development and yield in the world is biotic factors. Lentil plants are affected by many diseases caused by fungi, bacteria, viruses, nematodes and plant parasites. In the regions where lentil production is carried out in our country, the most important factor restricting lentil cultivation is soil-borne pathogens, including wilt, root and crown rot factors. Among the fungal factors that cause disease in lentil, *Fusarium avenaceum* (Fr.) Sacc. causes root rot, *F. culmorum* (W.G. Smith) Sacc. and *F. acuminatum* Ell. & Ev. root rot and wilt; *F. solani* (Mart.) Appel&Wollenw. Emend. Snyd. & Hans. root rot; *F. redolens* Wollenw. [Syn:*F. oxysporum* var. *redolens* (Wr.) Gordon] has been recorded to cause root and crown rot and wilt. Additionally, among soil-borne pathogens; *Sclerotium rolfsii*, *Rhizoctonia bataticola*, *Rhizoctonia solani*, *Pythium ultimum*. There are fungal disease factors such as. Within the scope of this review; The biology, epidemiology and control of important soil-borne fungal disease agents that cause phytopathological damage to lentil plants are included.

Keywords: *Fusarium* spp., Lentil, *Sclerotium* spp., *Pythium* spp., *Rhizoctonia* spp.

GİRİŞ

Dünya genelinde birçok ülkenin tarımsal üretiminde önemli rol oynayan yemeklik tane baklagiller, Türk tarımının da geleneksel ürünlerinden olup istihdama katkısı ve yüksek ihracat potansiyeli nedeniyle ekonomik açıdan önemli bir ürün grubudur. Mercimek bitkisi; uzun süre depolanabilir olması, ucuz ve kolay temin edilebilen bir gıda olması, bileşiminde %24-32 arasında değişen oranda protein, mineral bulundurması ve vitamin bakımından zengin olması nedeniyle insan beslenmesinde son derece önemlidir. (Eser, 1978; Bhatty, 1988; Erskine ve ark., 1990; Şehirali, 1988; El-Zoghbi, 1998; Kowieska ve Petkov, 2003; Raghuvanshi ve Singh, 2009).

Dünyada 2021 yılı verilerine göre 4.023.289 ton nohut üretimi gerçekleşmiştir. Türkiye, Hindistan, Kanada, Avustralya, Amerika, Çin ve İran'dan sonra dünya mercimek üretiminde, 263.000 ton üretim miktarı ile 7. sırada yer almaktadır (FAO, 2021). Ülkemizde 2022 yılı verilerine göre yeşil mercimek üretimi 45.000 ton olarak gerçekleşmiştir. Yozgat ili 18.965 ton üretim miktarı 1. sırada (%42.2) yer almaktadır (TÜİK, 2022).

Ülkemizdeki mercimek tarımı; insan gıdası olarak farklı kullanım alanlarına sahip iri taneli yeşil ve daha küçük taneli kırmızı olmak üzere iki şekilde yapılmakta olup her yıl ortalama 250–300 bin ton mercimek iç piyasada yemeklik ve 100–120 bin tonu ise tohumluk olarak tüketilmektedir. Ayrıca yıllara göre değişen oranlarda ihraç edilmekte ve önemli miktarda döviz kazandırmaktadır (Dölekoğlu, 2007). Mercimek, bitkisel özellikleri nedeni ile; nadasa göre özellikle toprağın üst 0-20 cm'lik kısmında mikrobiyolojik aktiviteyi kuvvetli derecede arttırması, tarımından sonra organik madde, toplam azot ve toplam boşluk hacmi bakımından da daha elverişli duruma getirmesi (Adak ve ark., 1998), vejetatif bitki parçalarının yeşil gübre vazifesi görmesi (Kara, 2008) nedeni ile toprak verimliliği ve canlılığı açısından da önemlidir.

Mercimek üretimi, çeşitli değişkenlere bağlı olarak Kasım ayının ikinci yarısı ile Aralık ayının ilk yarısı arasındaki dönemde kışlık olarak gerçekleştirilmektedir. Çeşit, toprak nemi, sıcaklık vb. etkenlere bağlı olarak değişmekle birlikte tohum ekiminden yaklaşık 2 hafta sonra çıkışlar gerçekleşir ve Nisan ayının ilk ya da ikinci haftasında çiçeklenmenin başlaması ile bitkinin vejetatif dönemi sonlanmış olur. Lokasyonlara göre değişmekle birlikte Mayıs ayı sonu ile Haziran ayının ilk yarısına kadar olan dönemde kapsüllerini dolduran ve hasadı yapılan kırmızı mercimek, böylece yaklaşık 6- 7 aylık bir vejetasyon sürecini tamamlamış olur.

Dünyadaki mercimek üretimi, gelişimi ve verimi etkileyen en önemli unsurlardan birisi biyotik faktörlerdir. Mercimek bitkisi fungus, bakteri, virüs, nematot ve bitki parazitlerinin neden olduğu birçok hastalıktan etkilenmektedir (Khare ve ark., 1979). Mercimekte hastalığa neden olan fungal etmenlerden *Fusarium avenaceum* (Fr.) Sacc.'un kök çürüklüğüne (Lin ve Cook, 1977; Fletcher ve ark., 1991); *F. culmorum* (W.G. Smith) Sacc. ve *F. acuminatum* Ell. & Ev.'un kökboğazı çürüklüğü ve solgunluğa (Fletcher ve ark., 1991); *F. solani* (Mart.) Appel&Wollenw. Emend. Snyd. & Hans. kök çürüklüğüne (Al Ahmad ve Mouselli, 1987); *F. redolens* Wollenw. [Syn:*F. oxysporum* var. *redolens* (Wr.) Gordon] ise kök ve kökboğazı çürüklüğüne (Taheri ve ark., 2011) ve solgunluğa (Riccioni ve ark., 2008) neden olduğu kaydedilmiştir. Bu derleme kapsamında; mercimekte toprak kökenli önemli fungal hastalık etmenleri güncel literatür desteğiyle kapsamlı bir şekilde ele alınmıştır.

Mercimekte zarar oluşturan toprak kökenli önemli fungal hastalıklar ve literatürdeki yeri

Mercimekte Fusarium solgunluğu, yetiştirildiği çoğu yerde kaydedilen önemli bir hastalıktır (Beniwal ve ark., 1993; Bayaa ve ark., 1995; Tosi ve Cappelli, 2001). Yapılan sörveylerde kurak alanlardaki solgunluk hastalığının artışının nedeni olarak *Fusarium oxysporum* f.sp. *lentis* (Fol) fungusunun ön plana çıktığı bildirilmiştir (Belabid ve Fortas, 2002). Mercimek solgunluk hastalığından dolayı ortalama kaybın %10 olduğu, ancak %66'ya kadar ulaşabildiği

kaydedilmiştir (Belabid ve ark., 2000). Özellikle ılıman geçen ilkbaharı kuru, sıcak bir yaz mevsimi izlediğinde solgunluk hastalığı, ürünün tamamen yok olmasına neden olabilmektedir. Spesifik formları ve farklı populasyonları ile en önemli fungal türlerden birisi olan Fol'in iletim demetlerindeki tıkanmalar nedeni ile solgunluğa (Carrera ve Noll, 1941; Wilson ve Brandsberg, 1965; Lin ve Cook, 1977; Al Ahmad ve Mouselli, 1987; Bayaa ve ark., 1997) ayrıca kök çürüklüğüne (Baniya ve Vaidya, 2011) neden olduğu bildirilmiştir.

Ülkemizde mercimek üretimini kısıtlayan ve verim düşüşüne sebep olan fitopatolojik sorunlardan en önemlisi toprak kökenli fungal etmenlerin neden olduğu mercimekte kök çürüklüğü ve solgunluk hastalığıdır. Bunlar bitkilerde gelişme geriliğine, yapraklarda sararma ve kuruyup dökülmelere, kök ve kök boğazında kahverengileşmeye, kökte incelmeye, saçak kök ve nodozite sayısında azalmalara neden olmaktadır.

Fusarium solgunluğu, genellikle bitkinin çiçeklenme-meyve kapsül oluşum döneminde veya yakın dönemlerinde ortaya çıkmaktadır. Hastalık belirtilerinin bitkide tepe yaprakların solması, bitkilerde bodurlaşma, bitkinin alt kısımlarındaki yaprakların buruşması ve kıvrılması ve enfekteli bitkinin gövdesinden yukarı doğru ilerleyerek devam ettiği görülmektedir. İleri aşamada bitkiler tamamen solarak ölebilmektedir. Kök belirtileri ise, iletim demetlerinin kahverengileşmesi, kazık kök uçlarının zarar görmesi ve bunların üst kısmında ikincil köklerin oluşması şeklinde ortaya çıkmaktadır.

İran'da *Fol*'in neden olduğu solgunluk ve *Ascochyta fabae*'nin oluşturduğu yanıklık hastalıklarının, mercimek veriminin düşmesinde önemli role sahip olduğu ifade edilmiştir (Hamdi ve Hassanein, 1996; Akrami ve ark., 2011; Mohammadi ve ark., 2012). Hindistan'da mercimek üretim alanlarında görülen solgunluk, kök ve kökboğazı çürüklüğü hastalıklarının etmenlerinin *Fol*, *Rhizoctonia bataticola, Rhizoctonia solani, F. equiseti, F. semitectum, Sclerotium rolfsii* ve *Alternaria* spp. vs. olduğu kaydedilmiştir (Agrawal, 1998; Chaudhary ve

Amarjit, 2002). Hindistan'da önemli mercimek üretim alanlarında toprak kökenli bu patojenler ve bunların neden olduğu ölümlerin, çiçeklenme boyunca devam ettiği ve kapsül oluşum döneminde varlığını sürdürdüğü belirtilmiştir (Chaudhary ve ark., 2010).

Arjantin'de mercimek solgunluğunun etmeni olarak mevcut türlere ek olarak *F. avenaceum*ve *F. orthoceros*'da kaydedilmiştir (Kotova ve ark., 1965). Mısır'da mercimek bitkisinin en önemli hastalıkları olarak solgunluk, *Phoma* yanıklığı ve gövde çürüklüğü (Bayaa ve ark., 1998); aynı şekilde Mısır'ın kuzeyinde *Fol* ve *R. solani*, en önemli fungal hastalık etmenleri olarak kaydedilmiştir (Hamdi ve Hassanien, 1996). Yeni Zelanda'da mercimek bitkilerinde kaydedilen patojenlerin *Aphanomyces euteiches, Sclerotinia sclerotiorum, Botrytis cinerea* ve *Ascochyta fabae* Speg. f.sp. *lentis* olduğu bildirilmiştir (Jermyn, 1986).

Mercimek üretim alanlarında görülen en önemli hastalıklardan bir diğeri *Uromyces vicia-fabae* (Pers.) J.Schröt. neden olduğu pas hastalığı, birçok ülkede olduğu gibi (Beniwal ve ark.,1993) Etiyopya'da da önemli ürün kaybına yol açmaktadır. Bu hastalık nedeniyle Etiyopya'da dane verim kaybının %25 düzeyinde olduğu tahmin edilmektedir. Zaman-zaman aynı ülkede ortaya çıkan epidemiler neticesinde bir milyon dolarlık bir finansal kaybın meydana geldiği ifade edilmektedir (Negussie ve ark., 1998). Mısır'ın New Valley bölgesinde yeni üretime başlanan mercimek bitkilerinde kök çürüklüğü ve çökerten hastalıklarına *R.solani* ve *F. solani* funguslarının, diğer bölgelerde ise solgunluk etmeninin *Fol* olduğu kaydedilmiştir (Abdel-Monaim ve Abo- Elyousr, 2012; Sallam ve Abdel-Monaim, 2012).

Soran (1977; 1979); İren ve ark. (1981), Ankara'da mercimek üretim alanlarında yapılan sörveylerde kök çürüklüğü hastalığına, *Fusarium* spp. *Rhizoctonia solani* ve *Pythium ultimum*'un neden olduğunu bildirmişlerdir. Khare (1981); Bellar ve Kebabeh (1983), Suriye'de mercimek üretim alanlarında yaptıkları çalışmalarda; çökerten, kök ve kökboğazı çürüklüğü etmenleri olarak *Fusarium* spp., *Phoma medicaginis* var. *pinodella*, *Rhizoctonia solani*,

Pythium spp., *Sclerotium rolfsii*, *Macrophomina phaseolina*, *Botrytis cinerea*; solgunluk etmeni olarak ise *F.oxysporum*'un yaygın olduğunu bildirmişlerdir.

Sclerotium rolfsii hastalık etmeninde; lezyonlar gövdeyi kuşatarak bitkinin üst kısımlarının klorotikleşmesine ve solmasına neden olur. Fungus, yağışlı havalarda kabarık beyaz bir büyümeyle kaplanabilen gövdelerde karakteristik beyaz lezyonlara neden olur (Kushwaha vd., 2019).

Etmenlerle mücadele

Fusarium türlerinin neden olduğu mercimek kök çürüklüğü ve solgunluk hastalığı ile tam olarak etkili bir mücadele yöntemi olmadığından kontrolü oldukça zordur. Toprak solarizasyonu, uyarılmış dayanıklılık, ekim tarihi ve derinliğinin ayarlanması, bitki ekstraktlarının kullanımı, hastalıktan ari ve fungusit uygulanmış tohum kullanımı gibi uygulamaların başarı oranının ise sınırlı olduğu bilinmektedir (Haware ve Nene, 1982; Jalali ve Chand, 1992; Belabid ve ark., 2010). Dayanıklı çeşit kullanımı en etkili ve ekonomik yöntem olmasına rağmen, patojen türler ve bunların patojenisitelerindeki çeşitlilik bu hastalığın kontrolünü güçleştirmektedir (Hawareve Nene, 1982; Jimenez- Gasco ve Jimenez-Diaz, 2003). Garkoti ve ark. (2013), Hindistan'ın Uttarakhand Eyaletinin Torai Bölgesi'nde mercimek solgunluk hastalığının, biyolojik savaş etmenleri ve organik katkı maddeleri ile önlenmesi konusunda yaptıkları çalışmada, Pant L-639 çeşidi ile 2010-2012 yılları arasında 2 yıl boyunca tarla denemeleri sürdürmüşlerdir. Çalışma sonucunda; *Trichoderma harzianum+Pseudomonas fluorescens* ile muamele edilen tohumların kullanılması ile Fusarium solgunluk hastalığının oluşumunun, %1,73-1,93 arasında değişen seviyelerde azaltıldığı bildirilmiştir. Organik katkı maddelerinin uygulanması ile özellikle çiftlik gübresi+atık kompost uygulamasında solgunluk hastalığı %1,69-1,81 arasında gözlendiği belirtilmiştir.

Kumar ve ark.(2014), Hindistan'da toplam 1,59 milyon hektarlık mercimek üretim alanında en önemli sorunun *Fol*'in neden olduğu solgunluk hastalığı olduğunu ifade etmişlerdir. Bu hastalığa karşı 2007-2009 yılları arasında *in vitro* ve tarla denemeleri ile farklı bitkisel yağların etkilerini araştırdıkları çalışmada, minimum hastalık oluşum düzeyi ve maksimum dane veriminin, nane yağı uygulaması ile elde edildiğini bildirmişlerdir.

SONUÇ VE ÖNERİLER

Yemeklik tane baklagiller içerisinde mercimek, Uzak ve Yakın Doğu, Akdeniz, Afrika, Güney ve Orta Amerika ülkelerinde binlerce yıldan beri tanınan, insan ve hayvan beslenmesinde kullanılan bir yemeklik tane baklagil bitkisidir.

Mercimek ekim alanlarının ve birim alandaki verimin son yıllarda gittikçe azalması, bazı sorunların yaşandığını göstermektedir. Mercimek üretimini sınırlandıran çeşitli faktörler vardır. Bunların bazılarını; kuraklık, yabancı otlar, hastalıklar, zararlılar ve hasat-harman esnasında ortaya çıkan kayıplar oluşturmaktadır. Bu faktörlerin en önemlilerinden biri de hastalıklardır. Bu hastalıklara çoğunlukla funguslar neden olmakta ve bitkide solgunluk, kök ve kök boğazı çürüklüğü ve çökerten şeklinde belirtiler ortaya çıkarmaktadır (Aydın ve ark., 2004). Önceki yapılan çalışmalar gösteriyor ki, bu hastalıklar içinde dünyada en önemli ve yaygın olanın Fusarium cinsi etmenlerin neden olduğu solgunluk hastalığıdır ve bu hastalık Kanada, Çin, Mısır, Hindistan, Suriye, Macaristan başa olmak üzere mercimek tarımı yapılan birçok ülkede yaygın olarak bulunmaktadır.

Mercimekte zarar oluşturan bu hastalık etmenlerinin mücadelesinde dikkat edilmesi gereken hususlar; sıcaklık, yağış ve bunların vejetastasyon dönemi boyunca dağılımı ile bu hastalığın oluşması için gerekli olan epidemiyolojik koşullardır. Ülkemizde hüküm süren karasal iklimde; yaz ile kış arasında sıcaklık farkı oldukça fazla olup yağışlar genellikle kış ve ilkbaharda gerçekleşmekte ve yaz mevsiminde ise kuraklık egemen olmaktadır. Ayrıca mercimeğin fide

döneminde olduğu Ocak ve Şubat, en soğuk aylardır. Bu kriterler dikkate alınarak ekim tarihinin ayarlanması ile kısmen de olsa hastalığın kontrol altına alınabileceği düşünülmektedir. Bunların dışında m^2'ye düşen tohum sayısının azaltılması, toprak analizi doğrultusunda ekimle birlikte taban gübrelemesinin yapılması, bitkinin sağlıklı gelişimi ve söz konusu hastalıklara karşı toleransının yükseleceği düşünülmektedir.

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MERCİMEK BİTKİSİNİN TOPRAK ÜSTÜ KISIMLARINDA FİTOPATOLOJİK AÇIDAN ZARAR OLUŞTURAN ÖNEMLİ FUNGAL HASTALIKLAR

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ÖZET

Baklagiller, insan beslenmesinin önemli bir parçasını oluştururlar. Yüksek protein içerikleri ve kalite açısından değerli olmaları nedeniyle tahıl temelli diyetlere önemli bir katkı sağlarlar. Baklagiller, ülkemizin gıda ve tarım ekonomisinde önemli bir rol oynarlar. Mercimek (*Lens culinaris* Medik.), kökeni Yakın Doğu ve Akdeniz bölgesine dayanan en eski bitkilerden biridir. Mercimek tohumu, diğer baklagillerle karşılaştırıldığında nispeten yüksek protein, karbonhidrat ve kalori içerir ve yüksek protein içeriği ve hızlı pişirilme özellikleri, bu bitkiyi birçok mercimek üretim bölgesinde en çok tercih edilen kültür bitkisi yapmaktadır. Biyotik ve abiyotik stresler nedeniyle, verimi istenen düzeylerin altında kalır. Biotik faktörler arasında hastalıklar, mercimek üretimine ciddi bir tehdittir. Mercimek, fungal, bakteriyel, viral, nematod ve bitki parazitleri tarafından oluşturulan bir dizi hastalıktan etkilenir. Bu hastalıklar sadece verimi azaltmakla kalmaz, aynı zamanda tohum kalitesini de olumsuz etkiler. Mercimek bitkisinin toprak üstü aksamında fitopatolojik açıdan zarar oluşturan başlıca faktörler, fungal hastalıklar gibi biyolojik üretkenliği sınırlayan etmenlerdir. Solgunluk, pas, Botrytis Gri küf ve Ascochyta yanıklığı, mercimek üretimini engelleyen başlıca hastalıklardır. Bu derleme kapsamında mercimek bitkisinin toprak üstü aksamında zarar oluşturan önemli fungal hastalık etmenleri detaylı bir şekilde araştırılmıştır.

Anahtar kelimeler: *Ascochyta lentis, Botrytis cinerea, Colletotrichum truncatum,* Mercimek, *Stemphylium botryosurm, Uromyces viciae-fabae*

FOLIAR FUNGAL DISEASES THAT CAUSE PHYTOPATHOLOGICAL DAMAGE IN LENTIL PLANTS

ABSTRACT

Legumes form an important part of the human diet. They make an important contribution to grain-based diets due to their high protein content and value in terms of quality. Legumes play an important role in our country's food and agricultural economy. Lentil (Lens culinaris Medik.) is one of the oldest plants, originating from the Near East and Mediterranean region. Lentil seed contains relatively high protein, carbohydrate and calories compared to other legumes, and its high protein content and fast cooking properties make this plant the most preferred in many lentil producing regions. Due to biotic and abiotic stresses, crop yield remains below desired levels. Among the biotic factors, diseases are a serious threat to lentil production. Lentils are affected by a number of diseases caused by fungal, bacterial, viral, nematodes and plant parasites. These diseases not only reduce yield but also negatively affect seed quality. The main factors that cause phytopathological damage to the aboveground parts of the lentil plant are fungal diseases. Wilt, rust, Botrytis Gray mold and Ascochyta blight are the main diseases that hinder lentil production. Within the scope of this review, important fungal diseases that cause damage to the aboveground parts of the lentil plant were investigated in detail.

Key words: *Ascochyta lentis*, *Botrytis cinerea*, *Colletotrichum truncatum*, Lentil, *Stemphylium botryosurm*, *Uromyces viciae-fabae*

GİRİŞ

Yemeklik tane baklagillerin besin maddesi olarak tarihçesi 5.000 yıl öncesine kadar dayanmaktadır (Devos, 1988). Bir yemeklik tane baklagil bitkisi olan mercimek, hem insan hem de hayvan beslenmesinde önemli bir yere sahip olup kültüre alınan en eski yemeklik tane baklagillerden birisidir. Mercimeğin ilk kültüre alındığı yerin verimli yarım ay dediğimiz Mezopotamya ile ülkemizin Güneydoğu Anadolu Bölgesi olduğu tahmin edilmekle beraber (Özdemir, 2002) tarımının yaklaşık olarak günümüzden 8.000 yıl öncesine kadar dayandığı bilinmektedir (Pellet, 1988).

Dünyada 2021 yılı verilerine göre 4.023.289 ton nohut üretimi gerçekleşmiştir. Türkiye, Hindistan, Kanada, Avustralya, Amerika, Çin ve İran'dan sonra dünya mercimek üretiminde, 263.000 ton üretim miktarı ile 7. sırada yer almaktadır (FAO, 2021). Ülkemizde 2022 yılı verilerine göre yeşil mercimek üretimi 45.000 ton olarak gerçekleşmiştir. Yozgat ili 18.965 ton üretim miktarı 1. sırada (%42.2) yer almaktadır (TÜİK, 2022).

Lens culinaris, yakın Doğu ve Orta Asya'ya yerli bir bitkidir. İddia edilen kültive tür Lens culinaris alt türü orientalis (Bioss.) Ponert, Türkiye, Suriye, Lübnan, İsrail, Ürdün, Irak, İran, Afganistan, Yunanistan, Özbekistan gibi bölgelerde bulunur (Ladizinsky 1979a, Cubero 1981, Zohary 1972).

Mercimek (*Lens culinaris* Medik.), enerji, protein, karbonhidratlar, lifler, mineraller, vitaminler ve antioksidan bileşiklerin önemli bir besin kaynağıdır. Aynı zamanda proteaz inhibitörleri, tanenler, β-galaktozit oligosakaritler ve fitik asit gibi çeşitli bileşenleri içerir (Adsule vd., 1989). Tarımsal üretimde verimi düşüren birçok faktörün var olduğu bilinmektedir. Mercimek üretim alanlarında düşük verime sebep olan en kritik cansız faktörlerin başında kuraklık, tuzluluk, yüksek oranda kireç, yüksek sıcaklık ve düşük sıcaklıklar, bitkinin büyümesi için önemli olan besin elementlerinin eksikliği gelmektedir (Paç, 2023). Bu cansız faktörlerin dışında önemli

verim kayıplarına sebep veren canlı yani biotik faktörlerin arasında sorun olan fungal hastalık etmenleri vardır.

Bu derleme kapsamında mercimek bitkisinin toprak üstü aksamında zarara neden olan önemli fungal hastalık etmenleri detaylı bir şekilde ortaya konulması amaçlanmıştır.

Toprak üstü aksamada zarar oluşturan önemeli fungal hastalıklar

Mercimek üzerindeki gri küf (GM), *Botrytis cinerea* fungal etmeninin neden olduğu ciddi ancak seyrek görülen bir hastalıktır. *Botrytis cinerea*, Kuzey Hindistan, Avustralya, Arjantin, Nepal, Mymar, Bangladeş ve Pakistan'ın birkaç bölgesinde ağır kayıplara neden olur ve uygun koşullarda %70-80 verim kaybına yol açar (Haware ve McDonald, 1992).

Mercimeğin bütün toprak üstü aksamı gri küften etkilenebilir. Hastalık ilk olarak alt yapraklarda belirgin lezyonlar olarak görünür; bu lezyonlar başlangıçta koyu yeşil olup yaşlandıkça gri-kahverengi, ardından kremsi hale gelir, büyür ve birleşir ve tüm yaprakçıkları etkiler. Şiddetli enfekte yapraklar yaşlanır ve yere düşer. Lezyonlar sapı kuşatır ve onu gri küfün tüylü bir tabakasıyla kaplar, sonunda sapı ve tüm bitkiyi öldürür (Lindbeck vd., 2009).

Gri küfün başlıca inokulum kaynakları; tohum, sklerotia, önceden enfekte bitki artıklarındaki miselyum ve alternatif konukçu bitkilerdir. Yüksek nem ve ılıman sıcaklık hastalığı teşvik eder. Çevresel koşullar ve bitki örtüsü yoğunluğu botrytis gri küf salgınlarının gelişimini etkileyen temel faktörlerdir. 15-25°C sıcaklık aralığı ve %95'in üzerinde nem oranı, özellikle çiçeklenme ve örtü oluşturmadan sonra hastalığın başlaması ve gelişimi için ideal olarak bulunmuştur (Kuchuran vd., 2021).

Mücadele yöntemi olarak Benomil, karboksin, klorotalonil veya tiyabendazol gibi fungisitlerle tohum uygulamaları inokulum seviyelerini azaltabilir.

Uromyces viciae-fabae fungal etmeninin neden oludğu pas hastalığı, mercimeğin önemli yaprak hastalığı olarak kabul edilir. Bu hastalık nedeniyle tamamen ürün kayıpları meydana

gelebilir. Pas hastalığı, mercimek yetiştiriciliği için potansiyel bir tehdit oluşturur ve %60 ila %69 arasında değişen ciddi verim kayıplarına neden olur (Sepulveda, 1985).

Pas püstülleri, yaprak, sap ve gövde üzerinde görülebilir. Pas, yaprakçıkların alt yüzeyinde ve baklalarda sarımsı-beyaz piknidia oluşumuyla başlar, tek başına veya küçük gruplar halinde dairesel bir şekilde bulunur. Daha sonra, kahverengi üredial püstüller, yaprakçıkların, sapların ve baklaların her iki yüzeyinde ortaya çıkar. Püstüller ovalden dairesel ve 1 mm çapına kadar olabilir. Daha büyük püstüller oluşturmak için birleşebilirler. Şiddetli enfeksiyonlarda yapraklar dökülür ve bitkiler kurur, etkilenen bitki baklalarda hiç tohum oluşturmadan veya küçük buruşmuş tohumlarla kurur (Negussie ve Pretorius, 2008).

Hastalık genellikle tarlada alçak noktalardan başlar ve diğer bölgelere doğru yayılır. Yüksek nem, bulutlu veya çiseleyen hava ile 20 ile 22°C sıcaklıklar hastalığın gelişimini destekler. Hastalık genellikle çiçeklenme/erken bakla döneminde meydana gelir (Sache ve Zadoks, 1994). Hexaferb ve Dithane M-45 gibi yaprak fungisitlerinin kullanılması en iyi kontrolü sağlar. Mancozeb, Bayleton ve Calixin gibi fungisitler, patojene karşı etkili bulunmuştur. Benomil, karboksin, metalaksil, oksikarboksin, tıram, triademafon gibi yaprak spreyleri, tek başına veya Dithane M-45 ile birleşim halinde de etkilidir (Yadav vd., 2007; Garkoti vd., 2013).

Ascochyta yanıklığı, tüm büyüme aşamalarında uygun koşullar altında toprak üstü bitki kısımlarını etkileyebilen *Ascochyta lentis* adlı fungal etmen neden olur. Hastalık, verim ve tohum kalitesinde azalmaya neden olur (Buchwaldt vd., 2018). Hastalığın belirtileri, yapraklar, yaprak sapları, gövdeler ve baklalarda lezyonları içerir. Yapraklar, yaprak sapları ve gövde üzerindeki düzensiz şekilli lezyonlar bej renkli ve baklalar ve tohumlarda daha koyu kahverengi renktedir. Şiddetli enfeksiyonda lezyonlar gövdeyi kuşatıp kopmalara ve lezyonun üzerindeki tüm dokuların ölümüne yol açabilir. Şiddetli enfeksiyon altındaki ürünler solabilir ve tohum

küçülebilir, boyutu küçülebilir ve renk değiştirebilir. Çiçekler ve baklalar düşebilir, verim kaybına yol açabilir (Buchwaldt, 2011).

Ascochyta lentis, enfekte tohumlardan fideler üzerinden taşınan bir hastalıktır. Hastalık serin, nemli hava koşullarını tercih eder. Hastalığın gelişimi için uzun süreli yaprak ıslaklığı gereklidir ve maksimum hastalık gelişimi, yaprak ıslaklığının 24 ila 48 saat sonrasında meydana gelir. 10°C ile 20°C arasındaki sıcaklıklar hastalık gelişimi için son derece elverişlidir ve maksimum hastalık gelişimi yaklaşık olarak 15°C'de meydana gelir (Dokken-Bouchard vd., 2016).

Ascochyta yanıklığının kontrol etmenin en ekonomik ve sürdürülebilir stratejileri, kültürel uygulamalar aracılığıyla sağlanır. Tarla rotasyonu (mercimeği dört yılda bir kez yetiştirmek), sertifikalı, hastalıksız tohum kullanımı hastalığı en aza indirmeye yardımcı olacaktır. Hasatta nemli hava koşullarından kaçınmak için erken ekim hastalığı en aza indirebilir. Benomil, karbendazim ve tiyobendazol gibi fungisitler etkilidir (Yadav vd., 2007; Garkoti vd., 2013).

Colletotrichum truncatum fungal hastalık etmeni de mercimeklerde infeksiyonlara sebep olur. Düzensiz şekilli, açık kahverengi nekrotik lezyonlar alt gövdelerde gelişmeye başlar ve birleşip gövdelere siyahımsı kahverengi bir renk verene kadar sayıları ve boyutları giderek artar. Yapraklardaki lezyonlar daireseldir ve her lezyonun ortasında az sayıda acervuli vardır ve çiçeklenmenin başlangıcında erken yaprak dökülmesi başlar. Enfekte bitkilerde acervuli'de konidia oluşur ve konidianın komşu bitkilere ikincil yayılması bitkiler yağmur sıçramasıyla oluşur. Fungus iletim demetleri dokusuna nüfuz eder, bu da bitkinin solmasına ve büyük kahverengiye neden olur. Çiçek açtıktan sonra tarlada ölmekte olan bitki parçaları belirgin hale gelir (Kaiser vd., 1998; Chongo ve Bernier, 2000).

Mercimek bitkisinde yaprak üstü aksamı etkileyen bir diğer hastalık *Stemphylium botryosurm* (Stemphylium yanıklığı) etmenidir. Yaprakçıklarda küçük, iğne başlı, açık kahverengi ile ten rengi lekelerin ortaya çıkmasıyla başlar. İdeal koşullar altında küçük noktalar hızla büyür ve 2-

3 günlük bir süre içinde yaprakçık yüzeyinin tamamını kaplar. Enfekte olmuş doku açık krem renginde görünür ve genellikle yaprakçığın tamamına yayılan veya uzun bir süre boyunca yayılan daha açık ve daha koyu alanlardan oluşan açısal desenlerle birlikte görülür. Enfekte olmuş yapraklarda hastalık hızla ilerler ve sadece terminal kısmı bırakılabilir. Saplar aşağı doğru bükülür, kurur ve yavaş yavaş kül beyazına döner, ancak baklalar yeşil kalır. Bazen enfekte gövdede beyaz misel büyümesi görülebilir (Hosen vd., 2009; Das vd., 2019).

SONUÇ VE ÖNERİLER

İç tüketimde ve ihracatımızda önemli bir yere sahip olan mercimek bitkisi gelişme dönemlerinde pek çok hastalıklara ve zararlılara maruz kalır. *Ascochyta lentis, Botrytis cinerea, Colletotrichum truncatum, Stemphylium botryosurm, Uromyces viciae-fabae* fungal etmenleri mercimeğin toprak üstü aksamında görülebilen etmenler arasındadır. Bu etmenlerle mücadelede kültürel, biyolojik ve kimyasal mücadele uygulamalarından oluşan entegre bir mücadele programı önerilebilir.

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BADEM GENOM DIZILEMESI – GEÇMIŞ, BUGÜN VE GELECEK

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ÖZET

Badem (*Prunus dulcis* L.) genelde dağlık bölgelerde yetişir ve Orta ve Batı Asya daki bu bölger anavatanı olarak kabul edilmektedir. Günümüzde, badem üretimi hızla artıyor ve bu da onu en önemli meyve ürünlerinden biri haline getiriyor. Rosaceae familyasının bir üyesi olan badem, tohumları için yetiştirilen ticari açıdan değerli bir ağaç türüdür. Türkiye badem üretiminde dünya sıralamasında ilk 10 ülke içerisindedir ve badem, özellikle tatlı badem, sık olarak tükettiğimiz kuruyemişler arasındadır. Badem yağı saç ve cilt bakımından, ayakkabı ve deri giysilerin korunmasına kadar pek çok şekilde kullanılır. Bademin kendisi ise vitamin, mineral ve yüksek kalitede protein içerir. Özellikle E vitamini ve sağlıklı yağ asitleri bakımından çok iyi bir kaynaktır. Badem meyvesinin, yüksek besin değeri ve insan sağlığı üzerine faydalı etkilerinden dolayı badem ağacı dünyada çok büyük bir öneme sahiptir. Yaklaşık 300 Mbp kompakt boyuta sahip diploid bir genoma (2n = 16) sahiptir. Yaklaşık 200 tür içeren Prunus cinsi, bademin yanı sıra sert çekirdekli meyveler (şeftali, kayısı, kiraz, erik gibi) gibi ekonomik açıdan önemli üyeleri de içermektedir. Günümüzde genom dizileme teknolojileri daha hızlı, daha hassas ve uygun maliyetli hale gelerek büyük ölçekli projelere olanak sağlıyor. Gelecekte daha hızlı, daha doğru ve daha ekonomik genom dizileme yöntemlerinin geliştirilmesi beklenmektedir. Bu gelişmeler, genetik araştırma ve uygulamaların kapılarını daha da açarak tarım alanındaki keşifleri hızlandıracaktır. Organizmanın tüm genom dizisi, evrimsel ve fonksiyonel gen çalışmaları için güçlü bir araç sağlar. Islah popülasyonlarındaki tüm genom dizisinin kesin bilgisi, ıslah programlarında yeni üstün çeşitlerin gelişimini hızlandırmak için çok önemlidir. Bu çalışma, bademlerin genomik özelliklerini ve hibridizasyon potansiyellerini araştırmayı ve Prunus cinsi içindeki karmaşık genetik ilişkilere ışık tutmayı amaçlamaktadır.

Anahtar Kelimeler: Badem, genom, sekanslama

ALMOND GENOME SEQUENCING – PAST, PRESENT, AND FUTURE

ABSTRACT

In general, Almond (*Prunus dulcis* L.) is known to grow in mountainous regions, and the regions of Central and Western Asia are considered its native habitat. Almond production has been increasing rapidly, making it one of the most important fruit crops. Almond (*Prunus dulcis*), a member of the Rosaceae family, is a commercially valuable tree species cultivated for its seeds. In Turkey, almond production ranks among the top 10 countries worldwide, and almonds, especially sweet almonds, are frequently consumed nuts. Almond oil is used in various ways, from hair and skincare to preserving shoes and leather garments. Almonds themselves are rich in vitamins, minerals, and high-quality protein. They are particularly a great source of vitamin E and healthy fatty acids. Due to the high nutritional value of almonds and their beneficial effects on human health, the almond tree holds significant importance globally. It possesses a diploid genome (2n = 16) with a compact size of approximately 300 Mbp. The *Prunus* genus, which comprises around 200 species, includes economically significant members like stone fruits (such as peach, apricot, cherry, and plum) along with almonds. Today, genome sequencing technologies have become faster, more precise, and cost-effective, enabling large-scale projects. In the future, the development of even faster, more accurate, and economical genome sequencing methods is anticipated. These advancements will further open the doors for genetic research and applications, accelerating discoveries in the field of agriculture. The whole genome sequence of the organism provides a powerful tool for evolutionary and functional gene studies. Precise knowledge of the whole genome sequence in breeding populations is crucial for accelerating the development of new superior cultivars in breeding programs. This study aims to explore the genomic characteristics of almonds and their potential for hybridization, providing insights into the complex genetic relationships within the *Prunus* genus.

Keywords: Almond, genome, sequencing

1. GİRİŞ

Badem (*Prunus dulcis* (Mill) D.A. Webb), şeftali, kiraz ve kayısı gibi diğer meyve türleriyle birlikte Rosaceae familyasının Prunoideae alt familyasına aittir. Birçok diğer Prunus türü gibi, bademin kromozom sayısı 2n=16'dır (Darlington, 1930). Yaklaşık 300 Mbp kompakt boyuta sahip diploid bir genoma sahiptir. Badem, sağlık faydaları ve yüksek besin değeri nedeniyle değerlidir, bitkinin önemi insan diyetinde artmakta ve dolayısıyla dünya çapında üretimi ve ticari değeri büyümektedir. Badem, üretim açısından en önemli meyve türlerinden birisidir.

Bu badem ıslah programlarının temel amacı yüksek verim elde etmektir. Bademin verimliliğini etkileyen iki ana faktör bulunmaktadır: Çiçeklenme tarihi: İklim meyveleri arasında en erken çiçeklenen tür olduğundan, geç çiçeklenen çeşitle üretim tehdit eden erken ilkbahar donu zararından kaçınmak için oldukça önemlidir (I Forcada ve ark., 2012). Geç çiçeklenen çeşitler, bahçelerin don hasarına daha fazla risk taşıdığı iç kesim bölgelerinde daha önemlidir. Diğer faktör ise: Kendi uyuşmazlık: Badem bitkisinin kendi uyuşmazlık doğası nedeniyle yetersiz çapraz tozlaşma düşük verimli bir ana nedenidir. Aynı çevresel ve ıslah koşulları altında, kendi uyumlu çeşitlerin ağaç başına ve alan başına üretimi, en verimli kendi uyumsuz çeşidinkinden iki kat daha yüksektir (Godini ve ark., 2002).

Bademin ticari değerinin artmasıyla birlikte, birçok ülke geç çiçeklenme, kendi uygunluk, hastalık ve zararlılara karşı direnç, yüksek çekirdek kalitesi ve verim gibi üstün özelliklere sahip yeni badem çeşitleri geliştirmeye odaklanmıştır. Ayrıca, araştırmacılar bademin kökeni, şeftali ve bademin ayrılması, acı çekirdeğin tatlı çekirdeğe mutasyonu ve badem evcilleştirmesi gibi biyolojik sorunları çözmeye çalışmaktadır. Tüm genom dizileme teknolojileri, bademdeki bu tarımsal ve biyolojik soruları çözmek için yeni ve hızlı bir yaklaşım sağlamaktadır. İleri nesil dizileme (NGS) teknolojilerindeki ilerlemelerle bir organizmanın tam genom dizilemesi birkaç günde çok düşük bir maliyetle yapılabilmektedir (Kersey, 2019). Şeftali (Verde ve ark., 2017),

tatlı kiraz (Shirasawa ve ark., 2017) ve Japon eriği (Zhang ve ark., 2012) gibi bademe yakın birçok akrabasının tüm genom dizileri yayımlanmıştır. Ancak, bademin tüm genom dizisi birkaç yıl öncesine kadar mevcut değildi. Sanchez-Perez ve ark., (2019) ve Alioto ve ark., (2020) tarafından iki badem tüm genom dizisi yayımlanmıştır. Bu çalışma, bademlerin genomik özelliklerini ve hibridizasyon potansiyellerini araştırmayı ve Prunus cinsi içindeki karmaşık genetik ilişkilere ışık tutmayı amaçlamaktadır.

2. BADEMDE GENETİK BAĞLANTI HARİTALAMA VE QTL ÇALIŞMALARI

Bademde genetik harita oluşturmak için kullanılan birçok moleküler markör türü vardır, bunlar arasında izoenzim, rastgele amplifiye edilmiş polimorfik DNA (RAPD), restriksiyon parça uzunluğu polimorfizmaları (RFLP'ler), amplifiye edilmiş parça uzunluğu polimorfizmaları (AFLP'ler) ve basit dizi tekrarları (SSR'ler) bulunmaktadır (Arus ve ark., 1994; Ballester ve ark., 2001; Dirlewanger ve ark., 2004; Gregory ve ark., 2005; Sanchez-Perez ve ark., 2007; Sanchez-Perez ve ark., 2010; Tavassolian ve ark., 2010). SSR, özellikle açık çaprazlama F1 popülasyonlarında co-dominant doğası nedeniyle genetik haritalama çalışmalarında çok değerli bir markör sistemidir. Çünkü F1 popülasyonlarında ebeveyn haritaları ayrı ayrı oluşturulmalı ve SSR gibi co-dominant markörler, her iki genetik haritayı birleştirmek için gereklidir. Bu, SSR'leri genetik bir bağlantı haritası oluşturmak için çok kullanışlı bir markör tekniği yapmaktadır. Bununla birlikte, SSR'ler bitki genomunda tek nükleotid polimorfizmaları (SNP'ler) markörlerine göre daha az bulunur, ki bu bitki genomlarında çok sık görünür. Ayrıca, SSR markörlerinin geliştirilmesi çok zaman alıcıdır ve birçok laboratuvar çalışması gerektirir. Önceki QTL çalışmalarının çoğu, düşük markör yoğunluğundan dolayı QTL'lerin doğru konumlarını ve önemli özelliklerle yakından ilişkili markörleri belirleyemedi. Bu nedenle, yüksek yoğunluklu bağlantı haritaları oluşturmak için diğer daha yaygın markörlerle

birleştirilen SSR markörleri, haritalama çalışmalarının tercih edilen markör sistemi olmuştur (Donoso ve ark., 2016).

İlk badem genetik haritası, 'Ferragnes x Tuono' F1 popülasyonunda (60 F1 birey) RFLP ve izoenzim markörleri kullanılarak oluşturuldu (Arus ve ark., 1994). Aynı popülasyonda Viruel ve ark., (1995), 120 RFLP ve 7 izoenzim markörü kullandı, Joobeur ve ark., (2000) ise daha doygun bir harita oluşturmak için aynı haritaya 54 RAPD ve 6 SSR markörü ekledi. Ballester ve ark. (1998), S lokusunu bağlantı grubu 6'da (LG6) haritaladı. Bir diğer çalışmada, Ballester ve ark., (2001), 'Felisia x Bertina' F1 popülasyonunda (134 F1 birey) badem için genetik bir bağlantı haritası oluşturdu. Araştırıcılar toplamda 81 RFLP ve 5 RAPD markörü haritaladı.

Prunus türleri arasındaki en önemli haritalardan biri genellikle T x E haritası olarak anılan 'Texas x Earlygold' haritasıdır ve bu, cins için bir referans harita olarak geniş bir kabul görmüştür. Bu haritanın en son versiyonu, 562 markör (361 RFLP, 185 SSR, 11 izoenzim ve 5 STS) içeriyordu ve toplamda 519 cM'lik bir mesafeyi kapsıyordu. Haritanın ortalama yoğunluğu 0.92 cM/markör ve en büyük boşluk LG4'te geç çiçeklenen bir lokusta 7 cM idi (Dirlewanger ve ark., 2004).

Sanchez-Perez ve ark. (2007), 'R1000 x Desmayo Largueta' F1 popülasyonunda (167 F1 birey) 56 SSR ve 11 özellik kullanarak bir badem genetik haritası oluşturdu ve bu özellikler arasında kendi uyumlu, çiçeklenme tarihi, çiçeklenme yoğunluğu, olgunlaşma süresi, yapraklanma tarihi, verim, çekirdek lezzeti, kabuk içi ağırlığı, kabuk sertliği, çekirdek ağırlığı ve çift çekirdek bulunmaktaydı. Bu özellikleri harita üzerine yerleştirdi.

Sanchez-Perez ve ark. (2010), 'R1000 x Desmayo Largueta' F1 popülasyonunda sweet kernel (Sk) lokusunu LG5'te haritalandı. Daha sonra araştırıcılar, daha önce Howard ve ark., (2005) tarafından LG5'te haritalanan 15 SSR primer çiftini test ettiler ve Sk lokusuna yakından bağlı birkaç SSR markörü buldular.

Sanchez-Perez ve ark. (2012), 'R1000 x Desmayo Largueta' F1 popülasyonunu kullanarak soğuk ve sıcaklık gereksinimleri ile çiçeklenme zamanı ile ilgili QTL'leri tanımladı. Soğuk gereksinimi için büyük bir QTL, LG4'te bulundu. Isınma gereksinimi ile ilgili iki QTL bölgesi, LG2 ve LG7'de tanımlandı. Çiçeklenme zamanı için büyük bir QTL, LG4'te bulundu.

Gregory ve ark. (2005), 'Nonpareil x Lauranne' F1 popülasyonunda (93 birey) RAPD, ISSR, SSR ve morfolojik markörleri kullanarak bir ebeveyn genetik bağlantı haritası oluşturdu. Ancak, test edilen 120 belirteç arasında yazarlar sadece 12 belirteci 161.9 cM'lik toplam bir uzunlukta haritalandı.

Wu ve ark. (2009), 'Nonpareil x Lauranne' popülasyonunda 12 SNP bazlı geni HRM (Yüksek Çözünürlüklü Erime) analizi kullanarak haritalandı, 12 olası gen altı bağlantı grubunda haritalandı.

Fernandez i Marti ve ark. (2011), 'Vivot x Blanquerna' popülasyonundan türetilen 77 F1 bitkisini kullanarak, uyuimazlık ile ilgili QTL'leri bulmak için çalıştı. T x E ('Texas x Earlygold') referans haritasından 102 SSR lokusunu test ettiler ve 52 markörü haritalandı. Araştırıcılar, uyuimazlık ile ilgili LG6 ve LG8'de iki QTL bölgesini tespit etti.

I Forcada ve ark. (2012), 'Vivot x Blanquerna' popülasyonunu badem fındığı kimyasal içeriği için QTL analizi için kullandı ve 8 daha fazla SSR markörü test etti ve haritaya 4 SSR markörü daha ekledi. Bu, 'Vivot x Blanquerna' popülasyonuna haritalanan toplam SSR lokus sayısını 56'ya çıkardı ve yağ, yağ asitleri, tokoferol ve protein içeriği ile ilgili QTL'leri haritaladı.

Fernandez i Marti ve ark. (2013), 'Vivot x Blanquerna' popülasyonunu ve aynı bağlantı haritasını kullanarak badem fındığı fiziksel özelliklerine ait 14 olası kantitatif karakter lokusunu altı genomik bölgeye haritalandı.

Donoso ve ark. (2016), 'Texas x Earlygold' popülasyonunda ve BC1 ve T1E popülasyonlarında çiçeklenme, fenoloji, meyve kalitesi, yaprak ve hastalık direnci için 42 özellik üzerinde çalıştı.

Genetik haritalama için 135 SSR markörü ve 9k uluslararası şeftali SNP konsorsiyumundan SNP belirteçleri kullandı. Sonuç olarak, LG6'da pistil uzunluğu için büyük bir QTL haritalandı. Çiçeklenme ve çiçeklenme zamanı için LG1, LG6, LG7, LG8 ve LG2'de altı büyük QTL tespit edildi. Sululuk için büyük bir QTLAZ, T x E haritasında LG1'in sonunda bulundu.

Goonetilleke ve ark. (2018), 'Nonpareil x Lauranne' çiftinden türetilen 231 F1 progenisini kullanarak 309 SNP primer çiftini (146'sı Nonpareail'de heterozigot, 162'si Lauranne'de heterozigot) haritalandı. Kabuk sertliği verileri rastgele 10 örnek için değerlendirildi ve kabuk sertliği için iki QTL, Nonpareil haritasında LG5'te, Lauranne haritasında ise LG2, LG5 ve LG8'de bulundu.

3. BADEMDE GENOM ÇALIŞMALARI

Son yıllarda, badem genomunun dizilenmesinde önemli ilerlemeler kaydedilmiştir. Bu, bademin tarımsal özelliklerini ve evrimsel tarihini incelemek açısından önemlidir. İleri nesil dizileme teknolojilerinin gelişmesi ile badem gibi model olmayan bitkilerin genomlarının dizilenmesi daha maliyet-etkin hale gelmiştir. Badem çeşitleri Lauranne ve Texas'ın genom dizileri yayımlanmış olup, bu durum kültüre alım süreci, tatlı çekirdeğe neden olan genetik mutasyonlar ve badem ile şeftali arasındaki evrimsel ilişki gibi önemli konularda bilgi sunmaktadır (Sanchez-Perez ve ark., 2023). Bu gelişmeler, Prunus cinsinde genetik ve evrimsel araştırmaları hızlandıracak, üretim çalışmaları için değerli bilgiler sağlayacak ve önemli tarımsal özelliklere yanıt verecektir. Ancak, bademdeki meyve eti gelişimi ve diğer önemli tarımsal özelliklere dair hala cevaplanmamış sorular bulunmaktadır.

Günümüzde genom dizileme teknolojileri daha hızlı, daha hassas ve uygun maliyetli hale gelerek büyük ölçekli projelere olanak sağlıyor. Gelecekte daha hızlı, daha doğru ve daha ekonomik genom dizileme yöntemlerinin geliştirilmesi beklenmektedir. Bu gelişmeler, genetik araştırma ve uygulamaların kapılarını daha da açarak tarım alanındaki keşifleri hızlandıracaktır.

Organizmanın tüm genom dizisi, evrimsel ve fonksiyonel gen çalışmaları için güçlü bir araç sağlar. Islah popülasyonlarındaki tüm genom dizisinin kesin bilgisi, ıslah programlarında yeni üstün çeşitlerin gelişimini hızlandırmak için çok önemlidir (Sideli ve Gradziel, 2023).

Genom içerisindeki her bir kromozoma ait fiziksel haritaların oluşturulması, hızlı gen dizileme ve klonlama araçları ile şeftali genomunun tam diziliminin oluşturulması üzerine odaklanmalıdır, böylelikle şeftali ıslah programlarında kullanılabilecek etkili moleküler markörler geliştirmek mümkün olabilir. Şeftali genomundaki gelişmeler, gelecekteki meyve ıslahı programları için değerli bilgiler sağlayacaktır. Genomik çalışmalar, şeftali meyve kalitesi seleksiyonunda ilgi çeken genleri keşfetmeyi mümkün kılabilir.

Birçok tür de genetik bilginin büyük ölçüde artmasının ana nedenlerinden biri, DNA dizileme maliyetlerinin azalması olmuştur. Bu durum, özellikle Yeni Nesil Dizileme (Next-Generation Sequencing, NGS) 'nin birçok türün genomunu dizilemesiyle süre gelmiştir. Günümüzde, küçük ve orta büyüklükte genomlara sahip birçok türün genomu dizilenmiştir (http://www.ncbi.nlm.nih.gov/genome/browse/). Özellikle, Basit Tekrarlı Diziler (SSR) ve Tek Nükleotid Farklılıkları (SNP) gibi moleküler markörlerin geliştirilmesi ile sağlanan ilerlemenin devamında ise doymuş genetik haritaların oluşturulmasını ve yetiştirilen türlerin en önemli karakterlerinin değişkenliğini açıklayan ana genlerin ve QTL'lerin genomik pozisyonlarının belirlenmesini mümkün kılmaktadır (Güney ve Kafkas, 2020; De Mori ve Cipriani, 2023). Arus ve ark. (2012), şeftali de yaptıkları bir çalışmada, yüksek yoğunluklu genetik haritalar oluşturmuş ve 40'tan fazla ana gen ile bağlantılı birçok QTL belirlenmişlerdir.

Genotipleme-yoluyla-dizileme (GBS) gibi yaklaşımların kullanımı, çeşitli badem çeşitleri veya genotiplerinin yeniden dizilimi temel alınarak yapılan analizler gibi yaklaşımlar da bu konuda önemli rol oynamaktadır (Elshire ve diğerleri, 2011). Daha önce haritalara yerleştirilen genler veya QTL'ler, referans Prunus haritasıyla hizalanmış haritalarda fiziksel haritada bulunmaktadır

(Dirlewanger ve ark., 1999; Etienne ve ark., 2002; Quilot ve ark., 2004; Li ve ark., 2021). Bu genlerin/QTL'lerin bulunduğu bölgelerin DNA dizisine dayalı olarak, bu bölgelerin doygunluğu için markörler geliştirmek kolaydır ve bu markörler, ayrışan populasyonlar veya genotiplerin koleksiyonlarıyla birlikte çalışarak, ilgili fenotiplerle birlikte incelenebilir ve hedef lokusun haritalandırılır (Michelmore ve ark., 1991). Gen/QTL'nin konumu belirlendikten sonra, bu kromozom bölgesinde karakterin ifadesi için aday olan genleri araştırmak ve bunların dizilimine dayalı markörler geliştirmek veya farklı bireylerdeki dizilim değişkenliğini incelemek ve gözlemlenen fenotiplerle ilişkisini incelemek de mümkündür.

İlk badem genomu, Sanchez-Perez ve ark., (2019) tarafından yayımlandı. Badem çeşidi Lauranne, Illumina ve PacBio dizileme teknolojileri ile birleştirerek genom dizilimi orataya konuldu. Bu kapsamda, PacBio'dan uzun okumalar kullanılırken, Illumina'dan kısa okumalar boşluk doldurma ve iskeleleme için kullanıldı. Lauranne genomunun genom büyüklüğü 246 Mbp ve N50 değeri 21.8 Mb'dir. Bunların arasında 1,080'i korunmuş bitki geni olan toplam 27,817 gen bulunmaktadır. Tek bir gen üzerindeki baskın bir mutasyon, acı ve toksik yabani badem fındıklarını tatlı badem çekirdeklerine dönüştürdü (Heppner, 1923). Ayrıca, tatlı çekirdek (Sk) karakteri, LG5'in merkezi bölgesine haritalandı (Sanchez-Perez ve ark., 2007). Ancak, Sk'nin mekanizması ve yolları bilinmemektedir. Sk'nin mekanizmasını ortaya çıkarmak için Sanchez-Perez ve ark., (2019), Sk lokusunda ayrışan 475 F1 bireyini içeren bir haritalama popülasyonu kullandı. Sonuç olarak, Sk lokusuna 0.1 cM ve 0.2 cM uzaklıktaki iki basit dizi tekrarı (SSR) belirlendi. Bu iki markörü referans badem genomuna hizaladıktan sonra, bu bölgede beş geni (bHLH1-5) kodlayan putatif temel heliks döngü heliks (bHLH) transkripsiyon faktörlerini içeren 46 kb'lik bir küme konumlandırıldı. Beş farklı bHLH geninin fonksiyonel karakterizasyonundan sonra, araştırıcılar, bHLH2'nin P450 monooksijenazın transkripsiyonunu kontrol ettiğini, bu da amigdalin biosentezinden sorumlu iki geni (PdCYP97D16 ve

PdCYP71AN24) kodladığını ortaya koydu. Sanchez-Perez ve ark. (2019), bHLH2'nin dimerizasyon alanında Leu'dan Phe'ye amino asit değiştiren bir nokta mutasyonunun, iki sitokrom P450 geninin transkripsiyonunu önlediğini, bu mutasyonun bademde Sk özelliğine yol açtığını öne sürdü. Bu çalışma, bademde acı çekirdekten tatlı çekirdeğe mutasyonu ve badem evcilleştirmesini başlatan bir keşfi ortaya konulmuştur.

İkinci badem tüm genomu, Alioto ve ark., (2020) tarafından dizilimi yayınlandı. İllumina kısa okumaları ve Oxfor Nanopore ile uzun okuma teknolojileri, mevcut Prunus bağlantı haritası (Donoso ve ark., 2015) ile birlikte Texas badem genomunu dizilimini elde etmek için kullanıldı. Texas genomunun genom büyüklüğü 227.6 Mbp ve N50 değeri 381.5 Kb'dir. Ayrıca, sekansların% 91.5'i bademin hizalandı. Toplam 27,969 protein kodlayan gen elde edildi ve bunlardan sorumlu olan 34,039 transkript bulundu ve bunlardan 32,559'u benzersiz protein ürünleri ile öngörüldü. Badem genomunun 16 diğer yakın ve uzak türle yapılan filogenomik karşılaştırması, badem ve şeftali'nin aynı soydan geldiğini ve yaklaşık 5.88 milyon yıl önce ayrıldığını gösterdi. Badem ve şeftali genomları çok sinetik olsa da, transpozon elemanlarının hareketinden kaynaklanan çoğunlukla varlık/eksiklik varyasyonlarının hala yüksek sayıda tespit edildiği belirlendi. TEs, genomik yapının değişmesine neden olabilir, bu da badem ve şeftali'nin mesokarp gelişimi ve çekirdek acılığı gibi önemli tarımsal özelliklerde ayrılmasında rol aladığını göstermektedir.

Maguvu ve ark., (2023) çalışmalarında, badem ağaçlarında Ceratocystis kanserine neden olan *Ceratocystis destructans* mantarı için ilk genom bilgisini sunmaktadır. Çalışmada, patojenle konak arasındaki moleküler etkileşimleri anlamak ve direnç ıslahı stratejileri geliştirmek için önemli genomik kaynaklar sağlar. Ayrıca, bitkilerin patojenler tarafından kolonize edilmesinde karbonhidrat-aktif enzimler ve diğer virülans faktörlerinin önemini vurgular. Araştırma, *C. destructans*'ta benzersiz proteinleri ve gen adaptasyonlarını belirlemek için tüm genom

dizileme, biyoinformatik araçlar ve ikincil metabolit gen kümeleme karşılaştırmalı analizini kullanmıştır. Çalışma, bu önemli badem kanseri patojeni üzerine gelecekteki araştırmalar için değerli bir kaynaktır ve fitopatojen mantarların virülans faktörleri ve ekolojik etkileşimleri konusunda anlayış sağlar. 27.2 ± 0.9 Mbp genom büyüklüğünde, 6924 ± 135 protein kodlayan gen ve ortalama %48.8 ± 0.02 GC içeriğine sahip olarak belirlenmistir.

Wu ve ark., (2023), çalışmalarında, Xinjiang, Çin'deki bademlerin popülasyon yapısını ve genetik çeşitliliğini analiz etmek için genom resequencing kullanımını tartışmaktadır. Çalışma, 108,481 yüksek kaliteli tek nükleotid polimorfizmalarını tanımlayarak ve evrimsel ağaç ve PCA sonuçlarına dayanarak badem çeşitlerini dört gruba ayırmıştır. Genetik yapı iki gruba ayrılmış ve gruplar arasında gen değişimi kanıtları bulunmuştur. Çalışma aynı zamanda büyüme, stres ve hormonlarla ilgili aday genleri, metabolik süreçler ve badem çeşitleri arasındaki yağ içeriği farklılıklarını tanımlamıştır. Bulgular, sonraki çeşit değişimleri ve ıslah çabalarını için bir temel sağlar. Ayrıca çalışma artan talep ve geleneksel ıslah yöntemlerinin sınırlamaları nedeniyle yüksek kaliteli bademlerin genetik iyileştirilmesi ve ıslahının önemini vurgulamaktadır. Popülasyon genetiği analizinde moleküler işaretçilerin ve işaretleme destekli ıslahın rolünü tartışmaktadır. Ayrıca, Xinjiang'deki badem çeşitlerinde seçilmiş genlerin genetik evrim analizi ve işlevsel açıklamasına dair bir araştırmaya inmektedir. Bu, Xinjiang, Çin'deki badem popülasyonlarının genetik çeşitliliği, popülasyon yapısı ve genetik iyileştirme potansiyeli konusunda değerli bir içgörü sunmaktadır.

Goonetilleke ve ark., (2023a) araştırmalarında, badem (*Prunus dulcis* L.) çeşitleri Nonpareil ve Lauranne'de badem ve çekirdek özelliklerini etkileyen genomik bölgeleri belirlemek amacıyla nicel özellik lokusu (QTL) haritalamanın kullanılıp kullanılamayacağı araştırılmış ve bu bölgelerin diğer iki badem popülasyonunda (Nonpareil × Constantí ve Nonpareil × Tarraco) etkileri incelenmiştir. QTL analizi ve genetik haritalama, daha önce 180 Nonpareil × Lauranne

F1 progenitörü kullanılarak keşfedilen tek nükleotid polimorfizmlerini (SNP'ler) kullanılarak gerçekleştirilmiştir. Nonpareil × Lauranne popülasyonunda, QTL'ler Nonpareil haritasında on bölgede ve Lauranne haritasında 16 bölgede tespit edilmiştir. Her Nonpareil QTL bölgesi ve çoğu Lauranne QTL bölgesi aynı zamanda Constantí ve/veya Tarraco popülasyonlarında da tespit edilmiştir. Çoğu QTL küçük etkilere sahipti, bu da burada incelenen özelliklerin belirteç destekli seleksiyon yerine genomik seleksiyon için daha uygun olabileceğini göstermektedir. Nonpareil ve Lauranne için QTL bölgelerinin genom dizileme montajlarına bağlanmasıyla, gelecekte değerlendirilebilecek bazı aday genler tanımlanmıştır. Ayrıca, araştırma, badem ve kiraz ağaçları gibi Rosaceae türlerine ait genomik ve genetik veriler için web veritabanlarının entegrasyonunu keşfetmiş, hortikültürel araştırmalardaki ilerlemelere ve ıslah stratejilerine dair bilgi sunmuştur.

Kloroplast genom dizileme, çeşitli DNA barkodları oluşturmak için giderek daha kullanışlı hale gelmektedir. Şu anda, sistematiğin ve çiçekli bitkilerin plastid DNA barkodunun geliştirilmesi için non-kodlayan genlerin kullanımı önemlidir. Hassan, (2023) bu çalışmada, badem cinsinin taksonomik düzeylerinde moleküler evrimi değerlendirmeyi ve trnH- ve psbA plastid kodlayan genlerinin iki önemli bölgesinin barkod olarak uygulanabilirliğini amaçlamaktadır. Bu bağlamda, 14 adet subg. Amygdalus türünün kloroplast genomları, yüksek değişkenlik gösteren kodlayan DNA barkodu bölgelerini aramak için dizi açıklamaları için seçilmiştir. Veritabanından 12 cins alınırken, iki cins, yani acı ve tatlı genotip, mevcut çalışmanın verilerine dayanmaktadır. Sonuçlar, 14 örnek üzerinde test edilen kodlayan genlerin en değişken alanının, ortalama uzunluğu 1058 bp olan trnH- ve psbA plastid genleri olduğunu gösterdi. Fitojenetik ağaç, acı ve tatlı badem türleri arasında örtüşme olmadan açık bir tanımlama sağlayan monofiletik açıklamaları doğru bir şekilde çizdi. Elde edilen veriler, tatlı bademin, vahşi badem, şeftali ve kirazdan türeyen bir evcilleştirme olayından geçtiğini öne sürmektedir.

Genom çapında birleşik çalışmalar (GWAS'lar), bu ilgi çeken alelleri (ve dolayısıyla QTL'leri) tespit etmek için güçlü bir araçtır. Pérez de los Cobos ve ark., (2023) bu çalışmada, 243 badem erişimini içeren bir koleksiyonda genetik yapıyı ve eklemeli ve eklemeli olmayan genotip-fenotip ilişkilerini keşfetti. Genetik yapı analizimiz, erişimlerin beş soydan oluşan bir alt gruplara bölünmesini güçlü bir şekilde destekledi; hepsi ortak bir kökene sahip erişimlerden oluşuyordu. Bu gruplardan biri sadece İspanyol erişimlerinden oluşurken, geri kalanı genellikle Çin, İtalya, Fransa ve ABD'den gelen erişimlerden oluşmaktaydı. Bu sonuçlar, ayrı modern badem yayılımının dört aşamaya bölündüğüne dair arkeolojik ve tarihsel kanıtlarla uyumludur: Asyatik, Akdeniz, Kaliforniya ve güney yarımküre'dir. Toplamda, nut weight, crack-out percentage, double kernels percentage ve blooming time için 13 bağımsız QTL buldular. Bulunan 13 QTL'den sadece bir tanesi eklemeli bir etkiye sahipti. Aday gen analizi ile, crack-out yüzdesinde bulunan ana QTL için Prudul26A013473, double kernels yüzdesinde bulunan QTL'ler için Prudul26A012082 ve Prudul26A017782, ve çiçeklenme zamanında bulunan QTL için Prudul26A000954 aday genleri olarak önerildi. Çalışma, badem yayılma tarihine dair bilgimizi artırırken, badem ıslahında büyük bir etki yaratacaktır.

Yüksek yoğunluklu tek nükleotid polimorfizmi (SNP) dizisi, bitki ıslahında yeni çeşit geliştirme konusundaki ilerlemeyi hızlandırmak için esastır. Bu bağlamda, Duval ve ark., (2023), 81 badem erişimini yeniden dizileyerek Axiom 60K badem SNP dizisini geliştirdi. Dizinin doğrulanması için 210 erişim genotiplendi ve SNP'lerin %82.8'i en iyi önerilen SNP'lerde sınıflandırıldı. Eksik veri oranı, badem erişimleri için %0.4 ila %2.7 arasında ve şeftali ile yabani genotipler için %15.5'in altında idi, bu da bu dizinin şeftali ve interspesifik şeftali-badem genetik çalışmalar için kullanılabileceğini göstermektedir. RMja (nematod direnci) ve SK (acılık) genleri ile bağlantılı iki SNP'nin değerleri tutarlıydı. Ayrıca, bir badem F2 soyağacından gelen 49 hibriti genotiplendi ve 1159 SNP içeren bir genetik harita

oluşturabildi. Hata oranları, replikaları karşılaştırarak ve F2 soyağacında Mendel kalıtımından sapmaları tespit ederek değerlendirildi ve %1'in altında kalmıştır.

Kendine uyuşmazlık (SI) sistemleri, genetik olarak kontrol edilen polen–pistil etkileşimleridir ve kendinden poleni reddetmeyi sağlar. Çiçek polimorfizmi ile ilişkilendirilen SI'ya dayanarak, SI iki türe ayrılabilir: heteromorfik ve homomorfik. Heteromorfik SI sistemi, distili ve tristili gibi çiçek parçalarının farklı konumları nedeniyle iki veya üç uyumsuzluk tipine sahiptir, homomorfik SI sistemi ise çiçek morfolojisine bakılmaksızın kendinden döllenmeyi engelleyen birçok farklı uyumsuzluk sistemine sahiptir. Homomorfik SI 'nun iki türü vardır: sporofitik kendine uyuşmazlık (SSI) ve gametofitik kendine uyuşmazlık (GSI). SSI 'da, poleni sağlayan diploid ebeveyn bitkinin (sporofit) genotipi uyumsuzluk tipini belirler, ve GOU'da, haploid polenin kendisi (gametofit) uyumsuzluk tipini belirler. GSI, bitki krallığında en yaygın SI sistemidir ve Solanaceae, Rosaceae ve Plantaginaceae familyalarında bulunabilir. Badem (*Prunus dulcis*), çoğunlukla çapraz tozlaşan bir türdür ve çoğu kültür kendinden uyumsuz olarak tanımlanmıştır. Birkaç badem kültür türünde kendinden verimli olduğu bilinmektedir (Goonetilleke ve ark., 2023b).

4. SONUÇLAR VE ÖNERİLER

Badem, önemli bir meyve türüdür ve genetik araştırmalar, bu bitkinin verimliliğini ve dayanıklılığını artırmak için önemlidir. Bitkisel özelliklerin ve evrimsel çalışmaların incelenmesi açısından bitkinin tam genom diziliminin bilinmesi son derece önemlidir. Son on yılda, yeni nesil dizileme teknolojilerinin hızla gelişmesiyle birlikte, bitkilerin tam genomunun dizilenmesi daha maliyet-etkin hale gelmiştir. Badem bitkisinin genom dizileme çalışmaları, genetik bilim ve tarım araştırmalarındaki ilerlemelerle birlikte önem kazanmıştır. Geçmişte, badem bitkisinin genetik yapısını anlamak için geleneksel yöntemler kullanılmıştır. Ancak, son

yıllarda genotipleme teknolojileri ve DNA dizileme yöntemlerindeki gelişmeler, bitki genomlarını daha ayrıntılı bir şekilde inceleme olanağı sağlamıştır. Badem bitkisinin genom dizileme projeleri gerçekleştirilmekte ve bu projeler genellikle yüksek kaliteli referans genomları oluşturmayı hedeflemektedir. Badem bitkisinin genom dizilemesi, genetik çeşitliliği anlamak, özellikle de farklı badem çeşitlerinin adaptasyonunu ve direncini belirlemek için önemlidir. Bu çalışmalardaki ilerlemeler, badem yetiştiriciliğini geliştirmek ve hastalıklara, iklim değişikliklerine ve diğer streslere karşı daha dayanıklı çeşitler geliştirmek için temel bilgiler sağlamayacaktır. Gelecekte, badem bitkisinin genom dizileme çalışmalarının daha da genişleyerek, bu bitkinin genetik potansiyelini tam anlamıyla ortaya çıkaracağı beklenmektedir. Bitkinin adaptasyon yeteneklerini artırmak, verimliliği optimize etmek ve kaliteli ürün elde etmek için genetik düzenlemelerin yapılmasına olanak tanıyacaktır. Ayrıca, bu çalışmalar, badem yetiştiriciliği için dayanıklı çeşitlerin geliştirilmesine yönelik daha spesifik genetik bilgileri ortaya çıkaracaktır.

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ELMANIN TRANSKRIPTOM VE GENOMIK ANALIZI (*Malus* × *domestica*)

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ÖZET

Elma (*Malus*× *domestica*), yumuşak çekirdekli meyveler arasında önemli bir yere sahiptir. Elma genotipleri, ıslah çalışmalarında vazgeçilmez bir genetik materyal olarak kabul edilir. Bu genotiplerdeki akrabalık ilişkileri ve genetik farklılıkların belirlenmesi, ıslah çalışmaları açısından hayati öneme sahiptir. Elmalar dünya çapında önemli bahçe bitkilerindendir. Taze olarak tüketiminin yanı sıra, şekerleme, gıda sanayisi, çikolata ve pasta endüstrisi gibi çeşitli alanlarda kullanılmaktadır. Son zamanlarda ise moleküler seviyede çalışmalar yaygın olarak yapılmaktadır. Elma bitkisinin transkriptomik ve genomik analizi, bitki biyolojisi ve tarım endüstrisinde önemli araştırma alanları olarak ortaya çıkmıştır. Transkriptom analizi, elmalardaki gen ekspresyonu düzenlemelerini anlamamızı sağlayarak, bu düzenlemelerin farklı gelişim aşamaları ve çevre koşulları boyunca nasıl değiştiğini ortaya çıkarır. Genomik analiz, bitkinin DNA dizisinin ayrıntılı bir görünümünü sağlayarak genetik varyasyonları, gen ailesi yapılarını ve evrimsel ilişkileri aydınlatır. Hem transkriptom hem de genomik analizler organizmaların biyolojik süreçlerini daha derinlemesine anlamamıza yardımcı olur. Elma genomunun altında yatan temel moleküler mekanizmaları anlamak için RNA dizilimi kullanılarak transkriptom analizleri yapıldı. Şimdiye kadar çoğu çalışma elma bitkilerinin genetik çeşitliliğinin yanı sıra meyvelerinde ve diğer dokularında bulunan besin değeri ve kimyasal bileşiklere odaklandı. Moleküler araçların gelişmesiyle birlikte transkriptomik ve genomik çalışmaların sayısı artmış, elma genomunun anlaşılmasına yönelik çabalar sarf edilmiştir. Bu çalışma elma çeşitlerinden elde edilen transkriptomik ve genomik verilere odaklanmaktadır. Son zamanlarda yüksek bitkilerde çok sayıda RNA tipi tanımlanmıştır. Bu çalışma, elma türleri ve çeşitleri üzerinde yapılan transkriptomik ve genomik çalışmaları derlemeyi amaçlamaktadır. Bu derleme, kloroplast genomlarından, gen etki alanlarından,

tanımlamalardan, sınıflandırmalardan ve çeşitli gelişimsel olaylarda ve stres yanıtlarında elmalar üzerinde yapılan RNA-Seq analizlerinden elde edilen transkriptomik bilgilerden türetilen bilinen düzenleyici işlevlerden yararlanır.

Anahtar Kelimeler: RNA-Seq, transkriptom, genomik, elma.

TRANSCRIPTOME AND GENOMIC ANALYSIS OF APPLE (*Malus* × *domestica*)

ABSTRACT

Apple (*Malus* × *domestica*) is one of the key pome fruits, and apple genotypes serve as vital genetic resources for breeding research. Establishing relationships and understanding genetic variations among apple genotypes is essential for successful breeding programs. Apples are globally significant horticultural crops, finding applications in various sectors, including fresh consumption, confectionery, the food industry, chocolate, and pastry production. Recently, studies at the molecular level have been widely carried out. Transcriptomic and genomic analysis of the apple plant has emerged as crucial research areas in plant biology and the agricultural industry. Transcriptome analysis enables us to understand gene expression regulations in apples, revealing how these regulations change across different developmental stages and environmental conditions. Genomic analysis provides a detailed view of the plant's DNA sequence, elucidating genetic variations, gene family structures, and evolutionary relationships. Both transcriptomic and genomic analyses help us gain a deeper understanding of the biological processes in organisms. To understand the fundamental molecular mechanisms underlying the apple genome, transcriptome analyses were conducted using RNA sequencing. Until now, most studies have focused on the genetic variation of apple plants, as well as the nutritional value and chemical compounds present in their fruits and other tissues. With the advancement of molecular tools, the number of transcriptomic and genomic studies has increased, and efforts have been made to comprehend the apple genome. This study focuses on transcriptomic and genomic data from apple varieties. Recently, numerous RNA types have been identified in higher plants. This study aims to compile transcriptomic and genomic studies conducted on apple species and cultivars. This compilation utilizes known regulatory functions derived from chloroplast genomes, gene domains, identifications, classifications, and transcriptomic information obtained from RNA-Seq analyses on apples in various developmental events and stress responses.

Keywords: RNA-Seq, transcriptome, genomic, apple.

1. GİRİŞ

Elma (*Malus* × *domestica*) Gülgiller (Rosaceae) familyasından armut ve malta eriği ile yakın akraba olup, üretim ve yetiştirme alanı bakımından diğer ılıman iklim meyvelerinin başında yer almaktadır. Haploit kromozom sayısı 17'dir (n=17). Elma çeşitlerinin büyük bir çoğunluğu diploid'dir (2n=34) (Güney, 2016). Elma, yumuşak çekirdekli meyveler arasında önemli bir yere sahiptir.

Elma genotipleri, ıslah çalışmalarında vazgeçilmez bir genetik materyal olarak kabul edilir. Son zamanlarda ise elmada moleküler seviyede çalışmalar yaygın olarak yapılmaktadır. Morfolojik, fizyolojik ve biyokimyasal yöntemler, genetik çeşitliliğin belirlenmesi için kullanılan yöntemlerdir ancak bu yöntemler, çevresel faktörlerden etkilenebilir ve uzun zaman alabilir. DNA markör tekniklerinin geliştirilmesiyle farklı ekolojilerdeki genetik materyaller daha hızlı ve güvenilir bir şekilde belirlenebilmektedir (Güney, 2016). RFLP (Sınırlı Parça Uzunluk Polimorfizmi), RAPD (Tesadüfî Çoğaltılmış Polimorfik DNA), ISSR (Basit Tekrarlı Diziler ArasıPolimorfizm), SRAP (Dizi İlişkili Çoğaltılmış Polimorfizm), AFLP (Çoğaltılmış Parça Uzunluk Polimorfizm), CAPS (Kesilip Çoğaltılmış Polimorfik Diziler), SSR (Basit Dizi Tekrarları) ve SNP (Tek Nükleotid Polimorfizmi) gibi markör teknikleri kullanılarak daha kısa sürede, daha güvenilir sonuçlarla, genetik çeşitlilik belirlenebilmektedir (Güney ve ark., 2018). Moleküler markörler, kaynaklarını bitki hücrelerinde bulunan DNA'dan alan moleküllerdir. Islah programlarında, belirli bir özellikle ilişkili moleküler markörün kromozom üzerindeki konumunun belirlenmesi, programların hızını artırabilir. Böylece, bir karakterle ilişkili markör, populasyon veya farklı populasyonlarda taramalar yaparak, istenmeyen özelliklere sahip

bireyler elenir. Bu sayede, birey sayısı azaltılır, hem maliyetler azaltılır hem de zaman tasarrufu sağlanır (Sönmezoğlu ve ark., 2010).

Transkriptom ve genomik analizler, bitki ıslahında kullanılan moleküler düzeydeki yöntemlerdir. Transkriptom analizi, bir hücre veya dokudaki genlerin ifade düzenini belirlerken, genomik analizler organizmanın genetik materyalini ve genlerin işlevini anlamaya odaklanır. Bu analizler, istenen özelliklere sahip bitkilerin seçilmesi, genetik temellerin anlaşılması ve bitki ıslahında hızlı ilerlemeler sağlanması için kullanılır. Bu çalışma, elmada transkriptom ve genomik analizler ilgili güncel araştırmalara odaklanarak genetik ilişkileri aydınlatmayı amaçlamaktadır.

2. ELMADA TRANSKRİPTOM ÇALIŞMALARI

Transkriptom analizi, canlılarda gen ekspresyonu düzenlemelerini anlamamızı sağlayarak, bu düzenlemelerin farkı gelişim aşamaları ve çevre koşulları boyunca nasıl değiştiğini ortaya çıkarır.

El-Sharkawy ve ark., (2015) çalışmalarında, 'Blondee' olarak bilinen bir elma somatik mutasyonunun, ve bu mutasyonun kırmızı kabuklu ebeveyni 'Kidd's D-8'nin transkriptom analizini ele alarak, mutasyonun temelinde yatan moleküler mekanizmaları ortaya koymaktadır. Toplamda 3,299 farklı ifade edilen gen tespit edilmiş ve antosiyanin ve epigenetik düzenleme ile yüksek derecede ilişkilendirilmiş bir gen ağı modülü ortaya çıkarılmıştır. Elmalardaki meyve rengini etkileyen genetik ve epigenetik faktörlere dair değerli içgörüler sunmaktadır. Araştırma, 'Gala' elmasının KID ve BLO adlı iki türünün genetik ve epigenetik analizine odaklanmış ve her iki türde de gen ifadesini analiz etmek için RNA-seq kullanmıştır. Ayrıca, çalışma,

elmalardaki meyve rengi varyasyonunda çevresel faktörlerin ve epigenetik düzenlemenin rolünü öne sürmektedir.

Temel lösin zıpper (bZIP) ailesi, bitkilerdeki en büyük transkripsiyon faktörü (TF) ailelerinden biridir ve bitki büyüme ve gelişiminde kritik roller oynar. bZIP proteinleri, çeşitli biyolojik süreçlerde ve çeşitli biyotik/abiyotik streslere tepki olarak görev yapar. Li ve ark., (2016) yaptıkları çalışmada, elmada toplam 114 bZIP geni tanımlandılar ve bunları sekanslarına dayanarak 10 alt gruba ayırdılar. Çalışma, genleri yapı, protein modeli ve kromozomal dağılım açısından karakterize etti ve bazı genlerin elma meyve gelişimi sırasında yüksek düzeyde ifade edildiğini buldu. Ayrıca, genlerin kuraklık ve tuz stresi altındaki ifadesini inceledi ve bunun stres tepkilerine katılımları olduğu ilişkilendirilmiştir.

Li ve ark., (2016) çalışmalarında, elma bitkilerinin kuraklık, soğuk ve yüksek tuzluluk stresi altındaki transkriptom analizini ele almış ve bu üç stres tedavisine verilen ortak farklı ifade edilen genler (DEG'ler) belirlenmiş ve bunların metabolik süreçler ve çevresel bilgi işlemede zenginleştiği ortaya çıkarmıştır. Kuraklık direnci geni DREB2a'nın transgenik bitkilerde aşırı ifadesinin, kuraklık ve tuz stresine karşı artan toleransa neden olduğu bir incelemeyi içermektedir. Elma da çeşitli streslere yanıt olarak ABA sinyalinin rolünü araştırdı ve direnç ıslahı için potansiyel hedefleri belirlediler. Gen ifadesi profil oluşturma araçlarını kullanarak elma meyve olgunlaşması ve olgunlaşması sırasındaki transkripsiyon dinamiklerini karakterize etmiştir, ayrıca elmalarda antosiyanin, stres yanıtları ve meyve renklendirme ile ilişkilendirilen genleri ve gen ağlarını tanımlamışlar.

Li ve ark., (2018) iki farklı elma çeşidinin ('Nagafu No. 2' ve 'Yanfu No. 6' (yani, bir tomurcuk mutasyonu gösteren 'Fuji' elma ağacı) çiçeklenme yetenekleri ile ilgili olarak transkriptomlarının kapsamlı bir analizini yapmışlardır. Araştırma, farklı olarak ifade edilen genlerin ve fizyolojik parametrelerin ifadesi ile kanıtlanan şekilde, çiçeklenme geçişindeki farkların şeker ve sitokinin sinyalleme yollarıyla ilişkilendirildiğini bulmuştur. Çalışma ayrıca elma ağacı büyüme ve çiçeklenme üzerindeki etkilerini anlamak için gibberellin ve 6-benzilaminopurin uygulamalarını içermiştir. Ayrıca, araştırma, elma ağaçlarında çiçeklenme geçişinin moleküler mekanizmalarını anlamak için gen ifadesi, hormon seviyeleri ve şeker metabolizmasını incelemiştir.

BAK1'nin bitki stres tepkileri üzerindeki etkileri bilgiler olsa da, bitki büyümesi üzerindeki etkileri hakkında pek bilgi bulunmamaktadır. MdBAK1'in aşırı ifadesi büyümeyi teşvik etmiş, kök hücre boyutunu ve sayısını etkilemiş ve eksojen brassinosteroidlere duyarlılığı artırmıştır. Transkriptom analizi, transgenik bitkilerde brassinosteroid ve etilen sinyallerinin, ksilem üretiminin ve stres tepkilerinin aktivasyonunu ortaya koymaktadır (Zheng ve ark., 2019).

Elma pası, dünya çapında elma (*Malus* × *domestica* Borkh.) için en ciddi hastalıklardan biri olan *Venturia inaequalis* (Cke.) Wint. adlı bir ascomycete mantarı tarafından oluşturulur. Hastalık yılda %30-40 meyve kaybına neden olmakta ve bazı bölgelerde tamamen kayba yol açabilmektedir. Masoodi ve ark., (2022) çalışmalarında, pas direncine sahip (Florina, Prima ve White Dotted Red) ve üç duyarlı (Ambri, Vista Bella ve Red Delicious) elma genotipinin karşılaştırmalı transkriptom analizi, yeni pas direnci genlerini keşfetmek amacıyla Illumina (HiSeq) platformu kullanılarak yapmışlar. Dirençli ve duyarlı genotiplerde 822 farklı ifade edilen geni tanımladılar, birçok genin dirençli çeşitlerde tutarlı bir şekilde yukarı regüle

olduğunu gösterdi. Ayrıca, metabolik, protein işleme ve bitki-patojen etkileşimi gibi çeşitli patikalara ait genleri buldular. Çalışmada, elma genotiplerinin pasına karşı direncin moleküler temelini aydınlatarak, pas direncini artırmak için potansiyel genler konusunda genetik ön bilgi sağlanmıştır.

Kılıç ve ark., (2023) çalışmaşlarında, Silisyumun elma bitkilerinde tuzluluk stresine karşı moleküler düzeyde sodyum (Na) taşıyıcıları üzerindeki etkisini incelemiştir. Silisyum uygulamasının, kısa ve uzun vadeli tuz stresine yanıt olarak sodyum taşıyıcı genleri SOS1 ve NHX1'in ekspresyon düzeylerini artırdığını belirlemişler. Bu, silisyum uygulamasının elma bitkilerinde tuz stresi hasarını hafifletmede yardımcı olabileceğini göstermektedir. Hem kısa vadeli hem de uzun vadeli tuz stresinde, SOS1 ve NHX1 genlerinin ekspresyon düzeyleri kontrol grubuna göre artmıştır. Sonuç olarak, Si uygulamasının, Malus türlerinde Na+ taşımasını düzenleyerek tuz stresi hasarını hafifletebileceği düşünülmektedir.

3. ELMADA GENOMİK ÇALIŞMALAR

Genomik analiz, bitkinin DNA dizisinin ayrıntılı bir görünümünü sağlayarak genetik varyasyonları, gen ailesi yapılarını ve evrimsel ilişkileri aydınlatır.

Velasco ve ark., (2010) çalışmalarında, elmanın yüksek kaliteli bir taslak genom dizisini konu almıştır. Araştırıcılar, nispeten yakın bir tarihli (>50 milyon yıl önce) genom genişleme olayı (GWD), Pyreae'de dokuz atasal kromozomdan 17 kromozoma geçişi sağlandığını saptamışlar. Elma üzerinde, çiçek ve meyve gelişiminde normalde rol alan MADS-box genlerinin bir alt kolu, reseptakül olarak adlandırılan sepallerin baz kısmının çoğalmasıyla genişlediğini

saptamışlar ve diğer Rosaceae özgü metabolizma ile ilgili gen aileleri, sorbitol taşıma ve asimilasyonu gibi konularda ön bilgiler elde etmişler.

SQUAMOSA promotör bağlama protein (SBP)-box gen ailesi üyeleri, bitki gelişiminde birçok önemli rol oynayan bitkiye özgü transkripsiyon faktörlerini kodlar. Li ve ark., (2013) elma genomunda 27 SBP-box geni tanımladı ve bunların bitki gelişimi ve stres sırasında hormon sinyaline yanıt verme potansiyellerini keşfetti. Ayrıca, elma içindeki SBP-box gen ailesinin evrimsel desenleri ve gen yapılarına odaklanarak, bu genlerin çeşitli biyolojik süreçlerdeki potansiyel düzenleyici rollerini anlama konusundaki önemini vurgulamaktadır.

Darwin Tree of Life projesi, Britanya ve İrlanda'daki 70,000 farklı eukaryot organizmanın genomunu dizilemeyi amaçlayan bir işbirliği projesidir ve Biyoloji, Bitki Koruma ve Biyoteknoloji alanlarında yeni perspektifler sunarak çalışma yöntemlerini dönüştürmeyi hedeflemektedir. Könyves ve ark., (2022) çalışmalarında, genom dizileri, uzunluklar, mitokondri ve plastit genomları ile tür taksonomisi hakkında bilgiler vermektedir. Çalışma, PacBio verileri, 10X Genomics Chromium verileri ve Arima Hi-C verilerine dayanarak elmanın özellikleri üzerinde triploidinin etkisine odaklanmaktadır. Dört elma çeşidinin genom dizileri, 643 ile 653 megabase arasında değişen bir uzunluğa sahip olduğunu göstermektedir. Her genome assembly uzunluğunun büyük bir kısmı (99.24 ila 99.74%), 17 kromozomal bölgeye düzenlenmiştir. Çalışmada, mitokondriyal ve plastit genomları da genome assembly edilmiş olup sırasıyla 400 kilobas ve 167 kilobas uzunluğundadır.

Genetik bağlantı haritaları, ilgi duyulan özelliklerle ilişkilendirilmiş genetik lokusları belirlemede kullanılabilir. Elma meyve özellikleri çevresel faktörlerden etkilenir ve nicel trait

lokusları (QTL) tarafından kontrol edilir. Oh ve ark., (2023) çalışmalarında, elma için tek ebeveynli ve entegre iki ebeveynli genetik bağlantı haritalarını, genotipleme-bi-sequencing (GBS) türetilmiş tek nükleotid polimorfizmaları (SNP'ler) ve basit dizi tekrarları (SSR'ler) kullanılarak oluşturmuştur. 'Gala' haritası, 1.96 cM'lik bir markör yoğunluğuna sahip 1,400.8 cM boyunca 725 GBS-SNP ve 40 SSR markörü içermektedir. 'Jonathan' haritasında ise 2.36 cM'lik bir markör yoğunluğuna sahip 1,635.7 cM boyunca 698 GBS-SNP ve 40 SSR markörü içermektedir. Bu iki tek ebeveynli genetik bağlantı haritasının 17 bağlantı grubu, 17 elma kromozomunu temsil etmekte ve referans genomun yaklaşık %69'unu kapsamaktadır. QTL analizi ile 'Jonathan' haritasının 9, 10 ve 13 numaralı bağlantı gruplarındaki meyve kabuğu rengi ile ilişkilendirilmiştir. Ayrıca, 'Jonathan' haritasının 13 numaralı bağlantı grubunda meyve asitliği ile ilişkilendirilmiş bir QTL'de belirlenmiştir.

Hanfu elması, Kuzeydoğu, Kuzeybatı ve Kuzey Çin'in serin bölgelerinde yetiştirilen ana çeşittir. Qin ve ark., (2023) PacBio, Illumina ve Hi-C dizileme verilerini kullanarak bir kromozom ölçeğinde Hanfu genomunu çalışmıştır. Hanfu genomunda toplam 39,617 gen bulunmaktadır. Karşılaştırmalı bir analiz, Hanfu ve diploid Hanfu elması anterleri kullanılarak kültüre edilen homozigot triploid HFTH1 genomları üzerinde yapılmış. Gen ailelerini tanımlamak ve farklı elma türleri arasındaki genetik ilişkileri değerlendirmek için çeşitli dizi teknikleri ve biyoinformatik araçları kullanmışlar. Bulgular, genetik araştırmalar ve yüksek dirence ve kaliteye sahip yeni elma çeşitlerinin geliştirilmesi için değerli kaynaklar sunmaktadır. Çalışmanın sonuçlarını destekleyen veri seti, NCBI Sequence Read Archive ve Figshare veritabanında açık erişime sunulmuştur.

Triheliks transkripsiyon faktörleri (TF'ler) ilk olarak GT elementleri olarak adlandırılan ışık tepki elementlerine özgü olarak bağlanmakta, bu nedenle bu aile aynı zamanda GT faktörleri ailesi olarak adlandırılır. Trihelix transkripsiyon faktörleri, GT-1, GT-2, SH4, GTγ ve SIP1 olmak üzere beş alt aileden oluşur ve biyotik ve abiyotik streslere yanıtlarda önemli roller oynar, ancak elmalardaki SIP1 genlerinin rolü hakkında pek bilgi bulunmamaktadır. Liu ve ark., (2023) çalışmalarında, gen genom çapında analizi ile ilk kez 12 adet MdSIP1 geni elmalarda tanımlanmış ve korunmuş MYB/SANT benzeri domainleri içerdiğini saptamışlar.

4. SONUÇLAR VE GELECEK PERSPEKTİFLERİ

Transkriptom ve genomik analizler, biyolojik ve genetik süreçleri daha iyi anlamamıza ve uygulamalar geliştirmemize olanak sağlar. Genomik ve transkriptomik veriler genellikle büyük ve karmaşıktır. Bu verileri etkili bir şekilde analiz etmek için entegre analiz platformları ve veri yönetimi stratejileri geliştirmek, araştırmacılara daha kapsamlı bir perspektif sunabilir. Bu analizler, bitki ıslahında daha hızlı ve hassas seçim yapılmasına, istenen özelliklere sahip bitkilerin daha etkili bir şekilde geliştirilmesine ve tarım verimliliğini artırmaya olanak tanır. Transkriptom ve genomik analizler, ıslah programlarında genetik temellerin daha iyi anlaşılmasını sağlayarak bitki yetiştiriciliği alanında önemli ilerlemelere katkıda bulunur. Şimdiye kadar çoğu çalışma elmanın genetik çeşitliliğinin yanı sıra meyvelerinde ve diğer dokularında bulunan besin değeri ve kimyasal bileşiklere odaklandı. Günümüzde elmada transkriptomik ve genomik çalışmaların sayısı artmış ve elma genomunun anlaşılmasına yönelik yoğun çabalar sarf edilmektedir.

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İNEKLER, YAPAY ET VE KÜRESEL ISINMA

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ÖZET

Bu çalışmamız, inekler dahil tüm ruminantlar ile tavuk ve evcil domuzları kapsamaktadır. Çalışma metni içerisinde grubun tüm üyelerinden söz edilmek istendiğinde grubu temsilen büyük harflerle İNEK kelimesi, grubun amiral üyesi olan ineklerden bahsederken ise küçük harflerle inek kelimesi kullanılmıştır. Birileri, Hollanda Hükümeti'ne baskı yapıp 2023-2028 döneminde Ülke inek varlığının %33 oranında azaltılmasını kabul ettirebilmiştir. Benzer baskı diğer dünya ülkelerinde olduğu gibi Ülkemiz Tarım Bakanlığı'na da yapılmaya başlandı. Bazı çevreler küresel ısınma konusunda İNEK' leri baş düşman ilan etmiştir ve bu malum çevreler yapay etin ve böceğin doğal ete alternatif olabileceğini ileri sürmektedirler. Bu bağlamda bazı sivil toplum kuruluşları ve onların sözcüleri üzerinden Biz hayvancılara ve çiftçilere muazzam bir dezenformasyon üzerinden inanılmaz boyutlarda hakaretler edilmektedir. Herkes İNEK' lerin anüsünden çıkanla ilgilenmektedir. Halbuki insanlık kendi beslenme sürecinde, bizim yapmış olduğumuz hesaplamalara göre, yıllık en az 3475 Milyon Ton bitkisel ürün atığı meydana getirmekte ve bu çevresel atıklar İNEK'ler tarafından bertaraf edilmektedir. Örneğin, buğday bitkisi. 2022 verilerine göre dünya buğday üretimi 774 Milyon ton'dur. Buğday bitkisinin gövdesini, yani samanı insan tüketemez. Aynı şekilde buğday danesini saran kepeğin de sadece %10-20'si insan beslenmesinde tüketilmekte ve geri kalanı tamamen bir çevresel atıktır. Dünya genelinde 774 milyon ton buğday tüketimine karşın saman ve kepekten dolayı yaklaşık 866 Milyon ton çevresel atık meydana gelmektedir. Ülkemizin önderlik ettiği Ukrayna Tahıl Koridoru projesi kapsamında 13 aylık dönemde onlarca gemiyle taşınan tüm tahıl miktarının sadece 33 Milyon ton olduğu dikkate alınırsa 3475 Milyon ton çevresel atığın ne kadar muazzam bir miktar olduğu görülecektir. İNEK'lerin olmadığı bir dünyada çevresel atık durumuna gelen saman ve kepek, ya tarlada ya da biyokütle tesislerinde yakılarak bertaraf edilmek zorunda kalınacaktır. Saman ve kepeğin biyokütle tesislerine taşınmasının lojistik maliyetleri muazzamdır ve bunun bir CO2 salınım karşılığı vardır. Çok daha önemlisi saman ve kepeğin tarlada ya da biyokütle tesisinde yakılmasıyla oluşacak CO2 miktarıdır ve bu konuda oluşabilecek CO2 miktarını hesaplamak üzere Ege Üniversitesi Yenilenebilir Enerji Enstitüsü laboratuarlarında deneysel olarak analizler yaptırılmıştır. İNEK'lerin diyetinde

buğday dışında yer alan arpa, şeker pancarı, pamuk çekirdeği, pamuk çekirdeği küspesi, yer fıstığı bitki samanı, domates salçası posası, soya küspesi, ay çiçeği küspesi, mısır samanı, çeltik kapçığı ve kavuzu dahil 19 kalem bitki incelememizde yer almıştır. Yaptığımız araştırmaya göre bu 19 kalem dünya genelinde İNEK'lerin beslenme diyetlerinin en az % 90-95'ini temsil ettiği hesaplanmıştır (meraya dayalı beslenme hariç). Bu 19 kalem bitkinin 2021 ve 2022 yıllarına ait dünya üretim verilerinden hareketle ne kadar çevresel atık meydana gelebileceği tek tek hesaplanmış ve bu bitkisel atıklar İNEK'ler tarafından tüketilmeyip yakılarak bertaraf edilmesi halinde ne kadar CO2 salınımı meydana geleceği ayrıntılı olarak hesaplanmıştır. Bizim araştırmamıza göre İNEK'ler dünya genelinde yıllık 3475 Milyon Ton bitkisel atığı bertaraf ederken yaklaşık 7.9 Milyar Ton CO2 salınımına engel olmaktadırlar. İneklerin anüsünden çıkan metan gazına dönük dezenformasyon inanılmaz boyutlardadır. Kimileri bir ineğin yılda 70-120 kg metan gazını atmosfere saldığını bile söyleyebilmektedir. Ancak İç Anadolu ve Doğu Anadolu'daki inek ahırlarının hangi boyutlarda olduğunu, kaç metre karelik alanda kaç adet inek barındığını çok azımız bilir. Maden ocaklarındaki grizu patlaması, bilindiği gibi ortamdaki metan gazı oranının %5'i geçmesi halinde meydana gelmektedir. Bizim hesaplarımıza göre inekler yılda 70-120 kg metan gazını dış ortama vermiş olsa ülkemizdeki inek ahırlarının neredeyse tamamında grizu patlamasının yaşanması gerekirdi. En sağlıklı verileri yayınlayan Hükümetler Arası İklim Değişikliği Paneli (IPCC) ve Uluslararası Enerji Ajansına (IEA)'ya göre İNEK' ler yılda 2.9 Milyar Ton metan gazını atmosfere salmaktadır. Halbuki İNEK'ler bizim hesabımıza göre 7.9 Milyar Ton CO2 emisyonunu önlemektedir. Üstelik kolayca alınabilecek önlemlerle, ki bunu bazı modern büyük çiftlikler başarmaktadır, 2.9 Milyar Ton metan miktarını %70-80 oranında azaltabilmek de mümkündür. Çalışmamız kapsamında insan beslenmesi için doğal ete alternatif olarak gündeme getirilen gerek yapay et gerekse böcek ile beslenmenin ticari olarak doğal ete alternatif olabilirliği de araştırılmıştır. Görülüyor ki dünya genelinde genel kamuoyu, yapay et ile böceğin doğal ete alternatif olabileceğini kabullenmiş durumdadır. Sanki bu konularda bazı malum çevrelerin tüm söyledikleri doğruymuş diye düşünülüyor. Bizim araştırmalarımıza göre dünya genelinde sözü edilen ve de yürürlükteki mevcut yapay et üretim teknolojileri dikkate alındığında, yapay etin hiçbir zaman doğal et ile rekabet edemeyecek olduğu tespit edilmiştir. Yapay et doğal ete göre yatırım verimliliğinde en az 118 kat daha düşük, işgücü verimliliğinde en az 20 kat daha düşük ve mutlak üretim maliyetinde yaklaşık 30 kat daha yüksek olduğu bizim araştırmalarımızda hesaplanmıştır. Böcek üretiminde ise böceklerin fizyolojik yapılarının doğal ve kaçınılmaz bir sonucu olarak tüketilen besin miktarının en az 50 ve hatta 100 katına varan oranlarda çevresel atık meydana gelmektedir. Kısacası yapay et ve böcekler, üretim maliyetleri açısından doğal et ile hiç bir zaman rekabet edemez. Üstelik yapay et üretiminin en önemli girdi kalemi Fetal Bovine Serum (FBS)'dir. FBS'nin mevcut üretim teknolojisi ise hamile ineğin karnındaki henüz doğmamış

buzağıya ihtiyaç duymaktadır. Dünya genelindeki yoğun araştırma faaliyetlerine karşın, birkaç duyuruya rağmen, ticari açıdan alternatif olabilecek ikinci bir FBS üretim teknolojisi henüz geliştirilememiştir. Yapmış olduğumuz oldukça ayrıntılı bir diğer araştırmaya göre İNEK'lerin olmadığı bir dünyada sadece gıda fiyatları değil aynı zamanda on binlerce endüstriyel ürünün fiyatları da çok yüksek oranlarda artmak zorunda kalacaktır. Şöyle ki demir-çelik, tekstil, kağıt, mobilya, inşaat, yapı kimyasalları, PVC ve kauçuk bazlı ürünler, ilaç ve tıbbi ürünler, tutkal, boya, kablo, antifiriz, gres, şarap, rakı ve meyve suları dahil on binlerce endüstriyel ürünün üretiminde, hayvansal ürünler ya ürün bileşeni ya da yardımcı malzeme olarak yer almaktadır. Bizim hesaplamalarımıza göre yıllık en az 155 Milyon ton hayvansal karkas artığı (kemik, kan, deri, tüy, kıl ve yağ vb.), endüstriyel hayvansal ürün haline getirilerek on binlerce sanayi ürünün üretiminde kullanılmaktadır. Günümüzde binlerce endüstriyel ürünün üretiminde, hayvansal ürünlerin sentetik veya bitkisel alternatifi mevcut olmasına karşın bunlar, hayvansal ürünlerle ticari açıdan rekabet edemeyecek durumdadır.

Anahtar Kelimeler: İnekler, Yapay Et, Küresel Isınma

COWS, ARTIFICIAL MEAT AND GLOBAL WARMING

ABSRACT

This study covers all ruminants, including cows, chickens and domestic pigs. When all members of the group were wanted to be mentioned in the study text, the word COW was used in capital letters to represent the group, and when talking about the cows, which are the admiral members of the group, the word cow was used in lowercase letters. Someone was able to put pressure on the Dutch Government and make it accept a 33% reduction in the country's cow population in the 2023-2028 period. Similar pressure began to be exerted on our country's Ministry of Agriculture, as in other countries of the world. Some circles have declared COWS the arch enemy regarding global warming, and these circles claim that artificial meat and insects can be an alternative to natural meat. In this context, we, livestock breeders and farmers, are being insulted to an incredible extent through tremendous disinformation through some non-governmental organizations and their spokesmen. Everyone is interested in what comes out of the COW's anus. However, according to our calculations, humanity creates at least 3475 Million Tons of plant product waste annually in its nutrition process, and these environmental wastes are disposed of by COWS. For example, wheat plant. According to 2022 data, world wheat production is 774 million tons. The stem of the wheat plant, that is, the straw, cannot be consumed by humans. Likewise, only 10-20% of the bran covering the wheat grain is consumed in human nutrition, and the rest is completely environmental waste. Despite 774 million tons of wheat consumption worldwide, approximately 866 million tons of environmental waste is generated due to straw and bran. If we consider that the total amount of grain transported by dozens of ships in a 13-month period within the scope of the Ukrainian Grain Corridor project led by our country is only 33 million tons, it will be seen what an enormous amount of environmental waste 3475 million tons is. In a world without COWS, straw and bran, which have become environmental waste, will have to be disposed of by burning them in the field or in biomass facilities. The logistics costs of transporting straw and bran to biomass plants are enormous and have a CO2 emission counterpart. Much more important is the amount of CO2 that will be formed by burning straw and bran in the field or in a biomass facility, and experimental analyzes were carried out in the laboratories of the Ege University Renewable Energy Institute to calculate the amount of CO2 that can be formed in this regard. 19 items of plants other than wheat in the diet of COWs, including barley, sugar beet, cotton seed, cotton seed pulp, peanut plant straw, tomato paste pulp, soybean pulp, sunflower pulp, corn straw, rice husk and husk, were included in our analysis. . According to our research , it has been calculated that these 19 items represent 90-95% of the nutritional diets of COWs worldwide (excluding

pasture-based nutrition). Based on the world production data of these 19 items of plants for the years 2021 and 2022, it was calculated one by one how much environmental waste could be generated, and how much CO2 emissions would occur if these plant wastes were not consumed by COWS but were disposed of by burning. According to our research, while COWs dispose of 3475 Million Tons of vegetable waste annually worldwide, they prevent the emission of approximately 7.9 Billion Tons of CO2. The disinformation regarding the methane gas released from the anus of cows is incredible. Some may even say that a cow releases 70-120 kg of methane gas into the atmosphere per year. However, very few of us know the size of the cow barns in Central Anatolia and Eastern Anatolia and how many cows are housed in how many square meters of area. As it is known, firedamp explosions in mines occur when the amount of methane gas in the environment exceeds 5%. According to our calculations, if cows released 70-120 kg of methane gas per year, a firedamp explosion would occur in almost all of the cow barns in our country. According to the Intergovernmental Panel on Climate Change (IPCC) and the International Energy Agency (IEA), which publish the most reliable data, COWs release 2.9 Billion Tons of methane gas into the atmosphere annually. However, according to our calculation, COWS prevent 7.9 Billion Tons of CO2 emissions. Moreover, with easily taken measures, which some modern large farms achieve, it is possible to reduce the amount of 2.9 Billion Tons of methane by 70-80%. Within the scope of our study, the possibility of both artificial meat and insect feeding, which are brought to the agenda as alternatives to natural meat for human nutrition, as a commercial alternative to natural meat, was also investigated. It seems that the general public around the world has accepted that artificial meat and insects can be alternatives to natural meat. It is thought that everything that certain circles say on these issues is true. According to our research, it has been determined that artificial meat will never be able to compete with natural meat, considering the existing artificial meat production technologies mentioned and in effect throughout the world. It has been calculated in our research that artificial meat is at least 118 times lower in investment efficiency, at least 20 times lower in labor productivity and approximately 30 times higher in absolute production cost than natural meat. In insect production, environmental waste occurs at rates of at least 50 and even 100 times the amount of food consumed, as a natural and inevitable result of the physiological structures of insects. In short, artificial meat and insects can never compete with natural meat in terms of production costs. Moreover, the most important input item in artificial meat production is Fetal Bovine Serum (FBS). FBS's current production technology requires the unborn calf in the womb of the pregnant cow. Despite intense research activities around the world, a second commercially alternative FBS production technology has not yet been developed, despite several announcements. According to another very detailed study we have conducted, in a world without COWS, not only food prices but also the prices of tens of

thousands of industrial products will have to increase at very high rates. Namely, in the production of tens of thousands of industrial products including iron and steel, textile, paper, furniture, construction, construction chemicals, PVC and rubber based products, pharmaceutical and medical products, glue, paint, cable, antifreeze, grease, wine, raki and fruit juices, animal products are included either as product ingredients or as auxiliary materials. According to our calculations, annually at least 155 million tons of animal carcass residues (bone, blood, skin, feather, hair and fat, etc.) are turned into industrial animal products and used in the production of tens of thousands of industrial products. Although there are synthetic or herbal alternatives to animal products in the production of thousands of industrial products today, they cannot compete commercially with animal products.

Keywords: Cows, Artificial Meat, Global Warming

GİRİŞ

İNEK' lere dönük yapılan onlarca farklı konulardaki dezenformasyonun başında küresel ısınmaya ilişkin söylenenler gelmektedir. Grubun amiral öğesi ineklerdir ve neredeyse tüm saldırılar inekler üzerinde yoğunlaşmaktadır. Örneğin, denilmektedir ki ''dünya üzerinde 2 Milyar inek var. Her biri yılda 70-120 kg metan gazı üretir. Bu nedenledir ki küresel ısınmanın en önemli nedenlerinden biri ineklerdir''(Kalkandelen, 2021, Anonim 1, 2019). Bu miktarlar, Birleşmiş Milletlerin bir kurumu olan IPCC – Uluslararası İklim Değişikliği Paneli ve IEA - Uluslararası Enerji Ajansı'nın raporlarında açıklananlardan 2-3 kat daha yüksektir. IPCC ve IEA, tüm İNEK'leri (ruminantlar, tavuk ve evcil domuzların toplamı yıllık 85-110 Milyon ton metan salınımından sorumlu tutmaktadır (Kutlu ve Özen, 2009). Yıllık 70-120 kg rakamının ve de günlük 227-495 gr. miktarının (Zang et al.) doğru olup olamayacağının çapraz sorgulaması şu şekilde yapılabilir: 1 m3 hava 1.225kg'dır. Havada metan gazı oranı %5 ve üzerine çıktığında yangın ve patlama meydana gelir. Maden ocaklarındaki grizu patlamalarının nedeni budur. Ülkemizde İç Anadolu ve Doğu Anadolu bölgelerinde maddi yetersizlik ve de bilgisizlikten dolayı çok küçük hacimli inek ahırları mevcuttur. Üstelik -10/-30 derece santigrad dondurucu soğuğa karşın kapı ve pencerelerde hava sirkülasyonunu engelleyici naylon perdeler kullanılır. Kışın bu inek damlarında bütün kapı ve pencereler kapalı tutulur. Örneğin, her bir ineğin günlük 120 kg metan ürettiği durumda 100 adet ineğin barındığı 6 mt x 50 mt x 2.5 mt boyutlarındaki bir ahırda inek başına 7.5 m3 hava (9.18 kg) mevcuttur. Her bir inek yıllık 120 kg, günde 0.328 kg metanı atmosfere verirse ahır içindeki havadaki metan oranı ilk 24 saat sonunda %3.58 seviyesine ulaşacaktır. Gün içerisindeki ahıra giriş ve çıkışlardan dolayı ve de kapı ve pencere kapak aralıklarından dolayı meydana gelebilecek hava sirkülasyonu günlük %20'ye kadar çıksa bile (genelde bu değerden çok daha azdır), birkaç gün içinde ahır ortamındaki metan gazı miktarı %5'lerin üzerine çıkacağı için bu durumda bütün kapalı sistem ahırların bomba gibi

patlaması ve içindeki insan ve ineklerin ahırla birlikte yanması gerekir. Halbuki dünya tarihinde böyle bir vaka meydana gelmemiştir.

Bunun gibi onlarca dezenformasyon ile karşı karşıyayız. Bu dezenformasyon bilgilerini yayma çabaları o kadar fazla ki bu dezenformasyonların yüzlerce medya ve sosyal medya haberinde yer aldığını ve birbirlerinden alıntı yapıldığını ve üstelik üzerine yorumların yapıldığını ve hatta birçok bilimsel makalelerin dahi bu yalan/yanlış bilgiler üzerine inşa edildiğini görüyoruz. Örneğin, denilmektedir ki ‘’çiftlik hayvanları direk ve dolaylı olarak küresel ısınmanın %18’inden sorumludur ve bu da 7.1 Milyar tondur (Sejian, V., et.al.). Bu durumda ortalama bir ineğin yıllık metan salınımı 205.78 kg, günlük ise 0.56 kg dolayında olması gerekmektedir. Bu rakamların doğru olması ise hiç beklenemez. Çünkü Anadolu’nun küçük hacimli ahırlarında ahır içi ortamdaki metan gazı oranı 24 saate varmadan %5’lerin üzerine çıkacaktır. Yine bu veriler her şeyden önce IPCC ve IEA’nın verisi olan 1.95-2.53 Milyar ton ile çelişmektedir. Üstelik IPCC ve IEA, atmosfere salınan insan kaynaklı CO2 miktarını 59 Milyar ton olarak açıklarken Sejian ve arkadaşalarının çalışmalarında bu rakam 39.9 Milyar ton seviyesine çekilmiş. Burada olduğu gibi İNEK’lerin metan salınımına ilişkin onlarca çelişkili açıklamalar vardır.

İNEKLER ve KÜRESEL ISINMA

IPCC’ nin en son 20 Mart 2023 tarihinde yayınlanan 6. Değerlendirme raporuna göre insan kaynaklı küresel ısınmada ‘’Tarım, hayvancılık, ormancılık ve diğer arazi kullanım kaynaklı’’ (Agriculture – Forest –Land Utilization : AFOLU) sektörün payı %22 olarak açıklanmıştır. 2016 yılı raporuna göre bu oran %18.5 idi. Yani %3.5 oranında bir artış var. Ancak FAO’nun verilerini incelediğimizde, 2016 yılına göre 2021 yılı sığır (inek) sayısına baktığımızda 2016 yılında 1674168 adet iken 2021 yılında 1529295 adete gerileyerek %8.6 oranında bir azalma

meydana gelmiştir(Tigem, 2022). Diğer taraftan dünya tarımsal arazi kullanım büyüklüğünde ise yatay bir seyir var. Sadece palm ve soya tarım alanlarının genişletilmesi söz konusudur. Buna göre diyebiliriz ki bu %3.5'lik artış esas olarak ''ormancılık ve diğer arazi kullanım kaynaklı'' başlığına ilişkindir. IPCC' nin 2016 yılı verilerine baktığımızda ''Tarım ve Hayvancılığın'' payı %11.9, Ormancılık ile diğer arazi kullanım kaynaklı başlığın payı ise %6.6 idi. 2016 yılı küresel insan kaynaklı CO2 emisyon miktarı ise 50 Milyar Ton iken 2021 yılında bu rakam 59 Milyar tona yükselmiştir.

2016 yılı analizinde hayvancılığın payı, %5.8 olarak açıklandı (Ritchie et al, 2020). Bilindiği gibi enterik fermantasyon ruminantlara özgüdür ve en fazla enterik fermantasyon ineklerdedir. Yani esas ağırlık sığırlarda olmak üzere İNEK'ler dünya genelinde 2.9 Milyar ton CO2 salınmasına neden olmaktadır, denilmektedir. 2021 yılındaki sığır sayısı 2016 yılına göre %8.6 oranında azalmasına (karşın AFOLU sektörünün payı %18.5'ten %22'ye çıkmış görünüyor. Bu durumda rahatlıkla diyebiliriz ki söz konusu %3.5 oranındaki artışın sebebi kesinlikle inekler değildir ve hatta 2.9 Milyar ton CO2 miktarının doğru orantılı olarak azalması beklenir. Üstelik her geçen yıl, dünya genelinde, modern çiftliklerin artışına bağlı olarak inekler kaynaklı metan gazı salınımının da azalması beklenir. Kısacası yeni yayınlanacak ayrıntılı raporlarda İNEK' ler kaynaklı toplam CO2 salınım miktarının 2.9 Milyar tondan daha fazla olmasını bekleyemeyiz, hatta daha düşük olması beklenir.

Yine onlarca makale ve ve yüzlerce medya haberinde soya bitkisi hayvancılık için yetiştiriliyor, denilmektedir. Bu tam anlamıyla bir dezenformasyondur. Dünya soya üretimi 360 Milyon tondur. 60 Milyon tonu fasulye olarak geri kalanı ise 57 Milyon ton soya yağı olarak değerlendirilmektedir. Bazı makalelerde dezenformasyon ileri seviyede olup;''Soya posası için yağı alınmış soya unu'' şeklinde bir adlandırma var. Bizim hayvancılık camiası soya ve diğer yağlı tohum posalarına küspe adını kullanmaktadır. Ama her halükarda bu küspeler tohumdan

yağı alındıktan sonra geriye kalan posalardır. Soya unu ifadesi tam bir dezenformasyondur. Bir tahıl ya da tohumun un olabilmesi için bütün halinde değirmende öğütülmesi gerekir. Aynı şekilde ayçiçeği bitkisi yağı için üretilir, kanola bitkisi de yağı için üretilir. Yağı alındıktan sonra geriye posaları kalır ve bu posaları insanlar tüketemez. Aynı şekilde şeker pancarı şeker üretimi içindir. Ama şekeri alındıktan sonra geriye kalan şeker pancarı posasını insanlar tüketemez. Yine aynı şekilde pamuk bitkisi insanlar için yetiştirilir. Pamuk çekirdeği de yağlı bir tohumdur, yağı alındıktan sonra geriye kalan posayı da insanlar tüketemez.

Çiğ soya fasulyesinin aroması kötüdür. İnekler un haline getirilmiş soya ununu tüketmekte zorlanırlar. Üstelik fermentasyonu da zordur. İneklerin diyetine soya unu koyduğunuzda ineklerin yem tüketimi azalır ve dolayısıyle süt üretimi de azalır. Soya sılajının da aynı şekilde kötü bir aroması vardır. İnekler iştahla tüketemez. (Ergin et al). Bu nedenledir ki genel olarak soya fasulyesi ne un olarak ne de silaj olarak inekler tarafından tüketilmez. Tabii ki soya silajını inek diyetinde kullanan çok küçük bir azınlık olabilir. Ancak bu, o çiftçilerin süt işletmeciliğini çok iyi bilmemelerinden ya da ellerinde başka alternatif olmadığındandır.

IPCC, 20 Mart 2023 tarihli raporunu hazırlarken 59000 adet bağımız makale ve araştırmanın tarandığından söz etmektedir. Ayrıca bu raporun hazırlanmasında onlarca uzman görev almış. Ancak görüyoruz ki şimdiye kadar yapılan tüm araştırmalarda, araştırmalara yön veren hakim paradigma ‘’Araştırmanın yapıldığı anın penceresinden gerçekleşenin fotoğrafını çekme ’’ temelindedir. Binlerce araştırmacı gibi, bu paradigma içinde hareket edilerek, örneğin, Climate Watch ve The World Resources Institute tarafından 2020 yılında yayınlanan bir raporda tarımsal artıkların yakılması başlığı için %3.5 gibi bir oran tespiti yapılmış. Açıklama olarak pirinç, buğday, şeker kamışı ve diğer bitkiler şeklinde bir ifade var. Aslında tarımsal artıkların toplam içindeki oranının %3.5 olduğu tartışılacak bir konudur. Çünkü araştırmacılar sadece gerçekleşenin fotoğrafını çekmeye çalışmaktadırlar. Gerçekte ise POTANSİYEL tarımsal

artıkların miktarı ise %3.5'in çok çok üzerindedir. Örneğin, buğday bitkisinin gövdesi ve ayrıca buğday danesindeki kepek birer çevresel atıktır. Bunlar çiftçi tarafından yakılmaz. Gerçekte ise bu çevresel atıklar, İNEK' ler tarafından tüketilir. Kısacası, insan kaynaklı küresel ısınma üzerine araştırma yapanlar, MEVCUT ARAŞTIRMA PARADİGMASININ bir sonucu olarak, konu ineklere gelince, ''SADECE İNEKLERİN ANÜSÜNDEN ÇIKANLARLA'' ilgilenmeye sevk edilmektedir (Guzman-Luna et al.2022, FAO,2019, Anonim 2, Anonim 3). Çünkü insan kaynaklı küresel ısınma nedenlerini araştıranlar, sahip oldukları paradigma gereği sadece bardağın dolu kısmı ile ilgilenmektedirler. Halbuki bu yerkürede İNEK' ler olmasa söz konusu bardak şu andakine göre en az %11.8 daha fazla dolmuş olacaktı. Yani atmosfere salınan CO2 miktarı 59 Milyar ton değil yaklaşık 66.9 Milyar ton olacaktı. Bu artış miktarının nasıl hesaplandığını takip eden paragraflarda detaylı açıklanacaktır.

İNEK' lerin Tükettikleri Protein ve Enerji Kaynakları ile Pozitif Çevresel Etkileri

Tablo-1'de tahıl, bitki ve yağlı tohumlardan ibaret 19 kalem yem girdisi listelenmiş ve ayrıca yonca otu listeye dahil edilmiştir.. Bu 20 kalem esas olarak İNEK'lerin diyetlerinin en az %95'ini teşkil eder. İneklerin diyetlerinde insanlarda olduğu gibi 3 temel kalem söz konusudur. Karbonhidratlar, yağlar ve proteinler. Başlıca karbonhidrat kaynağı olarak saman ve diğer otlar ile birlikte arpa ve mısırı görüyoruz. En önemli yağ kaynağı olarak ağırlıklı olarak pamuk çekirdeği ile palm bitkisi ve hayvansal artıklardan elde edilen by-pass yağları öne çıkmaktadır. Sabun ve kozmetik üreticilerinin yan ürün olarak by-pass yağı üretiyor olduklarını görüyoruz. Böylelikle sabun ve kozmetik üretim maliyetlerini düşürebilmeleri söz konusudur. Yağ üretim endüstrisi ile şeker ve pamuk işleme endüstrilerinde İNEK'lerin tüketebileceği enerji ve protein kaynaklarının neredeyse tamamı yan ürün niteliğinde üretilmektedir. İNEK'lerin olmadığı bir dünyada ise bunların hepsi kesinlikle birer çevresel atıktır ve bir şekilde bertaraf edilmeleri

gerekir. Yağ, şeker ve pamuk sanayicileri, İNEK'lerin bu çevresel atıkları tüketebiliyor olması sonucunda ana ürün maliyetlerini ve dolayısıyla şeker, yağ ve pamuk satış fiyatlarını oldukça aşağıya çekilebildiğini görüyoruz. Örneğin, şekeri insan tüketir. Ama şeker pancarının posasını İNEK'ler tüketir. Yine pamuk tekstil sanayisi için yetiştirilir. Pamuk kozasının üçte ikisi çekirdektir. Çekirdeğin bir kısmı yağı için işlem görür. Geriye çekirdek posası kalır ve bu posa çevresel atıktır. Pamuk yağına ihtiyaç az olduğundan pamuk çekirdeğinin büyük bir kısmı da posası gibi çevresel atıktır. Aynı durum soya ve ayçiçeği başta olmak üzere tüm yağlı tohumlar için de geçerlidir. Kısacası, İNEK'lerin çevresel atıkları bertaraf etmesi sonucunda başta yağ, şeker ve pamuk fiyatları olmak üzere binlerce ürünün fiyatı aşağıya çekilebilmektedir.

İnsanların beslenme diyetleri dikkatle incelenirse, diyetlerde yer alan tüm bitkisel ürünlerin her birinin üretiminde devasa bir çevresel atığın meydana geldiği görülür. Örneğin buğday. Buğday bitkisinin danesini un, ekmek olarak insan tüketir ama samanını ve kepeğini ise İNEK'ler tüketir. Dünya genelinde 774 Milyon ton dane buğday üretimi varken 866 Milyon ton çevresel atığı oluşur. Buğday bitkisinin gövdesi çevresel atıktır. Dekar başına elde edilen buğday kadar gövdesinin ağırlığı vardır. Biz bu oranı, %100 yerine %90 kabul edelim. Bu durumda saman miktarı 696 Milyon ton olur. Aynı şekilde daneyi saran kepek kısmı da çevresel atıktır. Buğday danesinin bile %23-32'lik kısmı aslında kepektir. Kepeksiz un üretimin toplam buğdayın %80' i oranında olduğunu kabul edersek en az 170 Milyon ton kepek çevresel atığı meydana gelir. Toplamda çevresel atık yaklaşık 866 Milyon tondur. Benzer mantıkla, arpa, pirinç, soya, meyve suyu, şeker pancarı, şeker kamışı, bitkisel yağlar, pamuk, domates salçası, patates ve havuç dikkate alındığında insanlığın yarattığı ve buna karşın ineklerin tükettiği muazzam bir çevresel atık vardır. Hesaplarımıza göre insanların yaratıp da İNEK'lerin tükettiği çevresel atık miktarı insan başına 420-440 kg olmak üzere yıllık minimum 3475 Milyon tondur. Bu devasa

büyüklükteki çevresel atık her yıl inekler tarafından bertaraf edilmektedir. Bu araştırmanın özeti Tablo-1'de verilmektedir.

Bilindiği gibi 01 Ağustos 2022 ile 17 Temmuz 2023 tarihleri arasında ''Tahıl Koridoru'' projesi kapsamında Ukrayna'dan tüm dünyaya taşınan tahıl, 33 Milyon ton olup bu taşıma işi 1000'den fazla gemi ile yapılabilmiştir. Düşünün 33 Milyon ton tahıl 1000'den fazla gemi ile taşınmıştır. Sonuçta binlerce kişinin dahil olduğu muazzam bir lojistik operasyonu ve muazzam bir lojistik maliyeti söz konusu olmuştur. Tahılın önce depolardan kamyonlara yüklenmesi, daha sonra gemilerle taşınması ve tekrar gemiden boşaltılıp kamyonlara yüklenmesi ve depo yerine ya da tüketim noktasına taşınması sonucunda inanılmaz miktarda bir CO2 salınımı meydana gelmektedir. Çünkü 33 Milyon ton tahılın lojistiği için 1000 den fazla gemi ve 2.5 Milyon'dan fazla kamyon lojistiği söz konusudur. Buna karşın dünya genelinde sadece buğday üretimi 774 Milyon ton ve sadece buğdaydan dolayı 866 Milyon ton çevresel atık meydana geliyor. Düşünün 33 Milyon tona karşın 866 Milyon için lojistik operasyonun büyüklüğünü…

Benzer bir kıyaslamayı Maraş depremi üzerinden yapabiliriz: Kimi analizcilere göre Maraş depreminde oluşan moloz miktarı 260 Milyon tondur (Sadece başlangıçta yıkılan binalar). Bu veriye göre ineklerin her yıl bertaraf ettiği çevresel atık miktarı 13-14 adet Maraş depremi büyüklüğündedir, diyebiliriz. 3475 Milyon ton çevresel atık yakılmayıp çöp dağları şeklinde biriktirilmiş olsaydı sorusunun cevabını sorgulayalım: Her biri 1 km çapında 300 metre yüksekliğinde konik çöp dağları oluşturalım. Bu durumda 3475 Milyon ton bitkisel atık, her yıl 20 bin adet çöp dağının yaratılmasını gerektirecektir ve üstelik her yıl dünya üzerinden 15700 km2'lik bir alan çöp dağları ile kaplanacaktır. Hollanda'nın tüm yüzölçümü; su alanları, yerleşim alanları ve dağlık alanlar dahil sadece 41850 km2 olduğuna göre her 32 ayda bir Hollanda büyüklüğünde bir alan atık dağları ile kaplanacak, demektir.

Tablo-1 tüm ruminantlar ile tavuk ve domuzların, bizim deyişimizle yani tüm İNEK' lerin, diyetlerinde yer alan tüm bitkisel ürünlerin bir listesidir, denilebilir. Ancak İNEK'ler, örneğin, karpuzun kabuğunu, zeytin dalının yaprak ve filizlerini de tüketir. Zeytin hasadı sonrası zeytin ağaçları aralanır. Yine bahar döneminde üzüm bağlarında aralama işlemi yapılır. Ortaya çıkan asma yaprak ve filizlerini de tüketirler. Bu tür bitkisel ürünlerden dolayı oluşan çevresel atıkların dünya genelindeki toplam miktarları aslında çok büyüktür. Örneğin, dünya genelindeki karpuz üretimi 100 Milyon ton dolayındadır. Bunun kabuk ve çekirdekleri çevresel atıktır ve en az 10-15 milyon ton ağırlığındadır. Ayrıca karpuz bitkisinin kendisi de çevresel atıktır. Ancak karpuzun tüketimi endüstriyel değildir ve tek tek evsel tüketimi vardır. Sadece hayvancı tükettiği bir karpuzun atığını İNEK'lerin diyetine karpuz atığı oluştukça ekleyebilir. Yine araladığı asma filizi ve yaprağını ya da zeytin ağacı filiz ve yaprağını da İNEK'lerin diyetine ekleyebilir. Ancak bu tür çevresel atıkların her biri çok büyük miktarlar teşkil etmesine rağmen bunların büyük ölçekli endüstriyel tüketimi olmadığı için bu tür atıklar, ya belediye çöplüklerine gitmektedir ya da çiftçiler tarafından yakılarak bertaraf edilmektedir. Bu tür oluşan çevresel atıkların yüz milyonlarca ton olabildiğini söyleyebiliriz.

Aşağıdaki tabloda yer alan 19 kalem bitkinin her biri için 2022 ve 2021 yılları dünya üretim rakamları üzerinden ineklerin ne kadar kısmını tüketiyor oldukları ayrı ayrı hesaplanmıştır. Mısır samanı ve buğday samanı için Ege Üniversitesi Yenilenebilir Enerji Enstitüsü laboratuarlarında yakılmaları halinde atmosfere ne miktarda CO2 saldıkları hesaplanmıştır. Diğer kalemler için sahip oldukları yağ ve su oranları dikkate alınarak bir öngörü yapılarak tüm 19 kalemin her biri için potansiyel CO2 miktarları tespit edilmiştir.

Bitki	İNEK' lerin İşgal Ettiği Arazi (hektar)	İNEK' lerin Bertaraf Ettiği Çevresel Atık Miktarı (Milyon ton)	İNEK' lerin Önlediği CO2 Miktarı (Milyon ton)
Buğday	29.3	738.6	1809.0
Pirinç	0	1266.0	1847.0
Arpa	21.6	151.0	604.0
Pamuk	0	49.0	220.0
Ay Çiçeği	0	29.3	125.9
Yer Fıstığı	0	102.0	306.0
Palm	0	14.0	36.0
Kolza	0	49.0	210.7
Soya	0	240.0	960.0
Şeker Pancarı	0	222.8	328.0
Şeker Kamışı	0	42.5	98.5
Mısır	114.6	487.3	1158.0
Yonca	35	0	0
Meyve suyu	0	78.0	176.0
Domates (Salça)	0	2.1	4.7
Badem	0	1.12	4.0
Aspir	0	9.0	26.4
Keten Tohumu	0	1.1	4.4
Havuç	0	2.14	8.56
Patates	0	2.6	6.7
TOPLAM	**199.5**	**3475.32**	**7901.0**

İnekleri ötekileştirmeye çalışanlar, sadece ineklerin anüsünden çıkan dışkıya bakarak üretilen metan gazını ve CO2'i hesaplamaya çalışmaktadır. Bizim araştırmamıza göre inekler, insanların her yıl yarattığı ve büyüklüğü yaklaşık 15.7 Bin km2 kadar olan bir çevresel atığı tüketerek her yıl 7.9 Milyar ton CO2'in atmosfere salınmasını önlemektedir. Buna göre inekler metan gazı üreterek atmosfere 2.9 Milyar Ton CO2 salarken çevresel atıkları tüketerek 7.9 Milyar ton CO2'i engel olmaktadır. Ayrıca bu çevresel atığı bertaraf etme lojistiğinin yaratacağı CO2 miktarını da düşünürsek bu rakam 9-10 Milyar ton düzeyine rahatlıkla çıkacaktır.

Deniliyor ki, ‘’hayvan yetiştiriciliği en büyük arazi kullanan sektör olup küresel biyokütlenin yaklaşık %60’ını oluşturmaktadır. Yer kürenin %65’ini İNEK’ler kullanmaktadır’’. Halbuki yukarıdaki tablodan da görüldüğü gibi ineklerin yem tüketimi açısından kullandığı tüm arazi büyüklüğü (çiftlik binaları hariç) yaklaşık 199.5 Milyon hektardır.

Buğday üretimi için var olan 223.7 Milyon hektarın çok az bir kısmı olan yaklaşık 29.3 Milyon hektarı İNEK’ler içindir. Ruminantların diyetinde buğday yer almaz, buna karşın evcil domuz ve tavuğun diyetinde yer alabilmektedir. Dünya arpa üretiminin bir kısmı bira üretiminde, insan beslenmesinde ve etanol üretimi vb. amaçlar için kullanılmaktadır. Bu nedenle toplam 47.9 Milyon ha’ın 21.6 Milyon ha’ı İNEK’ler içindir. Mısır üretimi de sadece İNEK’ler için değildir. Mısır insan beslenmesinde, mısır özü yağı üretiminde, nişasta üretiminde, bira üretiminde, etanol üretiminde ve biyodizel üretiminde vb. amaçlara dönük insan tüketimi için de kullanılmaktadır. Bizim hesaplamalarımıza göre 191 Milyon ha araziden 114.6 Milyon ha’lık kısmı İNEK’ler için kullanılmaktadır. Yonca üretiminin de %1-3 gibi çok küçük bir kısmı at beslenmesinde tüketilmektedir.

Dünya toplam arazisi (yayla, mera, çayır ve ekilebilir arazi dahil) 5 Milyar hektardır. Tarımsal amaçlı ekilebilir arazi büyüklüğü ise 1.5 Milyar hektar dolayındadır. Geriye kalan 3.5 Milyar ha arazi yayla, mera ve çayır olarak boş arazidir. Bu işe yaramaz arazilerin büyük bir kısmında mevcut haliyle hiçbir şey yetişmez. Diğer bir kısmı aslında ıslah edilse ve şahıslara devredilmiş olsa dünya tarımsal üretimini önemli ölçüde artırmak mümkündür. Ülkemiz gibi birçok ülkede meralık alanlar inanılmaz ölçüde verimsizdir. Bu tür arazileri çiftçiler, genelde, meyve, sebze ve üzüm kurutmada ya da ekipman vb. şeyler depolamak için de kullanmaktadırlar. Meraya dayalı hayvancılık özünde en büyük aldatmacadır. Hayvancıyı oyalamaktan başka bir şey değildir. Ülkemizin meraları yılın sadece birkaç ayında yeşillenir ve bu yeşil otlar İNEK’lerin hayatta kalabilmesini sağlayacak enerji ve proteini zar zor sağlar. Zaten akşama kadar merada

dolaşıp 5-10 km yol yürüyen İNEK'ler, meralık alanda tükettikleriyle gün boyu harcadıkları enerjiyi bile zorlukla karşılarlar. Çok zengin otlakların olduğu meralara sahip ülkeler vardır. Ancak şu kesindir ki bu alanlar ıslah edilip tarımsal faaliyet için kullanılmış olsa yaratılacak tarımsal hasıla, İNEK'lerin beslenmesine göre kat be kat daha yüksek olacaktır. Bu tip meraların İNEK'lere faydası varmış gibi görünmesinin tek nedeni kira/icar parası ödemiyor olmalarındandır. Ödeseler bile ödedikleri çok küçük rakamlardır. Kimse meraları İNEK'ler işgal ediyor demesin. İNEK'lerin meraya ihtiyacı yoktur. Bilinçli çiftçi hayvanını kesinlikle meraya salmaz. Mera hayvancılığı en büyük verimsizlik nedenidir. Örneğin, Siz hiç otomotiv sektöründe herkes 4.0/5.0 Endüstri uygulamaları temelinde şirketlerini yönetirken bazılarının Henry Ford'un 1900'lerdeki montaj hattı devrimi öncesi üretim iş modeli ile üretimlerini yönettiğini hiç gördünüz mü? Asla göremezsiniz. Çünkün çok kısa zamanda iflas ederler. Buna karşın meraya dayalı hayvancılık yapanlar karın tokluğuna ve devletin vereceği 3-5 kuruş hibe ve destek ile hayatta kalmaya çalışmaktadır.

İNEK'ler aslında bu 1.5 Milyar hektar arazinin sadece ve sadece 199.5 Milyon hektarını, yani toplamın sadece %13.3'ünü kullanmaktadır. İnekler her yıl ortalama 3475 Milyon ton çevresel atık ile yaklaşık 168.4 Milyon ton tahıl, 665.4 Milyon ton mısır ve 35 Milyon ton yonca otu tüketerek 1553 Milyon ton hayvansal ürün üretmektedirler. İNEK'lerin çok büyük biyokütle tükettiği doğrudur, ancak İNEK'lerin tükettiklerinin yaklaşık %80'i insanların kendi beslenme sürecinde yarattığı çevresel atıklardır.

İNEK'lerin Metan Salınımını Azaltacak Tedbirler

Çok basit bazı önlemlerin alınması halinde İNEK'lerin atmosfere saldıkları metan gazı miktarını %70-80 oranlarında azaltabilmek mümkündür.

Meraya dayalı hayvancılıkta İNEK'lerin günlük diyetlerinin neredeyse tamamını otlar teşkil etmektedir. Aile tipi işletmelerde ve de kesif yem maliyetini finanse etmekte zorlanan işletmelerde kaba yem ağırlık bir diyeti tercih edilmektedir. Yapılan birçok araştırma göstermiştir ki İNEK'lerin diyetinde kaba yem oranı azaltılıp kesif yem oranı arttıkça hem süt hem et verimi yükselmektedir hem de atmosfere salınan metan miktarını azalmaktadır (Lowet et al). Ülkemizde bazı işletmeler kaba yem miktarını %35'lere kadar düşürebilirken hayvan sağlığı dikkate alınırsa %45-50'lere kadar düşürülebilir.

Son zamanlarda geliştirilen bazı yem katkılarının da metan salınımını azalttığı tespit edilmiştir. Özellikle kırmızı yosun bazlı yem katkı maddeleri kullanılabilmektedir. Kısacası, meraya dayalı hayvancılıktan entansif hayvancılığa dönüldükçe, ana hammaddesi İNEK dışkısı olan biyogaz tesisleri yaygınlaştıkça, ineklerin diyetinde karbonhidratın proteine olan oranı düşürüldükçe, AR-GE'si yapılmış olan bazı yem katkı maddelerinin kullanımı yaygınlaştırıldıkça, süt ve et verimi yüksek ırklar, düşük verimlilerin yerini aldıkça ineklerin metan gazı salınımını önemli oranlarda azaltabilmek mümkün olacaktır.

İneklerin enterik fermantasyondan dolayı metal gazı saldıkları ve bu yüzden küresel ısınmaya sebep oldukları doğrudur. Yapılan bir araştırmaya göre enteric fermantasyonun İNEK'ler kaynaklı toplam metan emisyonunun içindeki payının %26.6-35.7 seviyesinde olduğu ve esas emisyonun kötü gübre yönetiminden kaynaklandığını göstermektedir (Grossi et al.). Irk ıslahı, rasyonda kaba yem oranının azaltılıp kesif yem miktarının artırılması ile bazı yem katkı maddelerinin kullanımı aksiyonları enterik fermantasyondan dolayı metan emisyonunun azalmasını sağlamaktadır. Yatırım maliyeti yüksek ve orta vadeli aksiyonlar olarak düşünebileceğimiz betonarme ve kapalı gübre depolama sistemleri ve biyogaz tesisi uygulaması ile meraya dayalı hayvancılık yerine entansif hayvancılığın tercih edilmesi aksiyonları ise metan emisyonunu önemli ölçüde azaltıyor olduğunu söyleyebiliriz. Bunun

sonucudur ki günümüz modern çiftliklerini, geleneksel çiftliklerle kıyasladığımızda ineklerin küresel ısınmaya etkilerinin %70-80 dolayında daha az olduğu görülür. Dünya inek popülasyonuna baktığımızda modern çiftliklerin toplam içindeki payı oldukça düşüktür ve büyük ihtimalle %10 oranın da altındadır. Modern çiftliklerde ileri teknoloji destekli gübre yönetimi ve ayrıca biyogaz uygulamaları sonucunda meydana gelen metan gazının hem doğayı tahrip etmesi önlenebilinmekte hem de hayvan dışkısı, faydalı ürün olan organik gübreye dönüşebilmektedir. Ülkemizde de bu konudaki endüstriyel girişimlerin yaygınlaşmya başladığını görüyoruz. Örneğin, en son Alarko Grubu'nun Haziran 2023 tarihinde açıkladığı 400 Milyon TL'lik yatırımı, biyogaz tesislerin yan ürünü olan atığı organik gübreye dönüştürme projesidir.

Gübre Fabrikaları ve Küresel Isınma

Tarımsal faaliyetler için toprakla buluşan sentetik ve organik gübrelerin yarattığı karbon emisyonu ve nasıl azaltılabileceği konusunda çok sayıda araştırma mevcuttur. Yine yapılan bir çalışmaya göre 2018 rakamlarıyla sentetik gübreler 1.13 Milyar ton CO2 emisyonundan sorumludur, denmektedir (Menegat, et al. 2022).

Dünya genelindeki inorganik ve kimyasal gübre üretimi toplamı 185 Milyon ton dolayındadır. Bizim yapmış olduğumuz araştırmaya göre gübre fabrikaları, yıllık 2.17 Milyar ton CO2 yaratmaktadır. Ayrıca görülmektedir ki gübre fabrikaları yıllık 416.2 Milyon ton temiz su tüketirken 408.9 Milyon ton kimyasalları ve ağır metalleri barındıran atık su meydana getirmektedir (Gao et al., 2023). Ulaşabildiğimiz araştırma raporlarında CO2 kaynakları listelerinde İNEK'leri ve pirinç üretimini ayrı başlıklar altında görüyoruz ama gübre fabrikalarını göremiyoruz. Eğer İNEK' lerin dışkıları endüstriyel ürün haline getirilmiş olsa gübre fabrikalarının en az yarı kapasitesine ihtiyaç kalmayacaktır. İNEK' lerin dışkılarının,

mevcut haliyle tarımsal üretimde direk kullanımının hem sakıncaları hem de zorlukları vardır. Zaten neredeyse tüm çiftliklerde, İNEK dışkısı endüstriyel hale getirilmediği için dünya genelinde oluşan tüm dışkının en az %60-70'i zayi olmakta, çiftliklerin içinde ve yakın çevresinde toprağa ve daha önemlisi yer altı ve yer üstü sularına da karışarak çevre kirliliğine neden olabilmektedir. Halbuki İNEK dışkısı endüstriyel ürün haline getirildiğinde hem kimyasal gübre üreten fabrikalara olan ihtiyaç azalacak hem de çevresel faydalarıyla birlikte ekonomik katma değer de yaratılmış olacaktır. İNEK dışkısı, endüstriyel gübre olarak kullanılabileceği gibi enerji hammaddesi olarak da kullanılabilir. Ege Üniversitesi Yenilenebilir Enerji Enstitüsünde yaptırdığımız analizlere göre %8-10 nem içeren inek dışkısının alt ısıl değerinin 4313 kcal olduğu tespit edilmiştir. Ayrıca iki farklı analiz örneğinde kül oranının %6'yı geçmemiş olması nedeniyle tüm kömür örneklerinden daha çevrecidir. Eğer dünya genelinde meydana gelen tüm inek dışkısı, biyokütle enerji üretimi için kullanılmış olsa yıllık 350-370 Milyar Dolar tutarında bir katma değer yaratılabilir. Büyük ihtimalle dünya genelinde birçok örneği vardır ama ülkemizde Güres Tavukçuluğun sır gibi saklanan ''gübreyi biyokütle olarak kullanarak elektrik enerjisi üretme teknolojisi'' yeterince yaygınlaştırılmış olsa bu devasa katma değer rakamına yaklaşılabilinir. İnek dışkısı, geliştirilmesi kuvvetle muhtemel birtakım endüstriyel prosesin devreye alınmasıyla pelet haline getirilerek kömüre alternatif yakıt haline getirilebilir. Kısacası, inek dışkısının çevresel zararlarını önlemenin ötesinde bir endüstriyel ürün haline getirilerek katma değer yaratabilmesi mümkündür.

Dünya genelinde süt ortalaması inek başına 10 litre/gün ortalamasının bile altındadır. Halbuki bu ortalamanın 40 litre/gün seviyesine, yetişkin sığır canlı ağırlıklarını ise 400-500 kg seviyesinden 600-800 kg seviyesine kolayca çıkarılabilmesi mümkündür. Böylelikle, inek popülasyonunu hiç artırmadan hayvansal protein ve enerji üretimini en az iki katına çıkarabilmek mümkündür.

Hayvansal Artık Ürünlerin İnsan Yaşamındaki Yeri

İNEK'ler yıllık 320 Milyon ton eti insan tüketimine sunarken, bizim araştırmamıza göre en az 155 Milyon ton atığı (deri, kıl, kemik, kan, tüy, yürek vb.) başta kozmetik, ilaç, tıp ve hazır gıda olmak üzere tüm sanayi sektörlerinin on binlerce ürünün üretiminde ya ürün bileşeni ya da üretim yardımcı maddesi olarak kullanılmaktadır. Bizim araştırmamıza göre demir çelik, tekstil, inşaat, kağıt, boya, otomotiv, elektronik dahil tüm sektörlerde hayvansal ürünlerin kullanımı vardır. Birçok konuda hayvansal ürünlerin, kimyasal/sentetik alternatifleri yaratılmış olsa da ana akım hala hayvansal ürünler temellidir. Çünkü ucuzdur, boldur, erişilebilirliği kolaydır ve birçok konuda ise alternatifi bile yoktur. Bizim araştırmamıza göre herhangi bir kimse %100 vegan yaşam tarzını sürdürmek istiyorsa bu ancak dağ başında taş devri insanı gibi yaşaması ile mümkün olabilir. Bu konu, araştırmamızın en kapsalı alt araştırmalarının başında gelmektedir. Hemen hemen tüm sanayi kolları araştırılmıştır.

İnsan yaşamında hayvansal ürünlerin kullanımının sadece bazı gıda ve kozmetik ürünler ile deri/yün ve ipekli kumaştan yapılmış giysiler ve ayakkabı ile sınırlı olabileceğini düşünmek çok büyük bir yanılgıdır. Hayvansal ürünler, tüm sanayi kollarının on binlerce ürünün üretiminde ya ürün bileşeni ya da yardımcı madde olarak yaygın bir şekilde kullanılmaktadır. İçinde yaşadığımız ev ve ofislerin hem kendilerinde hem içindeki eşyalarda; otomobil, tren, uçak ve bisiklet dahil tüm ulaşım araçlarında binlerce hayvansal ürün, ya ürün bileşeni olarak ya da yardımcı malzeme olarak günlük hayatımızda etrafımızı tamamen işgal etmiş durumdadır. Bu nedenledir ki %100 vegan yaşam, günümüz dünyasında kesinlikle mümkün değildir. Vegan cemaati üyelerinin kendilerine yasaklı olarak bildikleri ürünler, günlük hayatta kullanmak zorunda oldukları on binlerce ürünün yanında bırakın buzdağının su yüzündeki kısmını, sadece tepe noktasını teşkil eder. İnsan yaşamı, sadece boğazdan girenler ile birkaç giyim ve kozmetik

ürününden ibaret değildir. Günümüzün sıradan bir insanı, gerek evsel ve gerekse ev dışı yaşamında her an binlerce sanayi ürünleri ile muhataptır.

Günlük beslenmemizde ve kozmetikte yer alan çok sayıdaki ürünlerde birçok hayvansal ürünün günlük hayatımızda ne ölçüde yer aldığı konusuna az çok hepimiz farkındayız. Bu çalışmada ise hayvansal ürünlerin, çoğu kişinin farkında olmadığını düşündüğümüz sanayi sektörleri ile ilaç ve tıp alanı üzerinden günlük hayatımıza ne ölçüde girmiş olduğunu irdeleyeceğiz. Bu çalışmada; domuz, tavuk, büyükbaş ve küçükbaşın insan beslenmesi dışında kalan artıklarının, insan yaşamını çepeçevre çevreleyen on binlerce ürünün üretiminde nasıl kullanıldığını göreceğiz.

Hayvansal Atıklar

Hayvansal atıklar; iç yağlar, kuyruk yağı, kemik, deri, kıl, tüy, bağırsak, yürek, ayak ve kandan oluşuyor. İç yağ ve kuyruk yağları, don yağı olarak adlandırılır. Don yağları; oleo kimyasalları, yağ alkolleri ve metil ester türevleri üretiminde kullanılır. Yan ürün olarak da gliserin meydana gelir. Deri ve kemik ise ağırlıklı olarak jelatin ve kemik unu üretiminde yer almaktadır. Kıl, tüy ve kan ise önemli bir protein kaynağıdır. Yürek, bağırsak vb. birçok iç organlar evcil hayvan yemi üretiminde tüketilmektedir.

Kesilen her sığırın yaklaşık %50'si, domuzun %35-45'i, piliçin %72'si ve hindinin %78'i insan gıdası olarak tüketime sunulmakta, geri kalan kısmının büyük çoğunluğu ise rendering sanayinde (endüstriyel sabun üretim sanayinde) değerlendirilmektedir. Hayvansal kaynaklı yağların hemen hepsi büyük çoğunlukla palmitik asit, oleik asit, linoleik asit, stearik asit, linolenik ait ve margarik asit bakımından oldukça zengindir (Canpolat et. Al., 2003). Sanayi ürünlerinin üretiminde kullanılan ham yağlar, önce, endüstriyel sabun haline getirilir. Hayvansal yağlar, don yağı olarak isimlendirilir. Don yağındaki yağ asitlerinden sayısız şekilde oleo kimyasallar, yağ alkolleri, ve metil ester türevleri elde edilmektedir (Anonim 4, 2023).

Endüstriyel sabunların %90'ı hayvansal yağlardan, sadece %10'u ise bitkisel yağlardan üretilmektedir. Ancak hayvansal don yağları ve kuyruk yağları, atık durumunda olduğu için oldukça ucuzdur ve on binlerce sanayi ürünün maliyetinin düşürülmesinde önemli katkısı vardır.

Domuz, tabiatı gereği karkasında yaklaşık %70-75 oranında yağ içermektedir. Domuz karkası elde edildiğinde direk olarak %25-35'lik bir kısmı iç yağı olarak endüstriyel kullanıma ayrılmaktadır. Ayrıca kemik, deri, kıl ve kan dahil insan tüketimi dışında kalan tüm artıklar on binlerce endüstriyel ürünün üretiminde yer alır.

Kısacası sanayi kollarının herhangi birinde, palmitik asit dışında herhangi bir yağ asidi ile karşılaşıyorsanız bilin ki bu en az %90 ihtimalle hayvansal yağ kökenlidir. Fiyat rekabetinin yüksek olduğu bir üründe ise kesinlikle hayvansal yağ kökenlidir. Palmitik asit dışındaki bitkisel kökenli yağlar hem daha pahalı hem de insan faktöründen dolayı daha çok gıda ve kozmetik ağırlıklı bir kullanımı vardır. Hayvansal yağlardan elde edilen yağ asitlerinin bitkisel yağlardan elde edilenlere göre daha ucuz ve de daha kolay erişilebilir olması ve hatta birçok üründe ürün kalitesini artırıcı etkisinin olması nedeniyle endüstriyel sabun üretiminde neredeyse tamamen hayvansal yağ kullanılmaktadır. Endüstriyel sabunlar, tekstilden demir çeliğe, inşaattan kauçuk ve plastik sanayisine, boyadan kağıt sanayisine, otomotivden elektronik sektörüne kadar tüm endüstri kollarının on binlerce ürünün üretiminde yer alır. Bitkisel yağların kullanımı ise daha çok gıda ve kozmetik sektörü ile sınırlı kalmıştır. Sanayi işletmeleri için önemli olan maliyet, kalite, hammaddeye kolay erişebilirlik ile üretim prosesi kolaylığıdır.

Dünya bitkisel yağ üretimi 2018 verilerine göre 187 Milyon tondur. 2017 verilerine göre domuz eti üretimi 120 Milyon ton, tavuk eti üretimi 109 Milyon ton, büyükbaş ve küçükbaş kırmızı et üretimi ise 87 Milyon ton dolayındadır. Domuzda karkas verimi %70-75, yağ oranı %50-55'tir.

İç yağ oranı canlı bazında %40-45, karkas bazında ise %25-35 dolayındadır. Bu iç yağ insan tüketimine değil direk sanayi tüketimine gider. Bu durumda insan tüketimi dışında sanayi kullanımı için kullanılan miktar, deri, kıl, kan ve yağ dahil yaklaşık 65 Milyon ton dolayındadır, diyebiliriz. Büyükbaş ve küçükbaşta karkas et verimini %50 kabul edebiliriz. 87 Milyon ton kadar deri, kemik, kıl ve kan atığı olduğunu söyleyebiliriz. Tavukta ise karkas verimi %70-75, yani %72 olarak kabul edersek 30.5 Milyon ton tavuk atığı vardır diyebiliriz. Hepsini toplarsak, domuz atığı 65 Milyon ton, kırmızı et grubu atığı 87 Milyon ton, tavuk atığı 30.5 Milyon ton olduğuna göre toplam 183.5 Milyon ton atık, potansiyel olarak sanayinin kullanabileceği atık miktarıdır. Ancak %5 dolayındaki atık kısım, hiçbir şekilde kullanılamaz kısımdır. Ayrıca %10'luk bir kısım da atık toplama, lojistik ve benzeri aşamalardaki verimsizlikten dolayı kullanım dışı kalabileceğini öngörebiliriz. Buna göre rahatlıkla 155 Milyon ton hayvansal ürün, don yağı, iç yağı, kemik, deri, kıl, tüy ve kan olarak hemen hemen tüm sanayi kollarının on binlerce ürünün üretiminde kullanımına sunulmaktadır.

Dünya genelinde 320 Milyon ton hayvansal et üretimi vardır ve yaklaşık bu miktar kadar da hayvansal atık söz konusudur. Ancak 320 milyon ton hayvansal atığın önemli bir kısmı çeşitli nedenlerden dolayı sanayi kullanımına kanalize edilememektedir. Yine de sanayide kullanılan atık miktarı 155 milyon tondan az değil kesinlikle daha fazladır. Ayrıca et üretim istatistikleri kemikli et istatistiğidir. Örneğin, büyükbaşta, karkas etteki kemik oranı %17-24 arasında değişir. Bu kemiklerin de en az yarısı sanayi ürünleri üretimine kanalize olur. Geri kalanın rahatlıkla en az yarısı, bizim gibi ülkelerde, kelle/paça/ayak ve kemik iliği olarak insan tüketiminde yer alır. Aslında bizim buradaki amacımız hayvansal atık miktarını çok doğru rakamlarla tespit etmek değildir. Amacımız dünya bitkisel yağ üretim rekoltesi olan 187.5 Milyon tona yakın bir miktardaki hayvansal atığın on binlerce sanayi ürünleri üretiminde kullanılıyor olduğunu vurgulamaktır.

İç yağ ve kuyruk yağından oluşan don yağı, kimya fabrikalarında önce endüstriyel sabun haline getirilmektedir. Yan ürün olarak da gliserin üretilmektedir. Daha sonra oleo kimyasallar, yağ alkolleri ve metil ester türevleri üretilmektedir. Bu ürünler ise nihai ürünlerin üretiminde kullanılmaktadır. Kablo ve her türlü boya ve mürekkep üretiminden, metal saç levha, PVC, kauçuk ve plastik üretimine kadar, sentetik iplik üretiminden kumaş üretimine kadar, pil, akümülatör üretiminden yapı kimyasallarına kadar, mobilya üretiminden cila üretimine kadar, ilaçların kapsül ve tablet üretiminden birçok alternatifsiz yaşam kurtarıcı ilacın etken maddesi üretimine kadar, tel, iplik ve halat üretiminden şehir içme suyu ve atık su boru hatlarına kadar, alternatifsiz gres yağı üretiminden mineral yağ ve sigara üretimine kadar, bira, şarap ve rakı üretiminden her türlü meyve suyu üretimine kadar, her türlü kağıt ürününden, ürün etiketinden, ürün ambalajlarına, şişelerine ve kapaklarına kadar ve daha burada sayamadığımız on binlerce ürünün üretiminde kullanılmaktadır.

Kimya sanayindeki gelişmeler sonucunda hemen hemen her alanda sentetik alternatiflerinin geliştirilmiş olduğu da doğrudur. Ancak sanayi işletmeleri için maliyet, hammaddeye kolay erişebilirlik, üretim prosesi kolaylığı ve nihai ürün kalitesi çok önemlidir. Aşağıdaki bölümlerde ayrıntılı olarak inceleneceği gibi stearik asit, neredeyse tüm endüstri kollarında en yaygın olarak kullanılan yağ asididir. Hayvansal yağlarda, sığır ve domuzda %30 seviyesinde olması ve ayrıca iç yağların insanlar tarafından tüketilmemesi nedeniyle hem erişilebilirliği çok kolaydır hem de satın alma maliyeti oldukça düşüktür. Ayrıca hayvansal yağlardan arzu edilen oleo kimyasalların ve diğerlerinin üretim süreçleri hem kolaydır hem de üretim maliyeti sentetiğe göre daha düşüktür. Daha önemlisi birçok üründe elde edilen ürün kalitesi sentetiklere göre daha yüksektir. Örneğin, saç metal üretiminde kullanılan don yağı kaynaklı yağlar sentetik yağlara göre kalite açısından daha çok tercih edilmektedir. Aynı durum plastik ve kauçuk parçaların üretiminde de söz konusudur. Sentetik alternatiflerin ise daha çok vegan kullanıma

uygunluk aranan ürünlerin üretiminde tercih edildiğini görüyoruz. Halbuki bu sentetik ürünlerin üretim maliyetleri hem daha yüksek hem de insan sağlığı için zararlıdır. Örneğin, ilaç sektörü. Örneğin, mağnezyum stearat ilaç sektöründe akış ajanı, yağlayıcı ve topaklanma önleyici olarak kullanılır. Don yağından elde edilen ürün, ilaç üretiminde çok başarılıdır. Maliyet ve proses kolaylığı yanında istenilen mükemmel bir ürün kalitesini de sağlamaktadır. Buna karşın vegan tüketimde doğal ve de sağlıklı hayvansal ürün kullanmayalım derken oldukça zararlı kimyasallar kullanılmak zorunda kalınmaktadır. Örneğin, stearik asitin sentetik alternatifi olarak odun selülozundan elde edilen hidroksi propil metil selüloz isimli kimyasal kullanılmaktadır. Odun selülozu kulağa hoş geliyor ama esas problem odun selülozunun mağnezyum stearat tuzuna dönüşme sürecidir. Bu üretim sürecinde, kaçınılmaz olarak kloro metan ve propilen oksit kullanılmaktadır ve odun selülozu, bu çok tehlikeli ve de zararlı ve hatta yasaklı kimyasallarla reaksiyona girmek zorundadır. Bu kimyasalların insan sağlığına inanılmaz zararı vardır ve üstelik kanserojendir. Kloro metan'ın gıda ürünlerindeki kullanımı yıllar önce terk edilmiş olmasına karşın vegan ilaç amacıyla tekrar kullanımına başlanmıştır. Kloro metana maruz kalma, insanda uyuşukluk, baş dönmesi, konuşma ve yürümede zorluk yaratırken yüksek konsantrasyonlarda ise felç, nöbet ve komaya bile sebep olabilir, denmektedir. Sıvı kloro metan ile etkileşim ise cildi dondurabilmektedir. Günümüzde tüm dünyada herhangi bir üründe organiklik sertifikasyonu için herhangi bir herbisit ve pestisitte 'SIFIR' kalıntı şartı aranırken birçok ilacın üretiminde zararlı ve kanserojen olduğu tescillenmiş birçok kimyasal kullanıldığından eser miktarda dahi olsa bu kimyasalların mutlak bir kalıntısı kesinlikle söz konusudur.

Bazı bitkilerde az da olsa stearik asit mevcuttur. Genelde %1-1.5 dolayındadır. En fazla miktar, keten tohumunda olup o da çok düşük %3.3 oranındadır. Keten tohumu yağı üretimi ise toplam bitkisel yağ üretimi içinde %1-2 dolayındadır. Bu haliyle bitkisel yağların stearik asit

üretiminde domuz iç yağı ile rekabet edebilmesi asla mümkün değildir. Domuz iç yağında stearik asit oranı %30'dur ve üstelik hem çok ucuzdur hem de erişilebilirliği kolaydır. Ayrıca endüstriyel sabuna dönüşüm prosesi çok basittir. Bu etkenlerden dolayıdır ki yağlı tohumların ve bitkilerin endüstriyel sabun üretiminde domuz yağına alternatif olabilmesi mümkün değildir. Hayvansal yağların endüstriyel sabun üretiminde en öncelikli kullanılanı domuz iç yağıdır. Ancak sığır üretiminin yoğun olduğu bölgelerde ve de helal ve koşer şartı talep eden müşteriler için sığır iç yağı kullanılmaktadır.

Keten tohumu gibi bitkilerden stearik asit üretimi daha maliyetli olduğundan, erişilebilirliği çok zor olduğundan ve üretim yetersizliğinden dolayıdır ki vegan ilaçların üretiminde gerekli yağ asitlerinin metal tozunu (örneğin mağnezyum stearat) odun selülozundan üretme alternatifi tercih edilmektedir. İlaçların tablet ve kapsülünün üretiminde stearik asidin metal tozları neredeyse tek üretim kaynağıdır. Bu metal tozları içinde de en başarılısı mağnezyum stearattır. Bazı ilaç firmaları vegan kullanıma uygun ilaçların kapsül ve tabletinin üretiminde ise hayvansal kaynaklı alternatifi zaten kullanamıyor. Bitkisel kaynaklı alternatif ise hem erişebilirlik hem de maliyet açısından çok sıkıntılı olunca vegan üretim için odun selülozundan üretilen hidroksi propil metil selülozu kullanıyorlar. Bu selülozun üretimi için çok sayıda zararlı kimyasal kullanımı vardır. Sodyum hidroksit'in, kloro metan ve propilen oksit ile kimyasal reaksiyona girmesi söz konusudur. Kloro metanın kullanımı zararlı oluşu kanıtlanınca yıllar önce terk edilmiş ama vegan üretiminde tekrar kullanılmaya başlanmıştır. Propilen oksit ise akut toksit ve kanserojen olduğu tescillenmiş bir kimyasaldır.

Christien Meindertsma isimli bir Alman yazar domuzun insan beslenmesi dışında çok sayıda ürünün üretiminde kullanıldığını fark etmiş (Meindertsma, 2007). Konuya tam bir netlik kazandırmak için kesimi söz konusu olan herhangi bir domuzun nerelerde kullanıldığını fiziken takip etmek istemiş. Kesimi yapılmış bir domuza 05049 kodunu vermiş ve söz konusu domuzun

nerelerde tüketildiğini tek tek saptamış ve bu araştırmasını bir kitap haline getirip yayınlamış. Dövme mürekkebinden sigara üretimine, tutkaldan kek üretimine, antifrizden boya üretimine, biyodizelden krem üretimine, tef olarak bilinen müzik aletinden yapay kalp kapakçığı üretimine kadar 100 den fazla farklı ürünün üretiminde kullanılmış olduğunu fark etmiş. Domuz ürünün kullanıldığını tespit ettiği ve herkesi şaşırtacak birkaç ürünü sıralayacak olursak; mantar tapası, kağıt, mermi üretimi, kemik tutkalı, kibrit, sigara, heparin ve insülin ilacı, duvar kağıdı, zımpara, alçı, kitap kapağı, x-ray film, porselen fincan, sert ve yumuşak ilaç kapsülü… Gerçekte ise domuz ürünlerinin kullanım sahası, bu yazarın kitabında bahsedilenlerin toplam sayısı ile kıyaslanmayacak kadar çok fazladır. Yazar tek bir domuzu takip ettiği için, buzdağının su üstünde kalan tepesinin bir kısmına ancak ulaşabilmiş. Biz ise bu çalışmada yazarın çalışmasından çok daha geniş bir araştırma yaptık. Bizim çalışmamızda ayrıca büyükbaş ve küçükbaş ürünlere de yer verildiğinden ve ayrıca tüm sektörler sorgulandığı için oldukça geniş kapsamlı bir çalışma ortaya çıktı. Aynı şekilde, dinsel motifleri ön plana çıkararak domuz ürünlerinin insan yaşamındaki yerini araştıranlar da vardır. Ancak bu araştırmalar daha çok beslenme ve gıda tüketimi ile sınırlı kaldığından bizim çalışmamıza göre oldukça yüzeysel çalışmalar olarak sınırlı kalmıştır. Biz ise bu çalışmada hayvansal ürünlerin sadece beslenme ve tekstil ürünlerinde değil insan yaşamının tüm alanlarında bizi çepeçevre sarmış olduğunu göstermeye yöneliktir. Diğer bir deyişle, bu çalışmamız, bu çalışmayı detaylı olarak irdeleyen birinin ‘’günümüz dünyasında vegan yaşamın kesinlikle mümkün olamayacağı’’ kanısına kolaylıkla varabileceğini garanti edecek kapsamda olmuştur.

Yağ Asitleri

Don yağı, hayvani iç yağların eritilmesi ile elde edilir. Bu haliyle mum ve evsel sabun üretiminde kullanılır. Ancak esas kullanımı don yağının, yüksek basınç ve yüksek sıcaklık altında parçalanmasıyla ilk aşamada yağ asitleri karışımı ve yan ürün olarak gliserin elde edilir.

Sonraki aşama ise oleo kimyasalların, yağ alkollerin ve metil ester türevlerinin üretilmesi aşamalarıdır.

Don yağları; oleik asit, palmitik asit ve stearik asit vb. açısından oldukça zengindir. Ancak don yağlarını eşsiz kılan yağ asidi ise stearik asittir. Stearik asit hayvansal yağlarda %30 seviyesinde bulunurken bitkilerde ise oldukça azdır. Stearik asitin direk olarak kullanıldığı bazı ürünler olmakla birlikte esas kullanımı metal tuzları ile girdiği reaksiyon sonucu oluşan oleo kimyasallar üzerinden gerçekleşmektedir. Bu nedenle hayvansal yağların, tüm sanayi kollarında on binlerce ürünün üretiminde yaygın bir kullanımı vardır. Stearik asitin metal tuzları ile reaksiyonu sonucu çok sayıda stearat çeşidi oluşturulur ki her birinin binlerce sanayi ürünün üretiminde kullanıldığını görüyoruz.

Bu makalemizde; oleo kimyasalların, yağ alkollerinin ve metil ester türevlerinin tümüne yer verilmiş değildir. Özellikle yağ asitleri arasından sadece stearik asit ile sınırlı kalmanın ve onun sadece birkaç metal tuzu üzerinde yoğunlaşmanın, çalışma amacımıza ve misyonumuza ulaşmamızı sağlayacağına inandığımız için bu makalede, özellikle stearik asit ve bazı stearatlar üzerine yoğunlaşılmıştır.

Hayvansal yağların kullanım alanlarını incelediğimiz bu makalede, araştırma kapsamını bu kadar sınırlı tutmamıza rağmen bu çalışmamız, gerek Alman yazar Christien Meindertsman'ın çalışmasıyla gerek helal sertifikasının ihlal edildiği alanları ve ürünleri inceleme konusu yapan çalışmalarla kıyaslanamayacak ölçüde geniş olacaktır.

Don yağlarına geçmeden diğer bazı yağların kullanım alanlarından bir kısmına burada yer verelim: Paça yağı, sığır ve koyunların ayak ve incik kemiklerinden elde edilir. Saatler, dikiş makineleri ve silahlar gibi nazik makinelerin yağlanmasında kullanılmaktadır. Karaciğer yağı, ilaç endüstrisinde emülsiyon halde kullanılır. Stearin zifti, yağ asitlerinin damıtılmasıyla elde edilen bir artık olup yapışkan ve oldukça sertleşebilen bir maddedir. Su geçirmez karton ve

elektrik izolatörlerin imalatında kullanılmaktadır. İlikten çıkarılan yağlar, özellikle parfümeri imalatında kullanılır. Yapağı yağı stearini, mobilya sektöründe yapıştırıcı yağların imalatında kullanılır. Yapağı yağı oleini, iplik eğirme fabrikalarında tekstil yağlama hammaddesi olarak kullanılır. Gliserol zifti, gliserolün damıtılmasıyla elde edilmektedir. Her türlü kumaşın aprelenmesinde ve kağıtların su geçirmez hale getirilmesinde kullanılmaktadır. Üflenmiş yağlar, don yağına ısı uygulanması ile beraber içine hava üflenerek kısmen oksitlenmiş ve polimerize olmuş yağlardır. Suni deri imalatında, mineral yağlara karıştırılarak yağlama mustahzarları olarak kullanılır. Kükürtlenmiş yağlar, kükürt klorür ile muamele edilen yağlardır. Paslanmayı önleyici boya ve verniklerin üretiminde kullanılır. Don yağının içine az miktarda oksitlendirici maddeler katılarak elde edilen yağlar boya ve vernik sanayinde kullanımı vardır (Çengelci et al., 2011).

Don Yağları

Don yağının direk kullanıldığı alanlar da az değildir. Don yağı, özellikle, polisaj parlatma yağı, parlatıcı, ve cila olarak bakır, altın, gümüş, çelik esaslı ürünlerin parlatılmasında kullanılmaktadır. Kapı kolları, araç farları ve tekerlek jantlarının parlatılmasında , sadece ve sadece don yağlardan elde edilmiş parlatıcılar kullanılmaktadır. Bakınız: Trendyol, n11 vb. Polisaj işlemi esnasında, sertleşen fırçanın yumuşatılması ve cilayı daha kolay sarması amaçlı kullanılmaktadır. Yumuşak metallerin parlatılmasında kullanılır. Zımparalama sırasında aşındırıcı kumların kesicilik özelliğini yumuşatır. Böylelikle zımparalama sırasında çizik oluşumunu azaltır. Aşındırma sırasında aşırı ısınmayı engelleyerek yanık izi ihtimalini azaltır. Polisaj yaparken parlatma ve satinajda kolaylık sağlar. Şerit bant zımparada ömrünü uzatır. Dikişli koton fırçalarda ve pileli fırçalarda kullanılabilir. Metal, ahşap, plastik epoksi ürünlerin, otomobil pasta ve cilasında, altın ve gümüş takı ürünlerinin cilalanmasında kullanılmaktadır.

Don yağından elde edilen biyodizelin petrolden elde edilen dizele göre oldukça çevreci olduğu tespit edilmiştir. Soymartarim.com

Gemi inşa endüstrisinde kızak yağı olarak kullanımı vardır. Domuz yağının problemli cilt ve egzema tedavisinde direk kullanımı vardır. Don yağları, lehimleme sıvısı olarak yüzey pürüzlülüğü sebebiyle yapılan yağlama işleminde kullanılır. Haddeleme (metalin levha haline getirilmesi) endüstrisinde sentetik yağlama ürünlerine göre tercih edilmektedir. Don yağı, gres yağının ana bileşenidir.

Don yağ asidi, büyükbaş hayvanların iç yağlarından elde edilen ham yağın hidrolizi ve gliserolün ayrılmasıyla elde edilmektedir. Farklı kimyasal alanlarda kullanılan don yağı asidi, özellikle madeni yağ sektöründe gres yağı imalatında kullanılmaktadır (Anonim 6).

Ülkemiz hayvan varlığı konusunda Avrupa genelinde ilk sırada olmasına karşın yıllık 120.000 ton civarında bir don yağ ithalatımız var. Yani içerde yaratılan don yağı yeterli gelmemektedir. Dünya genelinde 30 milyon ton civarında bir don yağ eldesi vardır (Büyüközer, 2015).

Bu çalışmada ağırlıklı olarak stearatlara yer verilemektedir. Bundan önce yağ alkollerinden de birkaç cümle bahsedelim: Örneğin, yağ alkollerinden oleil alkol, sedef hastalığı ve seboreik dermatit hastalıklarının tedavisinde kullanılan ilaçların üretiminde yer alır. Tekstil kumaşlarının yumuşatılması ve yağlanmasında, karbon kağıdı, şablon kağıdı ve matbaa mürekkebi üretiminde kullanılmaktadır. Cilt kremlerinde, birçok farmasötik ve kozmetik üretiminde kullanımı vardır. Stearil alkol; saç kremleri, fondötenler, göz makyajı, cilt nemlendiricileri ve temizleyicilerinde yer alır. Stearil alkolün, reçineler, yağlayıcılar, parfüm ve kozmetik ürünlerinde yaygın bir kullanımı söz konusudur. Setil Stearil alkolün, ter kokusu giderici ve güneş bakım ürünlerinde kullanımı söz konusudur.

Stearik Asit

Stearik asit, en çok kullanılan yağ asitlerinin başında gelmektedir. Hayvansal yağlarda bitkisel yağlara göre 20-30 kat daha fazladır. Ayrıca hayvansal atık yağın bitkisel yağa göre daha ucuz olması nedeniyle stearik asit, neredeyse tamamen hayvansal yağdan üretilir. Bitkisel yağlarda eser miktarda olması nedeniyle bazı literatürde bitkisel yağ kaynaklarından hiç bahsedilmez. T.C. Milli Eğitim Bakanlığı, Gıda Teknolojisi, Lipitler, Ankara,2011. Çok geniş kullanım alanları aşağıdaki gibidir:

E570 E numarasıyla bazı gıdalarda katkı maddesi olarak kullanılır. Tekstil sektöründe, haşıllama aşamasında kumaşları yumuşatabilmek için kullanılır. Su geçirmez kumaşların imalatında kullanılır. Kauçukta hızlandırıcı ve yumuşatıcı aktivatör olarak kullanılır. Deterjan, şampuan ve tıraş kremi gibi kozmetiklerin üretiminde kullanılır. Boya ve vernik imalatında kullanılır. İlaç ve kozmetik sanayinde emülgatör olarak kullanılır. Havai fişek üretiminde alüminyum ve demir gibi metal tozlarının kaplanarak saklama ömrünü uzatmak için kullanılır. Güneş enerjisi santrallerinde paslanmayı giderici gresin üretiminde kullanılır. Kalıplama işlemlerinde ve gıda sektöründe yağlayıcı olarak, plastikleştirme süreçlerinde dengeleyici olarak, kauçuk vulkanizasyonunda su geçirmez ajan olarak kullanılır. Pil üretiminde kullanılır. Mum yapımının klasik bileşenidir. Seramik tozların enjeksiyonla kalıplanması ve preslenmesi sırasında yaygın olarak kullanılan bir yağlayıcıdır. PVC imalatında kullanılır. Gres yağının önemli bir bileşenidir. Plastiklerin plastikleştirilmesinde ve dengelenmesinde kullanılır. Tıbbi alanda merhemlerin, fitillerin hazırlanmasında önemli bir bileşendir. PVC boru, saç malzemeler, profiller ve filmlerin imalatında yaygın olarak kullanılmaktadır. Antifiriz üretiminde, özellikle uçaklarda kullanılan antifiriz üretiminde kullanılır. Nemlendirici krem imalatında boraks ile reaksiyona girerek işlevselliğini artırmaktadır. Parlatıcı malzemelerin

imalatında kullanılmaktadır. Taş kalıplarda, pişmiş köpük lateks için bir kalıp ayırıcısı olarak kullanılır. Pastel boya imalatında kullanılır.

Stearik asit, tüm kükürt vulkanizasyon sistemlerinde kullanılmaktadır. Kauçuk sektörü başta olmak olmak üzere endüstrinin çeşitli alanlarında değerlendirilebilen bu ürün, merdanelerde ve kalıplarda yapışmayı önleyici ve plastikleştirici olarak da değerlendirilir. Aktivatör ve kükürt vulkanizasyon işlemlerinde önemli bir yere sahip olan stearik asit kauçuk grade, aynı zamanda emülsifiye edici ajan olarak kullanılır. Kauçuk ve plastik sektöründe yoğun olarak kullanılır. Güçlendirici olarak kullanılır, dolgu işlevi görür, yüksek mukavemetli oldukları için daha uzun ömürlü ve daha kaliteli ürünlerin ortaya çıkmasına yardımcı olur.

Şekerlemelerde glikoz ile birlikte kullanılarak sertleşmeyi sağlar. Otomobil lastiği üretiminde salım ajanları olarak kullanılmaktadır. Alçı parça kalıp veya atık kalıptan döküm yapmak ve şilteli kil orijinalinden kalıp yapmak için kullanılır. Kurşun asit akülerin imalatında negatif plaka katkı maddesi olarak kullanılır. Cila üretiminde ve su arıtma ürünleri üretiminde kullanılır. Makine yıkama sıvıları/deterjanlar, otomotiv bakım ürünleri, kaplamalar ve yapıştırıcılar, kokular ve oda spreylerinde kullanılır. Yapıştırıcılarda, yağlayıcılarda ve kağıt ürünlerinde kullanılır. İzalatör yapımında kullanılır. İlaç sektöründe mantar öldürücü ajan olarak kullanılır.

Stearik asit, kağıt üretiminde vazgeçilmez bir katkı malzemesidir. Mikronize kalsit, stearik tuzlarından biriyle kaplanmakta ve kağıt endüstrisinde dolgu ve kaplama malzemesi olarak kulanılır. Böylece yüzey setleşir, düzlenir ve renk düzgünlüğü elde edilir. Kalsit ayrıca polimerik kompozit malzemelerde dolgu olarak yaygın bir şekilde kullanılmaktadır (Uçurum, 2014).

Stearik asit, domuz yağında ve don yağında %30 dolayında bulunurken sadece birkaç bitkide %1-2 civarında bulunur. Atamankimya.com En fazla keten tohumunda bulunur. O da %3.3

dolayındadır. Bitkilerde diğer yağ asitleri, kaprilik asit, palmitik asit, oleik asit vb. bol miktarda bulunur. Ancak stearik asit doğada çok yaygın değildir. En çok iç yağı ve hidrojene yağlarda bulunur (Karaca et. al., 2007).

Kalsiyum Stearat

Stearik asit ile kirecin reaksiyonundan elde edilir. Yüksek sıcaklığa, suya karşı oldukça dayanıklıdır, su itici özelliği vardır. Kaydırıcı, kalıp ayırıcı, stabilizatör, ve koyulaştırıcı görevi görür. Kullanım alanları çok geniş olup yiyeceklerde, bazı şekerlemelerde dahi kullanılır. İlaç, plastik, gıda, inşaat, kablo sanayinde yağlama ajanı, emülsifiye edici ajan, stabilize edici ajan, ayırıcı ve destekleyici ajan olarak ve kozmetiklerin temel maddesi olarak yaygın kullanımı vardır. Beton endüstrisinde çiçeklenmeyi önlemek için ve ayrıca su geçirmez özelliğinden faydalanmak üzere kullanılır. Çimento esaslı ürünlerde özellikle sıva, derz ve su izolasyon harçlarında su itici ajan olarak kullanılır. Kağıt, kalem ve boya kalemi endüstrisinde kaydırıcı, kağıt endüstrisinde kağıda parlaklık verip kağıdın toz tutmasını önlemek ve kağıt üzerinde olası çatlamaları önlemek üzere, tekstilde su geçirmez kumaş üretimi, plastik üretiminde pürüzsüz bir yüzey elde edebilmek için 1000 ppm'e kadar asit süpürücü olarak kullanılır. Sert PVC üretiminde füzyonu hızlandırıp, akışı geliştirip yüzeyde boloncuk oluşmasını engellemek amaçlı kullanılır. İlaç endüstrisinde jelleşme ve anti tack ajanı olarak kullanılır. Tablet kalıp ayırıcı ajan olarak işlev görür.

Mükemmel kaydırıcılık özelliği nedeniyle, plastik parçaların enjeksiyon ile üretiminde ve levha metallerden profil parça üretim sürecinde kullanılan mükemmel bir işlem kolaylaştırıcıdır. Ürün homojenliğini artırır, enerji tüketimini azaltır ve hammadde tasarrufu sağlar. Plastik sanayisinde iç kaydırıcı ve kalıp ayırıcı olarak kullanılır. Kaydırıcı ve su itici özelliklerinden ötürü kozmetik, farmasötik, gıda ve kimyasal formülasyonlarda topaklanmayı önleyici ajan

olarak kullanılır. Yapı kimyasallarının üretiminde derz, sıva ve su izolasyon ürünlerinde su itici ajan olarak kullanılır.

Çinko Stearat

Stearik asidin çinko tuzları ile reaksiyonu sonucunda üretilir. Endüstriyel olarak oldukça yaygın kullanımı vardır. Tüm metal sabunlar arasında en güçlü kalıp ayırıcıdır. Bu özelliğinden dolayı kauçuk ve plastik endüstrisinde ayrıcı ve yağlayıcı kullanımı ön plana çıkar. Kauçuk, poliüretan, polyester işleme sistemi, toz metalurjisi gibi birçok ürünün üretiminde ayırıcı madde olarak yaygın kullanımı vardır. Bazı boyalara parlaklık verir. Havalandırma tozunun ana bileşeni olarak, oyun kartları arasındaki sürtünmeyi azaltmak için kart manipülasyonu yapan sihirbazlar tarafından kullanılır.

Çinko stearat, hafif bir antiseptik ve büzücüdür ve iltihaplı ve tahriş edici cilt hastalıkları için lokal yapıştırıcı bir uygulama olarak kullanılmaktadır. Farmasötik formülasyonlarda, tablet ve kapsül imalatında %1.5 a/a konsantrasyonlarda bir yağlayıcı olarak kullanılır. Bebek banyo malzemeleri ve banyo tozlarında nemi emmek ve sürtünmeyi önlemek için kuru bir yağlayıcı olarak kullanılmaktadır. Temizleyici kremlerde ve şampuanlarda opaklaştırıcı bir madde olarak hizmet eder. Saç bakım ürünlerinde yağ için su emülgatörü olarak kullanılır.

Yapıştırıcılar ve sızdırmazlık ürünlerinde, otomotiv bakım ürünlerinde, yapı kimyasallarında, elektrik ve elektronik ürünlerde, yemek paketleme ürünlerinin imalatında kullanımı vardır. Mobilya üretiminde, boya ve kaplamaların üretiminde, mürekkep, toner ve renklendirici ürünlerin üretiminde, kişisel bakım ürünlerinde, plastik ve kauçuk ürünlerin imalatında, oyuncak üretiminde, ilaç üretiminde, metal üretiminde, matbaa mürekkebi üretiminde, sentetik kauçuk üretiminde çinko stearat kullanılmaktadır. Zımpara kağıdının aşındırıcılığını artırır, boya ve kaplamalarda matlaştırıcı görevi görür. Çinko stearat, PVC, polietilen ve ABS üretiminde oldukça etkili bir pigment dispersiyon yardımcısı ve yağlayıcısıdır. SMC (levha

kalıplama bileşiği) uygulamalarında viskozite değiştirici olarak kullanılır ve bitmiş ürünün yüzeyini iyileştirilir. Ayrıca poliolefin üretiminde asidik kalıntılar için bir temizleyici görevi görür ve polistiren üretiminde kalıp ayırıcı ve proses yağlayıcı olarak kullanılır. Taş yünü, kağıt, tekstil, inşaat kimyasalları ve boya endüstrisinde su itici olarak kullanılmaktadır. Çinko stearat; polistiren, renk konsantreleri, poliüretanlar ve poliolefinlerde kullanım için özel olarak tasarlanmış orta düzeyde kül, topaklanmayan bir üründür. Çinko stearat, birçok gıda paketleme ürünlerinde ve uygulamalarında FDA düzenleme koduna uygunluk taşır. Lastik, plastik, poliolefin, polistiren ve kauçuk endüstrisinde yaygın olarak ayırıcı ajan, ısı dengeleyici ve yağlayıcı olarak kullanılır. Ahşap kaplamalarda (laklarda) zımpara katkı maddesi olarak da kullanılır. Zımpara kağıdı üretiminde yağlayıcı ve mühürleyici olarak kullanılır.

Su itici ajan olarak özellikle çimento esaslı harçlarda, izolasyon malzemelerinde, derz malzemelerinde su iticilik istenen yüzeylerde kullanılmaktadır. Aynı zamanda kaydırıcı olarak kullanılmaktadır. Kauçuk ve plastik ile de uyumlu olmaktadır. Yapı kimyasallarında su itici olarak sıklıkla kullanıldığına rastlanmaktadır. Kauçuk sektöründe tozlama tozu olarak faydalanılmaktadır. Plastik, kauçuk, boya ve mürekkep endüstrisinde yağlayıcılar, kayganlaştırma maddeleri, ısı dengeleyiciler, kalıp ayırıcı ajanlar ve hızlandırıcılar olarak yaygın olarak tercih edilmektedir. Su bazlı boyalarda, şeffaflık, anti-köpüklenme, stabiliteyi sağlama, hızlı kuruma hassasiyetini iyileştirmek için de kullanılır. Su bazlı mürekkeplerde ajan olarak kullanılmasının yanında tekstil ürünlerinde yüzeyin hidrofobikliğini artırmak için cilalama ajanı olarak, kozmetik ürünlerde yüzey pürüzsüzlüğünü artırmakta, kağıt endüstrisinde özel kağıtların ve termal kağıtların yüzeylerinde su geçirimsizlik ajanı olarak, parlatma zımpara kağıtlarında cila özelliğini, aşınmaya karşı direnç ve yüzeyin su direncini artırmak amaçlarıyla kullanılmaktadır. Pil ve akümülatör üretiminde de kullanımı vardır.

Verniklerde, kaplama ve mürekkeplerde düzleştirici ve kumlaştırıcı ajan olan kullanılmaktadır. Kauçuklar için yağlayıcı, kurutma ve tozlaştırıcı ajan olarak, kimyasal sentezlerde bir katalizör olarak, beton, kaya yünü (sert yün), tekstil ve kağıtta bir su geçirmezlik katkısı olarak ve çimento esaslı izolasyon ürünlerinde su itici olarak kullanılmaktadır. Kablo sanayinde kaplama katkıları ve boya katkıları alanında da yaygın kullanımı vardır. Plastik endüstrisinde olduğu kadar kozmetik endüstrisinde de plastifiyan (plastikleştirici) olarak kullanılmaktadır.

Çinko stearat, ilaç endüstrisinde katılaşmış yağ ve yağlayıcıların hazırlanmasında kullanılmaktadır. Egzama, akne ve diğer cilt hastalıklarının tedavisinde toz ve merhemlerde kullanılan su itici, koruyucu bir ajan olarak kullanılabilir. İlaç kapsülü üretiminde yardımcı maddedir. Kauçuk endüstrisinde, kauçuk yağlayıcılar ve anti blokaj ajanı, kürleme katalizörü ortam aktivatörü olarak kullanılabilir. Tekstil ürünlerinde aydınlatma maddesi olarak kullanılabilir. Emaye boya sanayinde düzleştirici olarak kullanılabilir. Polisaj aşındırıcılarında yüzeyin cila özelliğini, aşınma direncini ve su direncini artırmak amacıyla kullanılır. Çinko stearat, endüstriyel olarak kullanılan bir çinko sabunudur. Tüm metal sabunları içinde en güçlü kalıp ayırıcısıdır.

Aluminyum Stearat

Don yağı ve alumdan hazırlanan sert, termoplastik beyaz bir toz olan alüminyum stearat, boya ve verniklerde kurutucu, koyulaştırıcı, emülgatör matlaştırıcı olarak kullanılır. Ayrıca su geçirmez kumaşlar, halatlar, kağıt, deri, beton ve sıva için kullanılmaktadır. Yağlı boyaya az miktarda (%2 veya daha az) eklenmekte olup boyaya tereyağlı bir kıvam verir. Alüminyum Stearat, pigment ve yağın ayrılmasını önler, vernikleri önemli ölçüde kalınlaştırır. Sanatçı boyası üreticileri, formülasyonda en çok alüminyum stearat kullanırlar. Boya, mürekkep ve greslerde yoğunlaştırıcı olarak kullanılır. Deri ve halat için su itici ve plastik ip içinse iyi bir yağlayıcıdır. Ayrıca su yalıtımı ve hava sürüklemesi için çimento üretiminde ve sıcakta eriyen

kağıt kaplama bileşiklerinde kullanılır. Ayrıca parfüm ürünlerinde, elektrik konektörü üretiminde, çimento boyaları, rafineri işlemlerinde, sondaj akışkanlarında, hidrolik aksamlarda, ilaç üretiminde tablet ve kapsül üretiminde kullanımı vardır. Alüminyum stearat su geçirmez kumaşlar, halatlar, kağıt, deri, beton ve sıva için kullanılır. Ayrıca fotoğrafik emülsiyonlarda bir bileşen olarak yer alır. Eyeliner, göz farı, maskara, ruj, allık ve makyaj ürünlerinin formülasyonunda yer alır. İlaçların ambalajlanmasında ve kozmetik için renklerin hazırlanmasında jel oluşturmak için kullanılır.

Gres ve yağlama yağlarında, mükemmel şeffaflık, sertlik ve su iticilik özellikleri verir. Yağlayıcılara eklendiğinde köpük giderme özelliği için kullanılır. Daha parlak ürünler üreten tel çekme gibi metal işlemede yağlayıcı olarak kullanışlıdır. Koyulaştırma ajanı veya süspansiyon ajanı olarak hareket ettiği için emaye ve lakelerin hazırlanmasında çok geniş uygulama alanı bulur. Pigmentin sarkmasını ve prizini azaltır, vernik kurutucu olarak çalışır. Branda ve tekstil endüstrilerinde, şemsiye üretiminde su geçirmezlik için önemli bir bileşen olarak kullanılır. Baskı mürekkeplerinde yüksek jelleşme özellikleri, koyulaştırma ve süspansiyon geliştirme için faydalıdır. Poliamidler ve termoset plastiklerin üretiminde yağlayıcı olarak kullanılır. Vulkanize edilmemiş kauçuk levhanın yapışmasını önlemek için toz alma tozu olarak kullanılır. Beton ve çimentoların suya dayanıklılığını artırmak için kalsiyum stearat ile birlikte önerilir. İç mekanlarda veya emaye boyalarda, dış cephe boyalarında bağlayıcı olabilir, su yalıtım malzemesi olabilir, gres, yağ ve cilalarda yağlama jeli olarak, tıraş kremi ve kozmetik ürünlerde mantar önleyici ve yağlayıcı olarak kullanılabilir.

Kurşun Stearat

PVC üretiminde ısı sabitleyici ve yağlayıcı olarak kullanılır. Sert boru, sert tahta, levha, film ve suni deri gibi çeşitli opak sert ve yumuşak PVC ürünlerinde kullanılır. Özellikle tel ve kablo

üretiminde uygundur. Ürünlere mükemmel elektriksel özellik verir. Sert içme suyu borusu üretiminde, kablo malzemesi, PVC boru üretiminde kullanılır.

Mağnezyum Stearat

Stearik asit ile mineral magnezyumu birleştiren beyaz bir tozdur. Magnezyum ile değişik oranlarda stearik ve palmitik asit içerir. Ağırlıklı olarak ilaç ve gıda takviye endüstrilerinde yaygınca kullanılır. Kalsiyum stearata göre daha pahalı olmasına karşın yapısında çok önemli özellikler barındırmaktadır. Bebeklere dönük vücut ve yüz tozları imalatında temel olan magnezyum stearat bileşiği, kusursuz partikül büyüklüğünden dolayı kullanıldığı cilde pürüzsüzlük katmaktadır. PVC üretiminde, diğer stearatlarla birlikte kullanıldığında çok önemli bir ısı stabilazitörü işlevi görür ve hatta bazı hamurlarda plastik işlem özelliklerini geliştirmek için plastifiyan ve lubrikant olarak da kullanılmaktadır. Üstün özellikli gres yağ imalatında jelleşme ajanı ve hidrofobik ajan olarak kullanılır. Yangın söndürme ekipmanlarında, kuru lubrikant olarak doldurulur ve topaklanmayı önler. Kauçuk imalat endüstrisinde ise yumuşatıcı, vulkanizasyon işlemlerinde hızlandırıcı, kalıplama işleminde kolaylaştırıcı ve kauçuk kavrulmasını önleyici ajan olarak kullanılmaktadır. Reçinelenmiş kauçuklarda ise bu ürün, oksidasyon ve sertleştirici işlevi görmektedir. Kısacası, kozmetik sektörü, boya sektörü, kauçuk imalatı, gıda sektörü, ilaç sektörü ve kablo sanayinde kullanımı vardır.

İlaç ve vitaminlere dönük kullanımındaki en önemli görevi yağlayıcılık işlevidir. Mağnezyum stearat, ilaç kapsüllerin üretiminde en çok tercih edilen stearattır. Fakat magnezyum stearat olmaksızın ilaç kapsülü üretmek mümkündür. İlaç kapsülünde kabul edilebilir kalite ancak magnezyum stearat ile sağlanabilmektedir. Magnezyum stearat, ilaçların bozulmasını önlemek ve emilimini geciktirmek için de kullanılır, böylece alınan ilacın bağırsakların doğru bölgesinde emilimini sağlar. Kapsüllü hap üretiminde aynı miktar dozun ayarlanabilmesi, en iyi magnezyum stearat ile sağlanabildiği görüldüğünden kapsüllü hap üretiminde neredeyse

tamamen magnezyum stearat kullanılmaktadır. Tablet hapların üretiminde de en çok kullanılan kayganlaştırıcıdır (Anonim 5).

Gliserin

Gliserin bütün hayvansal ve bitkisel yağların ortak yapıtaşı olarak, çoğunlukla yağ asitleri ile esterlenmiş halde trigliserid formunda bulunur. Endüstriyel sabun üretiminin %90'ı hayvansal yağlardan sadece %10'u bitkisel yağ kaynaklı olduğundan ve gliserin de sabun üretiminin doğal bir yan ürünü olduğu için piyasada karşılaşılan gliserinlerin %90'nın da hayvansal kökenli olduğunu söyleyebiliriz. Gliserin, ilaç, kozmetik, diş macunu, sentetik reçineler, dericilik, boya, sigara, gıda dahil birçok endüstri kolunda oldukça yaygın bir kullanımı vardır. Tüm bu sektörlerin gliserin ihtiyacı çok fazla olduğundan, doğal yolla üretilenlerin dışında mikrobiyal yolla ve biyokimyasal yöntemle de üretimi vardır (Yalçın, et. al.,2007) Doğal yolla üretilen gliserinler, özellikle gıda, ilaç ve kozmetik sektörleri tarafından tercih edilmektedir. Hayvansal yağlardan elde edilen biyodizelin de yan ürünü gliserindir Rakı üretiminde kullanılan gliserin, rakının donmasını geciktirir. İçindeki anasonun pul pul olmasını engeller. Gliserin, likörlerde kalınlaştırıcı olarak kullanılır.

Öksürük şuruplarında kullanılır. Şeker hastalığında dıştan deriye uygulanan merhemlerde bulunur. Kabızlık fitili olarak kullanılır. Çoğu diş macunu ve ağız gargara ürünleri gliserin içerir. Nargile tütünlerinde nem tutucu olarak kullanılır. Mürekkep gibi zor lekelerin kurumasını önlemekte ve lekeyi çıkarmakta gliserinden faydalanılır. Dinamit yapımında kullanılır. Nitrik asitle birleştiğinde dinamit üretilir. Ayaklarda oluşan yaraların tedavisinde ve özellikle nasır probleminin giderici krem ve ilaçlarda yer alır. Gliserin, dudakları soğuktan korur ve nemlendirir. Antiseptik özelliği sayesinde saç derisinde oluşan yaraların hızla iyileşmesine yardımcı olur. Güneş kremleri, yüz maskeleri ve tonerlerde yer alır. Bebek cilt ürünlerinde yaygın bir bileşendir. Kirlenmiş kulak temizliğinde kullanılan kulak damlalarının ana bileşeni

gliserindir. Aft rahatsızlıklarında en başarılı çözüm gliserindir. Ağız içi yaralar ve ağız kokusu için en iyi çözüm gliserin etken maddeli ilaçlardır. Gliserin, çiçek sektöründe çiçek kurutma için kullanılır. Burun tıkanıklığı için kullanılan birçok burun damlalarının ana etken maddesi gliserindir. Öksürük ilaçlarında kullanılır. Sedef ve egzema tedavisi ilaçlarında etken madde olarak yer alır. Birçok kulak tedavi ilaçlarında dolgu maddesi olarak da yer alır. Vücutta oluşan mantarlarla mücadelede gliserin kullanılabilmektedir. Hasar görmüş saçları onarır ve kırılmayı azaltır. Gıdalarda koruyucu olarak kullanılır. Dondurmada yapıyı düzeltir. Cam ve dolap kapağı gibi hassas yüzeylerin temizliğinde kullanılan temizlik malzemelerinde mutlaka gliserin vardır.

Jelatin

Memelilerin vücudundaki kemik, deri, kıkırdak, kas ve dokularda kolajen adı verilen yapısal bir protein bulunur. Jelatin de hayvanların doku, kas ve kemikleri ile kısmen hidrolize edilmiş kolajenin bir arada kullanılmasıyla elde edilen özel bir proteindir. Müslüman ülkeler ve İsrail'de üretilen jelatin çoğunlukla sığır kökenlidir, diğer ülkelerde ise çoğunlukla domuz kaynaklıdır. Dünya genelinde üretilen jelatinlerin %60'ı domuz jelatinidir. Çünkü domuzdan üretilen jelatinin maliyeti daha düşüktür. Ülkemizin jelatin ihtiyacının %80'i ithalat ile karşılanmaktadır(Can, 2015). Jelatin, ya deriden ya da kemikten üretilmektedir. Bitkisel jelatin diye bir şey yoktur. Bitkisel kolajen veya vegan kolajen olarak pazarlanan ürünlere dikkat etmek gerekir. Bu ürünler aslında kolajen içermezler. Kolajen üretimini destekledikleri söylense de bilimsel olarak kanıtlanmamıştır (Çavuşoğlu, 2020). Jelatinin kıvam koyulaştırıcı ve örtücü etkisine benzer bazı bitkisel içerikler vardır. Bu tip içerikler kullanılarak hazırlanan ürünler, hayvansal jelatine bir alternatif olarak sunulur. Bu tür içerikler, vegan beslenenlere dönük bir kandırmacadan öte bir şey değildir. Birçok sektördeki binlerce ürünün üretiminde hayvansal jelatin kullanılmaktadır. Meyve sularında kıvam düzenleyicisi olarak hayvansal jelatin kullanılır. Hayvansal jelatin; bira, şarap ve meyve suyu üretiminde durultma aşamasında

kullanılır. Tüm içeceklerde köpük önleyicisi olarak kullanılır. İçeceklerin ömrünü uzatır ve bozulmasını engeller. Örneğin, meyve suyunda kullanılmazsa çok hızlı küf oluşur. Çikolata, lokum ve jelibonda mutlaka hayvansal jelatin vardır. Ülkemizin çok ünlü bir markası sözde vegan çikolata üretmiş. Ama E nolu katkı maddelerine baktığınızda eser miktarda da olsa hayvansal ürün olduğu görülmüştür. Şuruplarda, kıvam düzenleyici olarak yer alır. Dondurulmuş ürünlerde yaşanan kristalizasyonu önlemek için jelatin kullanılır. Gümüş bromür esaslı fotoğrafçılıkta kullanılan bir materyaldir. Fotoğraf, sinema, röntgen ve radyografide kullanılan ve görüntü tespit etmeye yarayan yarı saydam plastik bir şerittir. Bu plastik şeridin yani gümüş bromürün üretiminde de jelatin kullanılır. Saç bakım ürünlerinde jelatin vardır. İlaç sektöründe ise ilaç tabletlerinde, serumlarda, kapsüllerde ve pastiller de bazı istisnalar hariç mutlaka hayvansal jelatin vardır. Kızıldeniz yosunundan, limon ve portakal kabuğundaki petkinden ve glutenden hayvansal jelatinin özelliklerine yakın bir ürünün üretimi mümkündür. Ancak hem çok pahalıya mal olur hem de istenilen miktarlardaki üretimi neredeyse imkansızdır. Laboratuvar ortamında üretilebilir, ancak endüstriyel karşılığı yoktur. İlaç sektöründeki tüm ilaçların, vitaminlerin ve gıda takviyelerinin sert ve yumuşak kapsüllerinin tamamı ya domuz ya da sığır jelatininden üretilir. Pastil ve tabletlerin dış kaplaması jelatindendir. Neredeyse tüm ilaçlarda dolgu malzemesi olarak hayvansal jelatin kullanılır. Serumlarda plazma ikamesi olarak kullanılır. Damla tipi ilaçlarda da dolgu maddesi olarak kullanılır. Bitkisel margarinde yapı düzenleyicisi olarak kullanılır. Yağ oranı düşürülmüş ürünlerde yağlı hissini verebilmek için kullanılır. Jelatinin film oluşturma özelliği vardır. Bu nedenle meyvelerin tazeliğini korumak için kullanılan film kaplamasının ana hammaddesi olarak kullanılır. Hazır çorba, hazır tatlı, helva, lokum ve benzeri birçok yiyeceklerde kullanılan en yaygın koruyucu ve de kıvam artırıcı madde jelatindir. İlaç sektöründe merhemlerde ve diş kalıplarının üretiminde kullanılır.

Kazein

Bu çalışmamızda kazeinin insan beslenmesindeki rolünden bahsetmeye gerek yok. Biz burada daha çok insan beslenmesi dışında nerelerde kullanıldığı konusunu araştırmaktayız.

Kazein, tutkal üretiminde kullanılmaktadır. Kazein bazlı yapıştırıcıların, özellikle, yanmaz kapıların lamine edilmesinde ve şişelerin etiketlenmesinde yaygın kullanımı vardır. Boya üretiminde de kullanılır. İç cephe ve dış cephe için orta derecede yıkanabilir ve cilasız bir dekorasyon sağlamaktadır. Kazein, aynı zamanda, su ile inceltilebilen yağlı boyalar olan emülsiyon boyalarda da emülsifiye edici ajan olarak kullanılmaktadır. Aynı zamanda boyalar için bağlayıcı olarak kullanılır, kontraplağı yapıştırmada ve aşındırmada da kullanılır.

Plastik bazlı giysi düğmelerinin üretiminde de kullanılır. Kumaş üretiminde elyafın rafinasyon işleminde kullanılır. Kumaş baskısı, boyutlandırma, tekstil cilaları ve blok lekelerin üretiminde de büyük önem taşımaktadır. Deri sanayinde gerek sentetik gerekse doğal deriler için yapıştırıcı olarak, derinin bahar atlaması ve işlenmesinde kullanılmaktadır. Ayakkabılar için temizleyici, macun ve cila üretiminde kullanılmaktadır.

Yapağı Yünü

Dünya genelinde 2 Milyon ton dolayında yapağı lifi üretilmektedir. Sanayi devrimi öncesi dönemde, yün insan yaşamındaki en önemli maddelerden birisiydi. Örneğin, 1660 yılında, İngiltere'nin ihracatının üçte ikisini yünlü tekstil ihracatı oluşturuyormuş. Petrol türevi kimyasal bazlı sentetikler, günümüz dünyasında, insan yaşamını domine ediyor olmasına rağmen yapağı yünü, günümüzde geleneksel kullanım alanlarının dışında, özellikle tıbbi tekstiller, geotekstiller, zirai tekstiller, teknik tekstiller, akıllı materyaller, koruyucu giysiler, izolasyon ve yalıtım, organik gübre gibi birçok alanda sentetiklere yerini bırakmamıştır. Çünkü yapağı yününün eşsiz fiziksel ve kimyasal özellikleri, yapağıyı çevreci ve de sağlıklı kılmaktadır. Sıcak ve soğuk tutması, esnek ve yumuşak olması, nemi ve kokuyu emmesi,

yanmaya karşı dayanıklı olması, geri dönüştürülebilir olması ve biyolojik çözünürlüğü nedeniyle insan sağlığının ön plana çıktığı ürünlerde hala yaygın kullanımı vardır (Ertaş, 2022). Yün lifi, medikal alanda çok yaygın kullanıma sahiptir; sargılar, basınçlı bandajlar, yara örtülerinin yapımında ve ayrıca yatak yaralarını önlemede kullanılmaktadır. Yün lifleri, yangınla mücadele için koruyucu giysilerde uzun süredir kullanılmaktadır. Yünün bitki beslenmesinde önemli olan azot, kükürt ve karbon içeren kreatin proteinlerinden oluşması, onun çevre dostu bir gübre olarak kullanılabilmesini mümkün kılmaktadır.

Maliyetinin çok düşük olması nedeniyle petrol türevi sentetik lifler birçok kullanım alanında doğal liflerin yerini almıştır. Ancak yapağı lifinin, hem bitkisel hem de sentetik liflere göre yalıtkanlık, hafiflik, elastikiyet, sağlamlık, güç tutuşurluk, daha antimikrobiyal oluşu, daha hidrofobik oluşu, hidrokarbonların absorbsiyonu ve filtrasyonu konusunda daha yüksek nitelikli oluşu sonucunda birçok tıbbi tekstillerin, endüstriyel koruyucu giysilerin, izolasyon malzemelerin, bazı geotekstillerin ve zirai tekstillerin ve bazı akıllı materyallerin üretiminde kaçınılmaz olarak yapağı lifi kullanılmaktadır.

Yapağı lifli esaslı kumaşlar, özellikle yangın söndürme ve metal işleme endüstrisinde, eriyik metallerin akıtılmasında ve özellikle demir ve alüminyum eritme tesislerinde kullanılmaktadır. Koyun yünü, 2003 yılından itibaren AB'nin mevzuatında yapı materyalleri kapsamına alınmıştır. Termal iletkenlik katsayısının yüksek oluşu zirai alanda tohum ve fidan üretiminde, bina izolasyon ürünleri üretiminde tercih edilen malzemelerin başında gelmektedir. Kirlenmiş suların arıtılmasında filtrasyonda en başarılı alternatiftir. Havacılık sektöründe uçuş personeli giysilerinde yaygın kullanımı vardır. Yüksek enerji verimliliği ve yangına karşı daha dirençli olması ve yüksek nem tutma kabiliyeti sonucunda endüstriyel, zirai ve tıbbi alanlarda geniş bir kullanım alanına sahiptir (Tüfekçi, et al, 2014).

Yapağının yağından elde edilen Lanolin, Olein ve Stearin

Lanolin; koyun ve keçi yününden elde edilen yapağı yağının saflaştırılması suretiyle elde edilir. Merhem kıvamındadır. Makine yağlarının imalatında, merhem ve kozmetik müstahzarlarının yapımında kullanılır. Ayrıca apre imalatında yaygın kullanımı vardır. Kozmetik, cilt kremleri, ve nemlendirici şampuanlarda bulunur. Bebek preparatları, hamur şampuanlarda, yanık yardımcıları, makyaj malzemeleri, saç sprey plastikleştiricileri, saç koruması, tıraş kremleri, el sabunları, evcil hayvan ürünleri, dudak stickleri, koruyucu krem ve losyonlar, güneş koruyucuları içinde lanolin bulunmaktadır. Ayrıca gıdayla temasa geçecek kauçuk maddeler için plastikleştirici, gıda teması için yüzey yağlayıcı, gıda temasında kağıt ve kağıt panosu için köpük giderici ajan, sulu ve yağlı gıdalarla temasta kağıt ve kağıt panonun komponenti, metalik eşya üretiminde yüzey yağlayıcı, selofanın komponenti olarak, kaplamalarda köpük giderici ajan olarak lanolin kullanılmaktadır. Lanolin, krem ve dudak sticklerinde çokca kullanılır.

Yapağı yağı oleini; iplik eğirme fabrikalarında tekstil yağlama maddesi olarak kullanılmaktadır.

Yapağı yağı stearini; endüstriyel yağlama yağları ve yapıştırıcı yağların imalatında katkı maddesi olarak kullanılmaktadır. Yapağı yağı, lanolin, lüks sabunların, makyaj kremlerin ve yağlı boyaların üretiminde kullanılmaktadır.

Mono ve Digliseritler (E420-495)

Gliserol veya gliserin, yağ asitleri ile birlikte yağların yapısını oluşturmaktadır. En büyük kaynak sabun fabrikalarının atık sularıdır. Gliserin, nem çekici özelliğinden dolayı gıdaların kurumasını önlemek için kullanılmaktadır. Gliserinin yağ asitleriyle yaptıkları esterler, (mono ve di) iyi bir emülsifiyer etki gösterirler. Unlu mamullere işlenebilirlik kazandırmakta, ekmek içi yumuşaklığı, kabuk gevrekliği ve ekmek hacmi artmakta, istenen gözenek yapısı teşekkül etmekte ve bayatlamayı geciktirilebilmektedir. Margarinlerde su ve yağ emülsiyonunu

sağlayarak homojen bir yapı oluşturmakta ve yağ salmasını önlemektedir. Kek yapımında yağın etkinliğini artırmaktadır. Kek yapımında kullanılmadığı takdirde kekte çökme meydana gelmektedir.

2010'ların sonlarında, Apeel Sciences şirketi, taşıma ve depolama için meyve ve sebzelerin solmasını ve korunmasını önlemek için plastik filmlere alternatif olarak monoasilgliserollerle Güney Amerika, Çin ve Japonya'nın bazı bölgelerinde pazara girmiştir (Forbes, 2018).

Eskiden meyve sebzeler bozulmasın diye plastik kaplama yapılırken günümüzde artık E471 gıda kodlu mono ve digliseritler kullanılmaktadır. Özellikle meyve kaplama maddesi olarak ülkemizde de yaygın kullanılmaktadır. Mono ve digliseritlerin üretiminde en ucuz kaynak domuzdur.

Sonuç olarak, endüstriyel ve evsel sabunların %90'ı hayvansal yağlardan üretiliyor olmasından dolayıdır ki meyve ve sebzelerin bozulmasını önlemek için ve ayrıca ekmek üretiminde, unlu mamul üretiminde, margarin üretiminde ve kek yapımında kullanılan mono ve di gliseritlerin %90 ihtimalle hayvansal kaynaklı olduğunu söyleyebiliriz. E471 katkı maddesi, ayrıca patates cipslerinde, tatlı soslarında, aerosol kremlerde, muhallebi tozlarında, margarinde ve dondurmada kullanılmaktadır. Endüstriyel kullanımı emülsifiye edici ajan olarak higroskopik tozlar için koruyucu bir kaplama, farmasötiklerde bir katılaştırıcı ve kontrol salma maddesi, reçine üretiminde yağlayıcı olarak kullanılmaktadır. E471 paketlenmiş gıdalarda oldukça yaygın kullanılan bir katkı maddesidir. E471, bisküvi üretiminde gevrekliği iyileştirir, bisküvi üretimini kalıptan çıkarmayı kolaylaştırır ve desenin net olmasını sağlamaktadır. Bitkisel yemeklik yağlarda da kullanımı vardır. Yemeklik yağ kristallerinin bir inhibitörü olarak kullanılır. Çikolata üretiminde, şeker kristallerinin çökelmesini ve yağ ayrışmasını ve çikolata yüzeyinin donmasını önlemekte, çikolatanın kırılganlığını iyileştirmekte ve ayrıca nemlenmeyi ve yumuşamayı önlemektedir (Anonim 5).

İlaç Endüstrisi ve Tıp Alanı Uygulamaları

İlaç endüstrisinde kapsül ve tabletin imalatında hayvansal ürünler dolgu malzemesi olarak kullanılmakta ve hala tüm sektörü domine etmektedir. Ancak veganlara uyumlu ilaç üretimi için hidroksi propil metil selülozun kullanıldığını görüyoruz. Bu ürün öz olarak odun selülozu içermektedir. Ancak ilaç endüstrisinde istenilen özellikleri sağlayabilmesi için önce sodyum hidroksit ile muamele edilmesi gerekiyor. Daha sonra ise klorometan ve propilen oksit ile reaksiyona sokulmaktadır. Ancak hayvansal ürün kullanmama adına kloro metan kullanımı tercih edilmektedir. Halbuki kloro metan insan sağlığı için inanılmaz derecede zararlıdır.

Kloro metan gazının solunması uyuşturucu etkisine benzer bir etkiye sahip olur. Klorometana maruz kalma uyuşukluk, baş dönmesi, şaşkınlık ya da nefes alma, konuşma ve yürümede zorlanmaya sebep sebep olabilir. Yüksek konsantrasyonda felç, nöbet ve komaya bile sebep olabilir. Hava yerine solunursa boğabilir. Sıvı klorometan ile etkileşim cildi dondurabilir. Propilen oksit ise beterin daha beteridir. Akut toksik ve kanserojen bir organik bileşiktir. Hayvansal ürün kullanmayan, yumurta, et ve balık yemeyen, süt içmeyen, süt ürünleri tüketmeyen birisinin her gün mutlaka B12, taurin ve kolajen başta olmak üzere çok sayıda vitamin ve gıda takviyesi alması gerekecektir. Bu kadar yoğun bir seviyede siyanür, kloro metan ve propilen oksite maruz kalan birisinde bu zehirli ve zararlı maddelerin birikmesi kaçınılmazdır. FDA ve benzeri kurumlar, bu zararlı maddeler vitamin ve gıda takviyesi ürünlerinde bir adet kapsül ve bir adet şişedeki 50-100 adetin insan sağlığı üzerindeki etkilerine bakarak karar veriyorlar. Bu haliyle sınırın altında kalıyor diyerek onay vermektedirler. Ancak vegan birey bu kapsül ve tabletlerden her gün 2-5 adetini almak zorunda ve yıllarca bu tüketime devam etmek zorundadır. Organiklik sertifikasyonunda istenmeyen bir zararlı varsa, örneğin glifosat, bunun organik üründe değerinin sıfır olması isteniyor. Zaten vegan ürünler için organiklik sertifikasyonun olmaması ayrı bir sorun. Bunu geçelim. Organiklikte, örneğin,

glifosat herbisitin üründeki kalıntı düzeyinin 'SIFIR' olması istenirken, kanserojen etkisinin olduğu kanıtlanmış olan bu katkı maddeleri bazı ilaç ve gıda takviyelerinde rahatlıkla yer alabilmektedir. Buna karşın organik olmayan sebze ve meyveler insan beslenmesinde oldukça ağırlıklıdır. Organik sebze ve meyve tüketimi ise oldukça azdır. Her gün bunların düzenli tüketimi olmaz. Buna rağmen organik ürünlerde 'sıfır kalıntı'' şartı mutlaka aranmaktadır. Halbuki vegan birey bu tablet ve kapsüllerin birden fazla adedini her gün tüketmek zorundadır. Nasıl oluyor da vegan ürün sertifikasyonu hala söz konusu değil. Bu kapsül ve tabletlerin uzun süreli kullanımının yaratacağı hasara ilişkin herhangi bir çalışma yapılmıyor. Ben şahsen kimyasalların yoğun olarak kullanıldığı bir fabrikada 10 yıl çalıştım. Bende kimyasallardan dolayı alerjik reaksiyon oluştu. Bu kimyasallar diğer 80-90 kişide bir sorun yaratmadı ama ben de yarattı. Aynı durum büyük bir ihtimalle bu kapsül ve tabletler için de geçerlidir.

Adrenalin ilacı. Anafilaksi gibi alerjik şok tedavisinde kullanılan hayat kurtarıcı bir ilaçtır. Bazı ilaçlar, besinler ve böcek sokmaları alerjik şoka neden olabilir. Diğer alerji ilaçları alerjik şok tedavisinde adrenalinden daha az etkilidir. Adrenalin, koyun ve sığırların böbreküstü bezlerinden elde edilir. Alternatifi sentetiklerdir. Sentetikler hem insan sağlığına zararlıdır hem de pahalıdır.

Albumin. Yumurta akı ya da sığır ve tüm ruminantların kanında bulunur. Gıda endüstrisi dışında tutkal ve ayakkabı cilası üretiminde kullanılır.

Ameliyat iplikleri. Katgüt, sığırın seroz zarından ya da koyun bağırsağının mukoza altı gözenekli dokusundan elde edilir. İpliğin, vücut tarafından absorbsiyon süresi uzatılması isteniyorsa krome asit tuzları ile kromizasyon işlemi görmüş olanları kullanılıyor. Ucuz olması ve hızlı erimesi sebebiyle ağız içi gibi mukoza dikişlerinde ve pediatrik olgularda tercih edilmektedir (Saçak, 2022). Günümüzde kullanımları giderek azalmıştır. Hızlı iyileşen dokuların kapatılmasında kullanılır. Kollajen dikiş ipliği ise sığırın fleksör kirişinden elde

edilmekte olup özellikle göz cerrahisinde kullanımı vardır. Laktik asit ve glikolik asitten üretilen doğal bir ameliyat ipliğidir. Sentetik ipliklerin kullanımı son yıllarda artmıştır. Ancak en yaygın kullanılan ameliyat ipliği ipektir. Günümüzde damar ligasyonu, dren fiksasyonu gibi cerrahi işlemlerde hala tercih edilmesinin birinci sebebi ucuz ve güvenli olmasıdır (Gemci et al., 2004). İlaçlar, doğal kaynaklardan ve sentezlenerek elde edilir. Doğal kaynak olarak, insan ve hayvan doku ve sıvıları, bitkiler, mikroorganizma ve mantarlar ile çeşitli mineralleri içeren madenler kullanılır. Kısacası, insan tedavisine dönük ilaçların üretiminde doğal alternatifi olduğu sürece sentetikler kullanılmamaktadır.

Alfa-Amilaz. Bakteriden ve domuzdan elde edilen bir enzimdir. Sindirime yardımcı olan pankreas enzimleriyle beraber kombine olarak kullanılır. İlaç dışında birçok sanayi üretiminde kullanılmaktadır. Bira üretiminde sakkarifikasyon öncesi nişastalı hammaddenin sıvılaştırılmasında ve ayrıca biranın tadını olumlu yönde etkilemek için kullanılır. Kitap endüstrisinde; yapıştırma ve kaplama maddelerinin yapımında kullanılmaktadır. Şeker üretiminde artık şekerin geri kazanılmasında ve ekmek üretiminde ekmeğin bayatlama hızının azaltılmasında kullanılmaktadır. Undaki nişastayı parçalayarak şekeri açığa çıkarır. Ekmekte parlak ve ince kabuk oluşumunu sağlar.

L-sistein. Domuz kılından yapılıyor olduğu ortaya çıkınca 2013 yılında, ekmek üretiminde kullanımı ve ithalatı yasaklanmış. Ancak görüldüğü gibi alfa amilaz enziminin ithalatı şu an yasak değil. İthalatı yapılan alfa amilaz enziminin bakteriden mi yoksa domuzdan mı üretildiği sorgulanmıyor.

Pankrealipaz. Sindirim enzimi olan pankrealipaz; proteolitik, amilolitik, lipolitik etkilidir. Domuz veya sığır pankreasından elde edilir. Nişasta sindirimi bozukluklarında, pankreas inflamatuar hastalıklarında ve pankreas cerrahi uygulamaları akabinde kullanılır.

Ardeparin. Antikoagülan etkili, düşük molekül ağırlıklı heparin ürünüdür. Mukozal heparin peroksidaz varlığında depolimerizasyonu ile domuzdan elde edilir. Kanın pıhtılaşma süresini uzatarak pıhtı oluşumu riskini azaltmayı hedefler. Kan dolaşımındaki pıhtılar ise bilindiği gibi inme, felç, bacak ve akciğerlerde tıkanıklığa sebep olabilir ve ölümcül sonuçlanabilir.

Dalteparin. Antitrombotik etkili, düşük molekül ağırlıklı heparin ürünüdür. Domuz mukozal heparinin nitröz asit depolimerizasyonu ile hazırlanır.

Enoksaparin, Nadroparin, Reviparin Na, Tinzaparin vb. Antitrombotik etkili, düşük molekül ağırlıklı heparin ürünüdür. Domuz mukozal heparinin benzilik asit esterinin depolimerizasyonu ile elde edilir.

Proktant Alfa. Akciğer sürfaktanı olup yeni doğanların solunum güçlüğünde kullanılır. Domuz dokularından elde edilir.

Sekretin. Sindirim sistemi hormonudur. Bağırsakları mide asidi hasarından korur. Domuzdan elde edilir. Karaciğerin safra üretimindeki yetersizliklerinde kullanılır.

Kalsitonin. Kalsiyum metabolizmasını düzenleyen hormondur. Balık ve domuz dokularından elde edilir. Başlıca osteoporoz, Paget hastalığı (osteitis deformans), osteogenesis imperfecta, hiperkalsemi tedavilerinde kullanılır.

Somatotropin. Hücre bölünmesini uyaran, karbonhidrat ve lipid metabolizmasını düzenleyen peptid yapılı bir büyüme hormonudur. Eksikliğine bağlı büyüme geriliğinde kullanılır. Sığır ve domuzdan doğal ekstraksiyon veya rekombinant DNA teknolojisi ile elde edilir.

Contractubex ilacı. Ciltte çeşitli nedenlerle oluşmuş yara izi tedavisinde, ameliyat izlerinin giderilmesinde, Dupuytren Kontraktürü ve travmatik tendon kontraktürü tedavisinde neredeyse tek alternatiftir. Domuz yağından üretilir (Arslan et. al., 2019).

Aşılar. Grip aşısı dahil olmak üzere hem çocuklar hem de yetişkin aşıların tümünde hayvan yan ürünleri vardır. Aşıların hazırlanışında jelatin, tavuk embriyo, kobay embriyo hücreleri ve serumları kullanılır.

Laktoz. Doğada sadece sütte bulunan dissakkarit formunda bir şekerdir. Birçok hap ve kapsülde yaygın olarak bir dolgu maddesi olarak kulanılır.

E1000. Cholic Asit; bütün omurgalıların safrasının normal bileşenidir. İneklerin safrasından çıkarılarak üretildiği gibi sentetik olarak da üretilebilir. Emülgatör özelliktedir.

E1105. Lisozim; Ticari olarak tavuk yumurtasından ya da bakteriden üretilir. Bebek besini içerisinde ve ilaç hazırlanmasında kullanılır.

Şellak. Şellak, kokkus laka isimli bir böceğin salgı maddesidir. Güney Asya ve Hindistan'da üretilir. Boyacılıkta, cilalamada, mürekkep yapımında, mühür mumu yapımında, ses kaydedicilerde kullanıldığı gibi yenilebilir şellak çeşitli şekerleme kaplamalarında kullanılıyor.

Elevit. Elevit isimli vitamin ilacındaki 'E' vitamini kaynağı domuzdur. Prospektusta, E vitamini kaynağı yazmaz. Ancak firma yetkililerine sorulduğunda bu doğrulanmıştır.

Gıda katkı maddelerinin üretiminde üç temel kaynak mevcuttur: Bunların bir kısmı sadece hayvansal kökenlidir, bir diğer kısmı ise hem hayvansal hem de bitkisel kökenlidir. Ancak hayvansal kökenli olanların hem maliyetleri çok düşüktür hem de hammadde erişilebilirlikleri kolaydır. Bu nedenle bu grup gıda katkılarını büyük ihtimalle çoğunun hayvansal kökenli olması kaçınılmazdır. Bir diğer grup ise kimyasal kökenli olanlardır. Kolayvegan.com sitesi, üyeleri uyarmak için gıda katkı maddelerini gruplandırmış. Listeyi dört gruba ayırmış. Kesin hayvansal kökenli olanlar ile hayvansal kökenli olabilecekleri listelemiş ve üyelerini bu konuda uyarmış. Ayrı bir grup daha oluşturmuş ki bunlar kesin bitkisel olanlar diye listelemiş. Ancak bu bitkisel kökenli listesine baktığımızda çoğunun aslında ise kimyasal olduğunu görüyoruz.

Bitkisel kökenli dedikleri grup incelendiğinde görülmektedir ki çok büyük bir kısmı aslında sentetiktir ve kimyasaldır. Üstelik bu sentetiklerin kanser dahil çok sayıda sağlığa zararlı yan etkileri tescillenmiş veya raporlanmış olmasına karşın, söz konusu vegan sitesinin, bu kimyasalları bitkisel demesi ve kendi cemaat üyelerini yanıltıyor olması kabul edilemez. Bu listede çok az da olsa gerçekten bitkisel olanlarını görüyoruz. Bu gerçekten bitkisel olanları incelediğimizde ise bunların insan sağlığına herhangi bir zararı ya da herhangi bir yan etkisi etkisinin bugüne kadar raporlanmamış olduğunu da görüyoruz.. Buna karşın diğer tüm sentetiklerin insan sağlına çok sayıda zararı olduğu raporlanmıştır.

Şimdi bu vegan sitesinin ‘’kesinlikle bitkisel dediği gıda katkı maddeleri’’den bazılarına bakalım:

E102- E107- E110- E122- E123- E124-E129. Bunlar kesinlikle bitkisel değildir. Kimyasal yolla elde edilebilir sentetik boya vericilerdir. Bu kimyasalların, çocuklarda alerjiye, hiper aktiviteye ve astıma yol açtığı raporlanmıştır. Hatta E123’ün sıçanlarda tümör oluşumuna, E129’un ise hayvanlarda mesane kanserine neden olduğu görülmüştür.

E127- E128-E131- E133. Bunlar da sentetiktir. Kırmızı ya da mavi renk vericilerdir. Anemiye sebep olduğu ya da histaminin serbest bırakılmasına neden olduğu görülmüştür.

E142. Sentetik yeşil renk sağlayıcıdır. Alerjiye ve anemiye neden olduğu görülmüş. Buna karşın klorofil kökenli E140 ve 141 bitkisel olduğundan hiçbir yan etkisi raporlanmamıştır.

E200- E300 grubu gıda koruyucuları. E200, E201, E202, E203 sorbik asit esaslı gıda koruyucularındandır. Esasında sorbik asit, Avrupa dağ ağacı meyvesinde (sorbus cucupoaria) doğal olarak bulunmasına karşın ticari uygulamalarda kimyasal yolla sentetik olarak üretilmekte ve sentetiğinin yaygın bir şekilde kullanıldığını görüyoruz. Yine E210, E211, E212, E213, E214, E215, E216, E217,E218 ve E219 gibi koruyucular benzoik asit, benzoatlar ve benzoik asit esterleridir ve meyvelerde ve özellikle kirazda bol miktarda bulunmaktadır. Yine

ticari uygulamalarda doğalı olan ve bitkilerden elde edilenlerin yerine ticari uygulamalarda kimyasal yolla üretilen sentetiği kullanılmaktadır. Özetle, söz konusu vegan sitesi, insan sağlığına hiçbir zararı olmayan hayvansal kökenli katkı maddelerini şiddetle yasaklarken kanser, alerji, anemi başta olmak üzere birçok sağlık problemine yol açma potansiyeli olan kimyasal kökenli sentetik gıda katkılarına dönük en küçük bir yorum yapmamaktadır. Çünkü piyasada bulunabilecek katkı maddeleri çoğunlukla ya hayvansal kökenlidir ya da kimyasal olarak üretilmiştir. Kimyasal olanlara dikkat edin, kullanmayın, tüketmeyin diyememektedir. Çünkü bitkisel olanları üretilebilirliği hem zor hem de pahalıdır. Halbuki hayvansal olanların çoğu hem ucuzdur hem de hammadde erişilebilirlikleri kolaydır. Ortaya şöyle bir sonuç çıkmaktadır; insanlar, alerji ya da kanser olabilir ama asla hayvansal ürün tüketmemelidir. Bu örnekleri aslında çoğaltmak mümkündür. Ancak bu örneklerin fikir vermesi açısından yeterli olduğu düşünülmektedir. Riboflavin, süt, yumurta, karaciğer ve sebzelerde bulunmasına karşın ticari olarak mayalardan sentetik olarak üretildiğini görüyoruz.

Görüyoruz ki kesinlikle bitkisel olduğunu söylemesine ve bitkisel kökenli katkı maddeleri arasında bitkiyle bağlatısı olmayan birçok kimyasal bu grup altında yer verilmiştir. Örneğin, E900. E900; polidimetilsiloksan, aslında gıdalarda köpük önleyici madde olarak kullanılan bir silikondur, kimyasaldır. Bu kimyasal, yüksek sıcaklıkları tolere edici etkinliği nedeniyle kızartma yağlarında yaygın olarak kullanılmaktadır.

İçecek Endüstrisi

Son dönemde rakı, şarap, bira ve meyve suyu üretiminde sentetik alternatifler, sektörü domine ediyor olmasına karşın hayvansal ürünlerin kullanımı bazı niş ve butik ürünlerde ağırlıklı olarak, kimi fabrikasyonitle üretimlerde ise sentetiklerle birlikte az da olsa kullanımı devam etmektedir. Örneğin alfa amilaz enzimi geçmişte ticari kullanımda özellikle hayvansal

yağlardan üretilirken günümüzde maliyet kaygılarının olduğu üretimlerde bakterilerden üretilmektedir.

Şaraplarda kullanılan hayvansal katkı maddeleri

Şarap üretimi tüm dünya geneline yayılmış ve bu nedenle çok fazla sayıda katkı maddesi kullanımı söz konudur. Butik üretimde başka fabrikasyon üretimde başka olduğu gibi ülke ülke farklı katkı maddeleri kullanılmaktadır. Hiç hayvansal katkı maddesinin kullanılmadığı şarap örnekleri ile karşılaşmak mümkündür. Ancak hayvansal katkı maddeleri şarap kalitesinin iyileştirilmesinde önemli katkıları olması sebebiyle çok sayıda hayvansal ürünün kullanıldığını görüyoruz.

Sütte bulunan laktik asit, şarapta agresif, keskin tadı olan malik asitliği yumuşatır. Malolaktik fermantasyon adı verilen işlem, neredeyse tüm kırmızı şaraplarda ve bazı tam gövdeli beyaz şaraplarda (örneğin, chardonnay) kullanılır.

İsinglass (balık kesesi): birçok beyaz şarapta arındırıcı olarak kullanılır, aksi takdirde beyaz şaraplar bulanık olur.

Durulama, şarap üretiminin önemli aşamalarından birisidir ve durulama için katkı maddesine ihtiyaç vardır. En fazla ve yoğunlukta kullanılan durultma maddeleri şunlardır: Jelatin, yumurta akı, süt tozu, bentonit ve bitkisel aktif karbon(kömür)' dür. En çok kullanılanı ise jelatindir. Tadı ve rengi iyileştirir. Esmerleşmiş şarapların rengini açar. Polifenolce zengin şaraplar için çok uygundur. Yumurta akı ise rengi koyulaşmış ve tadı acılaşmış beyaz şaraplarda kullanılır. Bentonit ise renk maddelerini absorbe ettiği için pek tercih edilmez. Genellikle jelatin ile durultmadan sonra gerekiyorsa, ikinci durultma için kullanılmaktadır. Bitkisel aktif karbon, yani kömür, özel durumlar dışında pek kullanılan bir madde değildir. Çünkü birçok şarap bileşenini ve vitaminleri yok etmektedir.

Şarap Durultma

Fransa ve İtalya'daki şarap üreticileri, yüzlerce yıldır büyük fıçı şaraplara bir veya iki yumurta akı ekliyor. Şarapta bulunan serbest proteinler yumurta akı proteinlerine bağlanır. Daha sonra bu proteinler dibe çökelir ve dipteki posayı bırakıldığında şarapta arzulanan berraklık böylece sağlanmış olmaktadır. Şarap üreticileri bu işleme 'İnce İşleme ve Raflama' demektedirler. Bu süreç için mikrobiyal/kimyasal alternatifler olmasına karşın şarap kalitesi açısından doğal katkı maddeleri daha bir ön plana çıkmaktadır. Yumurta akı, şarap için finisaj maddesidir. Kazein de şeri ve beyaz şaraplarda esmerleşme ve acılık oluşturan fenolik bileşiklerin içeriğini azaltarak şarabın berraklaşmasını sağlar. İsinglass diye bilinen balık kesesi, şarabı parlatmada, aydınlatmada çok başarılıdır. Domuz ya da sığır pankreasından elde edilen tripsin ile yine domuz veya sığır midelerinden elde edilen pepsin, şarap içindeki ısıya dayanıksız proteinleri azaltmak veya çıkarmak için kullanılmaktadır.

Bira üretiminde, durultma işlemi için peltemsi bazı maddeler, örneğin, balıkların yüzme keselerinden elde edilen bir tür jelatin kullanılır.

Bazı vegan siteleri, bira üretiminde hayvansal ürünlerinin sadece durulama aşamasında kullanıldığı ve bazı bira üreticilerin bu durulama aşamasında hayvansal ürünleri kullanmadan bira ürettiğini belirtmektedir. Bir kere gıda sektöründe, organiklik sertifikasyonu gibi vegana uygunluk sertifikasyonu yok. Üretici firmanın beyanını kabul etmek zorundasın. Ancak bira üretiminde alfa-amilaz isimli ve domuzdan elde edilen bir enzim kullanılmaktadır. Bu enzim es geçilmiş durumda. Bu enzimin görevi, sakkarifikasyon aşaması öncesi nişastalı hammaddenin sıvılaştırılmasında ve ayrıca biranın tadını olumlu yönde etkilemek için kullanılıyor. Her şey bir yana ürün etiketlerin vegan olup olmadığı hiç sorgulanmıyor. Kullanılan kağıdın, su itici özelliğinin kazanılabilmesi gerekli. Bu amaçla hayvansal yağ tabanlı bir metal sabununun kullanılması kaçınılmaz. Etiketteki mürekkep ve tutkal da hayvansal kaynaklı ürün içermesi neredeyse %100 ihtimal dahilindedir.

Yapay Et

İneklere dönük eleştirilerin gerçeklerle ne kadar bağdaştığını irdelemek ve tüm ötekileştirme çabalarının bazı mihraklar tarafından sistemli bir şekilde yapılma nedenlerini ortaya çıkarmaktır. İneklere dönük eleştirileri sorguladığımızda, bu eleştirilerin özellikle iki temel mihrak kaynaklı olduğunu görürüz. Birinci grup, ‘’yapay et’’ projesini gündeme getiren küreselcilerdir. İkinci grupta ise hayvansal bazlı beslenmenin yasaklanmasını ve bununla birlikte tamamen bitkisel bazlı beslenmeye geçilmesini savunanları görüyoruz. ‘’Yapay et’’ projesini savunanların, ‘’yapay et’’ üzerine çalışmaların yoğun bir şekilde devam etmesini destekleyenlerin bir görünürdeki amaçları vardır. Bir de esas amaçları vardır ki bu şu an uluorta dile getirilmemektedir.

Yapay Et Projesinde Görünürdeki Amaç

Görünürdeki amaçlarını şu şekilde özetleyebiliriz: Bu grubun sözcülerine göre dünya nüfusu hızla artmaktadır. Hayvansal ürün üretiminde ise ulaşılabilinecek en üst sınırlara zaten ulaşılmış durumdadır. Onlara göre, İNEK’lerin küresel ısınmaya etkileri çok büyüktür. Bitkisel ürünlerin, özellikle tahılların, sahip oldukları protein ve enerjinin tamamının insanlar tarafından tüketilmesi, kaynak kullanım verimliliği açısından daha doğru bir çözümdür. Bu nedenlerden dolayı tüm dünya insanlığı, en kısa zamanda yapay et tüketimine başlayarak hem küresel ısınmanın önüne geçilmesine hem de dünya kaynaklarının (su, toprak, enerji, tahıl vb.), insanlık yararına daha verimli bir kullanımının önünü açmalarına yardımcı olmalıdırlar, diye düşünülmektedir. Bu tez kesinlikle doğru değildir.

Görünürdeki amaç, dünya insanlığının her geçen gün daha fazla yapay et tüketmesini sağlamaktır. Bu amacı desteklemek üzere yapay ete dönük pozitif, doğal ete dönük negatif argümanlar geliştirmişlerdir. Ancak her iki argüman türü de çok büyük yalan ve dezenformasyon içermektedir. Pozitif argümanlar, yapay et tüketiminin sağlayacağı potansiyel

faydalar temelindedir. Onlara göre, yapay et temiz ettir. Yapay etin doğal ete göre, küresel ısınmaya etkisi daha azdır ve dünya kaynaklarının (su, enerji, bitki, tahıl, toprak vb.) kullanımı konusunda da daha verimli bir çözümdür. Bu pozitif argümanların yanında İNEK'lere dönük ve onları ötekileştiren negatif argümanlar da geliştirme ihtiyacı duymuşlardır. Çünkü yapay ete dönük yapılan harcamaların nedenlerini kamuoyuna açıklarken sadece yapay etin faydalarını anlatmak yeterli değildir. Aynı zamanda inekleri ötekileştiren ve onları kötüleyen ve hatta canavarlaştıran bazı argümanlar geliştirilmelidir ki yapay et çalışmalarına daha fazla destek ve taraftar toplanabilsin.

İNEK'lere dönük argümanların neredeyse tamamı, rasyonel temelden uzak, kesinlikle taraflı ve oldukça dezenformasyon temelli bir strateji üzerinde biçimlendirilmeye çalışılmaktadır. Çünkü inekleri ötekileştiren her argüman, yapay ete dönük bir destek demektir. İneklere dönük tüm argümanların tamamıyla dezenformasyon temelli olduğu bu araştırmamızda çok net bir şekilde ispatlandığını söyleyebiliriz.

Yapay Et Üretim Prosesi

Yapay et teknolojisi, özetle, kök hücreden kas hücresinin üretilmesi ve akabinde bir biyoreaktör içerisinde çoğaltılması prensibine dayalıdır. Şimdiye kadar yazılıp çizilenlere bakıldığında yapılmaya çalışılanın sadece biftek üretme, tavuk göğüs eti üretmeye çalışmaktan ibaret olduğu görülebilir. 25 Nisan 2022 tarihine kadarki gelişmeleri dikkate alacak olursak henüz yapay et (kültür eti) için arzu edilen malzeme girdileri geliştirilebilmiş değildir (lea, et. al., 2022). Şimdiye kadar geliştirilen başarılı tek yapı iskeleleri hayvansal temelli olan kolajen ve jalatinlerdir (Seah, et. al., 2022). Hollandalı çevreci araştırma şirketi olan CE Delft'in 2021 yılında yaptığı bir araştırmaya göre yapay et üretiminde muazzam bir enerji tüketimi söz konusu olduğu tespit edilmiştir. Yapay etin çevreye yararlı olabilmesinin tek yolu güneş ya da rüzgar enerjisi kullanmasıyla mümkün (Anonim 7, gazete oksijen, 05.01.2023). Bill Gates, zaten

Kasım 2022'de yaptığı bir açıklamada; ''Yapay et üretiminde çok yüksek miktarda enerji tüketimi var, Bu konuda yanıldık'', demiştir. Kimilerine göre doğal ete göre 25 kat daha fazla enerji tüketimi söz konusudur. ABD'deki Gıda ve Sağlık İnovasyon Enstitüsü'nden Derrick Risner'e göre yapay et doğal ete göre en az 4 ve hatta 25 kat daha fazla karbon emisyonuna neden olacağını tespit edilmiş. Ayrıca denilmektedir ki '' şu ana kadar hayvan hücrelerinin çoğaltabilmesindeki mevcut teknolojiler ve hatta var olan hammaddeler ticari olmaktan çok uzaktır (Anonim 8, indyturk.com, 16 mayıs 2023). Ayrıca bizim araştırmalarımız göstermektedir ki beslenme amaçlı yapay et projesi kesinlikle ekonomik ve rasyonel bir proje değildir, asla doğal etle ticari olarak rekabet edemez. Esas amaçları kesinlikle farklıdır. Beslenme amaçlı yapay et çalışmaları merdivenin sadece ilk basamağıdır. Yapay etin beslenmeye dönük rekabetçi olamayacağının nedenlerini kısaca aşağıdaki açıklamaya çalışacağız:

ABD'de ve İsrail'de yapay et üretim fabrikaları kuruldu. Yatırım tutarlarına bakacak olursak birisi 50 Milyon Dolar diğeri 14 Milyon Dolar. Future meat firmasınca yapılan açıklamalara göre 50 Milyon dolarlık yatırımın yapıldığı tesis, hali hazırda yılda 22 ton yapay et ürettiği ve tam kapasitede ise maksimum 181.4 ton et üretebileceği açıklandı. Tesisin arazi büyüklüğü ise 49000 m2.

Şimdi 181.4 ton üretim için gereken bu 50 Milyon Doların ne kadar ekonomik bir yatırım olduğunu anlamaya çalışalım: Bunun için dünya genelindeki 320 Milyon ton et tüketiminin tamamını ABD'de kurulmuş olan bu tesisin kopyalarını inşa ederek karşılamaya çalıştığımızda inanılmaz büyüklükte finansman ihtiyacının olduğunu görüyoruz! Dünya genelindeki tüm dönüşüm için 105 Trilyon Dolar'lık finansmana ve ayrıca 8.6 Milyon hektar net tesis arazisi ile okul, kreş, enerji üretim tesisleri, atık su, sosyal tesisler, itfaiye vb. yardımcı tesisler için 1.4 Milyon Hektar olmak üzere toplamda en az 10 Milyon hektar araziye ihtiyaç var demektir.

Halbuki 2022 yılında dünya genelinde yapılan tüm yatırımların tutarı sadece 1.8 Trilyon Dolar'dır. Buna karşın sadece yapay et dönüşümü ise 105 Trilyon Dolar'lık devasa bir yatırımı gerektirecektir. Dünya genelinde yapay ete dönüşüm süresi boyunca diğer tüm sektörlerde tek cent yatırım yapmayıp 1.8 Trilyon Doları sadece yapay et dönüşümüne harcayalım kararı alınsa dahi bu dönüşüm için en az 58-60 yıl gerekecektir. Şimdi de bizim ülkemize bakalım; ülkemizde arazi tahsisi yapılmış ve kuruluşu tamamlanmışlar olanlar dahil tüm OSB sayısı Ağustos 2023 tarihi itibariyle 390 adettir. Bu durumda ülkemizdeki yapay et dönüşümü için 1.12 Trilyon Dolar finansmana ihtiyaç var demektir ve ayrıca mevcut 390 adet OSB'nin dışında, sadece yapay et için yeni 227 adet ilave OSB'nin kurulması gerekmektedir. 61 yılda 390 adet OSB'nin ancak kurulabildiği ülkemizde ne bu kadar arazi vardır ne de bu işe ayrılabilecek 1.12 Trilyon Dolar paramız vardır. Akıl var, mantık var.

Şimdi de ABD'de ve İsrail'de kurulan bu yapay et işletmelerini işgücü verimliliği ve yatırım verimliliği açısından aynı ölçek bazındaki modern hayvancılık işletmelerinin biriyle kıyaslama yapalım. Yapmış olduğumuz araştırmaya göre, doğal et üretimi, yatırım verimliliği açısından protein üretimi baz alındığında yapay ete göre 118 kat daha verimlidir. Yine işgücü verimliliği açısından doğal et üretimi yapay ete göre en az 14 kat daha verimlidir. İnek çiftliğinde sağım işinde robot teknolojisi kullanmış olsak işgücü verimliliği en az 20 kat olacaktır. Bu verimlilik rakamlarının aksini söyleyenlerin yaptığı şey sadece kuyruklu yalanlarla dolu tam bir dezenformasyondur. Onların söyledikleri yalanların bilimsel detaylarını hiçbir yerde göremezsiniz. Biz bu çalışmada yapay et tesisi ile hayvan çiftliğini gerçek veriler üzerinden kıyaslamasını yaptık.

Literatür taraması yaptığımızda, çok sayıdaki araştırmacıya göre yapay et üretiminde, teknolojik gelişmeler açısından ihtiyaç duyulan tek sıkıntılı noktanın hücre büyümesinde kullanılan FetalBovine Serum (FBS)'ye ilişkin olduğudur (Kong, et.al., 2022). FBS'nin litre

fiyatı 300-400 Dolar ve 1 kg yapay et için 5-6 litre FBS'ye ihtiyaç olduğu dikkate alınırsa FBS maliyetinin, toplam maliyete etkisinin çok yüksek olduğu ve bu nedenle AR-GE çalışmalarının büyük çoğunluğu FBS' ye ikame ürün alternatifi geliştirmeye dönük olduğunu görüyoruz. Nisan 2023 tarihine kadar birkaç patent başvurusu olmasına ve Londra'da bir firma tesis kurma çalışmasını başlatmasına rağmen patent sahipleri dahi geliştirdikleri bu ikame ürünlerinin FBS' ye henüz ticari olarak alternatif olabileceğini öngöremiyorlar.

Yapay et üretiminde, üzerinde çalışılan bir diğer yöntem ise seçilen bakterilerin genetikleri ile oynanarak bu bakterilere kandaki ''hem'' hücrelerini nakledilmesi prensibine dayalıdır. Ancak bu yöntem GDO temelli bir teknoloji olduğundan ve kanser gelişimini sağlama ihtimalinin çok yüksek olması nedeniyle neredeyse terk edilmiş olan yöntemdir.

Hücre büyüme çözeltisinde, FBS dışında antibiyotikler, amino asitler, karbonhidratlar, inorganik tuzlar, tamponlama sistemleri, hormonlar, enzimler ve vitaminler yer almaktadır. Şu ana kadar ki tüm yapay et üretimi FBS' ye dayalıdır ve 2030 yılına dönük hedef ise dünya et üretiminin en az %10'unu yapay et ile karşılamaktır. Yani en az 32 Milyar kg. yapay et üretimidir. FBS ise 3-4 aylık gebe inek ameliyat edilerek ve karnında henüz gelişimini tamamlamamış buzağının tüm kanı çekilerek elde ediliyor. Sonuçta buzağı dünyaya bile gelemeden anne karnında öldürülmüş oluyor. Serum ise kandan santrifüj yöntemi ile ayrıştırılıyor. Kimine göre 5-6 kg serum elde edebilmek için 14 adet buzağının kullanılması gerekiyor. Ama kesin olan bir şey var, 3-4 aylık bir jenin buzağının kan miktarı ancak 1 kg olabileceği öngörüsünden yola çıkarsak 14 buzağı ölümü, çok yanlış bir tespit gibi görünmüyor. 1 kg serum için 1 adet buzağı düşünsek bile FBS'ye alternatif geliştirilmediği sürece 2030 yılında 32 milyar kg yapay et üretmek için en az 32 Milyar hamile ineğinin ameliyat edilmesi ve en az 32 Milyar buzağının katledilmesi gerekiyor. Dünya genelinde 2023 yılında bir yıl boyunca uygun olarak yaratılabilecek hamile inek sayısı 500 Milyon adeti geçmez. Bu sayı

zaten inek türünün devam edebilmesi için gerekli olan sayıdır. Bir yıl boyunca 32 Milyar adet hamile ineği bulabilmek hayalden öte tamamen imkansızdır. Üstelik 1 kg yapay et üreteceğim derken anne karnındaki cenin buzağıyı öldürerek en az 30-40 kat doğal eti heba ediyorsun. Çünkü yeni doğan buzağının doğum ağırlığı 30-40 kg arasındadır. Bu hedefler için hayal kelimesi dahi çok basit kalır. Aslında gerçekler ise insan beslenmesine dönük gıda açığını kapatmaya çalışmaktan öte başka şeyler olmak zorundadır. Akıl var, mantık var.

Görünen odur ki FBS'nin %100 aynısının sentetik veya bitkisel olarak üretilebilmesi çok zordur. Hele ticari olabilmesi daha zor. Çünkü FBS, embriyonun büyümesi için tüm faktörleri taşıyor: kas, kemik, deri, sinir sistemi vb. hepsinin oluşumu için hayati sıvıdır. Ülkemizden Prof. Dr. Can Akçalı 22 Mart 2022 tarihli bir röportajında bu tarihe kadar tüm geliştirilen ikamelerin henüz ticari olarak FBS'nin yerini almaktan uzak olduğunu ifade etmektedir. Üstelik kendisi FBS' ye ikame ürün geliştirip patentini almış olmasına rağmen kendisinin ve benzer diğerlerinin henüz ticarileşebilmekten uzak olduğunu belirtmektedir. Diyelim ki FBS'ye alternatif geliştirildi: Yaptığımız literatür taramamızda görünen şudur ki hali hazırda mevcut olan biyoreaktör temelli yapay et teknolojisine alternatif başka teknoloji arayışları yoktur. Yani önümüzdeki yakın dönemde ABD'deki kurulan tesisteki biyoreaktör teknolojisinden farklı bir teknoloji arayışı görülmemiştir. Belki tesis kurulum maliyetleri önümüzdeki yıllarda belli bir yüzdesel oranda azaltılabilir. Ama yatırım maliyetlerini 118 kat seviyesinde düşürebilmek ise sadece hayaldir. Zaten yapay et disiplininde yer alan araştırmacılar mikro detaylar içinde boğulduklarından ve bu durumdan ve de almış oldukları muazzam tutarlı dolar hibelerinden son derecede hoşnut olduklarından gördüğümüz kadarıyla herhangi bir kimse 320 Milyon ton yapay et üretimi için ne kadar finansman ihtiyacı meydana gelir noktasında değiller.

Büyüme çözeltisinde FBS kullanmalarına rağmen üretilen yapay ette B12 vitaminin olmaması önemli bir eksikliktir. Demir eksikliği de vardır. Daha önemlisi, yapay ete temiz et demelerine

karşın büyüme çözeltisinde önemli miktarda antibiyotik kullanılmak zorunda kalınıyor. Aksi takdirde hücre kültüründe çok hızlı kontaminasyon meydana gelebilecektir(Lea., et. al., 2023). Derrick Risner'in analizinde ifade edildiği gibi yapay et üretiminde enerji maliyetinin çok yüksek olduğu ve bunun için yenilenebilir enerji kaynaklarının kullanılması gerektiğinden söz ediliyor. Halbuki modern bir hayvan çiftliği kapalı alanının çatısının üçte birinde kurulan bir GES ile tüm enerji ihtiyacı fazlasıyla karşılanabilmektedir. Bu ispatlı bir iddiadır.

Bütün bunlara rağmen yapay et üzerine araştırmalar tam gaz devam etmektedir. 2021 yılına kadar yapay et araştırmalarına yapılan yatırım 3.1 Milyar Dolar olmuş. Birazcık maliyet muhasebesinden anlayan birinin yapay etin beslenme amacına dönük olarak en azından önümüzdeki 5-10 yıllık dönemde ticarileşemeyeceğini görür. Ancak yapay et teknolojisi çok daha ileri noktalara taşınırsa ve de kişiye özel bir insan organı (kalp, akciğer, pankreas vb.) üretilebilirse insan yaşlanmasını durdurabilmek mümkün olabilir. Yapay zeka ve robot teknolojisindeki gelişmelerin yanında yapay et teknolojisinde gelinebilecek nihai noktada, insansı robotların üretimi mümkün olabilir ve bu durumda insansı robotların ve de insan organlarının ürün satış fiyatının, kg. bazında milyon dolarlar etmesi ise kuvvetle muhtemel olacaktır.

Yapay Et Projesinde Gerçek Amaç

Esas amaçları ise yapay et teknolojisi üzerine yapılan çalışmaların başka teknolojik gelişmelerin önünü açacak olmasıyla ilişkilidir. Son yıllarda yapay zeka ve robot teknolojileri üzerinde oldukça mesafe kazanıldı. Bu iki çalışmayı tamamlayacak üçüncü öğe ise yapay ettir. Geleceğin robotunun insansı olması istenmektedir. Ayrıca yapay et teknolojisi, kişiye özgü organ geliştirme teknolojisinin de önünü açacaktır, diye düşünmektedirler.

İnsansı robotların geliştirilmesi ve insan yaşlanmasını geciktirici yapay et temelli insan organlarının geliştirilmesi hedefleri tek başlarına bir ölçüde masumane görünebilir. Örneğin,

kanserli akciğerler yerine yapay et teknolojisi sonucunda kişiye özel geliştirilen 18 yaş tazeliğindeki akciğerlere herkes sahip olmak isteyecektir. Ancak patenti ve de üretim haklarını elinde tutanlar fiyatı belirleme hakkına da sahiptir. Çok yüksek olabilecek ürün fiyatları sonucunda bu operasyona sahip olma hakkının otomatikman sadece çok küçük bir elit zümreyle sınırlı kalabilmesi de kuvvetle muhtemeldir. Diğer taraftan insansı robotların, tüm işgücünün yerini almaya başlamasıyla milyonlarca insan da işsiz kalmaya başlayacaktır.

SONUÇ

İnsanlık kendi beslenme sürecinde devasa miktarda çevresel atık meydana getirmektedir. Örneğin, buğdayı, şekeri, pamuğu, soya dahil çok çok sayıda bitkisel ürünü insanlar tüketir, ama bunların çevresel atıklarını İNEK'ler, açık ifadeyle, tüm ruminantlar, tavuklar ve evcil domuzlar tüketir. İNEK'ler yıllık yaklaşık 3475 Milyon ton çevresel atığı tüketerek yine yaklaşık 7.9 Milyar ton CO2 gazının emisyonunu önlemektedir. Yine bizim hesaplamalarınıza göre en az yıllık 155 Milyon ton hayvansal ürün onbinlerce endüstriyel ürünün üretiminde ya ürün bileşeni ya da yardımcı malzeme olarak yer almaktadır. Bu nedenledir ki İNEK'lerin olmadığı bir dünyada sadece gıda fiyatları değil onbinlerce sanayi ürünün fiyatı da önemli ölçüde artacaktır. Bizim araştırmamıza göre yapay et kesinlikle doğal ete alternatif olamaz. Çünkü yatırım verimliliğinde 118 kat, işgücü verimliliğinde en az 14-20 kat daha düşüktür, üretim maliyetlerinde ise en az 30 kat daha yüksketir. Yapay et araştırmalarının iki temel amacı vardır: Birincisi; insan yedek parçalarını üretebilmektir. İkincisi insansı robotları mümkün kılmaktır.

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ÇİNKO OKSİT (ZnO) NANOPARTİKÜLLERİN ANTİFUNGAL AKTİVİTESİ

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ÖZET

Son dönemde nanopartiküller (NP) birçok alanda sıklıkla kullanılmaktadır. Nanopartiküllerin biyolojik yöntemle üretimi, toksik olmayan stabilizer ve indirgeyici ajanlar kullanıldığı için son zamanlarda dikkat çekmektedir. Biyolojik sentez yaklaşımı; çevre dostu, uygun maliyetli ve sürdürülebilir bir yöntem olduğu için, fiziksel ve kimyasal yöntemlere kıyasla pek çok avantajlara sahiptir. Biyolojik yöntemde toksik kimyasallar yerine doğal hammaddeler (bitki ekstraktı, bakteriler, algler, mantarlar gibi) kullanılması bu endişeleri giderebilmek adına önem arzetmektedir. Doğal hammaddeler içerisinde sıklıkla bitki yaprakları, kök, meyve ve çiçekler kullanılarak farklı boyut ve şekillerde NP'ler üretilebilmektedir. NP'lerin bitki patojeni mantarları kontrol etmek için uygulanabilir bir tarımsal ürün olarak toprak ve bitkiler üzerindeki potansiyel etkilerinin araştırıcılar tarafından artan bir ilgiyle çalışılması devam etmektedir. Birçok çalışmada ZnO nanopartiküllerinin iyi bir antifungal ajan olarak hareket edebildiği bildirilmiştir. ZnO-NP'ler, düşük maliyetli, kanıtlanmış antimikrobiyal ve antifungal aktiviteye sahip olmasının yanında tarımda önemli bir mikro besin maddesi olmaları nedeniyle diğer NP'lere göre önemli avantajlara sahiptirler. ZnO-NP'lerin etkileri bitkiden bitkiye farklılık göstermekte olup ZnO-NP'lerin boyutu ve konsantrasyonunun yanı sıra uygulama yöntemine de bağlıdır. ZnO-NP'lerin antifungal etki mekanizması, hücre zarının bozulması, proteinlere ve DNA'ya bağlanma, reaktif oksijen türlerinin (ROS) üretilmesi, DNA amplifikasyon süreçlerinin bozulması ve çok çeşitli genlerde ekspresyonun değiştirilmesi vb. yollarıyla açıklanmaktadır. Patojen mantarların çevreye yayılmasında önemli olan mantar sporu çimlenmesini ve mantar misellerinin büyümesini engelleme potansiyelleri bulunmaktadır. Bu özelliklerinden dolayı tarımda patojenlerin büyümesini kontrol etmek veya önlemek ve mahsul verimliliğini artırmak için umut verici bir ajanlar olarak yüksek bir potansiyele sahiptir. Bununla birlikte, bitki

gelişimi, büyüme ve uzun vadeli toksisite üzerindeki etkilerine ilişkin araştırmaların sürdürülmesi gerekmektedir.

Keywords: Nanopartiküller, çinko oksit nanopartiküller, bitki patojeni funguslar, antifungal aktivite

ANTIFUNGAL ACTIVITY OF ZINC OXIDE (ZnO) NANOPARTICLES

ABSTRACT

Recently, nanoparticles (NPs) are frequently used in a wide range of research fields including food, medicine, agriculture, energy and material sciences. Biological production of nanoparticles has attracted attention due to the use of non-toxic stabilizers and reducing agents. The biological synthesis approach has many advantages over physical and chemical methods as it is environmentally friendly, cost-effective and sustainable. The use of natural raw materials (such as plant extracts, bacteria, algae, fungi) instead of toxic chemicals in the biological method is important to address these concerns. Among natural raw materials, plant leaves, roots, fruits and flowers are often used to produce NPs of different sizes and shapes. The potential effects of NPs on soil and plants as a viable agricultural product to control plant pathogenic fungi continues to be studied with increasing interest by researchers. Many studies have reported that ZnO nanoparticles can act as a good antifungal agent. ZnO-NPs have significant advantages over other NPs due to their low cost, proven antimicrobial and antifungal activity, as well as being an important micronutrient in agriculture. The effects of ZnO-NPs vary from plant to plant and depend on the size and concentration of ZnO-NPs as well as the application method. The mechanism of antifungal action of ZnO-NPs is explained by disruption of the cell membrane, binding to proteins and nucleic acids, generation of reactive oxygen species (ROS), disruption of DNA amplification processes and alteration of expression in a wide range of genes. They have the potential to inhibit fungal spore germination and the growth of fungal mycelia, which are important for the spread of pathogenic fungi in the environment. Due to these properties, they have a high potential as promising agents to control or prevent the growth of pathogens in agriculture and increase crop productivity. However, research on their effects on plant development, growth and long-term toxicity needs to be continued.

Keywords: Nanoparticles, Zinc oxide nanoparticles, plant pathogenic fungi, antifungal activity

GİRİŞ

Bitkiler, dünyanın her yerinde insanlar için başlıca besin kaynağı olup insan varlığı ve hayatta kalması için gerekli besinlerdir. İnsanlar dışında, çok çeşitli organizmalar ve mikroorganizmalar da bitkileri besin ve barınak kaynağı olarak kullanmaktadır. Bu süreçte, bu organizmalardan bazıları konukçularında hastalıklara neden olarak verimin düşmesine ve ağır ekonomik kayıplara yol açmaktadır. Ekonomik açıdan önemli patojenlerin neden olduğu bitki hastalıkları, bitkilerin hem insan hem de hayvan tüketimi için kullanılabilirliğini ve güvenliğini etkilemektedir (Pandey vd., 2018). Patojenlerin neden olduğu ortalama bitki hastalıkları, doğrudan veya dolaylı olarak yıllık mahsul verim kayıplarının % 20-40'ından sorumludur ve bu da küresel olarak 40 milyar dolara karşılık gelmektedir (Ab Rahman vd., 2018; Choudhury vd., 2018; Lima vd., 2019). Sürekli artan küresel nüfusa ek olarak, ürün kalitesi ve pazarlanabilirliğindeki dolaylı kayıplar, küresel gıda güvenliğinin sağlanmasının önündeki zorlu engeller olarak kabul edilmektedir (Fang ve Ramasamy, 2015). Günümüz tarımının karşı karşıya olduğu en büyük bitki hastalıklarından bazılarını en aza indirmek veya iyileştirmek için etkili ve daha sürdürülebilir çözümlerin geliştirilmesine olanak sağlayacaktır (Fang ve Ramasamy, 2015; Choudhury vd., 2018). Bu sorunu ele almak için kimyasalların (pestisitler, herbisitler ve insektisitler) ve biyolojik kontrol yöntemlerinin kullanımı gibi çeşitli yönetim stratejileri kullanılmıştır.

Fungal hastalıkların önemli verim kayıplarına neden olduğu bildirilmiştir (Grover ve Gowthaman, 2003). Son raporlara göre, dünyanın en önemli beş ürünü olan pirinç, buğday, mısır, patates ve soya fasulyesinin her yıl yaklaşık 125 milyon tonu mantar enfeksiyonları nedeniyle yok olmakta ve bu durum gıda güvenliği için en büyük tehditlerden biri haline

gelmektedir. Ekonomik ve verim kayıpları hariç tutulsa bile, *Penicillium*, *Fusarium* ve *Alternaria* gibi fungal patojenler, enfekte olmuş materyale salınan mikotoksinler yoluyla ciddi sağlık riskleri oluşturabilmektedir (Liu vd., 2013). Geniş spektrumlu fungisitler ve toprak fumigasyon biyositleri şu anda mantar enfeksiyonunu kontrol etmek ve mücadele etmek için kullanılmaktadır. Ancak, sürekli kullanımlarıyla birlikte, fungal patojenlerin fungisitlere karşı giderek daha dirençli hale geldiği fungisit direnci sorunu ortaya çıkmaktadır (Leroch vd., 2011). Bu nedenle, bu yaygın fungisitlere alternatifler bulunmasına ihtiyaç duyulmaktadır.

Nanoteknoloji, nano ölçekte yeni malzemelerin üretilmesiyle ilgilenen ve hızla gelişen bir alandır. Nanoteknoloji nano boyuttaki maddeleri sentezlemeyi ve karakterize etmeyi amaçlamaktadır. Boyutları 1-100 nm arasında değişen nano ölçekte malzemelerin kullanımını içerir (Sun vd., 2018; Kumari vd., 2020). 21. yüzyılda nanoteknoloji disiplinler arası bir alan olarak gelişmiştir. Metal nanopartiküllerin biyosentezi buna bir örnektir. Biyosentetik nanoteknoloji gıda ve yem, sağlık hizmetleri, biyomedikal bilimi, kozmetik, kimya endüstrileri, ilaç ve gen dağıtımı, enerji bilimi, elektronik, mekanik ve uzay endüstrileri alanlarında çok çeşitli uygulamalara sahiptir. Malzeme boyutunun küçültülmesi, çok çeşitli yeni fizikokimyasal özellikler ve malzeme bilimi ve biyomedikal uygulamalar gibi geniş bir potansiyel uygulama yelpazesi elde edilmesiyle sonuçlanır (Sivasankarapillai vd., 2019). Nanoteknoloji, kontrollü ilaç dağıtımını iyileştirme, aktif bileşenlerin kontrollü salınımı ve daha düşük dozlarda aktiviteyi iyileştirme gibi benzersiz özellikleri nedeniyle fungisitler ve pestisitler gibi sentetik antimikrobiyallere daha çevre dostu bir alternatif sunmaktadır. Ayrıca, yavaş ve kontrollü salınımları, hem yeraltı hem de yüzey sularının kirlenmesine neden olmamalarını sağlar (Malandrakis vd., 2019; Ajilogba vd., 2021).

Nanopartikülleri sentezlemek için yıllar boyunca kimyasal, fiziksel ve biyolojik veya yeşil sentez gibi farklı yaklaşımlar kullanılmıştır (Khandel vd., 2018). Bu sentez yöntemlerinden yeşil sentez yöntemi, maliyet etkinliği, zaman tasarrufu, daha az veya toksik olmayan malzeme ve atık kullanımı ve yöntemin çevre dostu olması gibi çeşitli nedenlerden dolayı yıllar içinde diğer sentez yöntemlerine tercih edilmiştir. Nanopartiküllerin yeşil sentezi, bitkiler, bakteriler, mantarlar ve algler gibi biyolojik materyallerin özütlerinin kullanılmasını içermektedir (Akintelu vd., 2019).

Nanopartikül biyosentezinin özelliklerinden biri, gelişmiş stabilite ile kullanılan biyolojik kaynağa göre oluşan nanopartiküllerin farklı morfolojisinin seçilebilirliğidir. Nanopartikülleri sentezlemek için gümüş, çinko, bakır, altın ve demirin farklı metalik tuzları kullanılmış ve *in vitro* olarak antifungal aktivitesi birçok bitkide gösterilmiştir (Ajilogba vd., 2021). Çinko (Zn), bu metal iyonları arasında daha az toksiktir ve Zn, bitkilerin hastalığa neden olan patojenlere karşı savunmasında önemli bir rol oynar (Kinraide vd., 2011; Cabot vd., 2019). Çinko oksit nanopartikülleri (ZnO-NP'ler), akıllı UV sensörleri, hedefli ilaç dağıtımı, antioksidan aktivite, biyosensörler, çevresel iyileştirme ve hatta kuraklığa toleransı artıran ajan ve mahsullerin besin kaynağı gibi geniş uygulama alanı nedeniyle ilgi çekmektedir (Singh vd., 2018; Sosna-Głebska vd., 2019; Fahimmunisha vd., 2020). Bu çalışma çinko oksit nanopartiküllerin (ZnO-NP'ler) kullanımını ve antifungal aktivite mekanizmalarını vurgulamayı amaçlamaktadır.

ÇİNKO OKSİT NANOPARTİKÜLLER

ZnO-NP'lerin toprak verimliliğini, bitki üretkenliğini ve çinko kullanılabilirliğini iyileştirmede yararlı olduğu bildirilmiştir (Rossi vd., 2019; Esper-Neto vd., 2020). ABD Gıda ve İlaç Dairesi,

diğer dört çinko bileşiğiyle birlikte ZnO'yu genel olarak güvenli (GRAS) ürün olarak sınıflandırmıştır (FDA Food ve İlaç İdaresi, 2015). Dünya çapında çeşitli uygulamalar için her yıl yaklaşık 550 ton ZnO-NP üretilmektedir (Bondarenko vd., 2013). ZnO-NP'lerin sentezi için bildirilen çeşitli çevre dostu yaklaşımlar (ultrasonik destekli sentez, mikrodalga destekli sentez vb.) bulunmaktadır (Bayrami vd., 2019). ZnO-NP'lerin sentezlenmesi ucuz, güvenli ve kolaydır. En büyük avantaj, biyosentezlenmiş nanopartiküllerin biyomedikal amaçlar için veya doğrudan canlı sistemlerde potansiyel uygulamasıdır. Bunun nedeni, fizikokimyasal yöntemlerle hazırlananlara kıyasla bu nanopartiküllerle ilişkili toksisite seviyesinin azalmasıdır. Diğer avantajlar, sentez prosedüründe kullanılan biyo-bileşenlerin stabilize edici etkileri ve nanopartiküllerin yüzey modifikasyonu ile korona oluşumu olabilir, bu da onları canlı sistemlerde daha uygun hale getirir (Singh vd., 2016).

Bitki aracılı sentez, fizibilite, kolayca bulunabilen bitkilerin kullanımı ve ZnO-NP'lerin çok çeşitli morfolojileri (kullanılan bitki özüne bağlı olarak) gibi bazı özellikler nedeniyle cazip hale gelmiştir (Agarwal vd., 2017). Ayrıca tarımda, ZnO-NP'ler *Alternaria alternata, Candida albicans, Monilinia fructicola, Botrytis cinerea, Fusarium solani, Colletotrichum gloeosporioides, Fusarium oxysporum, Verticillium dahliae* gibi çeşitli bitki patojenlerini kontrol etmek için kullanılmıştır (Khalil vd., 2020; Malandrakis vd., 2021; Malandrakis vd., 2022). Yedukar vd. (2016) *Ixora coccinea*'nın yaprak özütünü kullanarak ZnO nanopartikülleri (80-130 nm) sentezlemişlerdir. Lingaraju vd. (2016), *Ruta graveolens'*in sulu kök ekstraktından sentezlenen çinko oksit nanopartiküllerinin antibakteriyel ve antioksidan aktivitelerini rapor etmişlerdir. Ayrıca, Bala vd. (2014), *Hibiscus subdariffa* yaprak özütü kullanarak sıcaklığın ZnO-NP'lerin sentezindeki etkisinin antibakteriyel aktivitesi ve anti-diyabetik aktivitesi üzerindeki etkisini rapor etmişlerdir. Santhoshkumar vd. (2017), *Passiflora caerulea* yaprak

ekstresi kullanarak çevre dostu ve basit bir yöntemle ZnO-NP'leri sentezlemiş ve idrar yolu enfeksiyonuna neden olan mikroorganizmalara karşı iyi aktivite gösterdiğini bildirmişlerdir. Nanopartikül sentezi ve biyo-uygulamalarının araştırılması ile ilgili önceki çalışmalara dayanarak, farklı bitkilerle (*Cinnamomum tamala, Beta vulgaris, Brassica oleracea* var. *Italica, Cinnamomum verum*) ZnO-NP'lerin sentezlendiği bir çalışmada *Escherichia coli* (Gram-negatif) ve *Staphylococcus aureus* (Gram pozitif) ile bakteriyel ve *Candida albicans* ve *Aspergillus niger*'e karşı antifungal aktivite test edilmiştir (Pillai vd., 2020).

Birkaç araştırma, ZnO-NP'lerin hastalığa neden olan mikroorganizmalara karşı aktivitesinin partikül boyutlarının azalmasıyla arttığını öne sürmüştür (Rai, 2013). ZnO-NP'lerin çoklu ilaca dirençli bitki patojenleriyle mücadelede etkili olduğu da bildirilmiştir (Khalil vd., 2020). Bu nedenle, ZnO-NP üretimi, sayısız avantajı ve farklı alanlardaki geniş uygulamaları nedeniyle diğer metal içeren nanopartiküller arasında yalnızca silika ve titanyumdioksitlerin ardından üçüncü sırada yer almaktadır (Manoharan vd., 2015). Diğer metal oksitlerle karşılaştırıldığında, ZnO'nun daha kararlı ve güvenli olduğu düşünülmektedir (Kim vd., 2020).

ÇİNKO OKSİT NANOPARTİKÜLLERİN ANTİFUNGAL ETKİ MEKANİZMALARI

Birçok çalışma ZnO gibi inorganik nanopartiküllerin iyi antifungal ajanlar olarak hareket edebildiğini bildirmiştir (Dimkpa vd., 2013; Li vd., 2017). Örneğin, 500 µg/mL'nin hem maş fasulyesi suyu agarında hem de kumda bitki patojeni bir fungus olan *Fusarium graminearum*'un büyümesini baskıladığı bildirilmiştir (Dimkpa vd., 2013). Ayrıca ≥244 µg/mL ZnO nanopartiküllerinin hasat sonrası zararlı iki mantar olan *Botrytis cinerea* ve *Penicillium expansum*'un büyümesini *B. cinerea*'da misel deformasyonu yoluyla, *P. expansum*'da ise

konidiofor ve konidi oluşumunu engelleyerek inhibe ettiği bildirilmiştir (He vd., 2011). ZnO nanopartiküllerinin antifungal aktiviteleri üzerine çok sayıda yayın olmasına rağmen, etki şekilleri üzerine çalışmalar ve inhibisyona neden olan altta yatan moleküler süreçlere yönelik mekanistik araştırmalar hala az sayıdadır.

Çinko oksit nanopartiküllerinin antifungal etki mekanizması hücre zarının bozulması, proteinlere ve DNA'ya bağlanma, reaktif oksijen türlerinin oluşumu, bakteriyel DNA amplifikasyon süreçlerinin bozulması ve çok çeşitli genlerde ekspresyonun değiştirilmesi gibi yollardan biriyle açıklanabilmektedir (Gudkov vd., 2021; Dhiman vd., 2022). Antifungal molekülün bir mantar hücresi ile ilk etkileşim bölgesi hücre duvarıdır. Mantar hücre duvarının mekanik sağlamlığı, onu çeşitli biyotik ve abiyotik tehditlere karşı korunmada kritik bir yapı haline getirir (Gow vd., 2017). Yapılan bir çalışmada mantarların hücre duvarındaki morfolojik değişiklikleri incelemek için *Alternaria brassicae* 200 ppm ZnO nanopartikülleri ile muamele edilmiştir. Taramalı elektron mikroskobu sonuçlarına göre 200 ppm ZnO nanopartikülleri ile muamele edilen *A. brassicae*'nin deforme olmuş, düzensiz fungal hif ve sporlara sahip olduğu gösterilmiştir. Düzensiz, çarpık hifler ve mantar sporlarının yokluğu, hücre içi bileşenlerin salınımını ve hif büzülmesini teşvik edebilen hiflerin hücre duvarında ciddi hasar olduğunu göstermektedir. Çalışma, ZnO nanopartiküllerinin mantar hücre duvarı ile doğrudan fiziksel temas yoluyla hücre duvarı ve plazmalemma üzerinde yaralanmalara neden olarak *A. brassicae*'nin büyümesini engellediği sonucuna varmıştır (Dhiman vd., 2022). Ayrıca, filamentli mantarlarda stres tepkilerinden ve hücrelerde NP alımından sorumlu genler de rapor edilmiştir. Li vd. (2017), ZnO nanopartiküllerinin antifungal mekanizmalarının reaktif oksijen türleri (ROS) oluşumuna bağlı olduğunu bildirmiştir. Bununla birlikte, nanopartiküller

tarafından ROS üretiminin altında yatan moleküler mekanizmaya ilişkin bilgiler hala yetersizdir.

Bir başka çalışmada mantarların ZnO nanopartiküllerine maruz kalmasının, muhtemelen mitokondrinin membran potansiyelindeki değişiklikler ve mitokondri manganez tipi süperoksit dismutazı kodlayan SOD2 gibi antioksidan enzimlerin ekspresyonu yoluyla mitokondri işlevini değiştiren oksidatif hasara yol açtığını bildirmiştir (Wang vd., 2014). Sun vd. (2018) tarafından ZnO-NP'lerle muamele edilen misel hücrelerindeki gen ekspresyon seviyelerinin yüksek verimli transkriptom dizilimi üzerine yapılan bir çalışmada, *Aspergillus flavus*, oksidatif stres, çinko iyonu bağlama, transmembran taşıma ve oksidatif fosforilasyon süreçlerinde yer alanlar da dahil olmak üzere ZnO-NP'lere maruz kaldıktan sonra gen ifadelerinde çeşitli derecelerde değişiklikler göstermiştir.

SONUÇ

Nanoteknoloji alanındaki son gelişmeler, özellikle de herhangi bir boyut ve şekilde metal oksit NP'lerin hazırlanabilmesi, yeni antifungal ajanların geliştirilmesine yol açmıştır. NP'lerin kullanımı, mantar hastalıkları için yeni bir umut verici yaklaşım olarak önerilmektedir, çünkü bu yöntem, antifungal ilaçlara karşı patojen direnci ile sınırlı değildir. Nanopartiküllerin antifungal mekanizmaları, çinko iyonu (Zn^{2+}) üretimine, reaktif oksijen türlerinin (ROS) oluşumuna ve bu mikroorganizmalarda hayati biyokimyasal süreçlerin değişmesine ve sonuçta yaşam süreçlerini değiştirmesine bağlanmaktadır. ZnO-NP'lerin tarımda birçok kullanılabilir uygulaması vardır ve bu da toprak, bitkiler ve gıda üzerinde çok çeşitli potansiyel etkilere yol açar. ZnO NP'ler toprağa girdiğinde, toprağın özelliği değişir ve topraktan etkilenir. ZnO

NP'leri etkileyen toprak özellikleri pH, organik madde, elektriksel iletkenlik, katyon değişim kapasitesi, iyonik güç gibi fizyokimyasal ya da bitki kökü ve mikrobiyal eksudatlar gibi biyolojik etkenler olabilir. Toprak özellikleri, ZnO-NP'lerin topraktaki dağılımını, kümelenmesini, stabilitesini, immobilizasyonunu, biyoyararlanımını ve taşınımını etkilemekte, dolayısıyla çeşitli bitki türlerine karşı fitotoksisitelerini etkilemektedir. ZnO-NP'lerin bitki büyümesini ve gelişimini destekleyen benzersiz özelliklerine rağmen, ZnO-NP'lerin bitkiler ve toprak mikroorganizmaları üzerindeki toksikolojik etkileri üzerine yapılan araştırmalar sınırlıdır. Biyolojik materyaller kullanılarak sentezlenen NP'ler, biyojenik yüzey aktif maddeler ile kaplama işlemi nedeniyle daha kararlı ve biyouyumludur ve ayrıca bu sürece toksik kimyasallar dahil olmadığından çevreye daha az zararlı etki gösterirler.

ZnO-NP'lerin etkileri bitkiden bitkiye farklılık göstermekte olup ZnO-NP'lerin boyutu ve konsantrasyonunun yanı sıra uygulama yöntemine de bağlıdır. Özellikle üretim süreci, konsantrasyonlar, maruz kalma süresi, pH ve biyouyumluluk ZnO-NP antibakteriyel aktivitesi üzerinde etkilidir. Topraktaki bitki-ZnO NP etkileşimlerini etkileyen toprak bileşenlerini anlamak ve ZnO-NP toksisitesini belirlemek için daha fazla çalışmaya ihtiyaç duyulmaktadır. Ayrıca, ZnO-NP'lerin bitkisel üretim ve gıda zinciri üzerindeki biyolojik etkilerini değerlendirmek, bitkilerin fizyolojik, biyokimyasal ve moleküler mekanizmalarını ve ZnO-NP etkilerine yanıt olarak antibakteriyel aktivitenin yanı sıra bitkilerdeki gen ekspresyonu düzenlemesi üzerindeki etkilerini anlamak için de daha fazla araştırmaya ihtiyaç vardır. Bilimsel araştırmalar ve gelecekteki incelemeler, ZnO-NP kullanımının olumsuz etkilerini ve ilgili etkileri azaltmak için önerilerde bulunacaktır. Morfoloji, ölçek, fonksiyonel gruplar ve aktif adsorpsiyon/yükleme kabiliyeti gibi nanopartiküllerin yapısal özelliklerinin detaylı bir

şekilde anlaşılması, uygun nanopartiküllerin rasyonel seçimi için bir başlangıç noktası olarak faydalı bir rehber sağlayabilir.

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KENEVİRDE YETİŞTİRİCİLİĞİNDE EKONOMİK ÖNEME SAHİP FUNGAL HASTALIK ETMENLERİ

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ÖZET

Cannabinaceae familyasının bir üyesi olan kenevir (*Cannabis sativa*), lif ve ilaç ham maddesi elde etmek için yetiştirilen tek yıllık, otsu, dioik, çiçekli bir bitkidir. Kenevir, dünyanın birçok ülkesinde lif ve yağ kaynağı olarak kullanılmasının yanı sıra tekstil ve kâğıt endüstrisinde, inşaat malzemelerinin oluşturulmasında, otomotiv, enerji, kozmetik, ilaç ve kimya endüstrilerinde kullanılır. Son yıllarda, kenevir ekim alanındaki artış ile kenevirin birçok endüstriyel faaliyetlerde kullanılabilirliği, kenevir yetiştiriciliğinde hem verimin hem de kalitenin düşmesine neden olan biyotik ve abiyotik stres faktörlerinin sınırlayıcı etkilerini, en düşük düzeyde tutulması gerekliliğini ortaya koymaktadır. Dünya genelinde kenevir üretimini sınırlayan en önemli biyotik stres faktörlerinden biri olan fungal patojenler, kenevir bitkilerinin farklı vejetasyon evrelerinde, çökerten, kök ve kök boğaz çürüklüğü, yanıklık ve yaprak leke hastalıklarına neden olmaktadır. Literatür 400'den fazla fungal taksonun kenevirde hastalıklara neden olduğunu bildirirken, dünya genelinde her yıl en az 88 farklı fungal patojen kenevir bitkisini hastalandırdığı bilinmektedir. Kenevirde hastalığa neden olan fungal etmenlerden *Botrytis cinerea* çiçek ve gövde yanıklığa, *Sclerotinia sclerotiorum* ve *Sclerotinia minör* kenevir gövde kanserine ve *P. aphanidermatum*, *P. ultimum*, *Rhizoctonia solani*, *Macrophomina phaseolina*, *Fusarium solani*, *F. oxysporum*, *F. sulphurem*, *F. avenaceum* ve *F. graminearum* çökertenin yanı sıra kök ve kökboğaz çürüklük hastalığına neden olmaktadırlar. Kenevir yetiştiriciliğinde en yaygın olarak görülen yaprak leke hastalıklarından ilki *Septoria cannabis*

ve *S. neocannabina* ve *Cercospora* spp. neden olduğu sarı yaprak leke hastalığı iken, diğeri *Phoma* spp., *Ascochyta* spp. ve *Bipolaris* sp. neden olduğu kahverengi yaprak leke hastalığıdır. Bu derleme kapsamında; kenevirde önemli fungal hastalık etmenlerinin biyolojisi ve epidemiyolojisi yer almaktadır.

Anahtar kelimeler: *Botrytis cinerea, Cannabis sativa, Cercospora* spp., *Fusarium* spp., *Sclerotinia* spp., *Septoria* spp.

SIGNIFICANT FUNGAL PATHOGENS IMPACTING THE ECONOMIC VIABILITY OF HEMP CULTIVATION

ABSTRACT

Hemp (*Cannabis sativa*), a member of the Cannabinaceae family, is an annual, herbaceous, dioecious, flowering plant grown for fiber and pharmaceutical raw materials. Hemp is used as a source of fiber and oil in many countries around the world, as well as in the textile and paper industry, in the creation of construction materials, in the automotive, energy, cosmetic, pharmaceutical and chemical industries. In recent years, the increase in hemp cultivation area and the use of hemp in many industrial activities reveal the necessity to minimize the limiting effects of biotic and abiotic stress factors that cause both yield and quality in hemp cultivation. Fungal pathogens, one of the most important biotic stress factors limiting hemp production worldwide, cause canker, root and root collar rot, blight and leaf spot diseases in different vegetation stages of hemp plants. While the literature reports that more than 400 fungal taxa cause diseases in hemp, at least 88 different fungal pathogens are known to infect hemp plants worldwide every year. Among the fungal pathogens causing disease in cannabis, *Botrytis cinerea* causes flower and stem blight, *Sclerotinia sclerotiorum* and *Sclerotinia minor* cause hemp stem cancer, and *Pythium aphanidermatum, P. ultimum, Rhizoctonia solani, Macrophomina phaseolina, Fusarium solani, F. oxysporum, F. sulphurem, F. avenaceum* and *F. graminearum*, as well as root and root collar rot disease. Moreover, one of the most common leaf spot diseases in hemp cultivation is yellow leaf spot disease caused by *Septoria cannabis* and *S. neocannabina* and *Cercospora* spp. while the other is brown leaf spot disease caused by *Phoma* spp., *Ascochyta* spp. and *Bipolaris* spp. This review covers the biology and epidemiology of economical important fungal disease agents on hemp.

Keywords: *Botrytis cinerea, Cannabis sativa, Cercospora* spp., *Fusarium* spp., *Pythium* spp., *Sclerotinia* spp., *Septoria* spp.

1. GİRİŞ

Kenevirde hastalıklara biyotik veya abiyotik faktörler neden olmaktadır (Punja ve Rodriguez, 2018). Biyotik hastalık faktörleri arasında mantarlar, bakteriler, virüsler ve parazit bitkiler bulunur (McPartland, 1996; Şevik, 2020). Abiyotik nedenler arasında besin eksiklikleri, çevre kirleticiler ve genetik hastalıklar yer almaktadır. Endüstride ilaç ve lif amaçlı yetiştirilen kenevir çeşitlerinde hastalığa neden olan patojenler farklılık gösterebilir (Punja, 2018). Kenevir hastalıklarının yaygınlığı coğrafya ve iklime bağlı olarak değişir. Kuraklık, uygun olmayan sıcaklık ve monokültür tarım gibi çevresel stres faktörlerden etkilenmiş kenevir bitkileri hastalıklara daha yatkın hale gelmektedir (McPartland ve ark., 2000). Kenevirde 100'den fazla patojen hastalığa neden olur. Ancak bu patojenlerin bir düzineden azı, şiddetli hastalıklara sebep olmaktadır. Önemli hastalıklar arasında gri küf, yanıklık, kök çürüklüğü, solgunluk, yaprak lekeleri, makro ve mikro besin element noksanlıkları ve genetik hastalıklar bulunur (McPartland ve ark., 2000).

Kenevir birçok hastalığa yakalanmaktadır. Agrios (1997), lif ürünlerin %11'inin hastalıklara bağlı olarak kaybedildiğini bildirmiştir. Kenevirde hastalıklara genelde mantarlar neden olur ve bunu bakteriler takip eder. Virüs hastalıkları, böcek vektörlerine bağlı bir yaygınlık gösterdiklerinden dolayı, nadir olarak görülür (Schmidt ve Karl, 1970; Şevik, 2020) Kenevir hastalıklarının yaygınlığı örtü altı ve tarla koşullarında yetiştirilen bitkiler arasında değişmektedir. Ayrıca, kenevir bitkisinin farklı vejetasyon evrelerinde farklı hastalık yaygınlıkları görülebilir (Punja, 2018).

Son zamanlarda birkaç kenevir hastalıkları listesi derlenmiştir (McPartland, 1996; McPartland ve ark., 2000; Şevik, 2020), McPartland, (1996) taksonomiksel bölümler altında ve şiddet derecesi dikkate alınarak kenevirde görülen hastalıkları rapor etmiştir. McPartland vd. (2000) ilaç ya da lif amaçlı üretilen kenevir çeşitlerinde görülen hastalıkların ayrıntılı olarak

yer aldığı bir kitap yayınlamıştırlar. Bu kitapta hastalıkların yaşam döngülerinin yanı sıra mücadele yöntemleri hakkında da bilgi sunulmaktadır. Şevik (2020), kenevir bitkilerini olumsuz etkileyen önemli hastalıklar, belirtileri, bulaşma ve yayılma yolları ve mücadele yöntemleri kısaca özetlemiştir.

Bu bölümde kenevirde ekonomik zarara neden olan fungal hastalıklar ekonomik önemlerine göre sıralanmıştır. Bu bölüm, dünyada ve ülkemizdeki araştırma yayınlarından, referans metinlerinden elde edilen fungal hastalıklar hakkında bilgiler içermekte olup kenevirde yaygın görülen ve şiddetli fungal hastalıklar üzerine odaklanmıştır.

2. Fungal hastalıklar

Bilinen 100.000'den fazla mantar türünün çoğu saprofittir yani ölü organik maddeler üzerinde yaşarlar (McPartland ve ark., 2000). Ancak 10.000'den fazla mantar türü bitkilerde hastalığa neden olabilir (Agrios, 1997). Parazit mantarların her biri, bir ya da daha fazla bitki türüne saldırabilir. Kenevir patojenlerinin taksonomisi 1930'lardan beri göz ardı edilmiştir (McPartland, 1996). Tek başına mantarlarla ilgili olarak, bilimsel literatür 400'den fazla fungal taksonu patojen olarak belirtmektedir. McPartland ve ark. (2000) bu mantarlardan yaklaşık 88'inin kenevirde hastalıklara neden olduğunu bildirmiştir. Bu çalışmada açıklanan mantar hastalıkları ekonomik önemlerine göre sıralanmış olup; 1. Kök ve Kök Boğaz Hastalıkları, 2. Gövde ve Yaprak Hastalıkları ve 3. Çiçek Hastalıkları olmak üzere üç bölümde incelenmiştir (McPartland, 1996; McPartland ve ark., 2000; Bakro ve rak., 2018; Punja, 2018; Punja ve Rodriguez, 2018).

2.1. Kenevirin kök ve kök boğazında görülen fungal hastalıkları

Tohum ya da toprak kaynaklı mantarsal hastalıklara, neredeyse yalnızca toprakta yaşayan patojenik mantarlar neden olur. Kök ve kök boğaz hastalıklarına *Pythium* spp. gibi

Oomycetes sınıfına ait mantar benzeri patojenlerin yanı sıra, *Botrytis cinerea*, *Rhizoctonia solani*, *Sclerotium rolfsii* ve *Fusarium* spp., gibi gerçek mantarlar neden olur (Punja ve Rodriguez, 2018; Amaradasa ve ark., 2020; Garfinkel, 2020). Çökerten, kök ve kök boğazı hastalıkları içerisinde en çok bilinenidir. Kenevirde çökerten hastalığı çıkış öncesi ve sonrası olmak üzere iki farklı tipte görülür. Çıkış öncesi çökerten hastalığında tohumlar ya da fideler topraktan çıkmadan ölür. çökerten hastalığında, çimlenen fidelerde, genellikle toprak seviyesinde kahverengi bir çürüme gelişir, sonra solar ve devrilir. Daha yaşlı fidelerde (7-8 çift gerçek yapraklı dönem) kökler, infeksiyon sebebiyle yapışkan hale gelir, canlılığını kaybeder ve yumuşak bir doku gelişir. Bu hastalık belirtilerine ek olarak, genellikle bitki ölümüne yol açan yaprak yanıklığı ve bodurluk gibi yeşil aksamda hastalık belirtileri görülür.

Çökerten hastalığının en önemli biyotik ajanları arasında *Pythium* türleri ilk sırada yer alır. *Pythium* türleri zoospor (eşeysiz) ve oospor (eşeyli) olmak üzere iki tür spor üretir. Zoosporlar kamçılarını kullanarak yüzer ve bitkiden bitkiye hastalık yayar. Oosporlar, hastalığı zaman içinde (mevsimden mevsime) kışlayan spor olarak üretilir. *P. ultimum* kenevirin fidelerinde ve olgun bitkilerinde kök ve kök boğazında çürüklüğüne neden olur (Pitman ve ark., 2021). Kök çürüklüğü kök ucunda başlar ve toprak üst aksamdaki solgunluk ile son bulur. *P. ultimum* polifag bir tür olup dünya çapında ılıman bölgelerde yaşar. Bu patojen, özellikle düşük sıcaklıklarda (12-20°C) farklı konukçu bitkilerde görülen çökerten hastalığının nedenidir. *P. aphanidermatum* 19-32°C optimum gelişim sıcaklığı ile sıcak bölge *Pythium*'u olarak bilinmektedir (Chen ve ark., 2021). Bu tür, Hindistan, Kaliforniya ve Kanada'da kenevirin genç ya da olgun fidelerinde kök ve kök boğazında çürüklüğe neden olan patojenlerden biri olarak kayıt edilmiştir (Punja ve Rodriguez, 2018; Punja ve ark., 2018). Bu iki türün yanı sıra *P. dissotocum* and *P. myriotylum* türleri, sırasıyla Ontario ve Kaliforniya'da yetiştirilen kenevir bitkilerinin köklerinde çürüklüğe neden olur (Punja ve ark., 2021).

Macrophomina phaseolina özellikle olgun bitkilerde kömür çürüklük hastalığına neden olurken, kenevir fidelerinde çökerten hastalığına neden olmaktadır (Casano ve ark.,2018). Kenevirde kömür çürüklüğü hastalığı, tropik ve subtropik ülkelerde oldukça sık görülen bir hastalıktır. *M. phaseolina* özellikle sıcak iklim tahıllarından mısır ya da baklagillerden fasulye ve soya gibi bitkileri hastalandırır. Patojen tarafından etkilenen kenevir bitkisinde ilk olarak kloroz ve takiben solgunluk ve nekrozlar gelişir, sonunda bitkilerin bazılarında ölümler gözlemlenir (McPartland ve ark., 2000). Hasta bitkilerin sapları tamamen kurumadan önce, patojenin siyah piknidyumlarının gözlendiği toprak hattı ve üzerinde grimsi siyah renk değişikliği açığa çıkar. Hastalık toprak altına doğru ilerledikçe, köklerin vasküler iletim demetlerinde, kahverengi–mor ya da siyah renkte nekrotik alanlar oluşmaktadır (Casano ve ark.,2018).

Rhzoctonia solani, Avrupa ve Hindistan'daki lif ve ilaç için yetiştirilen kenevir bitkilerinde kök ve kök boğaz çürüklük patojeni olarak tanımlanmıştır (McPartland ve ark., 2000). Bu patojen genelde olgun bitkilerde şiddetli kök ve kök boğazı çürüklüğüne neden olur (Bakro ve ark., 2018). Polifag bir mantar olan *R. solani* dünya genelinde bir dağılıma sahip olup kenevir fidelerinde %78 ölüme neden olduğu rapor edilmiştir (McPartland, 1996). Toprakta saprofit olarak yaşayabilirler. Bu patojen, mantar patogenezinde, bilinenin aksini aşırı neme ihtiyaç duymaz. *R. solani*, kenevir bitkilerinde neden olduğu hastalık belirtileri genellikle oldukça zor fark edilebilen kılcal köklerdeki çürüklüklerle başlar (McPartland ve ark., 2000). Sonra yapraklarda kloroz ortaya çıkar ve bunu takiben bitkilerde solgunluk oluşur. Hastalığın ilerlemesi ile köklerden sapa doğru koyu kahverengi ve kuru yara alanları artar. Kenevir sapında toprak hattından yukarı doğru birkaç cm kök boğaz çürüklüğü gözlenmektedir (McPartland ve Cubeta, 1997) .

Fusarium solani, *F. oxysporum*, *F. brachygibbosum, F. equiseti, F. avenaceum* ve *F. graminearum* türleri kenevir bitkisinde çökerten hastalığının yanı sıra solgunluğa, kök boğaz çürüklüğüne, gözde çürüklüğüne, çiçek ve meyve çürüklüğüne neden olur (Punja, 2018; Sorrentino ve ark., 2019). Çökertene neden olan *Fusarium* türlerine ait konidiler yağmur ya da su sıçraması ile yayılır. Genelde sıcak iklimlerde yetiştirilen kenevir bitkilerinde kök ve kök boğazı çürüklüğünden neden olan patojen gruplarından biridir ((Bakro ve ark., 2018; Punja ve ark., 2018). *Fusarium* türleri nemli toprakta büyük ürün kayıplarına neden olurlar (Punja ve Rodriguez, 2018). Anacak doyma noktasına ulaşmış topraklarda yaşayamazlar. Bu türler sterilize edilmiş toprağa bulaştırılırsa oldukça şiddetli çökerten hastalığı ile karşılaşılır (McPartland ve ark., 2000).

2.2. Kenevirin gövde ve yapraklarında görülen fungal hastalıkları

Kenevirde en önemli ikinci hastalık grubu gövde ve yaprak hastalıklarıdır (McPartland ve ark., 2000). Bu hastalıklar arasında bulunan kenevirde kanser hastalığı, pamuksu yumuşak çürüklük, sulu yumuşak çürüklük, gövde çürüklüğü ve beyaz küf olmak üzere dünya çapında birçok isimle anılır (Garfinkel, 2021). Hastalık etmeni *Sclerotinia sclerotiorum* adlı bir mantardır. Bu hastalık Kanada'nın Ontario bölgesinde (Garfinkel, 2021) ve Alberta bölgesinde (Bains ve ark., 2000) ve Avustralya kenevir ekim alanlarında (Lisson & Mendham 1995) oldukça sınırlayıcı biyotik faktörlerden biri olarak rapor edilmiştir. *S. sclerotiorum,* bitki artıklarında veya toprakta sklerot olarak kışı geçirir. İlkbahar nemi ve ılık sıcaklıklar (15-20°C) çimlenmeyi başlatır (Rothmann ve McLaren, 2018). *S. sclerotiorum* neden olduğu hastalık belirtileri genellikle yaz sonunda ve tamamen olgunlaşmış bitkilerde gözlemlenir. Hastalık toprak hattında ya da buranın üst kısımlarında ortaya çıkabilir. Sulu lezyonlar önce saplarda ve dallarda görülür (Bains ve ark., 2000). Lezyonlar açık kahverengi kanserler oluşturur. Nemli

koşullarda, sapın yüzeyi beyaz miselyumla sarılır. Bu evrede, çiçeklenme başladıysa, genellikle durur (McPartland, 1996). Bitkiler bu durumda kalır veya solar ve sonunda devrilir. Genellikle Eylül ayına kadar, kanserlerin yüzeyinde siyah sklerotik dokular ortaya çıkar. Sapların içerisinde daha büyük sklerotlar oluşur.

Diaporthe phaseolorum kenevir gövdelerinde kanserli bölgelerin oluşmasından sorumlu olan fungal kökenli bir patojendir. Bu patojen ilk olarak 2019 yılında Amerika'nın Florida eyaletinde gözlemlenmiştir (Marin ve ark., 2021). Hastalık belirtileri kenevirin ana gövdesi üzerinde çeşitli boyut ve şekillerde, açıktan koyu kahverengiye kadar değişen renkte yaralar ile başlar. Zamanla lezyonlar geniş nekrotik alanlara birleşerek kanserli alanları oluşturur ve bu alanlar üzerinde piknidyumlar gözlemlenir (Santos ve ark., 2011).

Kenevir üretim alanları arasında, özellikle sık dikimin yapıldığı ve nisbi nemin yüksek olduğu üretim alanlarında, yaprak leke hastalıkları ile oldukça sık karşılaşılmaktadır (Punja, 2018). Kenevirde yaprak leke hastalığına neden olan birçok fungal patojen vardır. Bunlardan ilki *Septoria* (S. *cannabis, S. neocannabina*) ve *Cercospora* (*Cercospora cf. flagellaris*) türlerinin neden olduğu sırasıyla sarı ve zeytuni yaprak leke hastalığıdır (McPartland, 1995; Marin ve ark., 2020). Sarı yaprak leke hastalığının belirtileri sarı kenarlı küçük kahverengi lekeler olarak alt yapraklarda başlar (McPartland, 1995). Daha sonraki süreçte yaprak lekeleri birleşerek büyür ve kahverengiye dönüşür. Yaprak sararması, bodurluk ve bitki ölümü gibi daha ileriki hastalık belirtileri de görülür (Bakro ve ark., 2018). Bu hastalıkla, aşırı nemin olduğu ve sık dikim ile bitkilerin yeşil aksamlarının daha yoğun olduğu yaz aylarında sıklıkla karşılaşılır (McPartland ve ark., 2000). Yukarıda belirtilen koşullarda hastalık üretim alanlarında oldukça hızlı bir yayılıma göstermektedir. Zeytuni yaprak leke hastalığı, sarı yaprak leke hastalığına oldukça benzerdir. Zeytuni yaprak lekesi hastalık belirtileri küçük sarı benekler olarak başlayan, açık ten rengi veya koyu kahverengiye dönüşen, sarı haleli lezyonlara dönüşen ve şiddetli

infeksiyonlarda yaprak dökülmesine yol açmaktadır (Marin ve ark., 2020). İnfeksiyonlar alt kısımda bulunan yaşlı yapraklarda başlayarak üst kısımdaki yapraklara doğru ilerler. Diğer yaprak lekesi patojenleri olan *Phoma* ve *Ascochyta* türleri neden olduğu kahverengi yaprak leke hastalığı ikinci en yaygın yaprak leke hastalığıdır (McPartland, 1996). Bu hastalıklar bitkileri nadiren öldürmektedirler. Ancak kenevir verimini oldukça önemli miktarda düşürürler. Kenevirin lif çeşitlerinde özellikle nisbi nem oranının yüksek olduğu üretim alanlarında zeytuni yaprak leke *(Cercospora* sp.) hastalığı daha yaygındır (McPartland ve ark., 2000). Ancak ilaç endüstrisi için sera koşullarında yetiştirilen kenevir çeşitlerinde *Trichothecium roseum*'un neden olduğu pembe çürüklük birçok bitki ölümlerinden sorumlu patojendir (McPartland ve Hillig, 2008). Kahverengi yanıklık (*Alternaria* sp. ve *Stemphylium* sp.), antraknoz (*Colletotrichum* sp.) ve beyaz yaprak leke (*Phomopsis* sp.) hastalıkları kenevir yaprak leke hastalıkları arasında daha az sıklıkta görülürler (McPartland ve ark., 2000; McPartland ve Hillig, 2006; Tang ve ark., 2021;).

Pas, külleme ve mildiyö hastalıkları, diğer bitkilerde olduğu gibi kenevir üretiminde de oldukça önemli ürün kayıplarına neden olurlar (McPartland ve ark., 2000; Bakro ve ark., 2018). Bu üç hastalık etmeni obligat patojendir ve bu sebeblede, bu patojenler genellikle birkaç farklı konukçu bitkiyi kapsayan karmaşık yaşam döngüsü sergilerler. Bu hastalıklardan ilki kenevir pası olup kozmopolit bir dağılıma sahiptir. *Uredo kriegeriana* adlı fungusun neden olduğu kenevir pasının yaşam döngüsü ve kışlama mekanizması hakkında çok az şey bilinmektedir. Kenevir pasının belirtileri yaprak yüzeyinde sarı/turuncu lekeler olarak başlar ve sonunda yaprağın alt tarafında turuncu sporların (üredosporlar) kümeleri (püstüller) çıplak gözle görülür (McPartland ve ark., 2000). Obligat patojenlerin neden olduğu ikinci önemli hastalık olan külleme, *Golovinomyces cichoracearum*'un neden olduğu bir kenevir yaprak leke hastalığıdır (Bakro ve ark., 2018). Bu patojenin konukçu dizini arasında kabak, salatalık ve kavun gibi

kabakgillere ait bitkiler bulunur. Kenevir veya diğer bitkilerde görüldüğü gibi küllemenin en belirgin belirtisi yaprak üst yüzeyinde grimsi beyaz renkte külleme mantar oluşumudur (Punja, 2018). Ayrıca kenevirde, külleme hastalığının belirtileri arasında yapraklarda şekil bozukluğu, nekroz ve erken yaprak dökülmesi gibi belirtilerde görülmektedir (McPartland ve ark., 2000). Obligat patojenlerin neden olduğu son hastalık olan mildiyö, yarı ya da tam olgun kenevir bitkilerini hastalandırır. Bu hastalık dünya genelinde bir dağılıma sahiptir. Mildiyö hastalığına *Peronospora cannabina* ve *Pseudoperonospora humuli* olmak üzere iki Oomycet tür neden olur (Şevik, 2020). Her iki tür, lif ve ilaç endüstrisi için geliştirilen çeşitlerde hastalık oluşturur. Mildiyö hastalık belirtileri yaprak damarlarıyla sınırlı, düzensiz boyutta ve açısal şekilde sarı yaprak lekeleri olarak başlar. Lekelerin alt kısmındaki misel büyümesi en iyi sabahın erken saatlerinde görülür (McPartland ve ark., 2000). Hastalık yapraklarda hızla yayılır ve yapraklarda şekil bozukluğu oluşur. Kısa bir süre sonra yapraklardaki yanıklık sebebiyle bu infekteli yapraklar düşer. Hastalık bir yapraktan bir yaprağa, bir bitkiden bir bitkiye olacak şekilde üretim alanında yayılım gösterir (Bakro ve ark., 2018).

2.3. Kenevirin çiçeklerinde görülen fungal hastalıklar

Botrytis cinerea neden olduğu gri küf hastalığı, kenevirin hem örtü altı hem de tarla yetiştiriciliğinde üretimi sınırlayan en önemli ve yaygın hastalığı haline gelmiştir (McPartland ve ark., 2000). Özellikle sera koşullarında ilaç endüstrisi için kullanılan çeşitleri etkiler. Polifag bir mantar olan *B. cinerea* dünya genelinde birçok kültür bitkisinde hastalığa neden olur (Williamson et al 2007). Özellikle çilek ve bağ üretiminde oldukça kısıtlayıcı etkisi vardır (Köycü ve ark., 2018; Petrasch ve ark., 2019). Bu patojen yüksek nemli ve ılıman iklim koşullarında optimum gelişir. Gri küf hastalığının yaygınlığı ve şiddeti bulutlu, yağmurlu ve deniz iklimlerinde zirve yapar (Williamson et al 2007). Bu iklimlerde hastalık epidemi

boyutuna ulaşır ve kısa bir sürede tüm kenevir üretim alanlarını yok edebilir (Garfinkel, 2020). Gri küf, kenevir çiçek salkımlarında ve saplarda olmak üzere iki yerde infeksiyona neden olur (Bakro ve ark., 2018). Çiçek salkım infeksiyonları, ilaç çeşitlerinde ve büyük nem tutan dişi tomurcukları olan çeşitlerde yaygın olarak görülür. Çiçek salkım infeksiyonları tomurcuklarda başlar ve bu sebeble ilk belirtiler görülmez. Çiçek salkımları sararır ve solar ve takiben çiçek pistilleri kahverengileşmeye başlar. Yüksek nemde çiçek salkımları gri renkli miselyumla kaplanır. Düşük nemde gri küf hastalığı ortaya çıkmaz; infekteli çiçekler kahverengiye döner, solar ve ölür. Scheifele (1998), kenevir ekim alanlarında *B. cinerea*'nın sporadik infeksiyonları sonucu ortaya çıkan, salkım yanıklık hastalığının bulunma oranının %30-40 arasında değiştiğini rapor etmiştir. Diğer taraftan, *B. cinerea* tarafından oluşan sap çürüklük hastalığı daha çok lif çeşitlerinde görülmektedir (Patschke et al. 1997). Sap çürüklüğü klorotik bir renk değişikliği ile başlar. Sap üzerindeki klorotik lekeler hızla büyür ve bu alanlarda yumuşama ve suyu lezyonlar görülür (McPartland, 1996). Lezyonlar, üstlerindeki yeşil aksamı soldurarak sapları çevreleyebilir ve yüksek nemde, lezyonlar misel ve konidiler ile kaplanır (McPartland ve ark., 2000). İlerleyen süreçte saplarda küçük, siyah sklerotlar oluşabilir. *B. cinerea* tohum kaynaklı infeksiyonlara neden olabildiğinden hem çıkış öncesi hemde çıkış sonrası çökerten hastalığına neden olur (Bakro ve ark 2018). *B. cinerea* tarafından infekte edilmiş çiçeklerin tohuma dönüşmesi ve bu infekteli tohumların tekrar üretim için kullanılması, kenevir ekim alanlarında çökerten hastalığının epidemi yapmasına yol açabilir (McPartland ve ark., 2000).

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KAPARİ BİTKİSİNİN FİTOKİMYASAL BİLEŞİMİ, TIBBİ ÖZELLİKLERİ VE MOLEKÜLER GELİŞMELER

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ÖZET

Kapari, tipik olarak 1 ile 1.5 metre yüksekliğe ulaşan, yaprak döken, odunsu bir çalıdır. Kendine özgü etli, dairesel yaprakları ve çok sayıda organlarındaki kokulu beyaz ila pembemsi beyaz çiçekleri ile karakterize edilir. Kapari çalıları, özellikle bitkinin en çok tanınan kısmı olan küçük, yenilebilir çiçek tomurcukları üretme yetenekleriyle ünlüdür. Dayanıklılıkları ve zorlu koşullarda gelişme kapasiteleri, onları kurakçıl peyzaj ve az bakım gerektiren bahçe işleri için ideal bir seçim haline getiriyor. Bu çeşitli bitki, Akdeniz bölgesine. Güney Avrupa, Kuzey Afrika ve Orta Doğu dahil olmak üzere Asya'nın bazı bölgelerine özgüdür. Kurak ve yarı kurak iklimlerde yetişir. Hasat edilen çiçek tomurcukları, sirke veya salamurada marine edilerek çeşitli yemeklerde kullanılmaktadır. Çok sayıda çeşit içeren bir bitki cinsi olan *Capparis*, potansiyel terapötik uygulamalara sahip zengin biyoaktif bileşik dizisi nedeniyle dikkat çekmektedir. Bitkinin toprak üstü kısımları, kökleri ve tohumları da dahil olmak üzere farklı bitki kısımlarında bulunan biyoaktif bileşenler, çeşitli farmakolojik aktiviteleri bulunmaktadır. Kapari bitkileri, Capparidines gibi alkaloidlerin yanı sıra quercetin, rutin, kaempferol ve quercetin-3-O-rutinoside gibi flavonoidler de dahil olmak üzere potansiyel tıbbi özelliklere sahip alkaloid ve flavonoid kaynağıdır. Ayrıca, kaparilerin keskin ve acı tadından sorumlu olan hardal yağı glikozitleri de kapari bitkisinde bulunmaktadır. Kapari bitkisi, Akdeniz mutfağının derin köklerine sahip ve çeşitli biyoaktif bileşenlere atfedilen farmasötik değeri nedeniyle hem mutfakta hem de tıbbi geleneklerde özel bir yere sahiptir. İspanya, İtalya, Fas, Türkiye ve Yunanistan gibi Akdeniz ülkelerinde yaygın ekimine rağmen kapsamlı yetiştirme verileri hala belirsizliğini koruyor. Ayrıca bu çalışmada, Capparis'in potansiyel sağlık yararları hakkında

fikir vermekte olup, yetiştiriciliği, seçimi ve fitokimyasal profilindeki son moleküler gelişmeleri derinlemesine incelenmektedir. Ayrıca*, Capparis* ile iyileşen insan sağlığı sonuçları arasındaki ilişkiyi kurmak için daha fazla araştırmanın önemini vurgulamaktadır.
Anahtar Kelimeler: Kapari, Fitokimiyasal, Geleneksel tıp, karakterizasyon.

PHYTOCHEMICAL COMPOSITION, MEDICINAL PROPERTIES, AND MOLECULAR ADVANCES IN CAPER BUSH

ABSTRACT

The caper bush is a deciduous, woody shrub typically reaching a height of 1 to 1.5 meters (3 to 5 feet). It is characterized by its distinctive fleshy, circular leaves and fragrant white to pinkish-white flowers with numerous stamens. Caper bushes are particularly renowned for their ability to produce small, edible flower buds, which are the most recognized part of the plant. Their resilience and capacity to thrive in challenging conditions make them an ideal choice for xeriscaping and low-maintenance gardening. This diverse plant is native to the Mediterranean region and parts of Asia, including Southern Europe, North Africa, and the Middle East. It prospers in arid and semi-arid climates. The harvested flower buds are pickled in vinegar or brine to create the tangy capers widely used in various dishes. *Capparis*, a diverse genus of plants, has garnered attention for its rich array of bioactive compounds with potential therapeutic applications. The bioactive constituents found in different plant parts of the plant, including the aerial portions, roots, and seeds, highlight their diverse pharmacological activities. Caper bushes are known to be good sources of alkaloids, including Capparidines, as well as flavonoids such as quercetin, rutin, kaempferol, and quercetin-3-O-rutinoside, all of which possess potential medicinal properties, including antioxidant and anti-inflammatory effects. Additionally, mustard oil glycosides, responsible for the sharp and pungent taste of capers, are also present in the caper bush. Rooted in Mediterranean cuisine, *Capparis* has a special position in both culinary and medicinal traditions. Despite its extensive cultivation in Mediterranean countries like Spain, Italy, Morocco, Turkey, and Greece, comprehensive cultivation data remains elusive. The review provides insights into the potential health benefits of *Capparis* and delves into recent molecular advancements in its cultivation, selection, and phytochemical profile. It emphasizes the importance of further research to establish the relationship between *Capparis* and improved human health outcomes.

Keywords: *Capparis spinosa*, Phytochemicals, medicinal properties, Characterization.

1. INTRODUCTION

Plants with therapeutic and commercial value have long been considered essential resources for the cosmetic and pharmaceutical industries. Over the past decade, their significance has grown, especially with the recognition of essential oils extracted from these plants as crucial contenders in the evaluation of medicinal plants. There is a notable surge in interest from researchers, physicians, and the general public in the realm of medicinal plants. This increased curiosity stems from a growing awareness of the potential health benefits offered by natural remedies and a preference for alternatives to synthetic drugs that may have harmful side effects. Advancements in technology have enabled a more thorough examination of the chemical composition of plants, leading to the discovery of new drugs and plant-based therapies for various ailments. Furthermore, the rising demand for organic and natural products has driven the growth of the herbal supplement industry, turning medicinal plants into a lucrative market. Among the diverse array of these valuable plants, the Capparis genus, belonging to the Capparidaceae family, holds a prominent position. This species has been extensively employed in folk medicine since ancient times, particularly in regions of Western and Central Asia, as well as the Mediterranean basin, encompassing countries like Morocco, Spain, Tunisia, Italy, and Turkey (Saleem et al., 2015).

Capparis, the largest genus within the Capparaceae family, encompasses 250 species. The Capparaceae family, among the most noteworthy plant families, consists of 39 genera and 650 species, predominantly found in warm regions worldwide. This family shares a close connection with the Brassicaceae family, a medium-sized and economically important group of flowering plants commonly referred to as the mustard family. The affiliation between these

families is attributed to their shared capability of producing glucosinolates, commonly known as mustard oils (Kdimy et al., 2022).

The *Capparis* genus is widely distributed in dry and semi-arid regions of tropical and subtropical environments. A significant species, *C. spinosa* L., naturally thrives from the Atlantic coast of Morocco to Western Asia, including countries around the Caspian Sea and the Black Sea. Its distribution spans from North Africa, Europe, Papua New Guinea, and Australia to the Mediterranean basin, extending from Morocco to Crimea, Armenia, Iran, and Turkey (Saifi et al., 2011).

The well-developed roots of Capparis spinosa play a pivotal role in addressing the challenges posed by arid lands, particularly in the context of climate change. These roots exhibit a remarkable capacity for efficient water absorption, a trait that becomes increasingly vital in regions experiencing water scarcity and heightened aridity due to shifting climate patterns. The adaptability of Capparis spinosa extends beyond its capacity to thrive in water-scarce environments. Notably, the plant demonstrates a commendable level of drought tolerance, showcasing its ability to endure prolonged periods of water scarcity. This resilience is a valuable characteristic in the face of the escalating threat of droughts associated with climate change. Furthermore, Capparis spinosa showcases adaptability to challenging soil conditions, particularly in rocky or sandy terrains. This adaptability is crucial in regions where soil quality is compromised due to environmental degradation (Isagaliev et al., 2022). By flourishing in such diverse and challenging environments, Capparis spinosa emerges as a natural solution to climate change-related issues. Its robust root system, coupled with drought tolerance and adaptability to different soil types, positions it as a resilient species capable of thriving in the face of environmental adversity. As we confront the increasing impacts of climate change, the

unique attributes of Capparis spinosa make it a noteworthy contender in sustainable ecosystem management and climate-resilient agriculture.

Extensive studies by international researchers have delved into the comprehensive study of the capper bush, with its ethnopharmacological applications substantiated through various pharmacological and phytochemical investigations, alongside the economic justification derived from its cultivation. The intriguing focus of these studies lies in elucidating the antioxidant, renal protective, anti-inflammatory, and hepatoprotective properties inherent in the capper bush (Saifi et al., 2011; Kulisic-Bilusic et al., 2012; Zhang and Ma, 2018; Ramdani et al., 2020; Annaz et al., 2022). The therapeutic attributes ascribed to these species are intricately linked to their phytochemical composition, prompting a noteworthy emphasis on screening the plant for bioactive secondary metabolites across different plant parts. The genus has yielded an array of natural compounds, including polyphenols (such as flavonoids, phenylethanoid glycosides, and lignans), alkaloids, terpenes (like sesquiterpenes, iridoids), phenolic acids, and essential oils (Kulisic-Bilusic et al., 2012; Zhang and Ma, 2018).

Nevertheless, the composition of bioactive compounds, which contributes to diverse pharmaceutical characteristics, exhibits considerable variability contingent on the specific species and environmental conditions (Mollica et al., 2019; Ramdani et al., 2020). Recognizing the significant characteristics of this species and the imperative to advance breeding studies, this study aimed to comprehensively investigate recent advancements in understanding the biologically active compounds and pharmaceutical aspects of the capper bush. Additionally, the study seeks to explore molecular advances in decoding the nature of this plant, contributing to a more detailed comprehension of its pharmaceutical potential.

2. SECONDARY METABOLITES ISOLATED FROM *C. Spinosa*

Literature has demonstrated that *C. spinosa* serves as a substantial reservoir of biologically active secondary metabolites, positioning the plant as a promising source of pharmacologically relevant substances. Among these metabolites are Alkaloids, flavonoids, glucosinolates, and terpens.

2.1. ESSENTIAL OILS AND VOLATILE COMPOUNDS ISOLATED FROM C. Spinosa

Studies indicated that different parts of Capparis spinosa (*C. spinosa*) exhibit varying compositions of major essential oils and volatile compounds. Ascrizzi et al. (2016) reported that sesquiterpene hydrocarbons comprised 99% of the volatile compounds in the seeds of *C. spinosa*. The primary compounds were α-caryophyllene (45%), β-guaiene (15%), bicyclogermacrene (12%), and germacrene B (8%).

Notably, isothiocyanate derivatives were found to be the most prevalent compounds in the essential oil of *C. spinosa*. Afsharypuor et al. (1998) reported distinct compositions of essential oils in various parts of Capparis spinosa sourced from Iran. The leaf oil was notably characterized by the presence of thymol (26.4%), isopropyl isothiocyanate (11%), hexenal-2 (10.2%), and butyl isothiocyanate (6.3%). Conversely, the fruit oil predominantly consisted of isopropyl isothiocyanate (52.2%) and methyl isothiocyanate (41.6%). The root oil exhibited a composition primarily comprising methyl isothiocyanate (53.5%) and isopropyl isothiocyanate (31.4%). Capparis spinosa sourced from Turkey displayed distinctive compositions of essential oils, as evidenced by Ozcan and Chalchat (2007). Methyl isothiocyanate is notably present at a

concentration of 26.5% in young shoots and surges to 49.6% in floral buds. In Italy, the aromatic profile of *C. spinosa*, as reported by Romeo et al. (2007), exhibited a diverse composition with 22.2% aldehydes, 21% esters, and 8.42% sulfur compounds. Conversely, *C. spinosa* from Croatia, as analyzed by Kulisic-Bilusic et al. (2009), was characterized by an exceptionally high content of methyl isothiocyanate, comprising a remarkable content of 92.06% in its essential oil. Isothiocyanates, particularly methyl isothiocyanate, play a crucial role in enhancing the body's defense against oxidative stress. They stimulate cellular antioxidant systems and increase the activity of key enzymes. Additionally, these compounds have the capacity to induce apoptosis, a pivotal process in regulating cell populations and eliminating damaged cells, particularly in the prevention and treatment of cancer. Furthermore, isothiocyanates impact cytokine production and activity, contributing to immune system regulation and exerting anti-inflammatory effects. Both epidemiological evidence and experimental studies underscore the anti-cancer properties of naturally occurring isothiocyanates and their synthetic derivatives, showcasing their potential to inhibit the development and progression of various types of cancer (Kala et al., 2018).

2.2. PHENOLIC COMPOUNDS ISOLATED FROM *C. Spinosa*

Within Cappar bush, the phenolic compounds are predominantly represented by flavonoids, with a total of 173 compounds, including 52 flavonols, 48 anthocyanins, 11 flavanols, and 62 other flavonoids (e.g., flavones). Additionally, there are 82 phenolic acids, along with 26 lignans, 10 stilbenes, and 72 other low-molecular-weight phenolics, measured in terms of tyrosol equivalents (Bacchetti et al., 2011). Flavonoids serve as a distinctive characteristic of the aerial components of *Capparis spinosa*, encompassing fruits, flowers, leaves, and stems.

Among these flavonoids, rutin has been identified as the primary compound, with studies indicating higher concentrations in fresh *C. spinosa* flowers and leaves. Rutin is linked to potential health benefits, including cardio-protective effects, cholesterol-lowering properties, and activities with anti-cancer and anti-inflammatory attributes (Farha et al., 2022; Ganeshpurkar and Saluja 2017). Additionally, flavonols derived from flavonoids, such as kaempferol-3-glucoside, kaempferol-3 routineoside, kaempferol-3-rhamnorutinoside, quercetin 3-O-glucoside, quercetin 3-O-glucoside-7-O-rhamnoside, quercetin 3-O-[6‴-α- l-rhamnosyl-6″-β-d-glucosyl]-β-d-glucoside, and quercetin-3-O-rutinoside, were isolated from caper fruits and leaves. Furthermore, a flavonoid from the Sakuranetin flavanone group and biflavonoids, such as ginkgetin and isoginkgetin, belonging to the Flavone group, were abundantly found in fruits. These components are suggested to possess anti-inflammatory and neuroprotective effects (Zhou et al., 2011; Gull et al., 2015).

2.3.ALKALOIDS ISOLATED FROM *C. Spinosa*

Alkaloids constitute one of the most extensive compound groups in capers, making up 0.91% and 0.86% of the mass material obtained from root bark and fruits, respectively. Notably, leaves of the studied plant have not shown any reported presence of alkaloids. The isolated alkaloids fall into two main classes: indoles and spermidines. Spermidines are predominantly located in the roots, while indoles are abundant in fruits, indicating a primary concentration of alkaloids in the roots. The roots of *C. spinosa* have provided several newly identified spermidine alkaloids, including capparispine, capparispine 26-O-β-d-glucoside, and cadabicine 26-O-β-d-glucoside hydrochloride (Fu et al., 2008). Additionally, compounds like "stachydrine" and "3-

hydroxy-7-methoxy-2-methyl-4H-1,4-benzoxazine-4-carbaldehyde" have been determined from the roots of *C. spinosa* (Khatib et al., 2016; Boga et al., 2011).

2.4.GLUCOSINOLATES ISOLATED FROM *C. Spinosa*

Glucosinolates are sulfur-containing compounds found in various cruciferous plants, contributing to the distinctive flavors and potential health benefits associated with these plants. A total of 12 glucosinolates, including Glucocapperin, Glucoiberin, Progoitrin, Epiprogoitrin, Sinigrin, Gluconapoleiferin, Glucoalyssin, Gluconapin, 4-hydroxyglucobrassicin, Glucobrassicanapin, Glucobrassicin, and Gluconasturtiin, have been identified and isolated from *Capparis spinosa*. Glucocapperin emerges as the predominant glucosinolate in shoots and buds of the plant (Matthäus and Özcan, 2002). In the seeds of *C. spinosa*, the total glucosinolate content (on a dry weight basis) ranges from 42.6 to 88.9 µmol/g. Remarkably, more than 95% of this total content is attributed to Glucocapperin, underscoring its prevalence as the primary glucosinolate in both seeds and the aerial parts of *C. spinosa*, such as shoots and buds (Matthäus and Özcan, 2005).

3. BIOLOGICAL ACTIVITIES OF *C. Spinosa*

The utilization of various parts of the caper plant in traditional medicine across diverse cultures underscores its versatility and historical significance in the treatment of various ailments.

Renowned for its diverse medicinal properties, the capers plant finds application in alternative medicine for addressing a range of health issues, including diuretic, gout, rheumatism,

hyperlipidemia, hyperglycemia, hypertension, and liver and spleen disorders. Root bark and leaves of capers, when combined with vinegar or honey, were consumed in Arab, Chinese, and Greek traditions to combat ulcers. Ancient Egyptians and Arabs similarly used the roots mixed with vinegar or honey to alleviate liver and kidney disorders.

In India, different parts of the tree were employed against various diseases: buds and roots for poultry boils, leaves for poultry swellings, bark for coughs, asthma, and inflammation. Traditional Arabic medicine featured dried fruits for the oral treatment of diabetes and hypertension.

Ancient Romans utilized caper buds for treating paralysis, while in the Mediterranean basin, extracts from the root powder were employed to combat rheumatoid arthritis, osteoarthritis, and reduce joint inflammation. In Morocco, caper buds were used for eye infections, and dried fruits were consumed to address hypertension and diabetes.

In Turkey, various parts such as fruit, bud, root, root bark, and seed were used for ailments like headache, hemorrhoids, eczema, and fungal infections. Research studies evaluating methanolic and dichloromethane extracts from different parts of *C. spinosa* revealed high antioxidant activity, enzyme inhibition, and potential toxicity on breast cell lines. Secondary metabolite profiling identified 21 different compounds, supporting traditional uses and showcasing *C. spinosa*'s potential for new bioactive compounds.

In a comprehensive investigation, researchers conducted analyses on methanolic and dichloromethane (DCM) extracts derived from various parts of *Capparis spinosa*. Their evaluation encompassed antioxidant assays, enzyme inhibition tests, and toxicity assessments

conducted on breast cell lines. Notably, the methanolic extracts demonstrated elevated levels of total phenolic and flavonoid contents, showcasing significant efficacy in radical scavenging, cholinesterase, tyrosinase, and glucosidase inhibition. Meanwhile, the DCM extracts displayed noteworthy activities in potency reduction, phosphomolybdenum, metal chelation, tyrosinase, and α-amylase inhibition. The comprehensive secondary metabolite profiling unveiled 21 distinct compounds, aligning with the plant's traditional uses and indicating its potential as a source for developing new bioactive compounds (Saleem et al., 2021).

Additionally, a study conducted by Kulisic-Bilusic et al. in 2021 revealed that the administration of caper essential oil and aqueous infusion induced G2/M cell cycle arrest in a dose-dependent manner, as evidenced by flow cytometry analysis. These findings suggest that capers contain a combination of volatile and non-volatile compounds that may play a pivotal role in preventing colon cancer.

Moreover, another research endeavor highlighted the positive impact of caper extract on regulating inflammation-related genes in Alzheimer's patients, particularly in mice injected with amyloid-beta peptide (Aβ). The observed activity was attributed to the high levels of flavonoids present in the plant (Mohebali et al., 2018).

In a clinical study involving 54 participants with type 2 diabetes, it was found that individuals consuming 1200 mg of caper fruit extract per day for two months experienced significantly lower glycosylated hemoglobin and fasting blood sugar levels compared to the control group. These promising results indicated improvements in hypertriglyceridemia and hyperglycemia in diabetic patients (Huseini et al., 2013).

4. MOLECULAR ADVANCEMENTS IN GENOMIC STUDIES ON C. Spinosa

Capers, recognized for their resilience in arid conditions, hold significant economic importance, yet the scarcity of genetic studies has hindered comprehensive exploration. Addressing this gap, a study focused on the comprehensive examination of chloroplast genomes in *Capparis spinosa* L. and *Capparis decidua* Forsk, shedding light on their structural and genetic characteristics. The findings unveiled circular chloroplast genomes with dimensions of 157,728 bp for *C. spinosa* and 157,573 bp for *C. decidua*, each exhibiting a GC content of 35.91% and 35.96%, respectively. These chloroplast genomes were parsed into distinct regions: Large Single Copy (LSC), Small Single Copy (SSC), and a pair of inverted repeats. The commonalities between the two species encompassed 115 genes, comprising 80 protein-coding genes, 31 tRNA genes, and four rRNA genes. Phylogenetic scrutiny provided insights into the relationships among these medicinal plants within the Capparaceae family. Notably, *C. spinosa* demonstrated close affinity with *Capparis urophylla*, and both species formed a sister group with *C. decidua*. This phylogenetic information significantly contributes to our comprehension of the genetic architectures and interconnections among these valuable medicinal plants (Alzahrani et al., 2021).

In another distinct investigation, the plastid genome of *Capparis spinosa* L. underwent thorough scrutiny, revealing intricate structural details. The genome spans a length of 157,728 bp and showcases a quadruplex structure, characterized by a pair of inverted repeat (IR) regions measuring 26,337 bp, a large single copy (LSC) region spanning 86,732 bp, and a small single copy (SSC) region encompassing 18,322 bp. Among the 136 plastid genome genes identified in *C. spinosa*, 116 are situated in single-copy regions, while the remaining 19 are positioned

within the inverted repeats region. The plastome comprises a total of 80 protein-coding genes, 31 tRNA genes, and 4 rRNA genes. Repeat analysis illuminated the presence of various repeat types, with a notable prevalence of palindromic repeats. Specifically, the intergenic spacer accommodates 318 simple sequence repeats (SSR), predominantly composed of mononucleotides A/T. The outcomes of this meticulous plastid genome analysis not only contribute valuable insights for species identification but also lay a foundation for forthcoming investigations into genetic diversity and evolutionary dynamics within the genus *Capparis* (Alzahrani et al., 2022).

Lastly, the sequencing and assembly of *Capparis spinosa* var. herbacea (Willd.) yielded a high-quality reference genome measuring approximately 274.53 Mb in size. This genome, meticulously assigned to 21 chromosomes, unraveled intriguing insights. Tandem repeats constituted 19.28%, surpassing the average in plant genomes, while transposable elements made up 43.98%. The predictive analysis identified 21,577 protein-coding genes, achieving a remarkable 98.82% functional annotation. The examination of species diversity unveiled that *C. spinosa* var. *herbacea* and *Tarenaya hassleriana* diverged from a shared ancestor approximately 43.31 million years ago. This temporal perspective offers a profound understanding of the evolutionary trajectories within the Capparaceae family. Beyond taxonomic implications, this research presents a groundbreaking platform for exploring diversity, speciation, and evolution. The high-quality reference genome serves as an invaluable tool for deciphering the underlying mechanisms that confer drought and high-temperature resistance in *Capparis spinosa*, promising significant contributions to both agricultural practices and our understanding of plant adaptation strategies (Wang et al., 2022).

5. CONCLUSION

In conclusion, the exploration of the phytochemical composition, medicinal properties, and molecular advances in Caper Bush (*Capparis spinosa*) has provided valuable insights into its multifaceted significance. The diverse array of phytochemicals, including flavonoids, alkaloids, glucosinolates, and essential oils, underscores its rich chemical profile, contributing to its therapeutic attributes. The extensive traditional medicinal uses across different cultures further highlight its versatility in treating various health issues, from inflammatory conditions to diabetes. Molecular studies, such as genomic sequencing and chloroplast genome analysis, have enhanced our understanding of the genetic underpinnings and evolutionary relationships within the Capparaceae family. These scientific endeavors not only shed light on the molecular mechanisms behind the plant's resilience to environmental stressors but also pave the way for potential applications in fields like medicine and agriculture. The comprehensive examination of Caper Bush presented here signifies its importance as a valuable resource for both traditional healing practices and cutting-edge molecular research, emphasizing its potential contributions to human health and well-being.

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JOJOBA'NIN TARIMDAKİ POTANSİYELİ: TARIMSAL ZORLUKLAR VE TÜRKİYE'NİN BEKLENTİLERİNİN ELE ALINMASI

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ÖZET

Jojoba (*Simmondsia chinensis*), ilaç, kozmetik ve diğer sektörler de dahil olmak üzere endüstrilerdeki birçok kullanımıyla tanınan, kendine özgü sıvı balmumu içeren çok yıllık iki evcikli bir çalıdır. Özellikle Jojoba yağının ekonomik önemi, kozmetik endüstrisinde dikkat çekmektedir. Jojoba yağının bileşimi temel olarak balmumu esterlerinin (%97 civarında) yanı sıra yağ asitleri, yağ alkolleri, steroller ve az miktarda E vitamini içerir. Jojoba'nın zengin bir geçmişi vardır ve aşağıdakiler de dahil olmak üzere çeşitli durumlar için geleneksel ilaçlarda kullanılmıştır: soğuk algınlığı, dizüri ve obezite. Son araştırma çalışmaları, antioksidan, anti-inflamatuar, antimikrobiyal, antikanser, anti-akne, anti-sedef hastalığı, yara iyileştirici ve hepatoprotektif aktiviteler gibi tıbbi ve farmakolojik özelliklerini bildirmiştir. Bu sağlık yararlarının çoğu, simmondsin ve fenolik bileşikler gibi spesifik doğal bileşiklerin varlığına atfedilir. Ekonomik potansiyeline rağmen, Jojoba'nın yetiştirilmesi, sınırlı genetik çeşitlilik, zorlu çevre koşullarına olan talep, elverişsiz erkek-dişi bitki oranları, gecikmiş çiçeklenme ve uzayan tohum üretim zamanları gibi zorluklarla birlikte gelir. Bu derleme, Jojoba'nın farklı koşullara uyum sağlama, üretkenliği artırma ve yağ üretimini artırma yeteneğini geliştirmeyi amaçlayan moleküler ve yetiştirme tekniklerindeki son gelişmeleri ele almaktadır. Ayrıca Jojoba'nın genetiğini ve genetik çeşitliliğini anlama konusundaki ilerlemenin yanı sıra gelişmiş bitki çeşitleri geliştirme çabalara da dikkat çekmektedir. Ayrıca Türkiye'nin Jojoba yetiştiriciliğine uygunluğunu iklim ve tarımsal kabiliyetlerini de dikkate alarak değerlendirmektedir. Jojoba'nın hem tarım hem de sanayideki önemine ilişkin anlayışımızı pekiştiren ve tarım uygulamalarındaki en son gelişmeleri değerlendiren bu inceleme, Jojoba'nın

tam potansiyelinin nasıl açığa çıkarılacağına dair değerli bilgiler sunmaktadır. Ayrıca Türkiye'de Jojoba ekiminin yaygınlaştırılmasının fizibilitesini de değerlendiriyor. Bu kapsamda, sürdürülebilir yetiştirme yöntemlerini teşvik edilerek Jojoba'yı küresel tarım ve endüstriyel sistemlere daha da entegre etmektir.

Anahtar Kelimeler: *Simmondsia chinensis*, Yetiştirme, Eczacılık, Moleküler gelişmeler, Türkiye.

POTENTIAL OF JOJOBA IN AGRICULTURE: ADDRESSING CULTIVATION CHALLENGES AND TURKEY'S PROSPECTS

ABSTRACT

Jojoba is a perennial dioecious shrub with distinctive liquid wax that has become well-known for its many uses in industries including medicines, cosmetics, and other sectors. Particularly, the economic significance of Jojoba oil is noteworthy, especially in the cosmetic industry, where it plays a crucial role. The composition of Jojoba oil mainly comprises wax esters (around 97%), along with fatty acids, fatty alcohols, sterols, and a small amount of vitamin E. Jojoba has a rich history and has been used in traditional remedies for various conditions, including colds, dysuria, and obesity. Recent research studies have reported its medicinal and pharmacological properties, such as antioxidant, anti-inflammatory, antimicrobial, anticancer, anti-acne, anti-psoriasis, wound-healing, and hepatoprotective activities. Many of these health benefits are attributed to the presence of specific natural compounds like simmondsin and phenolic compounds. Despite its economic potential, cultivating Jojoba comes with challenges, including limited genetic diversity, the demand for harsh environmental conditions, unfavourable male-to-female plant ratios, delayed flowering, and extended seed production timelines. In this review, we explore recent advancements in molecular and breeding techniques aimed at enhancing Jojoba's ability to adapt to different conditions, increase productivity, and boost oil production. We also discuss progress in understanding Jojoba's genetics and genetic diversity, as well as the efforts to develop improved plant varieties. Moreover, we assess Turkey's suitability for Jojoba cultivation, taking into account its climate and agricultural capabilities. By consolidating our understanding of Jojoba's significance in both agriculture and industry and evaluating the latest developments in cultivation practices, this review provides valuable insights into how to unlock the full potential of Jojoba. It also considers the feasibility of expanding Jojoba cultivation in Turkey. The ultimate goal of this comprehensive analysis is to promote sustainable cultivation methods and further integrate Jojoba into global agricultural and industrial systems.

Keywords: *Simmondsia chinensis*, Cultivation, Pharmacy, Molecular developments, Türkiye

1. INTRODUCTION

In the face of climate change and increasing environmental challenges, it is imperative to assess and prioritize plants with a high capacity for adaptability and resilience. Evaluating these resilient species is essential for sustainable use, as they can play a crucial role in maintaining ecological balance, ensuring food security, and providing resources for various human needs, contributing to the overall resilience of ecosystems in the changing climate (Cotrina Cabello et al, 2023). This proactive approach aids in the identification of plant species that can succeed under evolving environmental conditions, making them valuable assets for sustainable agriculture, biodiversity conservation, and ecosystem stability. In the context of climate change, jojoba (*Simmondsia chinensis*) emerges as a notable candidate (Farag and Shehata, 2023). It can thrive in regions where the majority of other crops struggle or merely survive, enduring conditions such as salinity, alkalinity, or nutrient scarcity, primarily as a response to water scarcity (Abusaief et al. 2021). Renowned for its significance in the pharmaceutical industry, jojoba boasts a rich ethnobotanical history deeply rooted in the practices of indigenous communities inhabiting the arid southwestern deserts of the United States and northwestern Mexico (Gad et al. 2021). With historical applications dating back centuries, Jesuit priests documented the use of jojoba among these communities for addressing a myriad of skin and scalp disorders (Ashour et al. 2013). Native Americans highly valued jojoba fruit and oil, utilizing them for both nutritional and medicinal purposes. From aiding digestion to contributing to childbirth when mixed with chocolate, early reports from 1789 underscored the diverse applications of jojoba (González and Soler, 2023). Ground jojoba seeds were believed to be effective against facial wounds, and their oil was employed for wound treatment and rapid healing (Gad et al. 2021). Beyond its historical significance, jojoba stands out for its multipurpose medicinal properties, functioning as an emollient agent, addressing conditions

like acne and psoriasis, showcasing anti-inflammatory and analgesic activities, possessing antimicrobial properties, and aiding in the regulation of hyperglycemia and blood cholesterol levels (Habashy et al., 2005; Belhadj et al. 2020; Gad et al. 2021; El Gendy et al., 2023).

On the other hand, Biodiesel acknowledged as a sustainable energy source, grapples with challenges related to inadequate raw materials and elevated costs in comparison to petrodiesel. The considerable expenses, particularly sourced from critical food supplies, prompt economic considerations, especially amidst concerns about population growth and nutritional needs. In addressing these issues, prioritizing oil consumption in the food sector is deemed judicious. Jojoba oil emerges as a promising remedy for the feedstock challenge in biodiesel production, offering a sustainable, non-food-based alternative with liquid wax-rich seeds. This approach aligns with the goal of developing environmentally friendly and economically viable energy sources, as jojoba cultivation proves well-suited for arid environments, providing a potential solution for regions grappling with water scarcity (Shah et al, 2014; Sandouqa and Hamamre, 2019; Sandouqa and Hamamre, 2021).

Hence, taking into account the economic dimensions of jojoba in the industry, coupled with its adaptability to thrive in drought and challenging soil conditions, this research endeavors to offer comprehensive insights to shed light on jojoba cultivation practices, pinpoint challenges encountered by farmers, and put forth potential solutions. The overarching goal is to enrich jojoba cultivation in Turkey, thereby contributing to the sustainable development of the agricultural sector.

2. BOTANICAL CHARACTERISTICS, DISTRIBUTION, AND GLOBAL PRODUCTION

Simmondsia chinensis stands as the singular member of the Simmondsiaceae family. This evergreen, perennial, dioecious shrub is characterized by its woody nature and is indigenous to the Sonoran deserts spanning Southern California, Southern Arizona, and North-Western Mexico (Gentry, 1958). With a significant commercial value, Jojoba boasts over 300 market-available products globally. As the sole species in the Simmondsiaceae family, S. chinensis primarily inhabits an expansive area of nearly 260,000 square kilometers (100,000 square miles) within the geographical coordinates of 25° - 31° North latitude and 109° - 117° West longitude. The plant's documentation traces back to the early 1700s, with the first literary citation recorded in 1701 (Rawles, 2). Native to the Sonora Desert, covering regions between 25-31 degrees north latitude and spanning 259,000 km2 in southwestern states of the USA (Arizona, California, and Utah) and the northwestern states of Mexico (Baja California and Sonora), Jojoba is predominantly cultivated in bush form. Its initial description dates back to 1789, with Mexico emerging as the leading producer, followed by cultivation in the USA, Israel, Paraguay, Brazil, Italy, Argentina, Australia, Costa Rica, Spain, India, Sudan, and Pakistan. However, FAO data for jojoba production specifically cites Mexico, where 140 tons of jojoba seeds were produced in 2020 (Arya and Khan, 2016).

3. PHYSIOLOGY AND MORPHOLOGY OF JOJOBA PLANT

Jojoba, a robust and distinctive shrub, exhibits unique morphological features suited to its desert habitat. Characterized by a lifespan of 100-200 years, this dioecious evergreen typically reaches a height of 60-90 cm, though it can grow up to 2-3 m with proper irrigation, thriving at altitudes between 600-1200 m. Noteworthy adaptations include leathery gray-green leaves designed to

minimize water loss, deep roots extending 9-10 m into the soil, and resilience to drought conditions in well-drained sandy soils. Jojoba's small, green-yellow flowers are clustered on both male and female plants. The reproductive structures yield large capsules enclosing valuable liquid wax and seeds, with the seeds containing approximately 50% oil by volume. Jojoba's oil, rich in vitamin E, is a sought-after commodity. The plant's hardiness is reflected in its ability to withstand high temperatures (10-40°C) during photosynthesis, with optimal vegetative development occurring between 28-33°C. While jojoba can endure temperatures as low as -9°C, frost-free areas are preferable for cultivation, requiring at least one month of cool winter temperatures for blooming and fruit setting. Successful cultivation demands an average January temperature of 16.7 ºC or higher, ensuring temperatures do not fall below 3.8 ºC during cold winter months, and an average July temperature above 25.46 ºC but not exceeding 33.44 ºC. Optimal growth occurs in locations with a daily or more extended vegetation period. Jojoba cultivation thrives with an annual rainfall of 500 mm, displaying adaptability to various soil types with good water permeability and drainage (Ayanoğlu, 2001; Arya and Khan, 2016; Al-Obaidi et al. 2017; Gad et al. 2021; Aboryia et al., 2022).

4. ADVANTAGES OF JOJOBA CULTIVATION

The increasing challenges posed by climate change and environmental pollution, such as increased soil salinity and water scarcity, underscore the need for resilient crops. Jojoba, with its exceptional hardiness, emerges as a promising solution, exhibiting unique tolerance to saline soils, including those with elevated sodium chloride levels. This adaptability strengthens Jojoba as a multipurpose oilseed crop suitable for various agricultural landscapes (Abobatta, 2021).

The successful germination of Jojoba under challenging soil conditions, particularly in arid and semi-arid regions facing alkalinity and nutrient deficiencies, fills a crucial position where

traditional crops encounter difficulties. Its adaptability extends to temperate climates, capitalizing on temperature fluctuations between day and night for robust growth (Abusaief et al., 2021).

The evergreen nature of jojoba bushes not only adds aesthetic value but also practicality, as its leaves and thin branches are suitable for animal consumption, enhancing its agricultural utility (Abdel-Wareth et al., 2022). Beyond traditional applications, jojoba seeds offer a dual-use advantage—they are not only edible but also present opportunities for innovative biogas production. This dual-purpose characteristic amplifies the flexibility of Jojoba and its economic value, positioning it as a preferred choice for regions facing water scarcity and formidable agricultural challenges (Sandouqa and Hamamre, 2021).

5. CHALLENGES FACED IN JOJOBA CULTIVATION

While jojoba cultivation offers numerous benefits, overcoming specific challenges requires dedicated research and targeted breeding programs. Addressing these hurdles will contribute to the continued improvement and sustainability of jojoba cultivation practices. Here are some of these challenges:

5.1. HARVEST

One of the key factors contributing to the elevated production expenses of jojoba is the cost associated with harvesting. Typically carried out manually, the harvesting process incurs higher expenses, particularly in regions where labor wages are comparatively elevated, thereby impacting overall production costs (El-Emam et al., 2019).

5.2. ECONOMIC SUSTAINABILITY OF SEED PROPAGATION

Cultivating jojoba through seed-based methods (sexual propagation) proves economically impractical for farmers. Seed-grown plants tend to have a significant male-to-female ratio (5:1), leading to reduced seed fertility. In addressing these challenges, the use of vegetative propagation through stem cutting is favored; however, it lacks sexual recombination, potentially causing a loss of genetic diversity. Additionally, not all clones reproduce uniformly, contributing to the gradual loss of valuable genetic variations (Al-Obaidi et al., 2017).

5.3. GENETIC DIVERSITY MANAGEMENT

Maintaining genetic diversity poses a critical challenge in jojoba cultivation. Human-induced activities, habitat modifications, and domestication contribute to a decline in the effective population size of plant species, leading to the loss of genetic diversity and the potential threat of extinction. Balancing vegetative and reproductive cultivation is essential for successful jojoba farming. Proper strategies must be implemented to ensure effective propagation, considering challenges related to seed fertility, male-to-female ratios, and the need for genetic diversity (Inoti, 2017).

5.4. DIOECIOUS PLANT CHARACTERISTICS AND LONG JUVENILITY PERIOD

Jojoba, characterized as a dioecious plant, exhibits distinct male and female flowers on separate individual plants. Assessing genetic diversity separately in male and female genders proves beneficial for targeted breeding initiatives. Nevertheless, the protracted period (3-5 years) it takes for Jojoba plants to reach the flowering stage poses challenges for farmers in promptly discerning the gender of plants, impacting strategic planting decisions (Mohei et al., 2023).

6. ADDRESSING DIOECIOUS PLANT TRAITS: PROGRESS IN JOJOBA SEX DETERMINATION

The occurrence of sex separation in dioecious plants, such as jojoba, reflects an evolutionary strategy conferring selective advantages. Dioecious species, spanning various plant families and environments, represent distinct resource requirements for male and female plants owing to their specific reproductive functions. Natural selection for reproductive success is pivotal in shaping sexual differentiation, offering deep insights into plant evolutionary biology. Exploration of sexual differentiation and sex-specific chromosomes in dioecious species unravels essential details about the genetic foundations of these processes. While sex chromosomes in dioecious plants may seem indistinguishable, notable variations exist, with diverse patterns observed across plant species (Kafkas et al, 2015). Establishing the genetic basis of sexual dimorphism in jojoba necessitates reference genomes for both male and female plants. A recent study sequencing the genomes of male and female jojoba plants unveiled a notable distinction in their sex chromosomes. The larger male genome assembly, primarily attributed to significant differences in the Y chromosome, featured sex-specific regions harboring novel genes linked to flowering and stress response. The extensive diversity of sex chromosomes in jojoba implies an extended period of adaptation to distinct sex-specific roles. Evolutionary forces have facilitated the accumulation of numerous novel sex-specific genes, constituting a valuable gene resource for manipulating reproductive performance and environmental adaptation in crops (Sharma et al, 2008; Kumar et al, 2019).

7. SIGNIFICANCE OF MICROPROPAGATION IN JOJOBA CULTIVATION: ADDRESSING SEED SEX RATIO CHALLENGES

The significance of micropropagation in jojoba cultivation becomes obvious when considering the limitations associated with direct seeding. Direct seeding introduces genetic heterogeneity, with approximately half of the seedlings being male, leading to challenges for efficient pollination. Although establishing a plantation using asexual propagules may involve higher initial costs compared to seeds, it provides advantages such as time savings in replanting and the ability to cultivate crops of known sex and lineage. Vegetative propagation methods such as layering, grafting, or rooting semi-hardwood cuttings are alternative approaches; however, their effectiveness is limited by plant size and time of year. In contrast, micropropagation exploits the totipotency of plant cells, especially elite individuals, and provides a promising route for commercial mass production of pathogen-free superior clones. In vitro-derived jojoba plants display higher growth vigor, emphasizing the potential of micropropagation to overcome traditional propagation limitations and contribute to the cultivation of high-performance jojoba clones (Tyagi and Prakash, 2004; Llorente and Apóstolo, 2013).

8. POTENTIAL GROWTH OPPORTUNITIES OF JOJOBA IN TURKEY

Jojoba cultivation holds considerable promise in Turkey, particularly in regions closely resembling its natural habitat characterized by heat, drought, and semi-arid conditions. The Southeastern Anatolia Region, known for its warm temperatures and arid-semi-arid climate, and Turkey's Mediterranean Region, featuring hot and dry summers, emerge as favorable areas for jojoba cultivation. Despite potential challenges in the Central Anatolia Region, milder climates and suitable soil conditions present opportunities. Previous successful jojoba growth in coastal areas of the Mediterranean and Aegean regions underscores the plant's adaptability.

Focusing on further research and exploration in these identified regions is crucial to unlocking Turkey's substantial potential in cultivating this valuable plant. Jojoba cultivation is particularly recommended for dry areas unsuitable for conventional agriculture, such as the Mediterranean and Aegean regions, characterized by poor organic matter, calcareous soils without salinity issues, and light soils. Its root structure also makes it well-suited for sloping lands with erosion problems in these areas (Ayanoğlu, 2001). Cultivating jojoba in Turkey encounters challenges including limited awareness, particularly among farmers, agricultural priorities influenced by market demands, economic considerations, and the need for increased research and development investments.

9. CONCLUSION

In conclusion, jojoba exhibits significant potential in agriculture, offering solutions to cultivation challenges. While addressing specific hurdles like seed sex ratio and genetic diversity, it presents a promising opportunity for sustainable farming in Turkey. By overcoming these challenges through targeted research and adopting appropriate cultivation practices, Turkey can harness the full potential of jojoba in its agricultural landscape.

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HISTORY OF CLASSICAL ECONOMIC THOUGHT

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ABSTRACT

This research aims to examine the history of classical economic thought. This research is library research with a qualititative approach. The data sources used in this research come from various literature journal articles that are relevant to the research topic. The data analysis method used is content analysis of the literature sources used in the research. The results of this research is classical economics is generally regarded as the first modern school in the history of economic thought. The main thinkers and developers of this school include Adam Smith, Jean Baptiste Say, David Ricardo, Thomas Malthus and John Stuart Mill. This school was prominent until the mid-19th century, and was then replaced by neoclassical economics, which was born in Great Britain in 1870. The classical school emerged in the late 18th and early 19th centuries during the industrial revolution. The idea espoused by the classical school that output and price equilibrium can only be achieved if the economy is at full employment can only be achieved through the operation of free market mechanisms. In the history of economic theory, classical

economics is typically recognized as the first modern school. The Wealth of Nations had a significant impact since it contributed to the systematic and independent development of economics as a subject. According to classical economics, the free market will govern itself if no one interferes. This is what Adam Smith referred to as the "invisible hand" in metaphor, which would steer markets toward their equilibrium without outside intervention. The main problem of classical economics is a problem consisting of three main problems of classical economic theory, namely production, distribution, and consumption.

Keywords: history, economic, and classical

INTRODUCTION

In the history of economic theory, classical economics is typically recognized as the first modern school. Adam Smith, Jean Baptiste Say, David Ricardo, Thomas Malthus, and John Stuart Mill are some of the principal theorists and innovators of this school. This school was dominant until the middle of the 19th century, when neoclassical economics, which was created in Great Britain in 1870, took its place. Numerous academics disagree on what really constitutes classical economics, especially with regard to the years 1830–1870 and the development of neoclassical economics during this time. Ricardian economics, the school of thought founded by David Ricardo, James Mill, and their forebears, is the branch of economics to which the word "classical economics" originally belonged. Later on, though, the phrase came to be used to describe all of Ricardo's adherents.

The classical school of economics is thought to have started with Adam Smith's publication of The Wealth of Nations in 1776.5 In the history of economic theory, classical economics is typically recognized as the first modern school. The Wealth of Nations had a significant impact since it contributed to the systematic and independent development of economics as a subject. According to classical economics, the free market will govern itself if no one interferes. This is what Adam Smith referred to as the "invisible hand" in metaphor, which would steer markets toward their equilibrium without outside intervention.

MATERIAL AND METHODS

The research method used in this article is to use descriptive methods, namely through data collection techniques through literature studies and reference analysis. The literature study method, is a series of activities related to library data collection methods, reading and recording and managing research materials, where data and information sources are managed on various

sources that have been collected on literature studies related to the history of classical economic thought.

RESULTS AND DISCUSSION

History of classical economic thought

The term classical was first introduced by Karl Max, which was expanded by John Maynard Keynes, because the idea of individualism, no different from hedonism, had been discussed since ancient Greece. The classical school emerged at the end of the 19th century during the industrial revolution.

Beliefs of adherents of the classical school of thought:

1. The market will have the ability to self-correct or self-adjust or self-regulate.
2. Market law from Jean Baptiste Say, supply will create its own demand, always applies to the economy as a whole.
3. Price and wage levels in the economy are quite flexible, so they can quickly adjust to conditions.

Adam Smith is considered a milestone in the birth of modern economics because his work entitled The Wealth of Nations raised economic freedom and the invisible hand so that the economic system runs well.

Classical Economic System And Its Characters

Characteristics of the classical economic system:

1. The economy has a free enterprise system, meaning it automatically returns to equilibrium position by itself.

2. In the system, the government does not intervene. The role of government is to enforce the law and build economic supporting infrastructure.
3. Sellers and buyers automatically form a market price for goods the.
4. Wage levels are determined based on the law of demand and the law of supply of energy work.

Adam Smith (1723-1790)

Adam Smith was born in Scotland in 1723. Smith's works other than The Wealth of Nations, is The Theory of Moral Sentiments published in 1759 and notes from when he was a student in 1763, namely Lectures on Justice, Police, Revenue and Arms. Smith was one of the pioneers of the capitalist economic system. this economic system appeared in the 18th century in Western Europe and in the 19th century became famous there.

Smith's thoughts include:

1. Strongly supports minimal government interference as possible economy. There is an invisible hand that brings the economy to life balance.
2. Smith believed that population growth would increase output per capita by expanding the division of labor.
3. Smith supported international free trade between countries. Free trade will benefit England because it will allow companies to get cheaper goods from abroad. This in turn will reduce the production costs of exported goods.
4. Smith rejected monopoly power that would destroy the market.
5. Establish a tax system to finance public expenditure. Smith argued that taxes must be proportional.
6. The need for capital accumulation by saving and investing capital as an important key to economic growth. Capital investment as the best way to obtain maximum profits and

create prosperity for the people.Smith emphasized the importance of accumulation capital to achieve economic growth and prosperity.

7. The population will increase along with higher wage levels subsistence wage level. The population will remain constant if subsistence wages are stationary.

Jeremy Bentham (1748 -1832)

Jeremy Bentham was born in London in 1748. Bentham is known as an expert philosopher and social reformer. His contribution to economics is about satisfaction (utility). Bentham's work entitled Introduction to The Principles of Morals and Legislation, which implies that the principle of satisfaction (utilitarianism) is a principle moral. According to Bentham, what should be done is to maximize happiness and minimize sadness.

Bentham's thoughts in the book Defense of Ursury published in 1787 about interest rates. Bentham stated that there was no need to regulate prices because of usage money rather than the price of goods. Bentham also argued that prohibitive laws the practice of usury because there is a group of people who agree to pay interest rates so high that it is difficult to assume that usury is a violation.

Thomas Robert Malthus (1766-1834)

Malthus was born in England in 1766. In 1805, Malthus became became the first professor of political economy at the East India Company Colledge at Haileybury, Hertfordshire, England.

Malthus's first work, An Essay on the Principle of Population, was published in 1798. Malthus made the famous prediction that the population would overpowers the food supply, leading to a reduction in the amount of food per people. Land is the main production factor

whose number is fixed, while humans develops according to a geometric series and economic growth according to an arithmetic series. So that in the future various problems will arise in society, namely because impact of population pressure.Malthus explains that to overcome this problem is to carry out control or monitoring population growth. The solution offered is to postpone age marriage and reducing the number of children.

Principles of Political Economy as another work, written by Malthus in in 1820. Malthus argued that capitalist income was greater than investment. Capitalists prefer to save their income rather than invest in it. So Malthus proposed that the state change the distribution of income, so that people capitalists receive a smaller income and landowners receive a lot income. Jean Baptiste Say (1767 – 1832)

Say comes from France, which really worships Adam Smith. I was instrumental in doing it codification of Smith's thinking and summarized in his book Traite d'Economie Politique in in 1803, and supported the ideology of laissez faire.

Say's greatest contribution to the classical school was 'every offering will creates its own demand' or known as supply creates its own demand. This opinion is often called Say's Law. Say's Law is based on the assumption that Production value always equals income. Thus, in a state of balance, production tends to create its own demand.

1. Say built new ground in the classical economic model in four areas, that is: Arrange theory testing with facts and observations. According to Say, theories and models must be continually tested in the face of facts and observation.
2. Construct a subjective utility theory as a replacement for the labor theory of value. Say states that in determining the price or value of goods or services is the utility, right? the cost.

3. Say introduced the term entrepreneur. Entrepreneurs are economic agents who seek maximum profit by searching great opportunity.
4. Say's market law is the basis for macro models in business fluctuations and economic growth.

Robert Owen (1771 – 1858)

Owen was a social practitioner and economic reformer who was born in England in 1771.Owen was a utopian socialist. Owen's main contribution was behavioral Human society is not fixed or absolute and humans have free will to organize themselves into whatever form of society they desire.

1. Owen's work published in 1813, A New View of Society, an Essay on the Formation of Human Character, states that the social environment influence on the formation of human character.
2. Owen also established a general public fund, to which his workers donated one-sixth of his wages and these funds are used to maintain facilities free healthcare.
3. Owen also stopped working children under the age of 10 at his company, and they are provided with free education.
4. Owen was the originator of the birth of communities. The community produces goods for their own living needs and buy as little as possible from outside.

David Ricardo (1772-1823)

David Ricardo is an English political economist who was born in 1772. Ricardo is considered to make economics a solid science that involves precision math calculations.mathematics to solve economic problems was then followed by John Maynard Keynes, Paul Samuelson, Milton Friedman so that econometric models became popular.

Ricardo's famous theory is the theory of comparative advantage. Trading depends on comparative advantage or relative efficiency rather than absolute advantage. Countries will tend to sell goods that are relatively more efficient in their production. So that through specialization, each country will gain benefits from trade overseas.

Ricardo's most famous work is Principles of Political Economy and Taxation which was published in 1817. In this book, Ricardo argued that government spending is wasteful, and hinders capital accumulation as well growth in labor demand.

Ricardo also put forward a theory of income distribution which contains three elements that is:

1. Rental theory. The theory of rent put forward by Ricardo refers to Malthus's theory, namely differential rent theory. Rent comes from differences in soil fertility. When the land as fertility decreases, differential rent will increase.
2. Theory of wages. According to Ricardo, workers' wages depend on subsistence needs namely the minimum requirements needed for workers to survive.
3. Profit theory. Profit or profit is the residue after capitalists pay wages their workers and pay rent to landowners.

Antoine Augustin Cournot (1801-1877)

Cournot was born in France in 1801. Cournot was one of the founding fathers economic mathematics to analyze economic problems. His work is entitled Recherches sur les principes mathématiques de la Théorie des richesses or Reseraches into the Mathematical Principles of The Theory of Wealth published in 1838.

The analytical progress promoted by Cournot concerns the development of concepts and micro analysis model, namely:

1. Demand analysis

2. Analysis of cost and production determination by the company
3. The first analysis of how markets achieve equilibrium
4. Cournot was the first to distinguish between variable costs and fixed costs.
5. Cournot's view of how monopolists should behave to maximize profits
6. Only with perfect competition will sellers not be able to change the market price by changing the quantity supplied.

Cournot explains these concepts through mathematical calculations. Form specific functional or translating qualitative analysis into mathematical language implemented it.

John Struart Mill (1806 – 1873)

Mill was born in London in 1806. Mill was an active writer. His work is A System of Logic was published in 1843, On Liberty was published in 1859, which is the defense of individual freedom against all efforts to level society, Essay on Some Unsettled Questions of Political Economy published in 1844, as well Principles of Political Economy With Some of Their Applications to Social Philosophy appears in 1848.

Mill's famous concept in economics is about returns to scale, the idea of elasticity of demand, the existence of trade-offs resulting in mismatches in an economy, as well as opportunity costs.

Mill offers a new ideology in modern economics, where market laws must be respected, to understand the forces of supply and demand, the forces of trade and think how things will happen without forgetting the role of government and without forgetting the people who are at the center of these systems and goals.

Classic economic problems

There will be issues with the economic system itself based on the traits of the classical economic system, including:

1. Production issues

The creation of a product is the first fundamental economic conundrum. In order to avoid overproducing or underproducing in the market, producers—in this case, companies—must accurately forecast the goods and services that consumers will require as well as the quantity that will be produced. manufactured to ensure that the market is free from surplus or deficiency. This causes the production problem to consider the production projection more.

2. Distribution issues

Secondly, managing and resolving distribution issues and guaranteeing that commodities are supplied to customers in a quantity, on schedule, and with safety in mind. Goods can be delivered to customers in the proper amount, on schedule, and with no risk to quality.

3. Economi issues

The hardest issue to solve is whether a product will be effectively used and eaten as needed, or if it will be wasted because the market doesn't need it or because the product is too expensive for the average consumer. Therefore, consumers also need to be able to grow their income in order to be able to buy the sold and necessary commodities, therefore the problem is not just with producers since they are confused about production.

CONCLUSION

Classical economics is generally regarded as the first modern school in the history of economic thought. The main thinkers and developers of this school include Adam Smith, Jean Baptiste Say, David Ricardo, Thomas Malthus and John Stuart Mill. This school was prominent

until the mid-19th century, and was then replaced by neoclassical economics, which was born in Great Britain in 1870.

The classical school emerged in the late 18th and early 19th centuries during the industrial revolution. The idea espoused by the classical school that output and price equilibrium can only be achieved if the economy is at full employment can only be achieved through the operation of free market mechanisms.

The main problem of classical economics is a problem consisting of three main problems of classical economic theory, namely production, distribution, and consumption.

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BAZI AROMATİK BİTKİ POSALARININ SİLAJ OLARAK DEĞERLENDİRİLMESİ

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ÖZET

Bu çalışmanın amacı aromatik bitki posalarının silaj olarak kullanılabilirliğini belirlemektir. Değişen miktarlarda yonca kuru otu ve mısır, silolama sırasında kıyılmış aromatik bitki posaları ile karıştırılmıştır. Bu amaçla dört tekerrürlü dört farklı silaj hazırlanmıştır. Silajların ana bileşenleri sırasıyla kekik (*Origanum vulgare*) posası (OvP), zufa (*Hyssopus officinalis*) posası (HoP), altın otu (*Helichrysum italicum*) posası (HiP) ve lavanta (*Lavandula angustifolia*) posası (LaP) olmuştur. Silaj kavanozları 45-60 gün sonra açılarak fiziksel ve kimyasal değerlendirmeleri yapılmıştır. Kuru madde düzeyi HoP ve LaP silajlarında OvP ve HiP silajlarından yüksek bulunmuştur ($P<0.05$). Ham protein içeriği en yüksek Ho silajı olurken bunu sırasıyla HiP, LaP ve OvP grupları izlemiştir ($P<0.05$). Ham yağ ve ham kül oranı en yüksek HoP silajlarında bulunurken en düşük ham yağ HiP ve ham kül HiP ve OvP silajlarında belirlenmiştir ($P<0.05$). Gruplar arasında ADF ve NDF bakımından önemli bir farklılık bulunmamıştır ($P>0.05$). pH değeri 4.76 ile en yüksek HoP silajında belirlenirken en düşük 4.08 ile HiP silajında belirlenmiştir ($P<0.05$). Fleig skoru ise en yüksek HiP silajında olurken sırasıyla LaP, OvP ve HoP silajlarında belirlenmiştir ($P<0.05$). Elde edilen bulgular atık ürün olarak ortaya çıkan aromatik bitki posalarının silaj yapılarak değerlendirilebileceğini göstermektedir. Ancak hayvan beslemede alternatif yem kaynağı olarak kullanılabilirliğini belirlemek için hayvanların beslenme davranışları, istekli yem tüketimi ve performans üzerine etkilerinin incelendiği in vivo çalışmalara ihtiyaç vardır.

Anahtar kelimeler: Kekik, Zufa, Altınotu, Lavanta, Silaj, Alternatif Kaba Yem

EVALUATION OF SOME AROMATIC PLANT PULPS AS SILAGE

ABSTRACT

The aim of this study was to determine the usefulness of aromatic plant pulps as silage. Varying amounts of alfalfa hay and maize were combined with minced aromatic plant pulps during ensilage. For this purpose, four different silages were prepared in four replicates. The main components of the silages were *Origanum vulgare* pulp (OvP), *Hyssopus officinalis* pulp (HoP), *Helichrysum italicum* pulp (HiP) and *Lavandula angustifolia* pulp (LaP), respectively. After 45-60 days, the silage jars were opened and physical and chemical evaluations were conducted. The dry matter level was higher in HoP and LaP silages compared to OvP and HiP silages ($P<0.05$). HoP silage had the highest crude protein content, followed by HiP, LaP, and OvP groups ($P<0.05$). The highest ether extract and ash content was observed in HoP silages, whereas HiP had the lowest ether extract, and HiP and OvP had the lowest ash ($P<0.05$). There was no significant difference observed among groups regarding ADF and NDF levels ($P>0.05$). The pH value was highest in HoP silage with a value of 4.76 and lowest in HiP silage with a value of 4.08 ($P<0.05$). The Fleig score was highest in HiP silage and lowest in LaP, OvP and HoP silages, respectively ($P<0.05$). The obtained findings demonstrate that aromatic plant pulps, which are waste products, have potential usage in silage production. However, in vivo studies evaluating feeding behaviour, voluntary feed intake and animal performance are required to establish their suitability as an alternative feed source.

Keywords: *Origanum vulgare*, *Hyssopus officinalis*, *Helichrysum italicum*, *Lavandula angustifolia*, Silage, Alternative Forage

INTRODUCTION

Using non-food products derived from agricultural crops as animal feed enhances food security and also helps to alleviate environmental issues caused by their disposal. Moreover, such practices are likely to decrease feeding costs and increase profits for animal breeders.

Due to the ban on antibiotics, medicinal and aromatic plants have emerged as a key alternative in animal feed. Research demonstrates that including immune-enhancing, antimicrobial and antiseptic substances in rations can effectively reduce the use of antibiotics, even in cases of disease treatment procedures. Secondary metabolites (essential oils) obtained from aromatic plants have the following effects on ruminants; reducing energy loss by increasing the production of volatile fatty acids in the rumen, facilitating the digestion of difficult-to-digest nutrients such as cellulose and lignin, stimulating rumen microbial activity, changing the course of rumen fermentation in favour of the ruminant, having positive effects on rumen development, being alternative methane inhibitors, contain flavouring and appetising compounds, have antimicrobial, antiviral, antioxidant, sedative, bactericidal, fungicidal and antiparasitic effects against various microorganisms, anticarcinogenic and immune system enhancing properties (Kaçmaz, 2021). After extracting essential oil from medicinal and aromatic plants using methods such as distillation, extraction, multidirectional extraction or mechanical methods, the remaining pulp can be used by breeders in regions where essential oils are produced as a source of roughage due to their high nutrient content. Additionally, the presence of residual essential oils in the pulps is believed to improve the quality of the roughage. For this reason, it is important to investigate alternative roughage types.

Our country's geographical location allows for cultivating various medicinal and aromatic plants, including thyme and lavender, both of which belong to the Lamiaceae family. Castillejos et al. (2008) reported that thymol and carvacrol from polyphenols contribute to

thyme's antimicrobial effect. It was reported that animal feed supplemented with thyme, rosemary, hyssop, sage, and clove oil increased propionate and valerate ratios and decreased acetate to propionate ratio and butyrate levels. The thyme plant was also found to increase the concentration of rumen volatile fatty acids while decreasing ammonia nitrogen levels and pH. However, it should be noted that thyme essential oil contains 78-80% thymol and polyphenols, leading to a decrease in the thymol and polyphenol content of thyme pulp, a byproduct of the plant. Hyssop herb belongs to the Lamiaceae family. Due to their essential oils are used as preservatives in cosmetics and the food industry. They are used to increase the shelf life of foods. Golden grass herb is a perennial plant that belongs to the Asteraceae family. It contains tannins and curcumine. Tannins are considered antinutritional substances. However, when used in limited quantities not exceeding 5%, their consumption enhances feed utilisation and inhibits enteric fermentation in the rumen. Coumarin is a phytochemical that carries anticarcinogenic and antimicrobial characteristics. Lavender, a herbaceous plant that yields high-quality essential oil, is frequently used in the cosmetics and pharmaceutical industries. The essential oil of this plant exhibits an inhibitory effect on methane gas formation in the rumen. Studies have demonstrated that incorporating it as an additive in silages aids in the maturation process by providing support to the beneficial bacteria present in the silage content.

In light of the available information, the present study examined the potential for ensiling aromatic plant pulps - the waste byproducts of essential oil extraction - and evaluated the nutritional values of the resulting silages.

MATERIALS and METHODS

Origanum vulgare pulp (OvP), *Hyssopus officinalis* pulp (HoP), *Helichrysum italicum* pulp (HiP) and *Lavandula angustifolia* pulp (LaP) were obtained from the Medicinal and

Aromatic Plants Laboratory of the Department of Field Crops at Eskişehir Osmangazi University Faculty of Agriculture. The pulps were subsequently brought to the Department of Animal Science Laboratory at the same university and cut into pieces roughly 3-5 cm in length. Due to the high water content in all pulps (as feed weights 16.61%, 21.64%, 21.70% and 16.55% for OvP, HoP, HiP and LaP, respectively), alfalfa hay with 90.01% dry matter weight and maize with 86.46% dry matter weight were added to the silages and mixed to provide 33% dry matter in the silage raw material and ensiled in 1 kg glass jars in an airtight manner. Four groups with four replicates were created for this study. The groups were comprised of *Origanum vulgare* pulp at 87.55%, alfalfa hay at 7.84%, and maize at 5% (OvP); *Hyssopus officinalis* pulp at 79.61%, alfalfa hay at 15. 38%, and maize at 5% (HoP); *Helichrysum italicum* pulp at 85.55%, alfalfa hay at 10.30%, and maize at 5% (HiP); and *Lavandula angustifolia* pulp at 78.65%, alfalfa hay at 16.34%, and maize at 5% (LaP). The silage jars were allowed to ferment for 45-60 days before being opened for physical and chemical evaluations. Nutrient composition and cell wall components were analyzed following the procedures and equipment described by Kandemir and Kop-Bozbay (2023), which were identical to those used in our study. To investigate feed quality of pulp silages, Relative Feed Value (RFV) and RFV grade were determined using dry matter digestibility and dry matter intake data (Van Dyke and Anderson, 2000) by Rohvveder et al. (1978). The Flieg quality score and grade were determined following the methodology established by Kılıç (1986). pH measurements were obtained utilizing an electronic pH meter (HANNA Instruments HI2002-02).

The data were analyzed in SPSS 17.0 package program. The Kolmogorov-Simirnov test was applied for the data's normality assumption, and the variances' homogeneity was evaluated with the Levene test. The data of the study were subjected to a one-way analysis of variance. Duncan test, one of the multiple comparison tests, was used.

RESULTS and DISCUSSION

The nutrient composition, cell wall components and metabolic energy of aromatic plant pulps, alfalfa hay and maize used in the study are given in Table 1.

Table 1. Nutrient composition (%), cell wall components (%) and metabolic energy (kcal/kg DM) of silage materials

Material	DM	CP	EE	Ash	ADF	NDF	ME
Origanum vulgare pulp	92.83	12.80	3.84	7.34	33.70	41.96	2066
Hyssopus officinalis pulp	93.42	18.04	1.83	10.45	26.60	36.32	2291
Lavandula angustifolia pulp	93.02	11.48	1.88	8.99	36.24	51.57	1986
Helichrysum italicum pulp	89.88	8.01	1.94	3.63	43.80	50.34	1746
Alfalfa hay	91.98	16.77	1.20	7.73	34.35	41.00	2045
Maize	88.00	8.80	3.52	1.28	3.21	8.05	3030

DM: Dry matter; CP: Crude protein; EE: Ether extract; ADF: Acid detergent fiber; NDF: Neutral detergent fiber.

The nutrient composition, cell wall components, metabolic energy and relative feed values of silage groups are shown in Table 2. The dry matter level was higher in HoP and LaP silages compared to OvP and HiP silages ($P<0.05$). HoP silage had the highest crude protein content, followed by HiP, LaP, and OvP groups ($P<0.05$). The highest ether extract and ash content was observed in HoP silages, whereas HiP had the lowest ether extract, and HiP and OvP had the lowest ash ($P<0.05$). No significant difference was observed among groups regarding ADF, NDF and ME levels ($P>0.05$). The RFV calculated by using dry matter digestibility and dry matter intake values were not affected by the treatments ($P>0.05$).

Table 2. Nutrient composition (%), cell wall components (%), metabolic energy (kcal/kg DM) and relative feed values (RFV, %) of silage groups

Silage	DM	CP	EE	Ash	ADF	NDF	ME	RFV	RFV grade
Origanum vulgare pulp	30.90^{b}	11.43^{d}	3.13^{ab}	6.75^{c}	35.83	43.27	1999	131.06	High
Hyssopus officinalis pulp	33.99^{a}	15.88^{a}	3.34^{a}	8.00^{a}	37.45	42.69	1947	130.59	High
Lavandula angustifolia pulp	32.69^{a}	12.52^{c}	2.98^{b}	7.15^{b}	37.45	42.60	1947	131.25	High
Helichrysum italicum pulp	31.18^{b}	13.12^{b}	2.57^{c}	6.84^{c}	34.52	45.28	2040	127.41	High
P	0.001	0.000	0.000	0.000	0.381	0.099	0.595	0.889	
SEM	0.358	0.396	0.074	0.123	0.684	0.441	26.747	1.845	

DM: Dry matter; CP: Crude protein; EE: Ether extract; ADF: Acid detergent fiber; NDF: Neutral detergent fiber. SEM: standard error of the mean, a,b: within a row, means with different superscripts differ significantly (P<0.05).

Table 3 demonstrates the significant effect of treatments on the pH and Flieg quality score values of silage groups (P<0.05). The highest pH value was observed in HoP at 4.76, followed by OvP, LaP, and HiP silages (P<0.05). The Fleig score was highest in HiP silage and lowest in LaP, OvP and HoP silages, respectively (P<0.05).

Table 3. pH and Flieg quality score values of silage groups

Silage	pH	Flieg quality score	Flieg quality score grade
Origanum vulgare pulp	4.63[b]	85.90[c]	Very good
Hyssopus officinalis pulp	4.76[a]	80.80[d]	Good
Lavandula angustifolia pulp	4.52[c]	90.40[b]	Very good
Helichrysum italicum pulp	4.08[d]	07.90[a]	Very good
P	0.000	0.000	
SEM	0.059	2.367	

SEM: standard error of the mean; a,b: Within a row, means with different superscripts differ significantly (P<0.05).

Using agro-industrial by-products as feed can reduce costs and mitigate environmental pollution (Sadh et al., 2018). Among these products, medicinal and aromatic plant pulps need to be preserved due to their high water content to be stored for a long time and used as feed for animals. Silage is a suitable technique for this purpose. Unless procedures are implemented to decrease the moisture content to below 12% through drying, silage will be the most feasible approach for preserving medicinal and aromatic plant pulps. Silages offer ruminant diets with energy, protein, and easily digestible fibre (Grant and Adesogan, 2018).

To assess the quality of silage feeds, it is crucial to evaluate the dry matter and physical characteristics (Alçiçek and Özkan, 1997). The dry matter reflects the quantity of nutrients a specific feed provides the animal. In other words, nutrients (energy, protein, minerals and vitamins) are present in the dry matter of the feed. Considering that the dry matter content of the highest quality maize silages is between 25-32% (Kılıç, 1986), all the silages obtained in the present study can be considered as good quality in terms of dry matter content, and this shows that the ensiling potential of medicinal and aromatic plant pulps is high.

The variations in nutrient composition can be ascribed to the substance content. Notably, the HoP silage with the highest crude ash content exhibited the superior crude ash content. This linear correlation was evident across all groups, affirming our standpoint. Furthermore, the differences among groups in terms of crude protein contents indicated that the crude protein contents of the raw materials used were linearly impacted. The crude protein level in animal feed is key to determining feed quality (Gillen and Berg, 1998). Ruminant diets necessitate a minimum of 7-8% crude protein on a dry matter basis to maintain healthy microbial activities (Van Soest 1994). As a result, it can be said that the silages obtained in this study are high quality forage.

The RFV index is a widely used tool for comparison of feed varieties and prices, aiming to assess feed quality objectively. It should be noted that RFV values represent feed quality, with higher values indicating better quality, as reported by Jeranyama and Garcia (2004). The feed's crude protein content is not considered when calculating RFV, but higher RFV values are generally associated with higher protein (Stallings, 2006). The present study confirms these findings.

One of the significant factors impacting ensiling fermentation is pH. In quality silage, pH must range between 3.8-4.2. The pH values in the silages produced in the research demonstrated pH levels above acceptable thresholds for quality silages, except for HiP silage. Besides, HiP silage registered the highest score in Fleig score values utilized to assess silage quality.

Comparing the results from the present study with the data presented in the literature is challenging as no studies on silages made from medicinal and aromatic plant pulps exist. Nevertheless, adding dried thyme pulp to grass and alfalfa silages improved silage quality in a study (Aksu et al., 2017). Literature research on golden grass needed to yield more findings

regarding its use in animal nutrition science. Due to the tannin content of golden grass, it is important to limit the total tannin content of the feed to 5% to enhance feed utilization. Furthermore, it prevents enteric fermentation in the rumen by suppressing protozoa in the rumen microflora, which in turn prevents the activity of methanogen microorganisms. Apart from tannins, golden grass contains certain coumarins which have anticarcinogenic and antimicrobial properties. For these reasons, golden grass displays antioxidant effects in silages (Şen and Kalaycı, 2016). Studies have shown that adding rosemary, hyssop, sage, and clove oil to rations increased propionate and valerate ratios while decreasing the acetate/propionate ratio and butyrate levels.

On the other hand, using the thyme plant in silage increased rumen UYA and reduced ammonia nitrogen and pH (Castillejos et al., 2008). Duru (2019) discovered that incorporating lavender into alfalfa silage prevented dry matter losses by impeding the formation of unwanted components. Moreover, the proportion of NDF increased with the amount of lavender in the silage because of the lavender stem's high NDF ratio.

CONCLUSIONS

The inadequacy of feed resources in terms of quantity and quality and the fact that most of them are expensive have led feed producers and animal nutritionists to find new and alternative feed resources and to conduct research on these resources (Özdüven et al., 2005). In this context, silages obtained from medicinal and aromatic plant pulps can be used as alternative feed especially because of the phytochemicals they contain. However, in vivo studies evaluating feeding behaviour, voluntary feed intake and animal performance are required to establish their suitability as an alternative feed source.

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AN ECO-FRIENDLY APPROACH TO CONTROL INSECT PEST: NANOPESTICIDES

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ABSTRACT

Chemical control methods are preferred to control pests that cause a decrease in the quality and efficiency of agricultural products. However, excessive and uncontrolled use of chemicals causes insect pests to develop resistance, leaves residues in plants and soil, causing environmental pollution and serious health problems. For this reason, scientists are investigating environmentally friendly and reliable control methods as an alternative to chemical methods. Nanotechnology science, which is considered the revolution of the 21st century, is an interdisciplinary science that finds application in many branches of science, including medicine, food, pharmacology, textile, electronics, pharmaceuticals and agriculture. In agricultural applications, nanotechnology is used in areas such as plant and animal breeding, detection and prevention of plant diseases, reduction of pesticide use, pesticide and fertilizer production, and detection of toxic agricultural drugs. Nanopesticides, developed using higher performance nanomaterials, are considered as an effective and eco-friendly control agents in solving problems in agricultural production, especially agricultural pests. Nanopesticides and various nanoformulations have a broad-spectrum and can provide very effective protection even at low doses compared to conventional pesticides. On the other hand, the unique physical and chemical properties of nanoparticles may cause some unpredictable negative effects on agricultural products and ecosystems. For this reason, knowing the toxicological effects of nanopesticides, their interaction mechanisms with plants, and their potential effects on product quality and safety is important for the sustainable implementation of the use of nanotechnology in agriculture. This study aims to provide information about the possibilities of using nanopesticides in pest control and their effects on human health and the environment.

Keywords: Insect Pest Control, Nanopesticide, Nanotechnology, Sustainable Agriculture

1. INTRODUCTION

Nanotechnology science, which is considered the revolution of the 21st century, is an interdisciplinary science that finds application in many branches of science such as medicine, food, pharmacology, textile, electronics, pharmaceuticals and agriculture. In agricultural applications, nanotechnology is used in areas such as plant and animal breeding, detection and prevention of plant diseases, reduction of pesticide use, pesticide and fertilizer production, and detection of toxic pesticides. Nanotechnology in agriculture aims to control the use of chemical fertilizers, create advanced systems to reduce crop losses caused by biotic and abiotic stress factors, and give due importance to the protection of agriculture (Chhipa, 2017).

The use of pesticides is inevitable to deal with harmful insects and various plant diseases in agriculture. Due to the overdose and widespread use of pesticides, agriculture today faces major challenges such as pest resistance, bioaccumulation, environmental contamination, and health problems that need to be addressed and require urgent solutions. In order to overcome these problems with traditional pesticides, formulations using nano-sized materials have been developed. Nanopesticides developed using higher performance nanomaterials are considered as an effective and environmentally friendly control agent in controlling problems in agricultural production, especially agricultural pests (Yadav et. al., 2020; Nisha Raj et al., 2021).

1.1.Nanoparticles

A nanometer (nm) is a unit of length equal to one billionth of a meter. The concept of nanomaterials is generally used for materials with sizes ranging from 1 to 100 nm (Figure 1).

The properties that differentiate nanomaterials from macrosized materials evolve at a critical length scale below 100 nm. These are properties such as a) optics, b) physical durability, c) chemical reactivity, d) electrical conductivity, e) magnetism (Joseph and Morrison, 2006). Most importantly, it is the size of the nanoparticles that helps the active ingredients spread evenly over the pest surface, increasing its effectiveness.

If the nanomaterial,

- If all three dimensions are smaller than 100 nm, such materials are nanoparticle, quantum dots, nanoshell, nanoring and microcapsule;
- nanotube, nanowire and fiber if only two dimensions are less than 100 nm;
- If only one dimension is smaller than 100 nm, it is called thin film, layer and coating (Ersöz et al., 2018).

Nanoparticles can be inorganic, organic or hybrid in nature and can be produced naturally or synthetically. Nanoparticles existing in nature can be produced by photochemical reactions, forest fires, erosion, volcanic eruptions, plants and animals, and even microorganisms (Dahoumane et al., 2017).

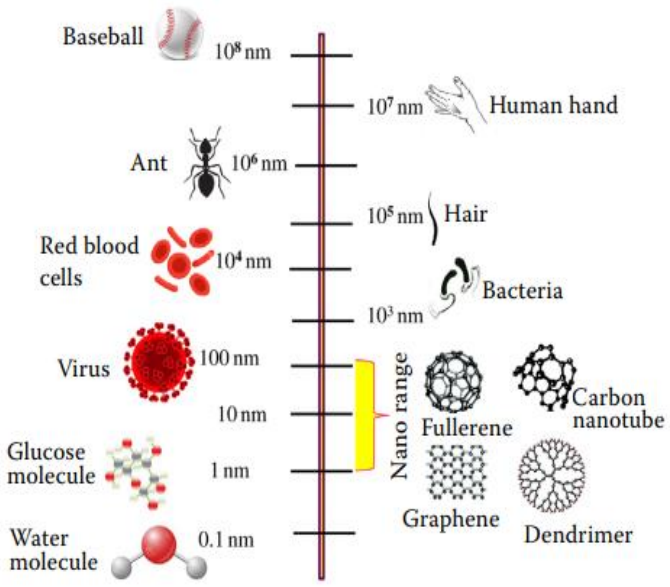


Figure 1. Comparison of the nano-size range to commonly known materials (Yadav et al., 2020)

1.2.Conventional Pesticides

The main problem with the production and use of pesticides is that the active substances generally consist of compounds that are poorly soluble or insoluble in water. This problem can only be solved by adding large amounts of organic solvents during the production process of pesticides. However, the addition of organic solvents increases the risk of ignition during the storage and transportation process and also increases the cost. Organic solvents pollute soil and water systems with their toxic properties and pose a threat to human/animal health by causing residues in plants and food products (Hayles et al., 2017). In addition, it is reported in studies that it not only promotes phytotoxicity but also causes dermal toxicity in practitioners. In pesticide applications, water is the most preferred solvent in terms of cost, availability and compatibility with nature. However, when diluted with water, it causes the chemical stability

of the active ingredient to decrease and may negatively affect its persistence and toxicity on the target organism (Knowles, 2005). Only 0.1% of pesticides applied by different methods (spraying, seed spraying, etc.) reach the target organism, while the rest is carried by surface waters, causing soil and water pollution (Li et al., 2023). Non-target organisms such as pollinator insects and birds may also be harmed. The active substance is released shortly after chemical application, so it is called "rapid release systems". Since the amount of active substance decreases rapidly in the pesticide system, its effects are short-term and therefore require repeated applications. Chemical pesticides with lipophilic properties accumulate in the tissues of living things at different trophic levels of the food chain (bioaccumulation) and cause toxic effects (Rizzati et al., 2016).

Pesticide formulation is a critical factor affecting the production, application and success of pesticide application. Biotic and abiotic factors such as ultraviolet rays, rain, pH, temperature and plant physiology reduce the effectiveness of traditional pesticide formulations. Due to these limitations and negative effects of conventional formulations, nanopesticides developed using nanotechnological methods attract the attention of researchers as an alternative control agent.

1.3.Nanopesticides

Nanotechnology emerges as an extremely attractive tool in achieving the goal of reducing the amount of pesticide use and as a branch of science that offers new methods for the formulation and distribution of pesticide active ingredients, as well as new active ingredients called “Nanopesticides”.

Nanoformulations are specifically designed to address the solubility problem of traditional pesticide formulations and release the biocide in a controlled and targeted manner. Its

formulation containing a carrier molecule with a very large surface area and nanosized active ingredients offers many unique advantages as well as increasing the solubility of insoluble or slightly soluble active ingredients (Margulis-Goshen and Magdassi, 2013). Compared to traditional pesticides, they are broad-spectrum nanotechnological designs that can provide very effective protection even at low doses. Using low doses is very important in reducing both the negative effects on non-target organisms and the phytotoxicity effect. In addition, these formulations that provide controlled release (nanogels, nanocapsules, nanospheres, micelles) can remain inactive until the active ingredient is released (Yadav et al., 2020). The release profile of an active ingredient varies depending on the chemical properties of the polymeric matrix used, the strength of chemical bonds and the size of the biocide molecules. Diffusion or disintegration of the polymer containing the active ingredient begins after contact with water and receiving appropriate stimuli (Xin et al., 2018). Controlled release systems can be applied in three different ways: **(1)** temporal controlled release, **(2)** spatially targeted release, **(3)** release using carrier systems designed to eliminate biological obstacles to the pesticide reaching the target pest. Nanoformulations reduce the risk of pesticide transport into the environment by controlling the release profile of the active substance. In addition, the catalytic properties of the nanoformulation can be improved to break down pesticide residues after a sufficient amount of active substance is released to protect the product (Kumar et al., 2019).

The most commonly used method in agricultural applications is encapsulation technologies. Because in controlled release formulations (sustained release and delayed release) prepared using encapsulation technology, hydrophobic or hydrophilic bioactive compounds can be trapped in micelles. Sustained release is a mechanism by which nanoencapsulation materials are designed for sustained release of active ingredients. In this system, the half-life and optimum availability of active ingredients are extended, and as a result, nano-encapsulated pesticides can

suppress pests for a longer time (Nuruzzaman et al., 2016). In addition, with this technology, the amount of pesticide used can be reduced while its stability can be increased, the pungent odors of the released chemicals can be suppressed, and biocompatibility with carrier systems can be assured. Studies have determined that chitosan can be a valuable carrier for controlled release due to some characteristic features (adsorption, non-toxicity, biodegradability) (Kashyap et al., 2015). Another advantage of polymer encapsulated nanoformulations is the low risk of degradation and leakage. Nanoformulations of pesticides can be classified as follows according to their intended use;

a) that increase the solubility of water-insoluble active ingredients,

b) that slow down the release rate of active ingredients,

c) that can achieve targeted delivery and increased chemical stability (Yadav et al., 2020).

It can also be divided into different categories according to the chemical structure of the nanocarriers, including Nanosuspensions/Nanodispersions, nanoemulsions, solid nanoparticle pesticide formulations, polymer-based nanopesticide formulations, nanosized metal and metal oxide formulations and lipid-based nanopesticide formulations. Nanoparticles; they can have structures and morphologies with different bonds such as nanofibers, nanocapsules, nanoliposomes, nanospheres, micelles, nanogels, solid lipid nanoparticles (Balaure et al., 2017).

Nanoemulsions

Nanoemulsions are oil-in-water (O/W) emulsions in which the pesticide is dispersed in water as nanodroplets and the surfactants are localized at the pesticide-water interface. It is in an advantageous position compared to traditional emulsions thanks to its small droplet size, transparent and translucent optical properties and controlled release mechanisms that provide stability against precipitation and creaming. Depending on the amount and type of surfactant

used, nanoemulsions can be further classified into (1) thermodynamically stable and (2) kinetically stable nanoemulsions. In general, nanoemulsions have been successfully applied in many industrial fields thanks to their low viscosity, high kinetic stability and optical transparency properties (Wu et al., 2001).

Nanosuspensions/Nanodispersions

Nanosuspensions or nanodispersions are pesticide formulations with the distribution of active ingredients such as nanocrystals or amorphous solid nanoparticles in a solution environment supported by physical methods. These nanoformulations facilitate the distribution of solid pesticides with poor water solubility (powder, nanocapsules, etc.) in the aqueous environment, thus increasing the biological effectiveness of the pesticide (Ormanoğlu et al., 2021).

Polymer-based nanopesticides

Polymer-based nanopesticides, such as nanoemulsions, increase the dispersion of active ingredients in the aqueous environment, acting as a protective reservoir. It facilitates the controlled and slow release of the pesticide active ingredient. With the increasing awareness of environmental protection, the use of natural or synthetic origin polymers as nanocarriers of insecticides is increasing. Pesticides are loaded into nanocarrier systems by encapsulation into the nanopolymeric shell, absorption onto the nanoparticle surface, attachment to the nanoparticle core via ligands, or entrapment within the polymeric matrix (Figure 2). In this way, various formulation types have been developed, including nanoemulsions, nanospheres, nanosuspensions, solid lipid nanoparticles, nanocapsules, nanosheets and mesopore nanoparticles. Polymer-based nanoparticles have flexibility that allows the simultaneous preparation and application of multiple pesticides with different modes of action (Ormanoğlu et al., 2021).

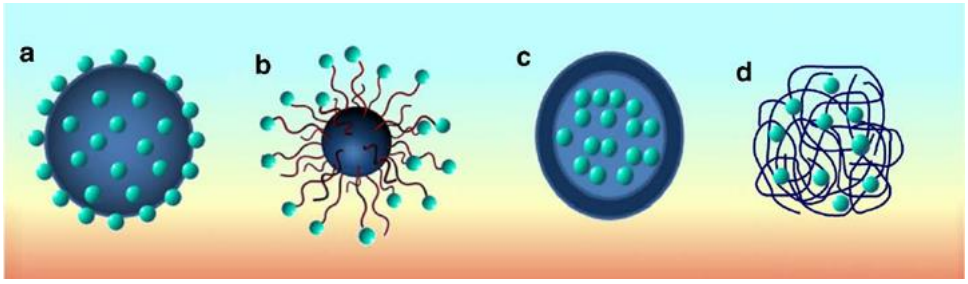


Figure 2. Methods of loading the active substance into nanocarrier systems a) adsorption on the nanoparticle surface b) attachment to the nanoparticle core via ligands c) encapsulation into the polymeric shell d) confinement into the polymeric matrix (Athanassiou et al., 2018)

Lipid-based nanopesticides

Lipid-based nanocarriers consist of phospholipids that can self-assemble into many bilayers that confine the aqueous phase (Sala et al., 2018). These are highly efficient nanocarriers for controlled active ingredient release due to their specific properties such as environmental safety, loading capacity, physiochemical storage stability and targeted smart release system (Zheng et al., 2013). The use of these materials in plant protection is a very new field of research, and there are few studies demonstrating their use as effective pesticide nanocarriers. Compared to nanopolymers, nanoemulsions, lipid-based nanomaterials can overcome the photodegradation of active ingredients without using any UV absorbers (Yadav et al., 2020). ***Nanoliposomes*** are vesicular structures consisting of a phospholipid bilayer surrounding an aqueous cavity on the inside. ***Solid lipid nanoparticles*** are spherical nanostructures with high melting points formed by dispersing oil particles in water (Balaure et al., 2017).

Solid Nanoparticle Pesticides

Inert powders such as silica, alumina (aluminum oxide) and clay are effective by causing both sorption and corrosion of the insect cuticle. Damage to the cuticle causes insects to lose water and die due to drying. Since its mode of action is physical, it is a form of control in which insects are less likely to develop resistance (Shah and Khan, 2014). It has been observed that

silica nanoparticles do not affect respiration or photosynthesis in various field and garden plants when applied to the plant leaf and stem surface (Hayles et al., 2017). It has been approved as a nanobiopesticide because it does not cause changes in gene expression in insect tracheas. The use of amorphous silica is also considered safe for humans by WHO (Ormanoğlu et al., 2021). Structures consisting of amorphous silica formed by the exchange of fossilized phytoplankton are known as diatom soil and are widely used in the world against stored product pests. The disadvantage of diatom soil is that it requires high doses of application, which causes negative effects on the storage of grains and some quality characteristics (Ormanoğlu et al., 2021).

Nanoclay or clay-based nanoformulations are thin layers of silicate material with a thickness of 1 nm and a width of 70-150 nm, commonly found in volcanic ash. They are considered as potential nanocarriers in agricultural applications due to their economic feasibility and high biocompatibility. Clay-based materials have proven to be a new approach for eco-friendly active ingredient delivery systems (Yadav et al., 2020).

Nanosized metal and metal oxide formulations

Metal and metal oxide nanoparticles have found application primarily in the field of medicine, but also in environmental protection and agriculture. These nanoparticles have very high surface/volume ratio, flexible pore size, high pore volumes, high thermal stability and effective surface properties compared to other traditional formulations. These can reduce the effects of traditional formulations on non-target organisms and contribute to solving solubility and toxicity problems (Yadav et al., 2020). There are three modes of biocidal action;

i. Antimicrobial activity through photocatalysis; The absorbed rays oxidize important molecular structures, resulting in the release of superoxide radicals that cause death in bacterial, fungal and viral organisms.

ii. It causes the release of cell contents through accumulation, dispersion, and damage to the cell membrane.

iii. It is the disruption of DNA replication by the uptake of metallic ions into cells (Chatterjee et al., 2014).

Metal nanoparticles either act as active ingredients alone or can be formulated with conventional pesticides. These formulations have excellent electronic properties and enhanced ion exchange capabilities, offering high adsorption capacity and multiple active sites for active ingredient delivery (Masoomi et al., 2016). The most commonly used metals and metal oxides for pesticide applications in agricultural ecosystems are; silver, copper, aluminum, zinc oxide nanoparticles and titanium dioxide (TiO_2) (Yadav et al., 2020).

2. CONCLUSION

One of the most important issues in the development of nanopesticides as an alternative to traditional pesticides is that they reduce water and soil pollution through reductions in pesticide application rates and losses. However, nanotechnology-based products, especially metal and metal oxides, can accumulate in living tissue and cause higher toxic effects. It may also create a new pollution problem in water bodies and soil. Nanoparticles may be prone to rapid degradation in sunlight due to their large surface area, leading to reduced effectiveness of active ingredients. When applied in the form of nanodroplet formulations, it may face the problem of premature evaporation before reaching the target.

The use of nanopesticides is increasing day by day due to their higher efficiency and reduced dosage requirements. However, humans and other organisms are also exposed to nanoparticles

during or after application. The effects of nanoformulations on non-target microorganisms, plants and other animals need to be investigated. Therefore, a better understanding of their interactions and their negative effects, if any, before their widespread use in plant production and protection is of great importance for a sustainable transition.

Nanoparticles have been reported to have phytotoxic effects on plant systems. Song et al. (2013), reported that using silver nanoparticles (AgNP), root elongation in tomato plants was reduced, while seedling growth and seed germination were negatively affected in rice plants. However, the environmental fate of pesticide nanoformulations on soil, groundwater and surface water is not fully known. Most of the studies aimed at determining the effects of nanopesticides on the environment are carried out under laboratory conditions. More comprehensive studies need to be conducted under field conditions in order to clearly demonstrate the environmental effects of the applied nanoformulations and obtain more realistic results.

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NOHUT ÜRETİM ALANLARINDA POTANSİYEL TEHDİT: ANTRAKNOZ (*Ascochyta rabiei*) HASTALIĞI

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ÖZET

Nohut (*Cicer arietinum* L.) Leguminosae (Fabaceae) familyasının Fabaideae alt familyasına ait bir baklagildir. Nohutun kökeni konusunda farklı görüşler öne sürülse de anavatanı olarak bilinen yer Türkiye'nin Güney Doğu Bölgesi'dir. Literatüre göre, nohut ekimi 7000-7500 yıl önceye dayanmaktadır. Nohut, fasulye (*Phaseolus vulgaris*)'den sonra dünyada en önemli ikinci baklagil bitkisi olup en az 55 ülkede yetiştirilmektedir. Nohut oldukça yüksek verim değerine sahip olmasına rağmen dünya genelinde birçok abiyotik ve biyotik stres faktörleri tarafından etkilenmektedir. Bu stres faktörlerini; hastalıklar, kuraklık, yüksek sıcaklık, don zararı, böcek zararları şeklinde sıralanabilir. Bugüne kadar 55 farklı ülkeden 67 fungus, 3 bakteri, 22 virüs ve mikoplazma ve 80 nematod olmak üzere 172 patojenin nohutta hastalığa neden olmaktadır. Dünya genelinde nohut verimini etkileyen biyotik stres faktörü olan antraknoz hastalık etmeni *Ascochyta rabiei* (Pass.) Labr. nohut üretimini sınırlayan ve ciddi ürün kayıplarına neden olan en önemli fungal patojenlerden birisi olup, bitkinin herhangi gelişme döneminde toprak üstü tüm kısımlarına saldırmakta ve bitkiyi ölüme kadar götürmektedir. Hastalık semptomları yaprak ucu solgunluğu, yaprak lezyonları, gövde kırılmalarına yol açan gövde lezyonları ve tohum hastalıklarına yol açan bakla lezyonları şeklindedir. En önemli zarar, gövde kırılmaları ve bakla enfeksiyonları sonucu oluşur. Fungal lezyonlar; yaprakçıklar üzerinde dairesel veya uzamış formda kahverengimsi-kırmızı hatlarla çevrelenmiş şekildedir. Yeşil baklalar üzerinde piknidyumları içeren iç içe geçmiş konsantrik halkalar şeklinde olup, bu dairesel lezyonlar siyah hatlarla çevrelenmiştir. Yapılan bu derleme kapsamında; nohut bitkisinde fitopatolojik açıdan ekonomik olarak oldukça önemli zarara neden olan nohut antraknoz hastalık etmenin biyolojisi, epidemiyolojisi ve mücadelesi yer almaktadır.

Anahtar kelimeler: Ascochyta yanıklığı, *Cicer arietinum,* Epidemiyoloji, Etiyoloji, Hastalık yönetimi

POTENTIAL THREAT on CHICKPEA PRODUCTION AREAS: ANTHRACNOSE (*Ascochyta rabiei*) DISEASE

ABSTRACT

Chickpea (*Cicer arietinum* L.) is a legume belonging to the subfamily Fabaideae of the family Leguminosae (Fabaceae). Although there are different opinions on the origin of chickpea, its homeland is known to be the South East Region of Türkiye. According to the literature, chickpea cultivation dates back 7000-7500 years ago. Chickpea is the second most important legume crop in the world after beans (*Phaseolus vulgaris*) and is cultivated in at least 55 countries. Although chickpea has a very high yield value, it is affected by many abiotic and biotic stress factors worldwide. These stress factors can be listed as diseases, drought, high temperature, frost damage, insect pests. To date, 172 pathogens including 67 fungi, 3 bacteria, 22 viruses and mycoplasma and 80 nematodes from 55 different countries cause diseases in chickpea. Anthracnose disease agent *Ascochyta rabiei* (Pass.) Labr., which is a biotic stress factor affecting chickpea yield worldwide, is one of the most important fungal pathogens that limit chickpea production and cause serious crop losses. Disease symptoms include leaf tip wilt, leaf lesions, stem lesions leading to stem breakage and pod lesions leading to seed diseases. The most significant damage is caused by stem breakage and pod infections. Fungal lesions are circular or elongated on leaflets, surrounded by brownish-red lines. On green pods, they are in the form of concentric concentric rings containing pycnidia and these circular lesions are surrounded by black lines. Within the scope of this review are included the biology, epidemiology and control of chickpea anthracnose, which causes economically important damage to chickpea plants in terms of phytopathology.

Keywords: Ascochyta blight, *Cicer arietinum,* Epidemiology, Etiology, Disease management

1. GİRİŞ

Nohut (*Cicer arietinum* L.) Leguminosae (Fabaceae) familyasının Faboideae alt familyasına ait bir baklagildir. Nohut baklagiller içerisinde iyi bir protein kaynağı olarak insanoğlunun sağlıklı beslenmesi, yoksulluğu ve açlığı azaltma ve ekosistem dengesini koruma gibi özellikleri nedeniyle dünya ekonomisinde büyük bir öneme sahiptir (Pande ve ark., 2005). Nohudun kökeni konusunda farklı görüşler öne sürülse de anavatanı olarak bilinen yer Türkiye'nin Güney Doğu bölgesidir. Pek çok kaynağa göre, bu bölgede nohut ekimi 7000-7500 yıl önceye dayanmaktadır. Bugün artık dünyanın pek çok ülkesinde nohut tarımı yapılmaktadır. Nohut, fasulye (*Phaseolus vulgaris*)'den sonra dünyada en önemli ikinci baklagil bitkisi olup en az 46 ülkede yetiştirilmektedir (FAOSTAT, 2019).

Dünyada 2019 verilerine göre nohutun ekiliş alanı 4.865.918 ha, üretim miktarı ise 5.898.440 ton olup üretimin çoğunluğu gelişmekte olan ülkelere aittir. Türkiye aynı yıl verilerine göre 281.741 ha ekim alanı ve 353.631 ton üretim miktarı ile Kanada, Hindistan, Avustralya'dan sonra dördüncü sırada yer almaktadır (FAOSTAT, 2019). Türkiye'de 2020 verilerine göre 520.595 ha nohut ekimi yapılarak yaklaşık 630.000 ton nohut elde edilmiştir. Nohut üretiminde 2018-2020 yılları ortalama verilerine göre birinci sırada 558.097 dekar alanda 71.484 ton nohut üretimi ile Kırşehir yer almaktadır. Yozgat ili, 577.460 dekar alanda 69.450 ton nohut üretimi ile Türkiye'nin toplam nohut üretiminin % 11.03'ünü karşılayarak nohut üretimi sıralamasında Türkiye ikincisi olmuştur (TÜİK, 2020).

Nohut oldukça yüksek verim değerine sahip olmasına rağmen dünya genelinde birçok biyolojik ve biyolojik olmayan stres faktörleri tarafından etkilenmektedir. Bu stres faktörlerini; hastalıklar (% 45), kuraklık (% 30), yüksek sıcaklık (% 6.25), don zararı (% 6.25), böcek zararları (% 6.25), şeklinde sıralayabiliriz (Singh 1987; Singh ve ark. 1994). Bu güne kadar 55 farklı ülkeden 67 fungus, 3 bakteri, 22 virüs ve mikoplazma ve 80 nematod olmak üzere 172

patojenin nohutta hastalığa sebep olduğu rapor edilmiştir (Nene ve ark. 1996). Dünya genelinde nohut verimini etkileyen en önemli biyolojik stres faktörü Ascochyta yanıklığıdır. *Ascochyta rabiei* (Pass.) Labr. [teleomorf, *Didymella rabiei* (Kov.) var. Arx] neden olduğu Ascochyta yanıklığı başka bir deyişle Antraknoz hastalığı, Nohut yetiştiriciliğinde ürün miktarında azalmalara, kalitenin düşmesine ve ürünün daha ucuza satılmasına neden olmaktadır. Ülkemizde ise ilk defa Bremer (1948) tarafından İç Anadolu ve Güneydoğu Anadolu bölgelerinde tespit edilmiştir.

Bu derleme kapsamında; nohut bitkisinde fitopatolojik açıdan ekonomik olarak oldukça önemli zarara neden olan nohut antraknoz hastalık etmenin biyolojisi, epidemiyolojisi ve mücadelesi yer almaktadır.

1.1. Antraknoz hastalığının coğrafik dağılımı

Kuzeybatı illerinden gelen ilk raporun ardından Hindistan kuzeyinde yer alan Pakistan'da nohut antraknoz hastalığı ilk kez rapor edilmiştir (Kaiser ve ark. 2000). Hastalık 6 kıtada 40'tan daha fazla ülkede rapor edilmiş ve gerek ülkemizde gerekse de dünya genelinde yapılan ekimler göstermiştir ki yeni nohut üretim alanlarına hızla yayılmaktadır. Kanada ve Avustralya'da nohut ekimi oldukça yaygın olarak yapılmaktadır. Özellikle Avustralya'da 1999 yılına kadar çeşitlerin nohut antraknoz hastalığına hassasiyeti nedeniyle üretim sınırlı bir şekilde gerçekleştirilmiştir (Ackland ve ark. 1998; Knights ve Siddique 2002).

Avustralya'da nohut antraknoz hastalığı şu anda verimi sınırlayan başka bir deyişle nohut alanının %95'ini etkileyen hastalıktır (Knights ve Siddique 2002). Diğer taraftan, Kanada'da 1995 yılında nohut üretim alanı 800 hektar iken 2000 yılında 700.000 hektara ulaşmış ve bu bölgelerde antraknoz hastalığından dolayı %70'ten daha fazla verim kaybının gerçekleştiği bilinmektedir (http://www.pulse.ab.ca/ascoch.pdf). Türkiye, Bulgaristan ve Latin Amerikada

noht antraknoz hastalığının oluşumu rapor edilmiştir (Kaiser ve ark. 1998; Kaiser ve ark. 2000; Endes 2021).

1.2. Antraknoz hastalık etmeni

Atraknoz hastalığına neden olan *Ascochyta rabiei* (Pass.) Labr. [teleomorf, *Didymella rabiei* (Kov.) var. Arx] heterotalik bir fungusdur. Hastalık etmeninin eşeyli ve eşeysiz dönemleri vardır (Trapero-Casas ve ark. 2012). Eşeyli dönemde pseudotesyaların içerisinde oluşan askosporlar primer inokulum kaynağı olarak infeksiyonu başlatmaktadır (Bayraktar ve ark. 2007). Daha sonra eşeysiz dönemde piknitlerin içerisinde oluşan pikniospor (konidi)'ları aracılığıyla hastalık bitkiden bitkiye, tarladan tarlaya yayılarak ve iklim koşullarının patojen için uygun olduğu dönemlerde, nohutta önemli miktarda verim kaybına neden olduğu bilinmektedir. *A. rabiei* hem tohum hem de hasat sonrası tarlada kalan bitki artıklarında kış gibi olumsuz koşulları miselyum, konidi ve askospor formunda geçirmektedir (Gan ve ark. 2006). Bu etmen, 10 ile 35°C sıcaklıklar arasında, infekteli bitki artıklarında 8 ay; infekteli gövde de 20 ay; tohum yüzeyinde 5 ay canlı kalabildiği gibi toprakta da serbest formda hayatta kalabilir (Pande ve ark. 2005).

1.3. Hastalık belirtileri

A. rabiei bitkinin yaprak, yaprak sapı, genç dallar ve kapsül olmak üzere tüm toprak üstü organlarını enfekte etmektedir (Nene, 1982). Hastalık simptomları yaprak ucu solgunluğu, yaprak lezyonları, gövde kırılmalarına yol açan gövde lezyonları ve tohum hastalıklarına yol açan bakla lezyonları şeklindedir. En önemli zarar, gövde kırılmaları ve bakla enfeksiyonları sonucu oluşur. Fungal lezyonlar; yaprakçıklar üzerinde dairesel veya uzamış formda kahverengimsi-kırmızı hatlarla çevrelenmiş şekildedir. Yeşil baklalar üzerinde piknidyumları

içeren iç içe geçmiş konsantrik halkalar şeklinde olup, bu dairesel lezyonlar siyah hatlarla çevrelenmiştir (Kaiser, 1973; Endes 2021). *A. rabiei*'nin piknidium oluşumu, misel gelişimi ve spor çimlenmesi için optimum sıcaklık 20 ºC dir. 20 ºC üzerindeki ve altındaki sıcaklıklarda spor çimlenmesi gerçekleşmesine rağmen, hastalık daha düşük oranda gelişir (Trapedo-Casas ve Kaiser, 1992). Yaprak ıslaklığı ve nem, hastalığın gelişimini en fazla etkileyen etmenlerdir. *A. rabiei*'nin enfeksiyonu ortalama 4-8 saat yaprak ıslaklığından sonra görülebilir. Yaprak ıslaklık süresi arttıkça hastalığın şiddeti de artmaktadır. Pseudotesyumların gelişimi ve olgunlaşması için nem kritik öneme sahiptir (Gamliel-Atinsky ve ark. 2005; Trapero-Casas ve Kaiser, 1992).

Antraknoz hastalık belirtilerini nohut bitkisinin tüm üst aksamında gözlemek mümkündür (Bayraktar ve ark. 2016). Tohum kaynaklı infeksiyonlar, fide çıkışında, fidelerin kök boğazında ve gövdesinde kahverengi lezyonlara yol açmaktadır. Daha sonra, bu lezyonlar genişleyerek gövdenin kırılmasına ve buna bağlı olarak da bitkinin ölümüne neden olur. Piknitler nekrotik lezyonlar üzerinde oluşmaktadır. Nohut ekim alanlarında, hastalık ile infekteli bitkiler başlangıçta dikkat çeken küçük nekrotik lezyonlar olarak görünür. Ancak, iklim koşullarının etmen için uygun olduğu koşullarda bu küçük lezyonlardan, ürünün tamamına hastalık hızlı bir şekilde yayılmaktadır. Hastalık belirtileri, nohut vejetasyonunun çiçeklenme ve kapsül bağlama evresinde en belirgin olarak gözlenmektedir (Trapero-Casas ve Kaiser 1992). Havai konidi ve askosporlar genç yaprakları infekte ederek bu yapraklarda hızla genişleyen küçük su emmiş nekrotik lekelerin oluşmasına yol açmaktadır ve ayrıca konidiler, infekteli aynı ya da en yakın bitkinin sağlıklı tüm üst aksamına su sıçraması yoluyla da infekte edebilir (Armstrong ve ark. 2001). Sonra, hastalık belirtileri yaprak, yaprak sapı, çiçek, kapsül, genç dal ve gövde gibi nohuttun tüm üst aksamında oldukça hızlı bir şekilde yayılmakta ve bu

nedenle bitkilerin organlarında ani bir çöküşün yanı sıra bitki ölümleri gerçekleşmektedir (Bahr ve ark. 2016).

1.4. *A. rabiei*'nin enfeksiyon mekanizması

A. rabiei'nin enfeksiyon mekanizması; uygun koşullar altında fungusun konidilerinin bitki yüzeyinde çimlendiklerini, çim tüpü ve appressorium benzeri yapılar oluşturduklarını, çim tüplerinin fungusun bitki kütikulasına tutunmasında yardımcı olan musilaj üretirler. Fungus appressorium oluşturduktan sonra kutinaz ve pektinaz enzimlerini salgılayarak hücre duvarlarını tahrip eder ve bunu takiben bitkiye penetre olur (Tivoli ve Banniza, 2007). Eğer fungusun başlangıç enfeksiyonu yapraktan olursa miselyum intersellüler olarak yaprak sapından gövdeye doğru ilerler oradan da bitkinin her tarafında gelişme gösterir. Aynı zamanda gövde direkt olarakta enfekte edilebilir. *A. rabiei* floemde yayılır ve kortikal parankima dokularına zarar verebilir (Jayakumar ve ark. 2005). Hastalanan dokuda karbonhidrat içeriği bakımından farklılıklar gözlenmekte, bunun ise bitkilerdeki enzim aktivitesinin etkilenmesinden ileri gelmektedir (Misaghi, 1982). Lekelerin yaprak yüzeyini tamamen kapladığı ve bitkinin yavaş yavaş kurumaya başladığı enfeksiyonun 11. gününden itibaren solunum da azalmaktadır. *A. rabiei* ile inokule olan hassas genotiplerde solunum artışı yapraklar üzerinde karakteristik antraknoz simptomlarının belirginleştiği 5. günde başlamakta ve sporulasyonun maksimuma ulaştığı 8. günde devam etmektedir (Farkas ve Kiraly, 1962). Hastalığın epidemik boyutlara ulaştığı tarlalar yanık ve kavruk bir görünüm kazanmaktadır. Elverişli koşullarda ilkbaharda pseudotesyumlardan askosporlar serbest kalırlar ve rüzgâr hareketleriyle en az 10 km taşınabilirler. Böylece hastalık bulunduğu yerden daha uzak mesafelere yayılır ve patojenle bulaşık olmayan nohut üretim alanlarına da giriş imkanı bulmuş olur (Trapero-Casas ve Kaiser, 1992b).

1.5. Antraknoz hastalığı ile mücadele yöntemleri

Ascochyta rabiei'nin kültürel mücadelesi hastalıklı bitki parçalarının yakılması, derine gömülmesi, ekim nöbeti ve sağlıklı tohumların kullanımıyla yapılmaktadır. Nohut yetiştiriciliğinde, hastalık zararının önlenmesinde ya da azaltılmasında, hastalığa dayanıklı ve ya tolerant çeşitler tercih edilmelidir (Schteinberg ve ark., 2000; Gan ve ark. 2006). Ancak *A. rabiei*'nin heterothalik bir fungus oluşu, dayanıklı bitkisel materyalin zamanla kaybolmasına yol açabilmektedir. Bu durum ise düzenli olarak dayanıklı çeşit geliştirme gereği ve gerçeğini ön plana çıkarmaktadır.

Kimyasal mücadele kolay uygulanabilirliği ve hızlı sonuç vermesinden dolayı en fazla tercih edilen yöntemdir. Ne yazık ki, ekonomik öneme sahip bu üründe nohut üreticileri bitki koruma konusunda yeterli bilgiye sahip olmaması ve ürününü kaybetme korkusu nedeniyle, bilinçsiz ve kontrolsüz fungisit uygulamaları yoğun bir şekilde yapılmaktadır. Bu hastalık etmenine karşı yoğun fungisit kullanımı nohut üretiminde büyük problemlere neden olabilir. Bu sorunlar kısaca, çevre kirlenmesi, gıdaların güvenli olmaması, hastalık etmeninin kimyasal savaşımda kullanılan fungisitlere karşı direnç kazanması olarak özetlenebilir.

A. rabiei ile etkin mücadelede, bir çok yöntemin kombine edilerek kullanıldığı entegre mücadele görüşü benimsenmiştir. Örneğin, sağlıklı tohum kullanımı, tohum ilaçlarının kullanılması, ekim nöbeti, toprağın derin sürümü, tolerant ya da dayanıklı nohut çeşitleri, yeşil aksam ilaçlaması gibi uygulamalarını entegre etmek, hastalıkla başarılı bir şekilde mücadele edilmesine olanak sağlar (Reddy ve Singh 1990; Akem ve ark. 2000).

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ÜLKEMİZDE UŞAK İLİNDE KOYUN YETİŞTİRİCİLİĞİ VE EŞME KOYUNU

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ÖZET

İklim ve çevre şartları uygun olduğu sürece dünyanın her yerinde koyun yetiştiriciliği yapılabilmektedir. Türkiye koyun yetiştiriciliği için ideal bir ülkedir. Türkiye'de genel olarak sert iklim şartlarına uyum sağlamış ve yetersiz meralardan yararlanabilen koyun ırkları bulunmaktadır. Ülkemizde son yıllarda koyun sayılarımız artmaktadır. 2001 yılında 26.972.000 baş olan koyun varlığımız 2018 yılında 35.194.972 başa yükselmiştir. 2022 yılında 44.687.888 baştan Haziran 2023 yılı verilerine göre de 42.565.444 başa düştüğü belirlenmiştir. Uşak ilinde ise 496.501 adet koyun bulunduğu ve bunun 175.000 başın Eşme ilçesinde olduğu belirlenmiştir. Tarım ve Orman Bakanlığının ‘’Halk Elinde Islah Projeleri’’ kapsamında genetik ilerleme ve bi örnek sürü eldesine gidilmiştir. Yapılan ıslah çalışmaları genel manada melezleme yoluyla yapılmıştır. Saf yeriştiricilik adına et- yapağı verim yönlü ve süt-döl verim yönlü ırkların da yetiştiriciliği son yıllarda ülkemizde ithalat yoluyla artmış damızlık üretimi yapan çiftlikler önemli bir sektör haline gelmişlerdir. Uşak ilimizde halk elinde ıslah projesi kapsamında pırlak koyunları seleksiyon yoluyla taban ve elit sürüler olarak ıslahı yapılmaktadır ve çalışmalar sonunda Eşme ırkı koyun elde edilmiştir. Eşme Koyunun kökeni Dağlıç ırkıdır. Kıvırcık koyunun Dağlıç ile melezlemesi ile ırkın özellikleri belirlemeye başlamış olup daha sonra da Sakız melezlemeleri ile Eşme Koyun ırkı ortaya çıkmıştır. Kombine verimli ve et verimi ön planda bir ırktır. 2011 yılında itibaren Eşme İlçesi koyunları için hem TÜBİTAK ve hem de Halk Elinde Islah projesi başlatılarak Eşme Koyunu ıslah edilmeye başlanmıştır. Eşme Koyun ırkı 10.09.2020 tarih ve 31240 sayılı Resmi Gazetede yayınlanarak tescillenmiştir. Eşme koyunu Uşak ili ve yakın çevre şartlarına uygun hem et verim özellikleri hem de süt verimi yönünden üreticileri memnun eden bir ırk olmuştur. Ayrıca Eşme ilçesinde 2016 yılında faaliyete giren Damızlık Test Merkezi de Eşme koyunu damızlık hayvan ihtiyacının karşılanmasını hedef almıştır. Bu çalışmada ülkemizde ve Uşak ilinde koyun yetiştiriciliğinin son durumu, ülkemizde koyun sayılarının arttırılmaya çalışılması ve Eşme ırkı koyunun genel özellikleriyle tanıtılması amaçlanmaktadır.

Anahtar Kelimeler: Koyun, verim, Eşme koyunu, halk elinde ıslah

SHEEP BREEDING AND EŞME SHEEP IN UŞAK PROVINCE IN OUR COUNTRY

ABSTRACT

Sheep breeding can be done anywhere in the world as long as the climate and environmental conditions are suitable. Turkey is an ideal country for sheep breeding. In Turkey, there are sheep breeds that are generally adapted to harsh climatic conditions and can benefit from inadequate pastures. Our sheep numbers have been increasing in our country in recent years. Our sheep population, which was 26,972,000 heads in 2001, increased to 35,194,972 heads in 2018. It was determined that it decreased from 44,687,888 heads in 2022 to 42,565,444 heads according to June 2023 data. It was determined that there were 496,501 sheep in Uşak province and 175,000 of these were in Eşme district. Within the scope of the "Public Breeding Projects" of the Ministry of Agriculture and Forestry, genetic progress and a sample herd were obtained. Breeding studies were generally carried out through hybridization. In the name of pure breeding, the breeding of meat-fleece yield-oriented and milk-seed productivity-oriented breeds has increased in our country through imports in recent years, and farms producing breeding stock have become an important sector. In the province of Uşak, within the scope of the public breeding project, Pırlak sheep are bred into grassroots and elite flocks through selection, and as a result of the studies, Eşme breed sheep were obtained. The origin of Eşme Sheep is the Dağlıç breed. With the crossbreeding of Kıvırcık sheep with Dağlıç, the characteristics of the breed began to be determined, and later, with the crossbreeding of Sakız, the Eşme Sheep breed emerged. It is a breed with combined productivity and meat yield. As of 2011, both TÜBİTAK and Public Breeding Projects were initiated for the sheep of Eşme District and the Eşme Sheep began to be improved. Eşme Sheep breed was registered by being published in the Official Gazette dated 10.09.2020 and numbered 31240. Eşme sheep has become a breed that satisfies producers in terms of both meat yield characteristics and milk yield, suitable for the conditions of Uşak province and the surrounding environment. In addition, the Breeding Test Center, which was established in Eşme district in 2016, aimed to meet the breeding animal needs of Eşme sheep. In this study, it is aimed to present the latest situation of sheep breeding in our country and in the province of Uşak, to try to increase the number of sheep in our country and to introduce the general characteristics of the Eşme breed sheep.

Keywords: Sheep, productivity, Eşme sheep, public breeding

GİRİŞ

Türkiye de koyunculuk genellikle meraya dayalı ekstansif olarak, aile tipi işletmeciliği şeklinde yapılmaktadır (Atasoy ve ark., 2003). Üreticiler için koyunculuk Türkiye'de tarih boyunca uğraştığı ilk ve en önemli hayvancılık faaliyetlerinin başında gelmiştir. Bakım ve besleme yönünden ülkemiz mera ve çayırlara dayalı besleme ucuz ürün eldesi yönünden koyunculuğun baş rol oynamasında ektin olmuştur. Koyun yetiştiriciliği et süt yün ve deri üretimi yönünden ülkemiz ekonomisi açısından önemli olmuştur.

Ülkemiz koşulları nedeniyle, koyun varlığında yıllar içerisinde inişli çıkışlı dalgalanmalar olsa da nüfus artışına paralel olarak, koyun varlığımızda artan bir seyir izlemiştir.Türkiye; coğrafi yapısı ve iklim özellikleri bakımından koyun yetiştiriciliğine uygun bir ülkedir. Türk halkının inancı gereği hayvansal tüketim ihtiyacını ruminantlardan ve kanatlı hayvanlardan karşılamaktadır. Lezzet ve damak tadı alışkanlığından dolayı koyun eti, koyun peynir ve koyun yoğurdu tercih öncellikleri arasında olup bu da koyunculuğun önemini artırmıştır (Akçapınar, 2000; Kaymakçı 2006; Tekin ve Akçapınar, 1994). Küçükbaş hayvan yetiştiriciliği bitkisel üretime uygun olmayan marjinal alanlar ve bitkisel üretim artıklarının değerlendirildiği bir üretim biçimidir. Türkiye'nin çayır ve meralarının sığır türünden ziyade koyun ve keçi türlerine daha uygun oluşu, kırsal kesimdeki halkın tüketim alışkanlıkları, koyunculuk için uygun bir ortam yaratmıştır (Ertuğrul ve ark. 2010).

Türkiye koyunculuğu ağırlıklı olarak otlatmaya dayalı besleme koşulları ve sınırlı girdi ile üretimin hedeflendiği, ekstansif bir yapıya sahiptir. Türkiye koyunculuk işletmeleri; küçük aile işletmeleri, yerleşik köy sürüleri, yayla hayvancılığı ve göçer hayvancılık işletmeleri şeklindedir (Kaymakçı, 2006).

1.KOYUN YETİŞTİRİCİLİĞİ

1.1.Koyun Islahı

İnsanlar göçebe hayatı yaşarken, yaşamlarını devam ettirmek için hayvanlardan elde ettikleri süt ve et veriminin yanında yapağı ve deri de önem arz etmekteydi. Günümüzde et ve süt üretimi daha çok öne çıkmaktadır. Islah çalışmalarında genellikle et ve süt üretimini artırmaya yönelik çalışmalar yapılmıştır. Hayvan yetiştiriciliğin genel kuralı olan; en az sermaye ile en kısa zamanda en fazla üretim yaparak karlı bir kazanç sağlamaktır. Bu kural doğrultusunda ıslah çalışmaları yapılmaktadır. Koyun ıslah çalışmalarında; sadece yüksek et ya da yüksek süt verimi istemek yetersiz kalabilir. Yüksek et üretimi istenilirken süt veriminin, yüksek süt üretimi istenilirken et veriminin de göz önünde bulundurulması gerekir. Et ve süt verimi arasında ters orantı olmamasına özen gösterilebilir. Hatta et ve süt verimi kombine olarak değerlendirilmelidir (Esen, 1997; Ünal ve Akçapınar, 1996).

Süt amaçlı koyun yetiştiriciliği yapılan işletmelerde genel olarak geçmişte ıslah amacıyla yurt dışında getirilen Doğu Friz (Ost-Friz) ırkı kullanılmıştır. Türkgeldi, Sönmez, Tahirova, ve Acıpayam ırkları Doğu Friz ırkının yerli koyun ırkları ile melezlemesi sonucu ortaya çıkmıştır. Melez hayvanlarda yaşama gücünün yüksek olması, süt ve döl verimleriyle canlı ağırlık artışlarının yerli ırklara oranla yüksek oluşu, doğal aşım problemlerinin olmaması gibi nedenler bu genotiplerin yaygınlaşmalarına neden olmuştur (Bingöl,2006).

Ülkemizde mevcut şartlarda yerli ırklarımızı tanımlamak ve ıslah edilebilme olanaklarını tespit edebilmek adına denenen saf yetiştirme ve seleksiyon çalışmaları, kamu araştırma

kurumlarında, ağırlıklı olarak Tarım İşletmeleri Genel Müdürlüğü (TİGEM)'e bağlı tarım işletmelerinde gerçekleştirilmiştir. İşletmelerde, çevre koyun yetiştiricilerinden toplanan yerli koyun ırkları üzerinde yapılan ayıklama sonrası saf yetiştirme ve seleksiyona dayalı ıslah yöntemleriyle verim güçleri ortaya konulmaya çalışılmıştır (Gürsoy, 2009).

1.2.Türkiye'de Koyun Yetiştiriciliği

İklim ve çevre şartları uygun olduğu sürece dünyanın her yerinde koyun yetiştiriciliği yapılabilmektedir. Türkiye koyun yetiştiriciliği için ideal bir ülkedir (Kaymakçı, 1990).

Hayvancılık sektörünün alt kolu olan küçükbaş hayvan yetiştiriciliğinde genel olarak zayıf çayır meralar ve nadas alanları, anız ve bitkisel üretime uygun olmayan alanlar değerlendirilerek elde edilen et, süt, yün, kıl, tiftik ve deri vb. ürünler dondurmadan tekstil sektörüne kadar geniş bir kullanım alanına sahiptir (Paksoy ve Özçelik 2008; Anonim, 2012). Türkiye sahip olduğu doğal ve ekonomik koşulları, tarımsal yapısı, gelenekleri ile koyun yetiştiriciliğinin yaygın olarak yapılmasına elverişli bir ülke konumundadır (Kaymakçı ve Engindeniz 2010).

Çizelge 2.1. Belirtildiği üzere son yıllarda ülkemizde koyun sayıları artmaktadır. Ancak 2022 yılında bir önceki yıla göre az bir düşüş olmuştur.

Çizelge 2.1. Türkiye'de Yıllara Göre Küçükbaş Hayvan Sayıları (Anonim 2023a).

Küçükbaş Hayvan Sayıları			
YIL	KOYUN	KEÇİ	KÜÇÜKBAŞ TOPLAM
2002	25.173.706	6.780.094	31.953.800
2003	25.431.539	6.771.675	32.203.214
2004	25.201.155	6.609.937	31.811.092
2005	25.304.325	6.517.464	31.821.789
2006	25.616.912	6.643.294	32.260.206
2007	25.475.293	6.286.358	31.761.651
2008	23.974.591	5.593.561	29.568.152
2009	21.749.508	5.128.285	26.877.793
2010	23.089.691	6.293.233	29.382.924
2011	25.031.565	7.277.953	32.309.518
2012	27.425.233	8.357.286	35.782.519
2013	29.284.247	9.225.548	38.509.795
2014	31.140.244	10.344.936	41.485.180
2015	31.507.934	10.416.166	41.924.100
2016	30.983.933	10.345.299	41.329.232
2017	33.677.636	10.634.672	44.312.308
2018	35.194.972	10.922.427	46.117.399
2019	37.276.050	11.205.429	48.481.479
2020	42.126.781	11.985.845	54.112.626
2021	45.177.690	12.341.514	57.519.204
2022	44.687.888	11.577.862	56.265.750

Genetik, çevre, bakım ve besleme şartları hayvanların verimlerini etkileyebilmektedir. Ülkemizde koyunculuk genel olarak meraya dayalı olarak yapılmaktadır. Ülkemizde meraların bilinçsiz kullanım neticesinde hayvanların gereksinimleri ve beslenmeleri için yetersizdir. Sadece meraya dayalı besleme hayvanın gereksinimlerini karşılayamayabilir. Bu da istediğimiz

verimi sağlamamızda engel oluşturur Her koyun ırkının iklim ve çevreye uyumu farklıdır. Koyunculuk yaparken genetik yatkınlığın yanında, hayvanın çevreye, bölgeye uyumu da göz önünde bulundurularak ırk seçimi yapılmalıdır (Düzgüneş, 1976; Kaymakçı ve Sönmez, 1992; Şekerden, 2001).

Türkiye'de koyun varlığının çoğunu seyrek otlu fakir meralara ve sert iklim koşullarına uyum sağlamış yağlı kuyruklu koyun ırkları oluşturmaktadır. Anadolu platosunun gerek yayılış alanı ve gerek sayı açısından birinci sıradaki ırkı Eskişehir'den Sivas'a kadar İç Anadolu bölgesine yayılmış bulunan Akkaraman koyunlarıdır. Daha doğudaki illerde ise Morkaramanlar bulunmaktadır. Diğer yağlı kuyruklu koyun ırklarımız arasında Göller bölgesinde Dağlıç, Güneydoğu'da İvesi, Kars yöresinde Tuj koyunu sayılabilir. Kıyı kesimlerde ise yağsız ince kuyruklu koyunlar bulunmaktadır. Bu gruba giren ırklardan Kıvırcık Trakya ve Marmara bölgesinde, Karakaya ise Karadeniz kıyı şeridinde yaygındır (Aşkın, 1995).

1.3. Uşak İlinde Koyun Yetiştiriciliği

Türkiye'de 2022 Aralık verilerine göre 17.023.791 baş sığır, 44.687.888 adet koyun, 11.577.862 adet keçi bulunmaktadır. Uşak ilinde ise 129.029 baş sığır, 261.288 adet koyun ve 49.605 adet keçi bulunmaktadır (Anonim, 2022a). Uşak İlinde İlçelere göre küçükbaş hayvan varlığı çizelge 2.3. gösterilmiştir.

Çizelge 2.3. Uşak İlinde İlçelere Göre Küçükbaş Hayvan Varlığı (Anonim, 2022b).

İLÇE ADI	**KOYUN**	**KEÇİ**	**TOPLAM**
BANAZ	27.797	9.765	37.562
EŞME	98.532	2.006	100.538
KARAHALLI	7.253	870	8.123
MERKEZ	79.725	19.928	99.653
SİVASLI	24.186	8.677	32.863
ULUBEY	23.795	8.359	32.154
TOPLAM	**261.288**	**49.605**	**310.893**

1.4. Eşme İlçesinde Koyun Yetiştiriciliği ve Eşme Koyunu

Eşme Koyunun kökeni Dağlıç ırkıdır. Kıvırcık Koyunun Dağlıç ile melezlemesi ile ırkın özellikleri belirlemeye başlamış olup daha sonra da Sakız melezlemeleri ile Eşme Koyun ırkı ortaya çıkmıştır. Kombine verimli ve et verimi ön planda bir ırktır. 2011 yılında itibaren Eşme İlçesi koyunları için TÜBİTAK, Halk Elinde Islah projesi başlatılarak Eşme Koyunu ıslah edilmeye başlanmıştır (Anonim, 2021b).

''Eşme Yöresi Kıvırcık Melezi Koyun Popülasyonu Damızlık Üretimin Yetiştirici Koşullarında Yapılandırılması'' projesi kapsamında batı Anadolu koyunculuğunda ön plana çıkan Uşak İli Eşme İlçesinde rekabet gücü yüksek, nitelikli damızlık koyun üretim sürecini gerçekleştirecek bir ıslah organizasyonunu hayata geçirerek bütün bölgeye hizmet verebilecek damızlık hayvan merkezi oluşturulmuştur. (Anonim 2016).

Eşme Koyun ırkı 10.09.2020 tarih ve 31240 sayılı Resmi Gazetede yayınlanarak tescillenmiştir. Eşme koyun ırkı genetik olarak incelenmiştir. Nei 'nin minimum genetik mesafe matrisine göre deogram incelendiğinde, Eşme Koyununun Kıvırcık Koyun ırkının yöresel formlarından farklı bir yer aldığı gözlenmiştir (Anonim, 2022a).

Çizelge 2.5. Eşme İlçesinde Koyun Irkları ve Sayıları (Türkvet, 2023).

İlçe	Irk	Baş
Eşme	Eşme	21.660
Eşme	Eşme M.	25.029
Eşme	İle de France	1.688
Eşme	İle de France M.	50
Eşme	Karacabey Merinosu	235
Eşme	Karacabey Merinosu M.	33
Eşme	İvesi	214
Eşme	İvesi M.	332
Eşme	Kıvırcık	7.636
Eşme	Kıvırcık M.	2.002
Eşme	Lacaune	1484
Eşme	Lacaune M.	8
Eşme	Merino Landschaf	920
Eşme	Merinos	3.337
Eşme	Merinos M.	4.352
Eşme	Ödemiş	353
Eşme	Ödemiş M	11
Eşme	Pırlak	19.152
Eşme	Pırlak M.	6.366
Eşme	Pırıt	12.288
Eşme	Pırıt M.	1273
Eşme	Romanov	6.060
Eşme	Romanov M.	78
Eşme	Sakız	2.282
Eşme	Sakız M.	2.084
Eşme	Suffolk	14
Eşme	Suffolk M	371
Eşme	Tahirova	1

1.4.1. Eşme Koyunu Genel Özellikleri

Et üretimi ve kalitesi bakımından ön plana çıkmasının yanında döl verimi de göz ardı edilmeyecek düzeydedir. Vücut tamamen beyaz renkli tüylerle kaplıdır. İnce kuyrukludur. Erkeklerin tamamı spiral boynuzludur. Dişiler genelde boynuzsuzdur. Orta büyüklükte kulak yapısına sahiptir. Diğer yerli ırklarımıza benzer baş yapısına sahiptir. Doğuran koyun başına kuzu verimi 1.42, ergin dişilerde canlı ağırlık 55-60 kg, erkekler-de 65-70 kg'dır. Ortalama doğum ağırlığı 3,5-4,0 kg, sütten kesimde canlı ağırlık 25-30 kg'dır.

Yetiştiricilik yerleşik aile işletmeleri şeklinde yapılmaktadır. Hayvanlar yaz ve kış aylarında kapalı barınaklarda barındırılmaktadır. Kışın meraya ek olarak ek besleme uygulanmaktadır. Yazın ise hayvanlar tamamen merada otlatılmakta ve ek besleme yapılmamaktadır (Aninim, 2023b).

SONUÇ

Eşme koyun ırkının tescili konusunda Tarım ve Orman Bakanlığı'nın üreticiler ile beraber yürüttüğü Halk Elinde Islah Projeleri kapsamında melezleme yöntemlerinin başarılı olduğu Eşme koyun ırkının tescillenmesi ile de ortaya çıkmıştır. Eşme ırkı; koyun yetiştiriciliğinde en önemli faktörlerden biri olan çevresel etkenlerin etkileri olan verim ve yaşama gücü gibi unsurlarıyla yöre üreticilerini tatmin eden verimli bir ırktır. Eşme yöresi koyun popülasyonun da 2010 yılı ikinci yarımında hayata geçirilen ıslah programı kapsamında yakın gelecekte devreye sokulması planlanan seleksiyon indekslerinin oluşturulmasında, yapılan çalışmalar ışık tutacaktır. Etkin bir seleksiyon indeksinin oluşturulabilmesi için pedigri kayıtlarını da içeren veri tabanının genişletilerek gerekli genetik parametrelerin tahmin edilmesi ve bu ırkın daha da yaygınlaştırılması gerekmektedir.

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ÜLKEMİZDE MERALARIN SON DURUMU VE KÜÇÜKBAŞ HAYVANLARIN MERALARDAN YARARLANMALARI

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ÖZET

Küçükbaş hayvan yetiştiriciliğinde karlı ve aynı zamanda verimli bir üretimde en önemli unsurun başında, hiç şüphesiz çayır mera varlığı ve bunların kalitesi gelmektedir. Üretim maliyetinin düşürülmesi yönünde ve küçükbaş hayvan varlığının sürdürülebilir olmasında çayır ve meralar oldukça önemli bir yere sahiptir. Ülkemiz mera alanlarımızda 1950 ile 1970 yılları arasında 16.5 milyon ha. (%43.5) azalma meydana gelmiş, akabinde 2000 yılına kadar artan hayvan sayısı, meraların yükünü 2.5 kat daha arttırmıştır. Günümüze kadarda artışlar meydana gelmiş, bu da hayvan başına düşen mera alanlarında sürekli bir azalmanın olduğunu göstermiştir. Ülkemiz kaba yem kaynakları hayvanlarımızın ihtiyaçlarını karşılayamayacak durumdadır. Toplam arazi alanlarımızın içerisinde yer alan çayır-mera alanı oranının, birçok ülkeyle karşılaştırıldığında iyi seviyede bulunmasına rağmen, ekolojik koşullar ve yanlış kullanımlar neticesinde, verimleri çok az düzeylerdedir. Sahip olduğumuz çayır-mera alanlarımızın büyük kısmının verim kapasitelerinin düşük olduğu ve özellikle kalite düşüklüğünden dolayı küçükbaş hayvanlarımızın yararlanamadığını söyleyebiliriz. Meralarımızın kalitesi ve otlama potansiyelinin düşük olması besin ihtiyaçlarının karşılanmasında yeterli görülmemektedir. Islah çalışmaları neticesiyle kaliteli kaba yem ihtiyacı azaltılması ve meralarımızın ot kalitesinin arttırılması büyük önem arz etmektedir. Tarım ve Orman Bakanlığı tarafından yürütülen "Mera Islah ve Amenajman Projeleri" ile meraların bir taraftan verimleri arttırılmaya çalışılırken, diğer taraftan amenajman tedbirleri ile kullanım kapasiteleri geliştirilmeye ve buna bağlı olarak da hayvancılık faaliyetlerinin ekonomik hale getirilmesi amaçlanmaktadır. Mera Kanunu kapsamında 2019 yılı itibarı ile yaklaşık 12 milyon hektar mera alanının tespiti yapılırken, bunun 8 milyon hektarlık kısmında tahdit işlemleri de tamamlanmıştır. Tespit, tahdit ve tahsis işlemleri tamamlanan meralarda Türkiye genelinde 1685 adet proje ile yaklaşık 1milyon hektar alanda ıslah ve amenajman

çalışmaları da yapılmıştır. Hazırlana çalışmada da Türkiye'de çayır ve meraların durumu ve son yıllarda ki değişimlerle gelişmeler ve son yıllarda ki mera ıslah çalışmaları ve küçükbaş hayvanların meradan yararlanma durumları incelenmiştir.

Anahtar Kelimeler: Küçükbaş hayvan, kaliteli kaba yem, mera ıslahı.

LATEST SITUATION OF PASTURES IN OUR COUNTRY AND THE USE OF THE PASTURES BY SHEEP AND GOATS

ABSTRACT

The most important element in profitable and efficient production in small cattle breeding is undoubtedly the presence of meadow pasture and their quality. Meadows and pastures have a very important place in reducing production costs and ensuring the sustainability of small livestock existence. Between 1950 and 1970, 16.5 million hectares of land were created in our country's pasture areas. There was a decrease (43.5%), and then the increasing number of animals until 2000 increased the burden on pastures by 2.5 times. Increases have occurred until today, which shows that there is a continuous decrease in pasture areas per animal. Our country's roughage resources are unable to meet the needs of our animals. Although the meadow-pasture area ratio within our total land area is at a good level compared to many countries, their productivity is at very low levels as a result of ecological conditions and misuse. We can say that most of our meadow-pasture areas have low productivity capacities and our small cattle cannot benefit from them, especially due to low quality. The quality and low grazing potential of our pastures are not considered sufficient to meet nutritional needs. It is of great importance to reduce the need for quality forage and increase the grass quality of our pastures as a result of breeding studies. With the "Pasture Improvement and Management Projects" carried out by the Ministry of Agriculture and Forestry, it is aimed to increase the productivity of the pastures on the one hand, and to improve their usage capacity through management measures, and accordingly, to make livestock activities economical. Within the scope of the Pasture Law, as of 2019, approximately 12 million hectares of pasture land were determined, and delimitation procedures were completed on 8 million hectares of it. In the pastures, where the identification, delimitation and allocation procedures have been completed, reclamation and management works have been carried out in approximately 1 million hectares of land with 1685 projects throughout Turkey. In the prepared study, the situation of meadows and pastures in Turkey, the changes and developments in recent years, pasture improvement studies in recent years and the utilization of pastures by small ruminants were examined.

Keywords: Small ruminants, quality forage, pasture improvement.

GİRİŞ

Koyun; ilk evcilleştirilen çiftlik hayvanları arasında bir tür olması ve insanların birçok ihtiyacına cevap verebilecek ürünlere sahip olmasının yanı sıra beslenme ve sürü idaresinin diğer hayvanlara göre daha kolay olması nedeniyle yetiştiriciliği daha fazla tercih edilen bir türdür. Diğer çiftlik hayvanlarıyla karşılaştırıldığında koyunlar, bakım ve beslenmesinin kolay olması ve insanlara çok yönlü faydalar sağlanması bakımından dünyanın bütün ülkelerinde yayılma şansına sahip olmuştur. Süt, yapağı veya et verimleri ele alınarak yetiştirilmesi sonucu çeşitli koyun ırkları ortaya çıkmasına neden olmuştur (Koyuncu, 2009).

Çayır ve meralar hayvan beslenmesinde çok önemli kaba yem kaynaklarıdır. Aynı zamanda flora ve fauna çeşitliliğinin ve gen kaynaklarımızın gelecek nesiller için korunması, tarımsal faaliyetlerin ve hayvancılığın etkili bir şekilde sürdürülmesi için, korunması ve geliştirilmesi mutlak suretle gerekli olan alanlardır

Türkiye'nin hemen her bölgesinde hayvancılık önemli yer tutmaktadır. Zira, Türkiye doğal bitki örtüsü, coğrafi ve sosyo-ekonomik yapısı itibariyle koyun yetiştiriciliğine çok uygundur. Ancak diğer alanlarda olduğu gibi hayvancılıkta da ekstansif bir durum görülmektedir. Hayvancılıkta bakım ve besleme durumunda yetersizlik söz konusudur. Yetiştirilen hayvanlar bakımsız, düşük verimli ve hayvancılık daha ziyade mera imkanlarına dayalıdır.

Gerek dünyada, gerekse Türkiye'de bitkisel üretim yapılamayan alanlardan yararlanabilme yollarından en önemlisi küçükbaş hayvan yetiştiriciliğidir. Mera alanlarının değerlendirilmesinde küçükbaş hayvan yetiştirilmesine öncelik verilmektedir. Koyunlar verimsiz meralarla nadas, anız ve bitkisel üretime uygun olmayan ürünleri değerlendirerek et,

süt, yapağı, kıl, deri ve gübre gibi ürünlere dönüştürülebilme yeteneğine sahiptirler. Genelde kırsal alanlarda yaşayan halkın geçiminde büyük payı olan bu yetiştiricilik dalından elde edilen ürünler, direk olarak kullanılabildiği gibi, dondurmadan, tekstile kadar çeşitli yan ürünlere dönüştürülerek de kullanılabilmektedir (Akçapınar, 2000).

1.1.TÜRKIYEDE MERALARIN DURUMU

Hayvansal üretimin vazgeçilmez yem kaynaklarından olan çayır ve meralar, doğal kaynakların muhafazası ve sürdürülebilirliği, yaban hayatının en önemli orijini, canlı çeşitliliği ile genetik kaynak oluşturması ve değişik kullanımlara hizmet etmesi gibi çok sayıda ekolojik işlevi üstlenmiş doğal bitki örtüleridir (Gökkuş, 2018). Ülkemiz mera alanlarımızda 1950 ile 1970 yılları arasında 16.5 milyon ha (%43.5) azalma meydana gelmiş, akabinde 1980 yılına kadar artan hayvan sayısı, meraların yükünü 2.5 kat daha arttırmıştır. Daha sonraki yıllarda azalış ve artışlar meydana gelmiş, buda hayvan başına düşen mera alanında sürekli bir azalmanın olduğunu göstermektedir (Anonim,2012; Gökkuş, 2018). Büyük bir öneme sahip meralar, ülkemiz arazilerinin %18.8'ni ve toplamda 14.6 milyon hektarlık bir alanı oluşturmaktadır. (Gökkuş,2001; Altın vd., 2011).

Ülkemizde çayır ve mera alanları varlığı değerlendirildiğinde, 2011 yılı Tarım Sayımı verilerine göre toplamda 14.611.920 ha olan çayır ve mera alanının, 1.449.313 ha'ı çayır ve 13.167.375 ha'ı meradan oluşmaktadır. Doğu Anadolu Bölgesi ülkemiz genelinde Çayır ve Mera alanları bakımından %56.80 ile en büyük paya sahiptir. Toplam çayır alanlarının yarıdan fazlası, toplam mera alanlarının da 1/3'ünden fazlası bu bölgededir. Bu veriler değerlendirildiğinde, ilk sırayı

%37.53'lük oran ile Doğu Anadolu Bölgesi alırken, İç Anadolu Bölgesi %31.27 ile ikinci, Karadeniz Bölgesi ise %10.38 ile üçüncü sırayı almaktadır (Çizelge 1).

Çizelge 1. Ülkemiz çayır ve mera alanları ile bu alanların kuru ot üretimleri (Anonim, 2011)

Bölgeler	**Çayır (Kuru ot)**		**Mera (Kuru ot)**		**Çayır-Mera(Kuruot)**	
	Alan (ha)	Üretimi (ton)	Alan (ha)	Üretimi (ton)	Alan (ha)	Üretimi (ton)
Akdeniz	44.951	134.853	630.729	283.828	675.680	418.681
Doğu Anadolu	823.163	2.469.480	4.662.289	2.098.030	5.485.495	4.567.510
Ege	52.827	158.481	750.055	337.525	802.882	496.006
G.Doğu Anadolu	47.881	143.643	948.349	426.757	996.230	570.400
İç Anadolu	181.905	545.715	4.388.276	1.974.724	4.570.181	2.520.439
Karadeniz	247.458	742.374	1.269.176	571.129	1.516.634	1.313.503
Marmara	51.131	153.393	518.501	233.326	569.632	386.718
Toplam	1.449.313	4.347.939	13.167.375	5.925.319	14.616.688	10.273.257

*Çayır alanlarının kuru ot verimi 3000 kg/ha ve mera alanlarının ise 450 kg/ha olarak hesaplanmıştır (Anonim, 2012).

1940 yılında 46.5 milyon ha olan ülkemiz meraları, 1950 yılında 37.9 milyon ha'a, 2009 yılında ise 3 kat azalma göstererek 14.6 milyon ha'a gelmiştir. Özellikle 1948-1951 yılları arasında yapılan Marshall yardımı ile traktör kullanımının etkisi de azalmaya etki etmiştir. Bu azalma hayvan başına düşen mera alanı ve birim mera alanına düşen hayvan sayısında da kendini göstermiştir. 1940 yılında bir hayvan birimi (HB) için 3.38 ha'lık mera alanı varken, bu oran 2000 yılında 1.18 ha'a kadar düşmüştür. Daha sonra bu oran 2009 yılı itibariyle 1.24 ha' a ulaşmış ve bir hektarda 0.3 (HB) otlarken, 2009'da bu oran 0.80'e çıkmıştır (İptaş ve Karadağ, 2010; Kuşvuran vd., 2011). Yıllar itibariyle gelinen noktada, birim alanda otlayan hayvan sayısında yaklaşık 3 katlık bir atış gerçekleşmiştir (İptaş ve Karadağ, 2010).

Meraların ıslah edilmesi amacıyla kiraya verilmesine imkân tanıyan 4342 sayılı Mera Kanunu ve kanun kapsamında çıkarılan yönetmelik Ülkemizde 1998 yılında yasalaşarak yürürlüğe girmiştir. Bu kanun gereğince illerde mera komisyonları başkanlığında sahip olduğumuz bu alanlarının tespit, tahdit, tahsis ve ıslah çalışmaları bütün illerimizde yürütülmektedir.

Türkiye'de 1940 yılında 44.2 milyon hektar olan çayır ve mera alanları, 1991 yılına kadar büyük bir azalış göstererek 12.3 milyon hektara düşmüş; Mera Kanunu'yla birlikte başlayan tespit ve tahdit çalışmaları sonucunda günümüzde 14.6 milyon hektara çıkmıştır (Anonim, 2021a). Tarım ve Orman Bakanlığı tarafından yürütülen "Mera Islah ve Amenajman Projeleri" ile meraların bir taraftan verimleri arttırılmaya çalışılırken, diğer taraftan amenajman tedbirleri ile kullanım kapasiteleri geliştirilmeye ve buna bağlı olarak da hayvancılık faaliyetlerinin ekonomik hale getirilmesi amaçlanmaktadır. Mera Kanunu kapsamında 2019 yılı itibarı ile yaklaşık 12 milyon hektar mera alanının tespiti yapılırken, bunun 8 milyon hektarlık kısmında tahdit işlemleri de tamamlanmıştır.

Tespit, tahdit ve tahsis işlemleri tamamlanan meralarda Türkiye genelinde 1685 adet proje ile yaklaşık 1milyon hektar alanda ıslah ve amenajman çalışmaları da yapılmıştır (Anonim, 2021b).

1.2. ÜLKEMIZDE MERAYA DAYALI KOYUNCULUK

Küçükbaş hayvan yetiştiriciliği kırsal alanlarda ve nispeten daha düşük maliyetlerle yapılabilecek bir hayvancılık sektörüdür. Dolayısıyla, küçükbaş hayvancılık, yapısı bakımından

kırsal kesimin önemli gıda ve gelir kaynağı olma özelliğini geçmişten beri korumaktadır (Kaymakçı ve ark., 2005).

Koyunlar, yılın 9-10 ayı meradan yararlanırken sadece yılın 2-3 ayında kesif yem tüketmektedirler. Kaba yemi en verimli şekilde değerlendiren çiftlik hayvanlarıdır. Yetiştiricilikte koyun alımı ve sürü kurulması kolay, maliyetinin düşük olması, büyükbaş hayvanlara göre daha avantajlı olmasının yanı sıra hastalık ve ölümle sonuçlanacak çeşitli olumsuz faktörlere göre risk minimum düzeydedir. Koyun yetiştiriciliğine yeni başlayacak yetiştiriciler az sermaye ile küçük bir sürü oluşturup, kolay ve az maliyetli barınaklarda yetiştiricilik yapmaya başlayabilirler (Akçapınar, 1994).

Ülkemiz kaba yem kaynakları hayvanlarımızın ihtiyaçlarını karşılayamayacak durumdadır. Toplam arazi alanlarımızın içerisinde yer alan çayır-mera alanı oranının, birçok ülkeyle karşılaştırıldığında iyi seviyede bulunmasına rağmen, ekolojik koşullar ve yanlış kullanımlar neticesinde, verimleri çok az düzeylerdedir. Hayvan beslenmesinde yem eksikliğinin giderilmesi amacıyla alternatif yem bitkisi arayışları başlamıştır (Okuyucu ve Okuyucu, 2006).

Ülkemizde özellikle koyunların otlatıldığı doğal meralar çok sayıda farklı bitki türünü bir arada barındırmaktadır. Meraları oluşturan bitki türlerinin besin madde bileşimi yetiştiği bölgeye göre farklılık gösterebilmektedir. Küçükbaş hayvancılık, ülkemizde aile işletmeleri şeklinde faaliyet gösteren önemli bir geçim kaynağıdır. Türkiye'nin kırsal alanları koyun ve keçilerin yaşam sürmesi açısından daha uygun oluşu, çayır ve meraların önemini daha da artırmıştır, ailelerin yaşamdaki tüketim alışkanlıkları gibi etmenler, küçükbaş hayvan yetiştiriciliğini daha da cazip hale getirmektedir (Kaymakçı ve Sönmez 1996).

Hayvanların yaşam faaliyetlerini devam ettirebilmek için ihtiyaç duyduğu besin maddesini karşılamak üzere üretilen yem bitkileri ayrıca toprağı ve suyu koruma, ekim nöbetinde kendinden sonra gelecek tarımsal ürünlerde verimi iyileştirme gibi niteliklerinin yanı sıra hasat edildikten sonra kurutulup veya silajı yapılarak kullanılan bitkilerdir. Baklagiller ve buğdaygiller familyasına ait çok sayıda tür yem bitkisi içerisinde yer almaktadır. Öte yandan dünyada bu familyaların dışında birçok bitki türleri hayvanların besinsel yem kaynağı şeklinde kullanılmaktadır. Bunlardan bir kısmı tarımsal ürün olarak üretilmekte, bir kısmı ise doğada kendiliğinden yetişmektedir (Temel ve Tan, 2012).

Hayvansal ürünlerin üretimi sırasında işletme giderlerinin en fazla payını yem giderleri oluşturmaktadır (%60-70) (Boğa, Çevik, 2012). Türkiyede meraya dayalı ekstansif koyunculuk işletmeleri, daha yaygın olduğundan, birim maliyet bakımından en fazla gelir getiren üretim kollarından biri olarak görülmektedir (Boğa, Seçer, 2015).

SONUÇ

Sahip olduğumuz çayır-mera alanlarımızın büyük kısmının verim kapasitelerinin düşük olduğu ve özellikle kalite düşüklüğünden dolayı küçükbaş hayvanlarımızın yararlandığını söyleyebiliriz. Meralarımızın kalitesi ve otlama potansiyelinin düşük olması besin ihtiyaçlarının karşılanmasında yeterli görülmemektedir. Islah çalışmaları neticesiyle kaliteli kaba yem ihtiyacı azaltılması ve meralarımızın ot kalitesinin arttırılması büyük önem arz etmektedir.

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SIĞIR YETİŞTİRİCİLİĞİNDEKİ ISLAH ÇALIŞMALARI VE ÜREMEYE YÖNELİK BİYOTEKNOLOJİK UYGULAMALAR

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ÖZET

Sığır yetiştiriciliğinde amaç verim elde edilmesidir. Islahta da elde edilen ekonomik ürün verimlerinin nitelik ve nicelik bakımından arttırılması amaçlanmaktadır. Verimle ilgili karakterlerin çok sayıda gen ve lokustan oluştuğunun tespit edilmesi ile yetiştiricilikte moleküler yöntemler ön plana çıkmaya başlamıştır. DNA tabanlı seleksiyon yöntemleri ile karakterlerde önemli genetik ilerlemeler sağlanmıştır. Teknoloji ve bilim alanlarındaki gelişmeler sayesinde, çok sayıda markör ile hayvanların yalnızca genotip bilgileri kullanılarak "Tahmini Genomik Yetiştirme Değerleri" ortaya konulabilmektedir. Genomik Seleksiyon olarak da bilinen bu yöntem, çiftlik hayvanlarında yapılan genom analizleri ve SNP çip teknolojisi ile son 10 yılda uygulanabilir hale gelmiştir, bu ve benzeri çalışmaların sayıları her geçen gün artmaktadır. Bu sayede düşük kalıtım dereceli, ölçümü masraflı ve zor olan karakterler generasyonlar boyunca analiz edilerek düşük maliyetle ve %90'a kadar güvenle seleksiyon yapılabilmesine imkan sağlamaktadır. Türkiye'de yerli ırkların verim düzeylerinin düşük olması ve seleksiyon yoluyla ıslah çalışmalarının uzun zaman alması nedeniyle, yerli ırkların verimli kültür ırkları ile melezlenmesine çalışmaları üzerinde durulmuştur. Bu doğrultuda Esmer, Simental, Holştayn ve Jersey ırkları ithal edilmiştir. İthal edilen saf kültür ırkları melezleme ve saf olarak üretimde kullanılmıştır. Ülkemizde ıslah çalışmaları Tarım ve Orman Bakanlığı, Türkiye Damızlık Sığır Yetiştiricileri Merkez Birliği tarafından yürütülmekte, hayvan kayıtları E-ıslah ve Türkvet sistemlerinde tutulmaktadır. E-ıslah sisteminde önsoykütüğü, soykütüğü ve döl kontrolü projeleri verileri kayıt edilerek ülke ıslah çalışmalarında kullanılmaktadır. Suni Tohumlama, Embriyo Transferi ve Rekombinant DNA verileride kayıt altına alınmaktadır. Hayvancılıkta ekonomik üretimi etkileyen en önemli faktörlerin başında döl veriminin iyileştirilmesi gelmektedir. Hayvan yetiştirme programında çoklu yumurta ve embriyo transferi istenilen genetik ilerlemeyi artırdığı ve generasyonlar arası

süreyi kısalttığı bildirilmektedir. Bu çalışmada ülkemizde sığır yetiştiriciliğindeki son ıslah çalışmaları ile biyoteknoloji uygulamalarında güncel gelişmelerin incelenmesi amaçlanmıştır.
Anahtar Kelimeler: Sığır yetiştiriciliği, verim, ıslah, biyoteknoloji.

BREEDING STUDIES IN CATTLE BREEDING AND BIOTECHNOLOGICAL APPLICATIONS FOR REPRODUCTION

ABSTRACT

The aim of cattle breeding is to obtain efficiency. The aim of breeding is to increase the economic product yields in terms of quality and quantity. Molecular methods have come to the fore in breeding with the detection that yield-related characters consist of many genes and loci. Significant genetic advances in characters have been achieved with DNA-based selection methods. Thanks to developments in technology and science, "Estimated Genomic Breeding Values" can be determined using only the genotype information of animals with a large number of markers. This method, also known as Genomic Selection, has become applicable in the last 10 years with genome analyzes and SNP chip technology in farm animals, and the number of such studies is increasing day by day. In this way, characters with low heritability, which are costly and difficult to measure, are analyzed throughout generations, allowing selection to be made at low cost and with up to 90% confidence. Since the productivity levels of local breeds in Turkey are low and breeding efforts through selection take a long time, emphasis has been placed on crossbreeding local breeds with productive culture breeds. Accordingly, Brown, Simmental, Holstein and Jersey breeds were imported. Imported pure culture breeds were used in crossbreeding and pure production. In our country, breeding activities are carried out by the Ministry of Agriculture and Forestry and the Central Association of Turkish Breeding Cattle Breeders, and animal records are kept in E-breeding and Turkvet systems. In the e-breeding system, preliminary pedigree, pedigree and offspring control project data are recorded and used in the country's breeding studies. Artificial Insemination, Embryo Transfer and Recombinant DNA data are also recorded. Improving reproductive efficiency is one of the most important factors affecting economic production in livestock farming. It is reported that multiple egg and embryo transfer in animal breeding programs increases the desired genetic progress and shortens the period between generations. In this study, it is aimed to examine the latest breeding studies in cattle breeding and current developments in biotechnology applications in our country.

Keywords: Cattle breeding, productivity, breeding, biotechnology.

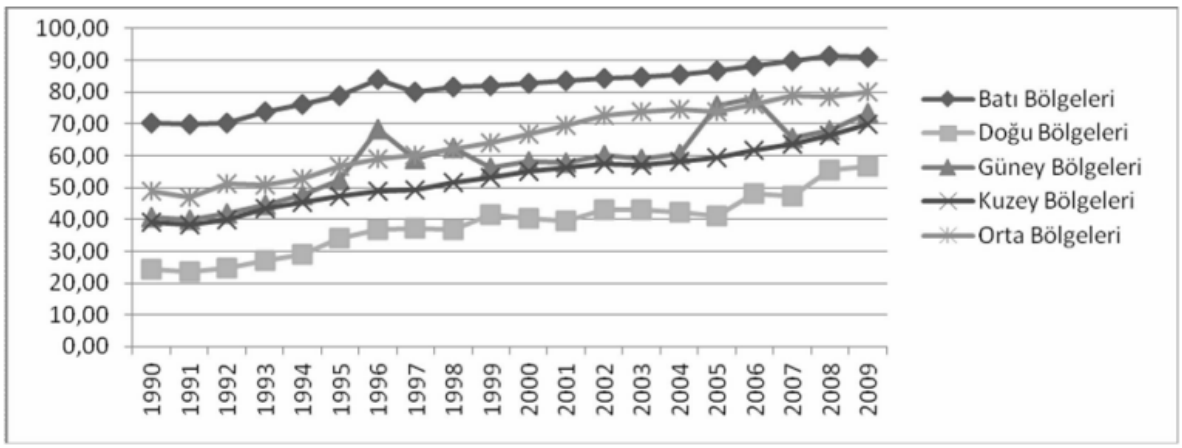
GİRİŞ

1923 yılından itibaren günümüze kadar ıslah çalışmaları incelendiğinde 1924 yılında Karacabey Harası görevlendirilmiş, takip eden yıllarda bunu diğer hara ve inekhaneler izlemiştir. Türkiye'de mevzuat bakımından ıslah çalışmalarının ilk adımı 1926 yılında yayımlanan 904 sayılı Islahı Hayvanat Kanunu'dur. Bu Kanun'la birlikte 1927 yılında, Türkiye dünyada Rusya'dan sonra sığırlarda suni tohumlama yöntemini uygulayan ikinci ülke olmuştur. 1925 yılında Avusturya'dan ithal edilen Avusturya Esmeri (Montofon) boğa ve inekler Karacabey Harasına getirilerek gerek kendi aralarında saf olarak yetiştirilmişler, gerekse izleyen yıllarda Bursa-Balıkesir bölgelerinin yerli sığırı olan boz ırk ile çevirme melezlemesi yöntemiyle ve suni tohumlama kullanılarak çiftleştirilmişlerdir. Bu sayede sonradan Karacabey Esmer Irkı olarak da adlandırılan ve Türkiye koşullarına tam uyum sağlamış bir ırk elde edilmiştir. Sığır ıslah çalışmalarına 1935'te Avusturya'dan, 1947'de İsviçre'den ithal edilen damızlık boğa ve ineklerle devam edilmiştir. 1950 yılında Devlet Üretme Çiftliklerinin kurulması ile birlikte damızlık üretim çalışmaları başlamış 1970 yılında ise köylere damızlık boğalar dağıtılarak sığır popülasyonunda iyileştirmeler amaçlanmıştır. 1973 yılında Türkiye'de ilk kez boğa spermasının dondurulması ile bu çalışmalar hız kazanmıştır. (Anonim, 2019).

1. ÜLKEMİZDE SIĞIRLARDA ISLAH ÇALIŞMALARI

Türkiye'de yerli ırkların verim düzeylerinin düşük olması ve seleksiyon yoluyla ıslah çalışmalarının uzun zaman alması nedeniyle, karar vericiler yerli ırkların verimli kültür ırkları ile melezlenmesine ağırlık vermişlerdir. Bu doğrultuda Esmer, Simental, Siyah Alaca ve Jersey ırkları ithal edilmiştir. İthal edilen saf kültür ırkları melezleme ve saf olarak üretimde kullanılmıştır (Akbulut ve Yavuz, 1998).

Hayvan ırklarının ıslah çalışmalarına Devlet Üretme Çiftlikleri, Türkiye Şeker Fabrikaları ve Ziraat İşleri Genel Müdürlüğü'ne bağlı kurumlarda başlamıştır (Yavuz, 1999). Islah çalışmalarında, damızlık hayvan ithalatının yanı sıra, suni tohumlama faaliyetleri 1949 yılında başlamış ve günümüzde de yaygın olarak devam etmektedir. Yapılan çalışmalar sonucu 1960'lı yıllarda toplam sığır varlığının % 1'ini oluşturan kültür ırkı ve melez hayvanların oranı (Anonim, 1997), bölgeler arası farklılıklar göstermekle birlikte 2010 yılında % 78,3'e yükselmiştir (Anonim, 2011). Damızlık sığır ithalatı uzun yıllardan beri yapılmasına rağmen, 1987 yılından itibaren hız kazanmıştır. Bu kapsamda 1990 yılında kalkınmada öncelikli yöreler için düve başına 1,0 TL, diğer bölgeler için 75 krş ödenmiş, 1994 ve 1996 yıllarında ithal edilen süt inekleri için değerinin %25-30'u oranında destekleme yapılmış ve bazı köy kalkınma kooperatifi üyelerine damızlık düve ithalatında ucuz kredi temin edilmiştir (Yavuz, 2001).



Şekil 1. Ülkemizde bölgelere göre kültür ve melez ırkı sığırların toplam sığır sayısına oranı (%) (Aksoy ve ark, 2012).

Şekil 1.1 de kültür ve melez ırkı sığırların toplam sığır sayısına oranı bakımından bölgeler itibariyle önemli farklılıklar olduğu anlaşılmaktadır. Söz konusu oran 1990-2009 periyodunda bütün bölgelerde artış göstermiştir. 1990 yılına göre 2009 yılında kültür ve melez sığır ırklarının oranı sırasıyla orta bölgelerde %31.3, güney bölgelerinde %32.5, kuzey bölgelerinde %30.7,

doğu bölgelerinde %32.3 ve batı bölgelerinde %21.0 artış göstermiştir. Bu veriler Türkiye sığır popülâsyonunun genetik ıslahında, kültür ırkları ile yapılan melezleme çalışmalarının sayısal olarak önemli bir gelişme sağladığını göstermektedir. 2009 yılında kültür ve melez ırkı sığırların toplam sığır sayısına oranı batı, orta, güney, kuzey ve doğu bölgelerinde sırasıyla %91.2, %80.3, %73.3, %69.9, %56.5 tür. (Aksoy ve ark, 2012).

Hayvan sayıları ve değişim oranları, 2021-2022

(Baş)

	2021	2022	Değişim (%)
Büyükbaş	**18 036 117**	**17 023 791**	**-5,6**
Sığır	17 850 543	16 851 956	-5,6
Manda	185 574	171 835	-7,4
Küçükbaş	**57 519 204**	**56 265 750**	**-2,2**
Koyun	45 177 690	44 687 888	-1,1
Keçi	12 341 514	11 577 862	-6,2

Şekil 2. Türkiye de 2021,2022 yılları Büyükbaş ve Küçükbaş Hayvan Sayıları Değişimi (TUİK,2022)

Şekil 2 de de 2022 yılında sığır sayıları incelendiğinde bir önceki yıla göre %5,6 lık bir azalış olduğu görülmektedir.

Hayvan sayıları ve değişim oranları, Aralık 2022-Haziran 2023

	Aralık 2022 (Baş)	Haziran 2023 (Baş)	Değişim (%)
Büyükbaş	**17 023 791**	**16 687 768**	**-2,0**
Sığır	16 851 956	16 520 965	-2,0
Manda	171 835	166 803	-2,9
Küçükbaş	**56 265 750**	**53 274 118**	**-5,3**
Koyun	44 687 888	42 565 444	-4,7
Keçi	11 577 862	10 708 674	-7,5

Şekil 3. Türkiye de 2021,2022 yılları Büyükbaş ve Küçükbaş Hayvan Sayıları Değişimi (TUİK,2023).

Şekil 3 te de büyükbaş hayvan kategorisinde, sığır sayısı Haziran ayı sonu itibarıyla bir önceki yılın Aralık ayına göre %2,0 azalarak 16 milyon 521 bin baş, manda sayısı ise %2,9 azalarak 167 bin baş olarak belirlenmiştir ve düşüşler görülmektedir.

Çevre şartlarının iyileştirilmesi yolu, amaca ulaşmada genetik yapının iyileştirilmesi yoluna nazaran daha avantajlı görünmektedir. Gerçekten çevre şartlarının iyileştirilmesi, verimi artırıcı etkisini aynı hayvanlar üzerinde, aynı dönemde gösterdiği halde; genetik yapı, ancak gelecek generasyonlarda iyileştirilebilmektedir. Ekonomik önem taşıyan kantitatif karakterlerde (verimlerde) çevre faktörlerinin genetik faktörlerden daha büyük etkiye sahip olmaları, dolayısıyla genetik yapıyı iyileştirme yolu ile amaca varmanın zorluğu da söz konusu avantajda rol oynamaktadır. Ancak bu husus, konuyu iyi kavramamış olanlar tarafından yanlış değerlendirilmekte hangi hayvan materyali ile çalışılırsa çalışılsın çevre faktörlerinin iyileştirilmeleri ile istenen verim seviyelerinin sağlanabileceği iddia edilmektedir. Bunlara, çevre faktörleri ne kadar iyileştirilirse iyileştirilsin genetik yapının sınırladığı seviyenin aşılamayacağını ilave etmek gerekir. (Aksoy,2003)

Yıllar	Sığır-Kültür	Sığır-Kültür Melezi	Sığır-Yerli	Toplam
1991	1.253.865	4.033.375	6.685.683	11.972.923
1995	1.702.000	4.776.000	5.311.000	11.789.000
2000	1.806.000	4.738.000	4.217.000	10.761.000
2005	2.354.957	4.537.998	3.633.485	10.526.440
2010	4.197.890	4.707.188	2.464.722	11.369.800
2015	6.385.343	5.733.803	1.874.925	13.994.071
2018	8.419.204	7.030.297	1.593.005	17.042.506
2019	8.559.855	7.554.625	1.573.659	17.688.139
2020	8.838.498	7.594.127	1.530.274	17.962.899
2021	8.824.784	7.641.100	1.384.659	17.850.543
2022	8.295.825	7.324.866	1.231.265	16.851.956

Şekil 4.Türkiye Kültür Melez ve Yerli Sığır Varlığı (TUİK,2023)

1991 yılında 2022 yılına kadar yerli ırk sığırlarımızın sayısı azalırken kültür ve kültür melezlerinin sayılarındaki artışlar Şekil 4 te görülmektedir. Sığır yetiştiriciliğinde çevre şartları ile birlikte genetik yapının da iyileştirilmesi gerekmektedir. Genetik yapının iyileştirilmesi ise ıslah ile mümkün olacaktır.

1.1. ISLAH YÖNTEMLERİ

-Saf Yetiştirme

Bir grup içerisinde uygulanan yöntemdir, Güvenli olması yanında ilerleyen zamanlar genetik varyasyon daralır.

-Akrabalı Yetiştirme

Akraba bireyler arasında uygulanan çiftleştirmedir, istenilen genlerin yayılması için faydalı bir yöntemdir ancak akrabalı yetiştirme depresyonuna neden olabilir.

-Melezleme

Farklı ırkların çiftleştirilmesi şeklinde uygulanır. Genetik varyasyonu arttırmak için kullanılır.

-İyileştirme Melezlemesi

İstenilen özelliklere sahip erkek bireylerin dişi bireylerle çiftleştirilmesidir.

-Kombinasyon Melezlemesi

İkiden fazla ırk ile yeni bir popülasyon oluşturmak için tercih edilir. Oluşturulan grup içerisinden seleksiyon yapılması uygun olacaktır.

-Çevirme Melezlemesi

Verim özellikleri düşük olan ırkın üyeleri, üstün verimli ırk bireyleri ile çiftleştirilir. Doğan bireylerde yine üstün verimli ırk bireyleri ile çiftleştirilir. Bu döngü doğan yavruların üstün verimli ırka dönüşünceye kadar devam eder.

-Kullanma Melezlemesi

Bu yöntemle elde edilen bireyler sadece üretimde kullanılır ve ebeveynlerinde daha üstün verime sahip olurlar, melez azmanlığı adı da verilir.

Ülkemizde ıslah çalışmaları Tarım ve Orman Bakanlığı, Türkiye Damızlık Sığır Yetiştiricileri Merkez Birliği tarafından yürütülmekte, hayvan kayıtları E-ıslah ve Turkvet sistemlerinde tutulmaktadır. E-ıslah sisteminde önsoykütüğü, soykütüğü ve döl kontrolü projeleri verileri kayıt edilerek ülke ıslah çalışmalarında kullanılmaktadır.

1.2. ÜLKE ISLAH ÇALIŞMALARINDAKİ PROJELER

Döl Kontrolü Projesi

Verimin arttırılması, yüksek gebelik oranı, kolay doğum döl kontrolü projesinin amaçlarıdır. Projede suni tohumlamadan faydalanılır, Boğa olarak seçilecek hayvanların ana ve babaları seçilir ve programlı bir şekilde çiftleştirmeler sağlanır ve elde edilen bireylerin döl kontrollerinde başarılı olanların spermaları suni tohumlama uygulamalarında kullanılır. Döl kontrolü projesi ile 7000 Lt, %4 yağlı süt verebilen, 750 Kg canlı ağırlığa sahip, ayak, tırnak, meme yapısı ideal, hastalıklara ve çevre şartlarına dayanıklı genotip elde etmektir.

Ön Soykütüğü Projesi

Anne ve baba kayıtları bulunup ama verim kayıtları olmayan hayvanların kayıt olduğu projedir. Soykütüğü projesine geçecek hayvanlar için geçici bir sistemdir. Bu proje ile hayvan, işletme, süt verimi, suni tohumlama kayıtları tutularak soykütüğü projesine hazırlık yapılır.

Soykütüğü Projesi

Soykütüğü projesi ıslah çalışmaları için veri tabanıdır. Islah programları veri olmadan yürütülemez. Soy kütüğü projesi bu veriyi sağlayabilecek projedir. Projede işletme, hayvan, aylık süt ölçüm kayıtları, yağ oranı ölçüm kayıtları, tohumlama kayıtları, buzağılama kayıtları, sağlık kayıtları, sürüden ayrılma ve sürüye giriş kayıtları, sınıflandırma ile ilgili kayıtlar, sürü döl verimi kayıtları, damızlık değer tahmini verileri işlenmektedir.

Türkiye Damızlık Sığır Yetiştiricileri Merkez Birliği (TDSYMB) e-ıslah veri tabanı kayıtları itibariyle, Soy kütüğüne kayıtlı 125.334 adet üye işletme bulunmakta olup, bu işletmelerde 1.945.991 baş'ı inek olmak üzere toplamda 4.784.978 baş sığır kayıtlıdır. Bu ineklerde soy bilgileri, üreme, tip sınıflandırması, süt miktarı, sütün kimyasal kompozisyonu ile ilgili verim kayıtları Yetiştirici Birlikleri tarafından takip edilmektedir (Anonim, 2020).

		İnek sayısı			Toplam sığır sayısı		
İşletme Türü	n	x̄ ± Sx̄	En az	En fazla	x̄ ± Sx̄	En az	En fazla
Kamu	32	458.50±112.81	3	2085	987.90±235.13	17	4220
Kooperatif Üyesi	10273	4.81±0.056	1	109	11.48±0.14	1	295
Şahıs	113628	16.06±0.058	4	1490	39.30±0.20	4	15130
Şirket	1401	176.91+8.96	4	5582	415.45±21.07	4	10747
Genel	125334	17.11±0.14	1	5582	41.60±0.34	1	15130

Şekil 5. Soy kütüğü işletme sayısı ve işletme başına düşen ortalama sığır sayıları (baş) (Anonim, 2020)

Verim yönü	n	%	Hayvan varlığı	n	%
Sütçü Irklar	2248951	73.23	Holstein Friesian	2.225.261	72.46
Kombine Irklar	771380	25.12	Simental	612.388	19.94
Etçi Irklar	20377	0.66	Esmer	145.776	4.75
Yerli Irklar	30349	0.99	Diğer Kültür Irk	57.283	1.87
-	-	-	Yerli Irklar	30.349	0.99
Toplam	3071057	100	Toplam	3071057	100

Şekil 6. Irk bazında soykütüğüne kayıtlı sığır sayıları (Anonim, 2020).

Suni Tohumlama

Suni tohumlama, sığırlarda genetik ilerlemeyi sağlayan ve yaygın biçimde kullanılan etkin yöntemlerdendir. Bu metod, bir inekten elde edilen buzağı sayısını artırmaz ancak yüksek genetik potansiyele sahip bir boğanın üstün genetik kabiliyetini çok sayıda yavruya aktarma imkânı sağlar. Ayrıca popülasyonun gelişmesi istenen yöne doğru geliştirmeye imkan sağlar.

Embriyo Transferi

Embriyo transferi dişi bireylerin üreme kanallarından bir yada daha fazla embriyonun alınarak başka dişilere transfer edilmesidir. Uygulamanın ana amacı üstün niteliklere sahip ineklerden elde edilecek yavru sayısını arttırmaktır. Yöntemle bir dişiden alınabilecek yavru sayısı kat kat arttırılmış olur.

Ülkemiz açısından embriyo transfer uygulamasının gelişen süt sığırcılık işletmeleri ve bu işletmelerde en iyi verimi alabilmek için genetik ilerlemenin iyileştirilmesi amacıyla yakın gelecekte uygulama şansı bulacağı öngörüsü ağırlık kazanmaktadır.(Sağırkaya, 2009).

Rekombinant DNA

Rekombinant DNA tekniğinden hayvan ıslahı ve hayvansal ürünlerin artırılmasında yararlanabilmek için öncelikle her bir hayvan türünde ilgili genlerin belirlenmesi, genetik polimorfizmlerin tespiti ve gen haritalarının yapılması gerekmektedir. Buna bir durum tespiti gözü ile bakılabilir. Hangi genlerin nerelerde yerleşmiş olduğunun anlaşılması, genler arasındaki bileşiklik ilişkileri ve genlerin çevre faktörleri ile olan interaksiyonları konularına da açıklık getirir. (Ward, 1986)

SONUÇ

Teknolojideki hızlı değişim, gen teknolojisinin ve moleküler biyolojinin Dünyadaki ıslah çalışmalarında kullanımını da beraberinde getirdi. Ülkemizde de ıslah konusundaki gelişmeler takip edilmektedir. Özellikle devlet eliyle ıslah konusuna sahip çıkılmalı ve bu konuda teknolojiler takip edilmeli ve AR-GE çalışmaları yoğun bir şekilde yapılmadır. Islah çalışmaları artan insan nüfusuna yetecek kadar hayvansal üretim gerçekleştirilmesi mümkün kılabilir. Bu konuda enstitüler, üniversiteler, Sivil Toplum Kuruluşları etkin bir şekilde kullanılmalı ve çalışmalara dahil edilmelidir.

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TÜRKİYE'DE SİMENTAL SIĞIR IRKI YETİŞTİRİCİLİĞİ VE ET ENDÜSTRİSİNDEKİ ÖNEMİ

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ÖZET

İnsan nüfusundaki artışla birlikte beslenme ve gıda sorunları artmaktadır. Dengeli ve yeterli beslenme az gelişmiş veya gelişmekte olan ülkelerin temel sorunu olmakta ve ülkeler bu sorunu çözmek için çözüm yolları aramaktadır. Bu sebeplerden dolayı her zaman hayvancılık sektörü diğer sektörler içinde de önemini koruyacaktır. Sığır besiciliği; genç hayvanlara uygun besleme ile bakım koşulları sağlanarak, miktar ve kalitesi yüksek et elde etmek amacıyla hayvanların kesim olgunluğuna getirilmesi için yapılan faaliyetlerdir. Günümüzde de artan dünya nüfusunun ihtiyacını karşılayabilmek için birim hayvandan daha fazla verim elde edebilmenin yolları araştırılmaktadır. Sığır varlığı ile dünya sıralamasında yüksek bir yerde olsak da, ülkemizde artan nüfus oranına bağlı olarak üretilen kırmızı et miktarı talebi karşılayamamaktadır. Ülkemizde besi sığırı denilince ilk akla ırklardan biriside Simental ırkıdır. Bu ırk, ülkemizin hayvancılık sektöründeki sorunları da dikkate alındığında fiyat istikrarsızlıkları, et üretiminin maliyet yüksekliği, birim hayvandan alınan verimin diğer ülkelere göre nazaran düşük olması gibi sebeplerden dolayı sığır eti üretiminde önemli rol oynamaktadır. Holstein ırkına göre daha dayanıklı olması, et verimin yüksek olması, süt yağı oranının yüksek olması ve birçok bölgemizde uyum içerisinde yetiştirilebilmesi nedenlerinden dolayı yetiştiricilerimiz tarafından tercih edilmektedir. Günümüz de hayvan ürünlerinin karlılığına göre bazı dönemlerde Simental sığır ırkına yönelik talep artışı gözlenmekte ve ülkemizdeki damızlık hayvan yetersizliğinden dolayı özellikle Avrupa ülkelerinden ithalatı gerçekleştirilmektedir. Bu çalışmada ülkemizdeki et endüstrisinin genel durumu, Simental erkek danalarında besi kabiliyeti ve karkas özelliklerinin araştırılması ve diğer ırklarla karşılaştırılması amaçlanmıştır.

Anahtar Kelimeler: Et Üretimi, Besi Performansı, Simental Irkı, Endüstri

SIMMENTAL CATTLE BREEDING IN TURKEY AND ITS IMPORTANCE IN MEAT INDUSTRY

ABSTRACT

Nutrition and food problems increase with the increase in human population. Balanced and adequate nutrition is the main problem of underdeveloped or developing countries, and countries are looking for solutions to solve this problem. For these reasons, the livestock sector will always maintain its importance among other sectors. Cattle breeding; These are activities carried out to bring animals to slaughter maturity in order to obtain meat of high quantity and quality by providing appropriate feeding and care conditions for young animals. Nowadays, ways to obtain more efficiency per unit animal are being investigated in order to meet the needs of the increasing world population. Even though we are in a high place in the world rankings with the presence of cattle, the amount of red meat produced in our country due to the increasing population rate cannot meet the demand. When it comes to beef cattle in our country, one of the first breeds that comes to mind is the Simmental breed. Considering the problems in our country's livestock sector, this breed plays an important role in beef production due to reasons such as price instability, high cost of meat production, and lower yield per unit animal compared to other countries. It is preferred by our breeders because it is more durable than the Holstein breed, has a high meat yield, has a high milk fat rate and can be grown in harmony in many regions. Nowadays, depending on the profitability of animal products, an increase in demand for the Simmental cattle breed is observed in some periods, and due to the lack of breeding animals in our country, it is imported especially from European countries. In this study, it was aimed to investigate the general situation of the meat industry in our country, the fattening ability and carcass characteristics of Simmental male calves and to compare them with other breeds.

Keywords: Meat Production, Fattening Performance, Simmental Breed, Industry.

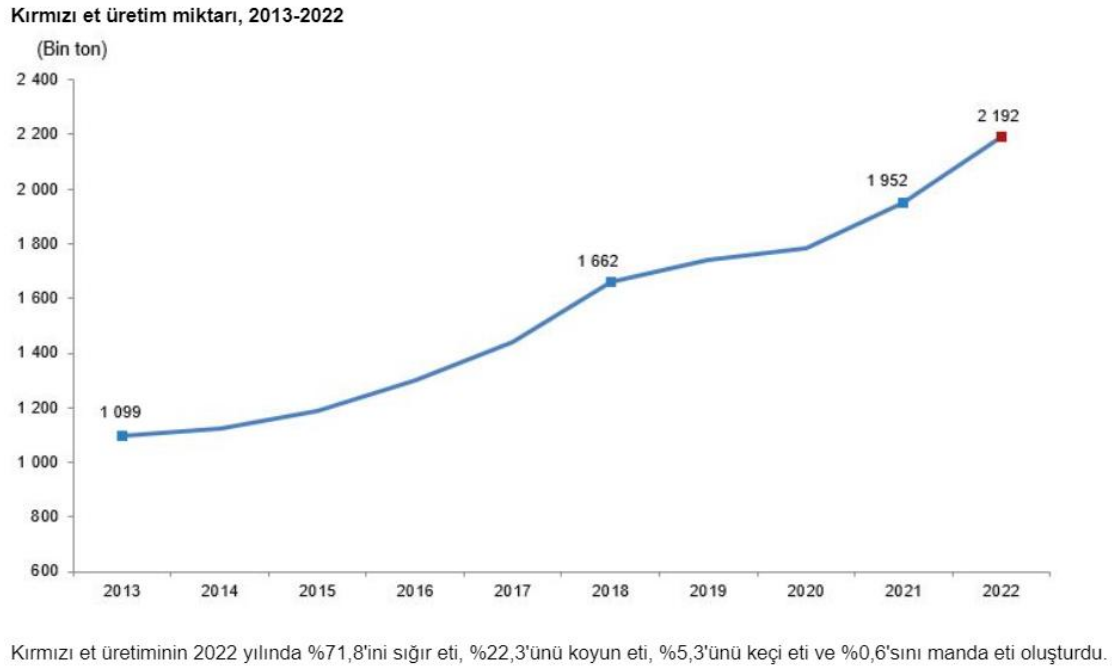
GİRİŞ

Hayvancılık sektörü Türkiye'de, nüfusun yeterli ve dengeli beslenmesi, kırsal kalkınmanın gerçekleştirilmesi, tarımsal işsizliğinin azaltılarak köyden kente göçün önlenmesi gibi ekonomik ve sosyal açılardan stratejik bir öneme sahiptir (Karagöz, 2009; Bayraç ve Çemrek, 2011). Dünya et üretiminin %30 civarı sığırlardan, %5 civarı ise küçükbaş hayvanlardan karşılanırken, Türkiye'de domuz eti tüketilmediğinden et üretiminin %88'i sığırlardan, %12'si ise küçükbaş hayvanlardan sağlanmaktadır. Nüfus artışına bağlı olarak dünyada hayvan sayısı ve kırmızı et üretimi her geçen yıl artmaktadır. 2015 yılında ufak çapta bir düşüş görülse de 2016 yılında üretim tekrar artmış ve USDA verilerine göre içinde Türkiye'nin de olduğu 18 ülkede 289 milyon büyükbaş hayvan üretimi, 53 ülkede de 60 milyon ton civarında sığır eti üretimi gerçekleşmiştir. 2017 yılında da bu ülkelerde 61 milyon tonu aşkın sığır eti üretimi, 293 milyonu aşkın da büyükbaş hayvan üretimi gerçekleşeceği tahmin edilmektedir. Toplam sığır varlığı bu 18 ülkede 2016 yılı itibariyle 1 milyar 280 milyon baş civarında olup, 2017 yılında 1 milyar 292 milyon baş olması beklenmektedir. Dünyada en fazla büyükbaş hayvan varlığına sahip ülkeler sırasıyla, Hindistan, Brezilya, Çin ve ABD'dir. (Anonim,2018)

	Aralık 2022 (Baş)	Haziran 2023 (Baş)	Değişim (%)
Büyükbaş	**17 023 791**	**16 687 768**	**-2,0**
Sığır	16 851 956	16 520 965	-2,0
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Küçükbaş	**56 265 750**	**53 274 118**	**-5,3**
Koyun	44 687 888	42 565 444	-4,7
Keçi	11 577 862	10 708 674	-7,5

Şekil 1. Ülkemizde hayvan sayıları ve değişim oranları, Aralık 2022-Haziran 2023 (baş) (TUİK, 2023a).

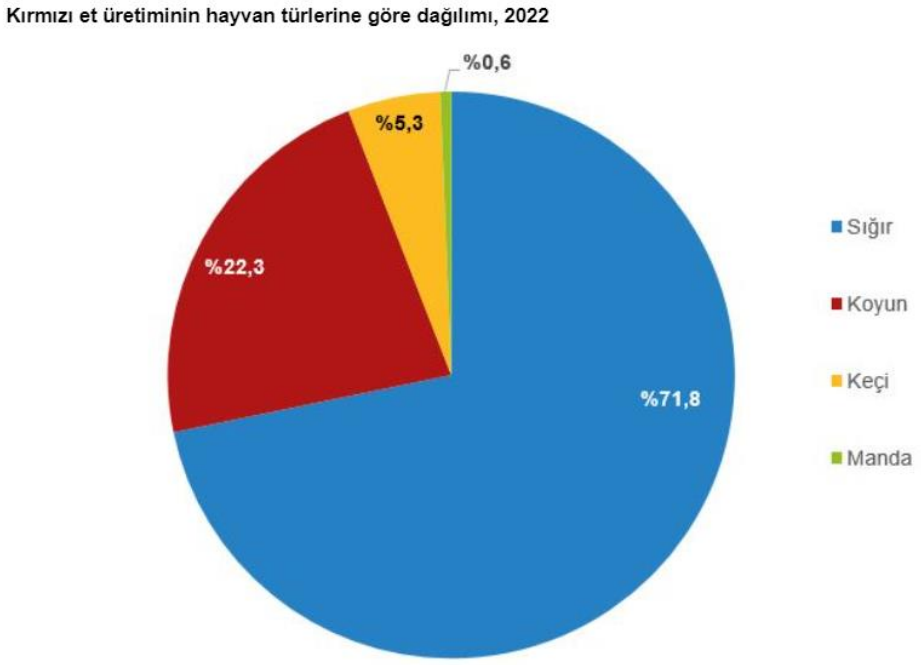
Şekil 1 de büyükbaş hayvan kategorisinde, sığır sayısı Haziran ayı sonu itibarıyla bir önceki yılın Aralık ayına göre %2,0 azalarak 16 milyon 521 bin baş, manda sayısı ise %2,9 azalarak 167 bin baş olarak belirlenmiştir ve düşüşler görülmektedir. Şekil 1'de hayvan sayılarının 2023 yılında, 2022 yılına göre düştüğü, ancak şekil 2 'de ise et üretiminin arttığı gözlemlenmektedir. Buradan iki sonuç çıkarılabilir. Birincisi üretimin daha çok et üretimine doğru kaydığı yada birim hayvan başına alınan et veriminin arttığı. Ülkemizde hayvancılık sektörü piyasasındaki dalgalanmalar üreticilerin bazen et üretimine bazen de süt üretimine yöneltebilmektedir.



Şekil 2. Kırmızı et üretim miktarları (Bin Ton)(TUİK, 2023b)

Kırmızı et üretim tahmini, Tarımsal İşletmelerde Hayvansal Üretim Araştırmasından elde edilen demografik verilere dayalı olarak belirlenen "Kasaplık Güç Oranı" ile hesaplanan "iç popülasyondan kesilen hayvan sayısı" ile "ithalattan kesilen hayvan sayısı"nın ortalama karkas ağırlıkları ile çarpılması suretiyle elde edilmektedir.Buna göre 2021 yılında 1 milyon 952 bin 38 ton olan kırmızı et üretimi, 2022 yılında %12,3 artarak 2 milyon 191 bin 625 ton olarak

tahmin edildi. Bu kapsamda bir önceki yıla göre sığır eti üretimi %7,7 artarak 1 milyon 572 bin 747 ton, koyun eti üretimi %26,8 artarak 489 bin 354 ton, keçi eti üretimi %22,6 artarak 115 bin 938 ton, manda eti üretimi ise %25,4 artarak 13 bin 586 ton oldu. (TUİK, 2023b)



Şekil 3. Kırmızı et üretiminin hayvan türlerine göre dağılımı (TUİK, 2023c)

Tablodan da anlaşılacağı üzere Ülkemizde kırmızı et üretimin hayvan türlerine göre dağılımı incelendiğinde; 2022 yılında üretimin daha çok sığır cinsi hayvanlardan sağlandığı anlaşılmaktadır.

Türkiye et üretimini yüksek maliyetle gerçekleştirmekte bu nedenle küresel rekabet şansı bulamamaktadır. Türkiye, kırmızı et ve canlı hayvan ithal eden ülkeler arasındadır. Türkiye 2016 yılında büyük oranda Bosna-Hersek'ten olmak üzere 5 bin 720 ton et ithalatı, buna karşılık 129,3 ton kırmızı et ihracatı gerçekleştirmiştir. (Anonim,2018)

	AB (25)	TÜRKİYE
Karkas[7] Ağırlığı (kg)	268,4	175,8
Süt Verimi (kg/baş)	5.880	1.709
Süt Tüketimi (kg/kişi)	90	30
Kırmızı Et Tüketimi (kg/kişi)[8]	62[9]	12

Şekil 4. Türkiye ve AB'deki Temel Hayvansal Ürün Göstergeleri (Ünlüsoy ve ark. 2010).

Yukarıdaki göstergelerden takip edilebileceği üzere, AB'nin verimlilikte Türkiye'den belirgin bir şekilde önde olduğu görülmekte olup, karkas ağırlığında 1,5, süt veriminde 3,4 kat fazla verimliliğe sahip AB'de kişi başına süt ve et tüketimi ülkemizin yaklaşık 3 katıdır. (Ünlüsoy ve ark. 2010). FAO'nun 2011 yılı verilerine göre kişi başına sığır eti tüketiminin yüksek olduğu bazı ülkeler Yeni Zelanda (47.6 kg), Arjantin (43 kg), Avustralya (40.6 kg) ve ABD (37 kg)'dir. 2009/2011 yılları ortalamasına göre; Türkiye kişi başına sığır eti tüketiminde 4.5 kg ile dünya sığır eti tüketim ortalamasının altındadır. Kişi başına koyun eti tüketiminin yüksek olduğu ülkeler ise; Moğolistan (45.1 kg), Türkmenistan (26.1 kg), Yeni Zelanda (20.5 kg)'dır. AB ve OECD ülkelerinde kırmızı et tüketiminin çoğunluğunu domuz eti oluşturmaktadır. AB'de kişi başına domuz eti tüketimi 32 kg'dır. 2009/2011 ortalamasına göre; Türkiye'de kişi başına koyun eti tüketimi 3.58 kg ile dünya koyun eti tüketim ortalamasının üzerindedir. (Saygın Ö, Demirbaş N, 2017)

SİMENTAL IRKI YETİŞTİRİCİLİĞİ

Çok yönlü bir sığır olan Simmental (SIM), dünyanın en eski ve en yaygın yetiştirilen ırklarından birisidir. Bu ırk çok sayıda sığır genotipinin geliştirilmesine de kaynaklık etmiştir. Simmental,

yüksek süt ve döl verimi yanında, besi performansı ve hastalıklara dayanıklılık gibi özellikleri nedeniyle üreticiler tarafından son yıllarda tercih edilen bir ırk haline gelmiştir. Dünyanın değişik ülkelerinde melezlemelerde tercih edilmesinden ve değişik Simmental kökenli genotiplerin geliştirilmesinden dolayı ırkın evrensel standardını belirlemek zor olsa da, gen havuzunun azalma riski yoktur. Türkiye'de hem yerli hem de kültür ırkları ile melezlenerek yetiştirici koşullarına uygun yeni Simmental kökenli genotiplerin geliştirilmesi önerilebilir. (KOÇ, 2016).

Simental, ismini kaynak bölgesi olan batı İsviçre'nin Bernese Oberland'ında Simme Irmağı vadisinden alan çok yönlü bir sığır ırkıdır. Almancada Thal ya da Tal kelimesinin vadi anlamına gelmesinden dolayı ırkın kelime anlamı "Simme Vadisi" dir. Simmental sığırı, dünyadaki sığır ırklarının en eskilerinden ve en fazla yayılanlarından birisidir. Kombine verimli (et+süt+çeki gücü) bir sığır ırkı olan bu ilk olarak İsviçre'de geliştirilmiştir. Simmental ırkına ait ilk sürü defteri 1806 yılında oluşturulmuş, ilk birlik ise "Kırmızı ve Beyaz Alaca Simmental Sığır Birliği" adıyla 1890'da İsviçre'de kurulmuştur. Ancak Batı İsviçre'de çok daha önceye ait kilise ve kilise dışındaki şahısların kayıtlarında iri, verimli, kırmızı ve beyaz renkli sığır olduğuna dair kanıtlar da bulunmaktadır. Bu kırmızı ve beyaz hayvanlar "gösterdikleri hızlı gelişme, dikkati çeken süt, tereyağı, peynir üretimi ve çeki hayvanı olarak kullanılmalarından" dolayı hep istenen hayvanlar olmuşlardır (Anonim, 2015).

Simental ırk tosunlarla yapılan besi çalışmalarının sonuçlarına göre ortalama günlük canlı ağırlık artışı (GCAA) 1095 g, yemden yararlanma katsayısı 6.94 ve kesim randımanı % 56.8 dir. Bu sonuçlar ırkın Türkiye şartlarında tatmin edici düzeyde besi performansına sahip olduğunu göstermektedir. Almanya'da performans test sonuçlarına göre Simental tosunlar

Bavyera'da 1382 g, Baden Württemberg'de 1335 g GCAA sağlamışlardır (Meyn ve ark., 1990). Bu veriler Türkiye'de elde edilen ortalamadan yaklaşık 300g yüksektir.(Akbulut,2013).

Simental ırk ineklerin Türkiye şartlarında süt verim özellikleri incelendiğinde bu ırkta laktasyon süresi 291 gün, 305 günlük ve gerçek süt verimi sırasıyla 3176 ve 3043 kg, sütte yağ oranı % 4.10 dır. Burada 305-gün süt veriminin gerçek süt veriminden büyük çıkması yararlanılan araştırmaların bir kısmının farklı olmasından kaynaklanmaktadır. Gerçek ve 305-gün süt verimini birlikte sunan 4 araştırmanın sonucuna göre 305-gün süt verimi 3036 kg olarak şekillenmiştir. Simental ırkı sığırlar Almanya ve Avusturya'da yaygın olarak yetiştirilmektedir. Bu ırkın Almanya'da sürü defterine kayıtlı sürülerde laktasyon süresi 317 gün, 305 günlük süt verimi 4401 kg, gerçek süt verimi 5323 kg ve süt yağı oranı % 4.01 olarak bildirilmiştir (Meyn ve ark., 1990). Avusturya'da ise ırkın gerçek süt verimi 4738 kg, yağ oranı % 4.14 olarak tespit edilmiştir (Hartmann ve ark., 1990). Irkın Türkiye şartlarında tespit edilen yağ oranı yukarıda anılan ülkelerde bildirilen değerlere benzerdir. Ancak süt verim performansı bakımından Türkiye ortalaması Almanya ortalamasından yaklaşık 2300 kg ve Avusturya ortalamasından 1700 kg düşüktür. Ayrıca süt verimi Türkiye'de hiçbir işletmede ırkın ithal edildiği bu ülkeler düzeyine ulaşamamıştır. (Akbulut,2013).

Özellikler	AS	n	Xw	Sx	Max	Min
Laktasyon Süresi (Gün)	5	650	291	5.3	315	280
305-Gün Süt Verimi (kg)	7	1210	3176(3036)	123	3518	2350
Gerçek Süt Verimi (kg)	4	614	3072	146	3560	2350
Sütte Yağ Oranı (%)	3	217	4.10	0.11	4.30	3.87

Şekil 5. Simental ırkının süt verim özellikleri, (Akbulut,2013). AS: Araştırma sayısı, n: Verim kaydı sayısı, Xw: Ağırlıklı ortalama, Sx: Standart hata. Parantez içindeki değer her iki verimi bildiren 4 araştırmanın ortalamasıdır.

SONUÇ

Simental ırkı, Ülkemizin hayvancılık sektöründeki sorunları da dikkate alındığında fiyat istikrarsızlıkları, et üretiminin maliyet yüksekliği, birim hayvandan alınan verimin diğer ülkelere göre nazaran düşük olması gibi sebeplerden dolayı sığır eti üretiminde önemli rol oynamaktadır. Holstein ırkına göre daha dayanıklı olması, et verimin yüksek olması, süt yağı oranının yüksek olması ve birçok bölgemizde uyum içerisinde yetiştirilebilmesi nedenlerinden dolayı yetiştiricilerimiz tarafından tercih edilmektedir. Günümüz de hayvan ürünlerinin karlılığına göre bazı dönemlerde Simental ırkına yönelik talep pik yapmakta ve ülkemizdeki damızlık hayvan yetersizliğinden dolayı özellikle Avrupa ülkelerinden ithalatı gerçekleştirilmektedir. Sığır eti üretimi baz alınarak değerlendirildiğinde ülkemiz için çok önemli bir ırk olduğu ve sayılarının mevcutta oranla arttırılması gerektiği düşünülmektedir.

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SAFRAN BİTKİSİNE GENEL BİR BAKIŞ

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ÖZET

Çalışma; güçlü bir antioksidan olmasının yanı sıra geniş bir kullanım alanı olan Safran bitkisinin (Crocus sativus L) etkinliği ile ilgili literatür bulgularının birleştirilmesi çabasıdır. Safran, kuzey yarım kürenin tropikal ve subtropikal bölgelerinde yayılış gösteren daha çok İtalya, İspanya, Yunanistan gibi Akdeniz'e kıyısı olan ülkelerde ve Türkiye dahil olmak üzere Çin, İran ve Azerbaycan'da kültürü yapılan kormlu (sert soğanlı), çok yıllık, otsu bir bitkidir. Safran bitkisinin kimyasal analizi sonucunda amino asitler, karbonhidratlar, mineraller, pigmentler, proteinler ve vitaminler gibi 150 den fazla uçucu ve uçucu olmayan bileşenin varlığı tespit edilmiştir. 34 den fazla terpen ve bunların esterleri olan uçucu bileşen içermektedir. Bitki özlerinin kimyasal analizi sonucunda bitkinin temel bileşenleri karotenoid
yani krosinler, krosetin, karotenoidin ve safranaldır. Safran, ekonomik değeri yüksek olan bir baharattır. 150 tane safran çiçeğinden 1 g safran ve 147 bin taze çiçekten 1 kg kuru safran elde edilmektedir. Safranın yaklaşık dört bin yıl boyunca önemli bir tıbbi kullanım alanına sahip olduğu ve tarih boyunca 90'ın üzerinde tıbbi rahatsızlığın tedavisinde kullanıldığı bildirilmiştir. Arapça "Zaferaan" sözcüğünden gelen Safran, boya, gıda, ilaç, kozmetik gibi çeşitli endüstri dallarında kullanılmaktadır. Günümüzde safran çoğunlukla gıda sektöründe kullanılmaktadır. Fizyolojik ve biyokimyasal etkinliği olan bu bitkinin akademik alanlarda birçok çalışmaya zemin hazırladığı görülmüştür. Bu bağlamda bitki medikal sahada etkin bir şekilde kullanılmaya başlanmıştır. Beslenme ve sağlık alanında da tercih edilen safranın bilinçli ve güvenli kullanımı oldukça önemlidir. Bu nedenle derlememiz de, safran bitkisi hakkında güncel bir veri sunumu sağlayarak, safranın hastalıkların önlenmesinde rolü hakkında bilgileri güncellenmiş literatür bilgileri eşliğinde gözden geçirerek araştırmacılar ve ilgililerin dikkatine sunmak amaçlanmıştır.

Anahtar Kelimeler: Safran, Antioksidan, Biyolojik Etkinlik, Kimyasal Analiz.

A GENERAL OVERVIEW OF SAFFRON

ABSTRACT

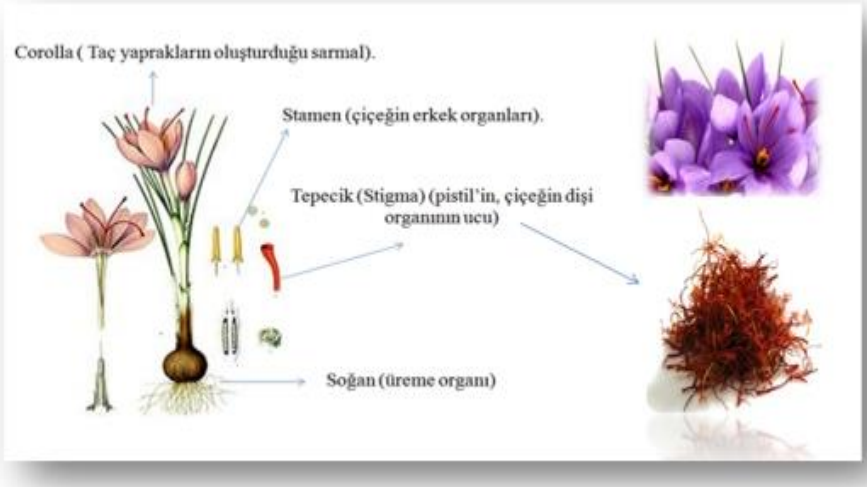
Study; It is an effort to combine literature findings regarding the effectiveness of the Saffron plant (Crocus sativus L), which is a powerful antioxidant and has a wide range of uses. A perennial herbaceous plant with hard bulbs called corms, saffron is grown mostly in Mediterranean nations like Greece, Italy, and Spain as well as in China, Iran, and Azerbaijan, which includes Turkey. It is found throughout tropical and subtropical regions of the northern hemisphere. As a result of the chemical analysis of the saffron plant, the presence of more than 150 volatile and non-volatile components such as amino acids, carbohydrates, minerals, pigments, proteins and vitamins was detected. It contains more than 34 volatile components, which are terpenes and their esters. As a result of chemical analysis of plant extracts, the main components of the plant are carotenoids, namely crocins, crocetin, carotenoidin and safranal. Saffron is a spice with high economic value. 1 g of saffron is obtained from 150 saffron flowers and 1 kg of dried saffron is obtained from 147 thousand fresh flowers. Saffron has been reported that it has been used in the past to treat more than ninety various health issues and to have had significant medical uses for about 4,000 years. Saffron, which comes from the Arabic word Zaferaan; is used in various industries such as paint, food, medicine and cosmetics. Today, saffron is mostly used in the food industry. In numerous academic fields, there was physiological and biochemical activity. This plant has begun to be used effectively in the medical field. Storage and safe use of safran, which is preferred in the field of nutrition and health, is very important. Because of this, we review the information about saffron's role in diseases along with updated literature information in order to present an up-to-date data presentation about the saffron plant and bring it to the attention of researchers and other interested.

Keywords: Saffron, Antioxidant, Biological Effect, Chemical Analysis.

GİRİŞ

1. Safran

Kuzey yarım kürenin tropikal ve subtropikal bölgelerinde yayılış gösteren safran *(Crocus sativus L.)* İtalya, Yunanistan, İspanya, Türkiye olmak üzere, Çin, İran, Azerbaycan'da kültürü yapılan sert soğanlı, otsu, çok yıllık bir bitkidir. Arapça "Zaferaan" sözcüğünden türeyen Safran, gıda, kozmetik, boya, ilaç gibi çeşitli endüstri dallarında kullanılmaktadır. Taze stigmalar da bulunan acı tattaki pikokrosinin kurutma prosesi sırasında hidrolizi sonucunda ortaya çıkan hoş aromalı safranal bileşeni sayesinde safran bu alanlarda kullanılmaktadır. (1). Safran, bitkinin stilus ve stigma kısımları kullanılarak elde edilmektedir (Resim 1.1) (2,3). 1 gram safran için yüzelli tane safran çiçeği ve 1 kilo gram kuru safran elde etmek için yüzkırkyedi bin çiçek kullanılır. Bir kilogram kaliteli safran üretiminin maliyeti ikibindolar olan safran ekonomik değeri yüksek bir baharattır (4).



1.1. Safranın Kimyasal Analizi

Safran genel olarak % 15-16 oranında su, % 13-14 karbonhidrat, % 10-14 protein, % 9-10 gamlar, % 8- 13 oranında oleik asit, stearik asit, palmitik asit, laurik asit olmak üzere bitkisel

yağlardan, % 6-7 oranında pentozlar, % 6-7 nişasta ve dekstrin, % 5-8 kül, % 4-5 lif ve % 0.8-1 uçucu yağdan oluşmaktadır. Safran ayrıca P, K, Na, Ca ve Fe gibi minerallerle B_1 ve B_2 vitaminleri de içermektedir (5). Ayrıca tirisin, luteolin, apigenin, mirisitin, kamferol ve kuersetin safranda bulunan fenolik yapıdaki bileşiklerdendir (1). Ana bileşenlerinden krosetin, safranal, pikokrosin ve krosin farmakolojik özelliklere sahiptir (6). Safran renk özelliğini cis ve trans şeklinde bulunan krosinler safranın renkli olmasından sorumludur. (1,5). Altın sarısı rengi veren krosin, kendi ağırlığının 100.000 katı suyu sarı renge boyayabilen etken maddedir. Aynı zamanda yemeklere sarı bir renk vermektedir. Krosinler; renklendirme özelliğinden dolayı saç, yün ve ipek boyası olarak da kullanılır. (7). Safranın rengi ile birlikte kalitesini etkileyen diğer bir özelliği de tatı ve aromasıdır. Safranalın öncü bileşeni olan pikokrosin safrana acılık veren ve safranın tattan sorumlu ana bileşenidir (7).

GELİŞME

1.2 Safran ve Fitoterapi

İnsanlık tarihinin bilinen en eski doğal tedavi yöntemlerinden biri olan fitoterapi bitkilerle hazırlanan ilaçlarla hastalıkları önlemeyi ve tedavi etmeyi amaç edinmiştir (8). Antik çağlardan günümüze kadar çoğu bitkinin sahip olduğu kimyasallar nedeniyle hastalıkların tedavisinde kullanıldığı bilinmektedir (9). 4000 yıl boyunca önemli bir tıbbi kullanıma sahip olan safranın doksanın üzerinde tıbbi rahatsızlığın tedavisinde kullanıldığı belgelenmiştir Sümerliler safranı ilaç ve iksirlerinin hazırlanmasında kullanmışlardır; Eski Mısırlılar ise yaraları ve sindirim sistemi hastalıklarını tedavi etmek amacıyla kullandıkları bildirilmiştir. Tıp âlimlerinden olan Hipokrat eserlerinde safranın diş, göz, kulak ağrılarında, ülser tedavisinde ve kan durdurucu etki gösterdiğinden bahsetmişlerdir. Eski Roma'da bu bitkiyle hazırlanan yağ, aromatik su ve merhemler karaciğeri rahatlatmak, öksürüğü kesmek, akciğer sağlığı ve göz iltihaplarını

gidermek için kullanılmıştır. (10). Eber papirüslerinde (M.Ö. 1500 yılı) safranın böbrek rahatsızlıkları için kullanıldığından bahsedilmektedir (9). Safranın içerdiği fitokimyasalların biyoaktivitesini belirlemek için çok sayıda in vivo ve in vitro çalışma yapılmış ve safran kullanımının depresyon, mide rahatsızlıkları, kanser riskini azaltıcı uykusuzluk, kalp damar hastalıklarını azalttığını bildirmişlerdir (11). Safranal önemli bir nörotransmitter olan asetil kolin metabolizmasında görev alan, asetilkolinestreaz enzimine bağlanarak, bu enzimi inhibe edebilmektedir. Asetilkolinesteraz inhibitörü olan safranal Alzheimer, Parkinson gibi nörodejeneratif hastalıkların tedavisinde etkilidir (12). Safranal, toksik amyloid yapılı bileşiklerin oluşumunu azaltarak nörodejeneratif hastalıkların tedavisinde yararlı etkiler göstermektedir (13).

1.3. Safran'ın Kullanım Alanları

Boya Sanayi: Boyama gücünün yüksek olması ve parlak sarı renk vermesi nedeniyle eskiden kumaş ve ipliklerin boyanmasında kullanılmıştır. Pahalı olması sebebiyle yerine sentetik boyalar geçmiştir. (14).

Gıda Sanayi: Gıda sanayinde geniş bir kullanıma sahip olan safran; çorba çeşitlerinden etli yemeklere, tatlılardan tuzlulara, kurutulmuş meyvelerde, ülkemizde lokum, zerde gibi tatlılarda ve safranlı pilav yapımında kullanılmaktadır. Örneğin, içeceklerde, yemeklerde ve tatlılarda renklendirici ve tatlandırıcı olarak kullanılmasına dair kitaplar yayımlanmıştır. Safranlı besinlerin fiyatı daha yüksek olmaktadır (14).

İlaç Sanayi: Safran içeren ilaçlar; bronşit, sindirim bozukluğu, iktidarsızlık, gut ağrıları, kalp çarpıntısı, nefes zorluğu, iştahsızlık, uykusuzluk gibi rahatsızlıklarda kullanıldığı bildirilmiştir. Örneğin, Japonya, Fransa, Amerika Birleşik Devletleri, Rusya, İspanya İngiltere ve Romanya'da yapılan kanser araştırmalarında umut verici sonuçlar alındığı belirtilmektedir (14).

Kozmetik sanayinde: İçerdiği aktif bileşikler ve kozmetik formülasyonlarında doğal ürünlerin kullanımın artması nedeniyle kozmetik endüstrisinde kullanımı hızla artmaktadır. Ünlü parfüm markalarına ait ürünlerin temel bileşenlerinden biri olmakla beraber bazı tütsü çeşitlerinde de kullanıldığı bildirilmiştir (15). Kozmetik preparat olarak bazı saç toniklerinde bulunduğu rapor edilmiştir (14).

1.4.Antioksidatif Etkileri

Tıbbi bitki litaretüründe yer alan safran günümüzde önemi gittikçe artan tedavi edici etkiye de sahip olan antioksidan etki gösteren bir bitkidir. Safran bileşenlerinden biri olan safranalın radikal süpürücü aktivitesi ona antioksidan, antikanser, antidiyabetik ve hipotansif özellikler kazandırdığı çeşitli çalışmalarla belirlenmiştir (16). 2,2-Difenil-1-Picrylhidrazil (DPPH) radikali için bir hidrojen atomu sağlama potansiyeli nedeniyle % 34 radikal süpürme aktivitesine sahip olduğunu tespit eden Assimopoulou ve ark. 2005 yılında safranalın gıda, farmakoloji, kozmetik sanayi gibi birçok alanda kullanılabileceğini göstermiştir (17). İskemi-reperfüzyon (IR) sonucunda çeşitli doku ve organlarda oksidatif stres artmakta ve hasar gelişebilmektedir. Safranalın rat hipokampusünde IR sonucu oluşan oksidatif stresi azaltarak nöronal hücre ölümlerine karşı koruyucu etki gösterdiği bildirilmiştir (18). Miyokart ınfarktüsü sonucu artan lipid peroksidasyonuna hem safranal hem de safran ekstraktının doza bağımlı olarak ratlarda oksidatif stresi azalttığı, yüksek safranal dozunun en iyi antioksidan aktivite segilediği belirtilmiştir (19). İnfertil erkeklerde sperm morfolojisi ve hareketlilik üzerine safran antioksidan olarak olumlu etkilidir (20). Maleki ve arkadaşları 2016 yılında yaptıkları çalışmada egzersiz stresi ile meydana gelen sperm DNA hasarını safranın iyileştirdiğini bildirmişlerdir. (21). Aynı zamanda safranın spermdeki kromatin anomaliliklerini ortadan kaldırdığı rapor edilmiştir (22). Vaez vd., (23) safranın sperm zar bütünlüğünü olumlu

etkilediğini aynı yılda Asadi ve arkadaşları da yaptıkları çalışmada kadmiyuma maruz kalan sıçanların epididim sperm parametrelerinin safran tarafından olumlu etkilendiğini bildirmişlerdir (24). Diyabetli sıçanların testis dokusunda safranalın antioksidatif etki gösterdiği bildirilmiştir (25) Safranal'ın güçlü bir antioksidan olduğunu gösteren başka çalışmalar da yapılmıştır. Ratlarda yapılan bir çalışmada yaşın ilerlemesi ile karaciğerde artan lipid peroksidasyonu ve azalan antioksidan enzim aktivitelerine karşı safranal'ın hasarı azalttığı bildirilmiştir (26). 2015 yılında yaşlı sıçanların beyninde oluşan oksidatif hasara karşı da etkili oluğu Samarghandian vd., tarafından rapor edilmiştir (27). Rat hipokampüsünde serebral iskemi ile oluşan MDA (Malondialdehit) artışını safranalın azalttığı Hosseinzadeh ve Sadeghnia (18) tarafından bildirilmiştir. CCl_4 tarafından meydana gelen karaciğer hasarının azalmasında safranalın antioksidan etkinliğinin sebep olduğu vurgulanmıştır (28). İn vitro bir çalışmada safranalın deride oluşan serbest radikalleri engellediği ve dermal enzimlerin inhibisyonuna sebep olduğu bildirilmiştir (29). Diyabet olan sıçanlarda akciğer dokusu ve bronkoalveoler lavaj sıvısında nitrik oksit ve MDA düzeylerindeki artışı inhibe etmiştir (30). Astımlı farelerde yapılan çalışmada da yine antioksidatif özelliği bildirilmiştir (31). Mide ülseri olan ratlarda safranalın koruyucu olduğu gözlenmiştir (32). Diyabetli sıçanların testis dokusunda safranalın antioksidatif etkisi de bildirilmiştir (25). Miyokard iskemi-reperfüzyon üzerinde olarak safranalın antioksidan etkinliği rapor edilmiştir (33). Sığır aort endotel hücrelerinde mitojenle aktifleşen protein kinaz (MAPK) yolağını etkileyen safranal antioksidan ve anti-apoptotik bir ajan olarak davranmıştır (34). Ayrıca cisplatin ile oluşturulan nefroktoksisiteye karşı koruyucu etki sergilemiştir (35). Ovalbumin duyarlı kobaylarda toplam nitrik oksit ve nitrit serum düzeylerinin azalttığı bildirilmiştir (36). Safranal siyatik sinirleri zedelenmiş sıçanların kanındaki MDA seviyelerini düşürmüştür (37). Hosseinzadeh ve ark.(38) safranalın antioksidan etkinliğini araştırdıkları çalışmada Safranal, deoksiriboz deneyinde doza

bağımlı olarak hidroksil radikalini süpürme aktivitesi gösterdiğini bildirmişlerdir. Rat hipokampusunde safranalın kinolinik asit tarafından indüklenen oksidatif hasarına karşı koruyucu etkilere sahip olduğu Sadeghnia ve arkadaşları (39) tarafından bulunmuştur. Sevimli ve arkadaşlarının 2023 yılında yaptıkları çalışmada subkronik tiner inhalasyonuna maruz kalmış ratlarda tiner toksikasyonuna karşı kullanılan safranalın özellikle zayıflayan antioksidan sistemi desteklemesiyle oksidatif stresi düşürerek olumlu etkilerini gösterdiği, beyin ve akciğer hücrelerinde hasarı azalttığı, artmış oksidatif stresin olumsuz etkilerinin tamponlamasında ve komplikasyonların önlenmesi veya hafifletilmesinde safranalın koruyucu olabileceği ortaya konulmuştur (40).

1.5 Antiinflamatuvar Etkileri

Safranın inflamasyon ve ilgili metabolik hastalıkları nasıl önlediği üzerine olası mekanizmalar halen çalışılmakta olup safranın zengin polifenol/karotenoid içeriği sayesinde inflamasyonu önlediği ileri sürülmüştür. Safranın antiinflamatuar etkisi; antioksidan etkinliği veya antioksidan gen veya protein ekspresyonunu arttırarak, metabolik sendroma bağlı pro-enflamatuar sitokinler veya endotoksin aracılı kinazları ve transkripsiyon faktörlerini bloke ederek, endoplazmik retikulum stres sinyalini zayıflatarak, histon deasetilaz aktivitesini arttırarak inflamasyonu bastırmak veya kronik enflamasyonu yoğunlaştıran transkripsiyon faktörlerinin aktive ederek ve metabolik-gen ifadesini indükleyerek oluşturduğu bildirilmiştir (41).Tamaddonfard ve ark. (42) krosin, safranal ve diklofenakın sıçanlarda lokal inflamasyon ve ağrı üzerine etkisini araştırdıkları çalışmada, lokal inflamasyon ve inflamatuvar ağrının kangren modelinde krosin, safranal ve diklofenak (referans ilaç olarak) için anti-inflamatuar ve antinosiseptif aktiviteler gösterdiği sonucuna ulaşmışlardır. Sıçanlarda diyabetik nefropatide safranalın inflamasyon ve oksidatif stres üzerine iyileştirici etkileri araştırılmıştır. Safranalın

antioksidatif ve anti-inflamatuar etkileri nedeniyle böbrek dokusunda görülen disfonksiyonu ve doku hasarını azalttığı bulunmuştur (43). Ovalı (16) çalışmasında safranalın özellikle TNF-α ve IL-1β seviyelerini düşürerek inflamasyonu azaltmış olabileceğini bildirdikleri çalışmalarında diyabetik tedavide faydalı olabileceğini savunmuşlardır. Safranalın miyokardiyal IR hasarına karşı etkilerinin incelendiği çalışmada safranalın antioksidan ve antiinflamatuvar etkisini miyokardiyal IR hasarı oluşan gruplarda antioksidan düzeylerini normalize ederek ve inflamatuvar bir stokin olan TNF-α düzeylerini düşürerek yapabileceği bildirilmiştir (44).

1.6. Antikanserojenik Etkileri

Çeşitli adenokarsinoma hücre hatlarıyla (LD50, MDAMB-231 ve MCF-7) yapılan invitro çalışmalarda safran bileşenlerinin kanser hücrelerinde proliferasyonu engellediği ve antikanser ajanı olarak kullanılabileceği bildirilmiştir (45,46). Safran ve onun bileşenlerinin, serbest radikal zincir reaksiyonları üzerine önleyici etkisi, hücresel DNA ve RNA sentezinde inhibe edici etkisi, doğal olarak oluşan karotenoidlerin retinoidlere metabolik olarak dönüşümü ve karotenoidlerin hücresel DNA-protein etkileşiminde rol oynayan bir enzim olan topoizomeraz II ile etkileşimi ile antitümöral etki gösterebileceği tespit edilmiştir (47). Çalışmalar, A vitamini dönüştürme potansiyeli olmayan karotenoidlerin kullanımının kansere karşı daha etkin koruma sağlayabileceğini ve toksisiteyi önleyebileceğini göstermektedir. Karotenoidlerin antitümör etkilerini; antioksidan aktivite, kanserojen metabolizmasının modülasyonu, , hücre proliferasyonunun inhibisyonu, hücre büyümesinin ve hücre döngüsü ilerlemesinin düzenlenmesi, bağışıklık modülasyonu, hücre-hücre uyarımı, hücre farklılaşmasının arttırılması, boşluk birleşim iletişimi, apoptozis ve retinoide bağlı sinyalizasyon ile olabileceği belirtilmiştir. Crocus stavius çiçeğinden elde edilen ve karotenoid bakımından zengin bir baharat olan safranın kanser önleyici ilaç olarak biyokimyasal ve immünolojik aktivite

gösterdiği Azam ve ark. (47) tarafından rapor edilmiştir. Samarghandian ve Shabestari (48) yaptıkları çalışmada prostat kanseri hücre hattında safranalın doza bağımlı antitümör etkisini rapor etmişlerdir. Safranalın düşük dozlarda bile antitümör aktivitesi nedeniyle safranın en güçlü toksik bileşeni olduğu bildirilmiştir (49).Safranal kolon kanseri hücrelerine karşı antikanser etkisini mTOR/PI3K/Akt yolunun baskılanmasıyla apoptozisi başlatarak ve mitokondriyal membran potansiyel (MMP) düzeyini azaltarak göstermiştir (50). Hepatosellüler karsinom hücrelerinde safranal, DNA çift iplikçik kırılmasına ve ER-stres aracılı hücre ölümüne neden olmaktadır (51). Safranal oral skuamöz hücreli karsinomda sitotoksik etki göstererek apoptotik davranış göstermiştir (52). Anti-tümör aktivitesini nöroblastom hücreleri üzerinde de göstermiştir (53). S fazlı kinaz ilişkili protein 2 (Skp2) regülasyonu ile prostat kanser hücrelerinin çoğalmasını baskılamıştır (54). Safranalın, K-562 insan kronik miyelojen lösemi hücrelerinin büyümesini engellediği bildirilmiştir (55).

1.7 Antinosiseptif Etkileri

Non steroidal antienflamatuar (NSAID) ilaçlar orofasiyal ağrı tedavisinde en sık kullanılan ilaçlardır. NSAID'lerin ve morfinin yan etkileri nedeniyle, yüzlerce yıldır ağrıyı ve iltihaplanmayı azaltmak için kullanılmış olan bitkisel ilaçlar gibi doğal bileşikler üzerine çalışmalar artmıştır. Çeşitli ağrı modellerinde krosin ve safranalın anitinosiseptif etkiler gösterdiği bildirilmiştir (56,57). Hosseinzadeh ve Shariaty (58) fareler üzerinde yaptıkları çalışmada safranalın antinosiseptif ve anti inflamatuar özelliklerini vurgulamıştır. Hosseinzadeh ve Younesi (56) Crocus sativus L.özütünün farelerde antinosiseptif ve antiinflamatuar aktivitesini araştırdıkları çalışmalarında Crocus sativus L.bitkisinin stigma ve yapraklarına ait sulu ve etanolik maserasyon ekstraktlarını kullanmışlardır. Safran stigmasının ve petalinin sulu ve etanolik özütlerinin antinosiseptif etkisinin yanı sıra akut ve/veya kronik

anti-inflamatuar etkinliğe sahip olduğu sonucuna varmışlardır. Hosseinzadeh ve Jahanian (59) çalışmalarında Crocus sativus L.'nin stigmasının sulu ve etanollü ekstraktlarının ve bileşenlerinin farelerde morfin alım sendromu üzerine etkilerini değerlendirdikleri çalışmalarında ekstraktların ve krosinin, yoksunluk sendromunu azaltmak için opioid sistem ile etkileşime girdiği sonucuna ulaşmışlardır. Erfanparast ve ark. (57) çalışmalarında krosin ve safranalın inflamatuvar ağrı için antinosiseptif etkiler gösterdiğini tespit etmişlerdir. Krosin ve safranalın diklofenak ile indüklenen antinosiseptiviteyi artırdığını belirtmişlerdir.

1.8 Farmakolojik Etkileri

Safranalın farklı dozları ve farklı metotlar kullanılarak canlıdaki birçok sistem üzerine hem in vivo hem de in vitro çalışmalarda etkileri incelenmiştir. Özellikle merkezi sinir sistemi üzerinde birçok araştırma yapılmıştır. Safranal'n, farelerde yapılan bir çalışmada antidepresif özelliği belirlenmiştir (60). Pentilenetetrazol tarafından indüklenen nöbetler üzerine safranalın antikonvülsan aktivite gösterdiği tespit edilmiştir (61). Tip-1 diyabetik sıçanlarda öğrenme ve hafıza bozukluklarına karşı iyileştirici özelliği rapor edilmiştir (62). Bu veriler göz önüne alındığında safranal'ın şizofreni hastalığını tedavi etme şansının olabileceği umut edilmektedir (63). Parkinson hastalığı üzerinde Keap1/Nrf2 sinyal yolunu düzenleyerek serbest radikallerin artışını ve hücre apoptozisini önleyerek (64), multipl skleroz hastalığı üzerine yapılan in vitro bir çalışmada ise safranal oligodentrosit (OLN-93) hücre yaralanmasını önlemiştir (65). Alzheimer hastalığı üzerinde de olumlu etkisinin olduğu bilinmektedir (66). Yapılan başka çalışmada ise in vitro PC12 hücrelerinde beta-amiloid peptid ile Alzheimer modeli oluşturulmuş ve safranalın MAPK ve PI3 Kinaz yolaklarını etkileyerek apoptozisi engellediği sonucuna varılmıştır (67). Forouzanfar ve diğerlerinin (68) yaptıkları çalışma ile de bu sonuç desteklenmiştir. Diğer bir çalışma safranal'ın farelerde akut ve kronik epilepsi modellerinde

genel olarak nöbeti inhibe ettiği bildirilmiştir (69). Ayrıca hipertirodizmin neden olduğu beyin hasarını korumuştur (70). Safranal'ın geçici reseptör potansiyel ankyrin 1 (TRPA1) kanalını aktive ederek antinoseptif özellik gösterdiği rapor edilmiştir (71). Huntington hastalığı üzerinde yapılan bir çalışmada ise safranalın motor disfonksiyonunu engelleyerek koruyucu etki gösterdiği bildirilmiştir (72). Safranalın kalp hızını azaltarak ve vasküler gevşemeyi sağlayarak kan basıncını düşürdüğü rapor edilmiştir (73). Ayrıca Ca^{+2} regülasyonu ile miyokardiyal iskemiyi iyileştirmiştir (74). İzoproterenol kaynaklı miyokard enfarktüsünde lipid peroksidasyonunu azaltarak kardiyoprotektif özellik göstermiştir (75). Safranal'ın sol ventrikül fonksiyonlarını ve miyokardın genel hemodinamik durumunu iyileştirdiği belirtilmiştir (33). Pıhtılaşma mekanizmasını etkileyerek antikoagülan olarak da rol oynamaktadır (76). Safranal, Th1/Th2 dengesizliği ile ilişkili inflamatuar hastalıklarda terapötik etkilere göstermiştir (77). Anti-inflamatuar etkiye sahip olan safranal koliti hafifletir ve makrofaj aracılı iltihabı bastırır (78). Escherichia coli hücrelerinin büyümesini baskılayarak antimikrobiyel aktivite göstermiştir (79). Safran ekstratının Salmonella enterica üzerindeki bakterisidal etkisinin safranaldan kaynaklı olabileceği bildirilmiştir (80). Safranal ve epoksidasyon türevleri, Staphylococcus aureus'a karşı önemli bir aktivite sergilemiştir (81). Açlık kan glikoz, HbA1c seviyelerini önemli ölçüde azaltan safranal kan insülin seviyelerini anlamlı seviyede artırarak antihiperglisemik aktivite sergilemiştir (82). Protein tirozin fosfataz 1B (PTP1B) enzimini inhibe eden safranal tip 2 diyabetik olan farelerde antidiyabetik ajan olarak faydalı olmuştur (83). Safranal tip 2 diyabet oluşturulmuş sıçanlarda hem antienflamatuar hem de antioksidatif etki göstererek böbrekte oluşan hasarı azaltmıştır (43). Hipertrigliseridemia, hiperglisemi, Obezite ve hipertansiyon gibi olanzapinin neden olduğu farklı metabolik bozuklukları hafifletmiştir (84).Streptozotosin kaynaklı diyabetik ratların tedavisinde etkili olmuştur (85).

Ayrıca in vitro bir çalışmada antitübülin bağlayıcı ajan olarak rol almıştır (86). Safranal, hızlı olmayan göz hareketi (NREM) uyku süresini artırmış, NREM uyku gecikmesini kısaltmış ve NREM uykusunun delta güç aktivitesini artırmıştır (87). Sıçanlarda yapılan bir çalışmada ise retinitis pigmentosa hastalığında fotoreseptör hücre dejenerasyonunu yavaşlattığı ve retina damar ağı bozulmasını iyileştirdiği görülmüştür (88). Bu etkilerine ek olarak, safranal'in immun sistem için de güvenilir bir bileşik olduğu düşünülmektedir (89). Safranal'ın Wistar sıçanlarda hem metabolik hem de davranışsal stres belirtilerinin azalmasında önemli bir etkisinin olduğu sonucuna varılmıştır (90).

SONUÇ

İnsanlar bilerek ya da bilmeyerek ilaca, kimyasal maddeye ve ksenobiyotiğe maruz kalmaktadır. Bunlara mesleki olarak, çevresel ya da besin maddeleri yoluyla maruz kalınmaktadır. Canlılardaki fizyolojik ve biyokimyasal süreçler bu maruziyetlerden etkilenmekte ve organizmada serbest radikaller oluşmaktadır. Ancak bu radikallerin organizmaya zarar vermesi güçlü bir savunma sisteminin varlığı ile engellenebilir. Bu yüzden serbest radikallerin dengede tutulması çok önemlidir. Bu denge bozulduğunda serbest radikallerin zararlı etkileri ortaya çıkarak organ ve sistemleri olumsuz etkiler. Bu nedenle güvenli antioksidanlar ve bu antioksidanların dozlarının bilinmesi son derece önemlidir. Safranın sahip olduğu yüksek radikal süpürücü aktivitesi sayesinde gıdalarda, içeçeklerde, farmakolojide, yaşlanmaya karşı koruyucu etkileri (antiaging) nedeniyle kozmetik sanayi gibi birçok alanda kullanılabileceği bildirilmiştir. Antitümör, antigenotoksik, hafıza ve öğrenmeyi güçlendiren, nöroprotektif, analjezik ve antiinflamatuar, antikonvülsan, antianksiyete, antidepresan, antihipertansif ve antihiperlipidemik etkiler gibi çok çeşitli farmakolojik etkileri olduğu bilinen safranın günlük yaşamda ve hekimlik uygulamalarında önemsenmesi gerekir.

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BİTKİ BÜYÜME DÜZENLEYİCİLERİ VE BESİ ORTAMININ GARNEM ANACININ MİKROÇOĞALTIMINA OLAN ETKİLERİ

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ÖZET

Garnem; şeftali, nektarin, badem ve erik çeşitleri için iyi derecede aşı uyumu gösteren kuvvetli gelişen klon anaçlardan biridir. Türün verim ve kalite üzerinde oldukça olumlu etkisi olmakla birlikte ağır bünyeli ve kireççe zengin topraklarda da yetiştiriciliği yapılabilen bir anaçtır. Ayrıca kök ur nematodlarına oldukça dayanıklıdır. Ticari değeri yüksek bu anacın doku kültürü ile hastalıktan ari ve seri bir şekilde üretimine yönelik mikroçoğaltım çalışması yapılmıştır. Çalışmamızda MS (Murashige ve Skoog) ve DKW (Driver ve Kuruyuki) ortamları temel alınarak bu ortamlarda karşılıklı olarak hormon denemeleri kurulmuştur. Bitki büyüme düzenleyicileri olarak kullanılan; BAP, IBA, IAA ve GA_3 tek, ikili veya üçlü kombinasyonlar şeklinde ve farklı dozlarda uygulanmıştır. Çalışmada besi ortamı olarak DKW; bitki büyüme düzenleyicileri olarak BAP ve IAA kombinasyonunda bitki gelişiminin daha sağlıklı olduğu gözlenmiştir. Elde edilen veriler ışığında, Garnem anacının mikroçoğaltımında, tek bir büyüme düzenleyicinin değil, farklı büyüme düzenleyici kombinasyonlarının birlikte etkisinin incelenmesi gerektiği ortaya çıkmıştır.

Anahtar Kelimeler: Garnem, in vitro, mikroçoğaltım, bitki büyüme düzenleyicileri

EFFECTS OF PLANT GROWTH REGULATORS AND NUTRIENT MEDIUM ON THE MICROPROPAGATION OF GARNEM ROOTSTOCK

ABSTRACT

Garnem is one of the strong and vigorous rootstocks that show a high degree of graft compatibility for peach, nectarine, almond, and apricot varieties. While this species has a significantly positive impact on yield and quality, it can also be grown in heavy and calcareous-rich soils. Additionally, it is highly resistant to root-knot nematodes. Micropropagation studies for this high commercial value rootstock have been conducted using tissue culture methods to produce disease-free and rapidly. In our study, experiments involving hormone applications were established using MS (Murashige and Skoog) and DKW (Driver and Kuniyuki) media as the basis. Plant growth regulators, such as BAP, IBA, IAA, and GA3, were applied as single, double, or triple combinations at different doses. In the study, DKW medium and the combination of BAP and IAA as plant growth regulators were found to promote healthier plant development. Based on the data obtained, it has been revealed that, in the micropropagation of Garnem rootstock, the effect of different growth regulator combinations together, not a single growth regulator, should be investigated.

Keywords: Garnem, in vitro, micropropagation, plant growth regulators

1. GİRİŞ

Prunus persica L. Batsch (Şeftali) *Rosaceae* familyasından olup 2n=16 kromozoma sahiptir. Prunus cinsi yaklaşık 340 tür ile temsil edilmekte olup birçok tür ve çeşidi yenilebilir meyve olarak yetiştirilmektedir(Reeves et al., 1992, Anonim, Byrne et al., 2012).

Şeftaliler, tat ve aroma açısından çok lezzetli ve çekici olarak kabul edilmektedir. Şekerli, sulu ve güzel çiçekleri ile geniş bir popülerliğe sahiptir. Sıkça "meyvelerin kraliçesi" olarak adlandırılmaktadır. Düşük kolestrol ve düşük yağ içerdiğinden diyabetik diyetler için önerilmektedir. Şeftaliler, vitamin A, kalsiyum ve potasyum gibi besin maddeleri bakımından zengin bir kaynaktır (Byrne et al., 2012).

Şeftali de dahil olmak üzere ılıman iklim meyve türlerinin üretim zorlukları; yüksek verimli dirençli çeşitlerin eksikliği, hastalık ve zararlılar ile kaliteli fidan azlığıdır. Şeftali ağacının büyümesi, verimliliği ve ömrü diğer meyve türlerinde de olduğu gibi uygun bir anaç seçiminden büyük ölçüde etkilenmektedir.

"Garnem", badem (*Prunus amygdalus*) × şeftali (*P. persica*) melezi bir klon anaçtır. Kırmızı yapraklar, iyi canlılık, kolay klonal çoğaltım, kök-knot nematodlara karşı direnç ve kalkerli topraklara uyum gibi birçok istenilen özelliğe sahiptir (Felipe, 2009). Melez anaçların çoğaltılması, diğer meyve türleri gibi, eşeyli ve eşeysiz yöntemlerle gerçekleştirilir. Tohumlarla üreme veya çoğaltma, genetik depresyona ve genetik olarak saf olmayan tohumların üretilmesine yol açar, bu nedenle genetik bir birliktelik kaybolur ve üretilen bitkiler anaç olarak kullanılmak için uygun olmaz (Dixon ve Gonzales, 1996). Bu nedenle, *in vitro* çoğaltım yöntemleri, birçok hastalıksız ve çeşitlere uygun bitki üretimi özellikle anaçların ticari kitlesel çoğaltımı için etkili bir alternatif sistem sunar (Kose ve Canli, 2015, Erfani et al., 2017)

Garnem, İspanyol orjinli bir anaçtır ve GF677 fidanını takip ederek üçüncü sıradadır (Reighard, 2011). Garnem, genotip olarak (Felipe, 2009) ve tarla değerlendirmesiyle (Zarrouk et al., 2005)

uyumlu olarak en canlı bitkiler veren anaçtır. Ancak, çok düşük köklenme yüzdelerinden dolayı çelikle çoğaltımda kitle ölçeğinde çoğaltılması zordur (Ammer, 1999). Şeftalilerde geleneksel vegetatif çoğaltma yöntemlerinin kullanılması oldukça zordur, çünkü düşük çoğaltma oranına ve aynı zamanda zor bir çoğaltmaya neden olmaktadır (Stylianides et al., 1989).

Meyve ağaçlarının *in vitro* çoğaltılması dünya genelinde virüs içermeyen benzer bitki materyali elde etme amacıyla geliştirilen bir süreçtir. Mikroçoğaltım, diğer vegetatif çoğaltma yöntemlerine göre bir alternatiftir (Martinez-Gomez et al., 2005). Stylianides et al., (1988), çelikle çoğaltma, aşılama veya daldırma ile çoğaltma gibi geleneksel vegetatif çoğaltma yöntemlerinin genellikle uğraştırıcı, zaman alıcı, mevsime bağlı, düşük çoğaltma oranına sahip ve özellikle şeftali üzerinde oldukça zor olduğunu bildirmiştir.

Bitki rejenerasyonu birçok faktörden etkilenebilmektedir. Kültür ortamı, bitki büyüme düzenleyicileri, agar, eksplant türü ve ışık koşulları bunlardan bazılarıdır. Örneğin, sitokininler somatik organların indüksiyonunda önemli faktörlerden biridir (George 1993; Magyar-Tabori et al., 2010). Eksplantın fizyolojik ve kronolojik yaşı ile *in vitro* kültür süresi de organ oluşumunu etkilemektedir (Hammerschlag et al., 1985). Ayrıca, odunsu bitkilerin olgun dokularından bitki rejenerasyonunun zor olduğu da bilinmektedir (Smigocki et al., 1991).

Şeftali, *in vitro* rejenerasyon konusunda en dirençli türlerden biridir (Bhansali et al., 1990; Padilla et al., 2006). Şeftali bitkilerinin başarıyla rejenerasyonu, genç eksplantların kullanılmasına rağmen nadirdir. Genellikle şeftali içerisinde vegetatif eksplant olarak olgunlaşmamış tohumlar sıklıkla kullanılmaktadır (Meng ve Zhou 1981; Hammerschlag et al., 1985; Scorza et al., 1990; Bhansali et al., 1991; Smigocki et al., 1991; Svircev et al., 1993; Pérez-Clemente et al., 2005). Şeftali yaprak eksplantlarından *in vitro* sürgün apex kültürlerinden alınan doku kültürlerinde adventif sürgünlerde rejenerasyon başarılı olmuştur (Gentile et al.,

2002). Declerck ve Korban (1996), kallus indüksiyonu için yaprak gibi vegetatif organların segmentlerini kullanmıştır.

Tarımın alt sektörlerinden biri olan meyvecilik, ülkemizin birçok bölgesi için önemli bir geçim kaynağıdır. Meyvecilikte bahçe tesisi genel olarak aşılı fidan, dolayısıyla anaç kullanımı ile gerçekleştirilmektedir. Bunun iki önemli nedeni vardır. Birincisi; toprak kökenli hastalıklar, böceklerle taşınan hastalık veya zararlılar, ekstrem soğuk veya sıcaklıklar, düşük kaliteli topraklar, düşük kaliteli veya yetersiz su koşullarına dayanıklılık sağlamak ve ikincisi ise üzerine aşılı çeşitten daha yüksek verim ve kalite elde etmektir (Ferguson ve ark., 1990). Bu nedenlerden ötürü meyvecilikte anaç kullanımı önem arz etmektedir (İpek, M. 2015)

2. MATERYAL VE METOD

2.1. Bitki Materyali

Çalışmada Nisan ayı içerisinde yeni çıkan sürgünlere ait sürgün uçları eksplant olarak kullanılmıştır. Sürgünler Has Biotech Araştırma Geliştirme Tarım Sanayi ve Ticaret A.Ş.'ye ait seralarda yetiştirilen 2 yıllık fidanlardan alınmıştır. Aşağıda fidanlara ait fotoğraf verilmiştir (Şekil 1).

Şekil 1. Araştırmada kullanılan 2 yıllık Garnem fidanları

Figure 1. 2-year-old Garnem trees used in the research



2.2. Sürgün Uçlarının Sterilizasyonu

Garnem bitkilerinden Nisan ayında alınan sürgün uçları öncelikle akan çeşme suyu altında 10 dakika boyunca tutulmuşlardır. % 5'lik fungusit çözeltisinde (Aktor) 5 dakika bekletildikten sonra durulanmışlardır. Ardından materyaller % 70'lik etil alkol ile 1 dakika muamele edilmiş ve daha sonra saf su ile alkolden arındırılmıştır. Birkaç damla Tween 20 (% 0.1) damlatılmış % 20 ticari sodyum hipoklorit (ACE) içeren solüsyon içerisinde 20 dakika bekletilerek 3 kez 5'er dakika süreyle steril saf su ile çalkalanmıştır. Aşağıda bu aşamalara ilişkin fotoğraflara yer verilmiştir (Şekil 2).

Şekil 2. Sterlizasyon aşamasına ilişkin görüntüler

Figure 2. Images of the sterilization stage



2.3. Kültür Ortamı ve Bileşimi

Çalışmada 2 farklı besin ortamı ve büyümeyi düzenleyici maddeler ile kombine edilmiş 5 farklı çoğaltma ortamı kullanılmıştır. Denemede kullanılan büyümeyi düzenleyici madde kombinasyonları ve ortam numaraları Çizelge 1'de verilmiştir. Besin konsantrasyonu içerisine tam kuvvetli Murashige ve Skoog, (1962) (MS) ve Driver, J. A., & Kuniyuki, A. H. (1984) (DKW) ortamı (Phyto Tech Lab), büyümeyi düzenleyici maddeler eklenip, 30 g L^{-1} sakkaroz ve 7 gL^{-1} agar eklenerek pH'ı 1 N NaOH ya da 1 N HCl kullanılarak 5.7'ye ayarlanmıştır.

Hazırlanan besin ortamları 425 ml'lik cam kavanozlara yaklaşık 40 ml konulmuş ve 121 °C'de 1.2 atmosfer basınçtaki otoklavda 20 dakika süreyle tutularak sterilizasyonu yapılmıştır.

Çizelge 1. Denemede kullanılan çoğaltma ortamı içeriği (mg L^{-1})

Table 1. Propagation media content used in the experiment (mg L^{-1})

MS-DKW	BAP (mg/l)	IBA (mg/l)	IAA (mg/l)	GA_3 (mg/l)
1	2	-	-	-
2	2	0,1	-	-
3	2	0,1	-	0,5
4	0,5	-	0,1	-
5	2	-	-	0,05

2.4. Araştırmada İncelenen Özellikler

Eksplant başına düşen sürgün sayısı (EBBS) (adet): Her eksplantta gelişen sürgünler sayılarak not edilmiştir.

Vitrifikasyon oranı (VO) (adet): Her kavanozdaki vitrifikasyonlu bitkiler sayılarak not edilmiştir.

2.5. Verilerin analizi

Deneme 3 tekerrürlü ve her tekerrürde 10 eksplant olacak şekilde tesadüf parselleri deneme desenine göre yürütülmüş, 3 alt kültür boyunca elde edilen veriler, MİNİTAB 17.0 paket programı kullanılarak Varyans analizine ($p<0.01$-$p<0.05$) tabi tutulmuştur.

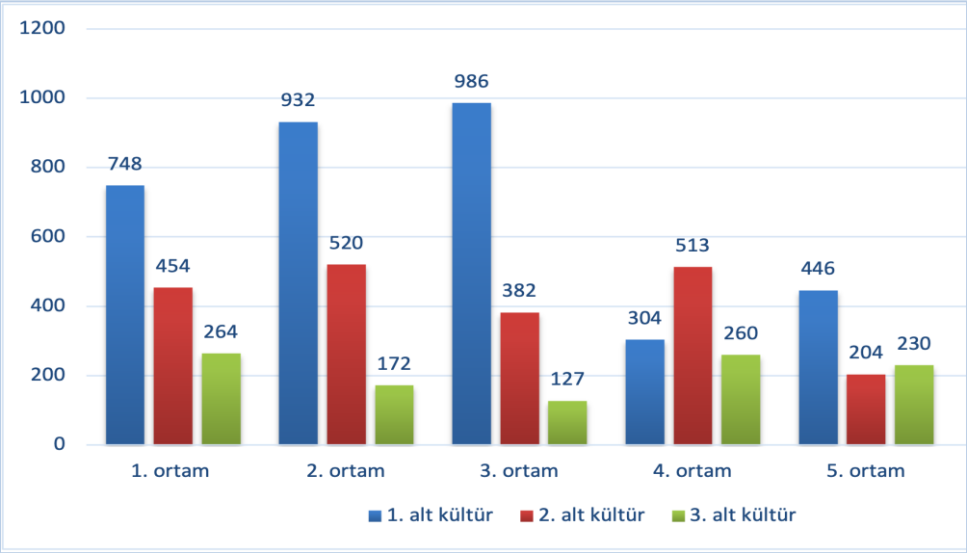
3. BULGULAR VE TARTIŞMA

Garnem'in *in vitro* çoğaltılması üzerine MS ve DKW temel besin ortamları kullanılmıştır. Çoğaltma aşamasında kullanılan farklı besin ortamlarının (MS-DKW) eksplant başına düşen sürgün sayısı üzerine etkisi incelendiğinde, ortamlar arasındaki farklar istatistik olarak önemli

bulunmamıştır (p>0.05). Aşağıdaki grafiklerde ortamların ve alt kültürlerin eksplant sayısı bakımından karşılaştırılması verilmiştir (Şekil 3, 4).

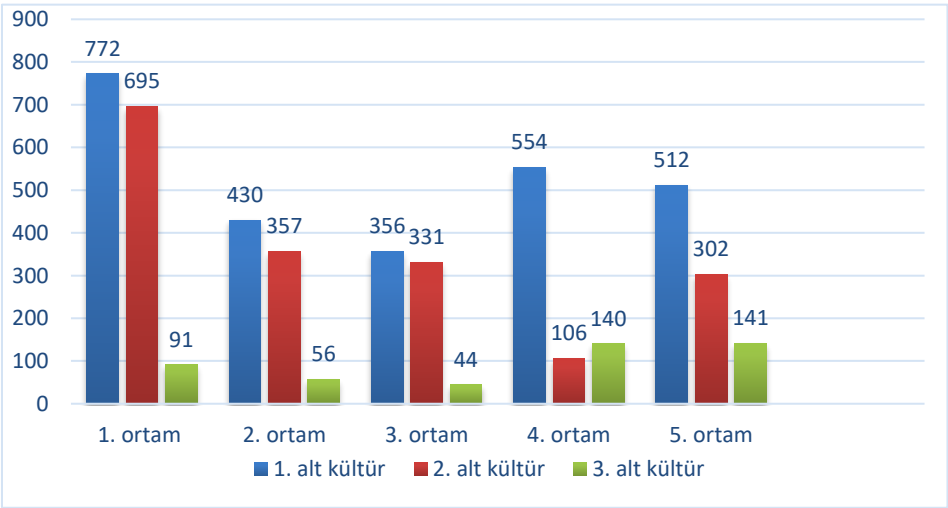
Şekil 3. Ortamların ve alt kültürlerin eksplant sayısı bakımından karşılaştırılması (DKW)

Figure 3. Comparison of media and subcultures by number of explants (DKW)



Şekil 4. Ortamların ve alt kültürlerin eksplant sayısı bakımından karşılaştırılması (MS)

Figure 4. Comparison of media and subcultures by number of explants (MS)



Çoğaltma aşamasında kullanılan farklı besin ortamlarının (MS-DKW) vitrifikasyon oranlarına baktığımızda ise ortamlar arasındaki farklar istatistiki olarak önemli bulunmuştur (p< 0.05) (Çizelge 2). MS besin ortamındaki vitrifikasyonun daha fazla olduğu görülmüştür. Arab et al.,

(2014), MS ortamının ve BAP'ın G×N15 anaçlarının çoğalma hızı üzerinde etkili olduğunu fark etmiştir, ancak kültür ortamındaki yüksek NH_4NO_3 ve sitokinin miktarının sürgün büyümesinde inhibe edici etkiye neden olduğunu belirtmiştir (Erfani et al., 2017).

Çizelge 2. Ortamların vitrifikasyon oranı bakımından karşılaştırılması

Table 2. Comparison of media by vitrification rate

Besin ortamı	Ortalama
DKW	6,64b
MS	28,82a

Aynı sütunda farklı harflerle gösterilen ortalamalar arasındaki fark istatistik açıdan önemlidir ($p<0.05$).

Çizelge 3. Büyümeyi düzenleyici maddelerin (BDM) vitrifikasyon oranı bakımından karşılaştırılması

Table 3. Comparison of growth regulators based on vitrification rate

BDM	Ortalama
3	34,08a
2	28,53ab
4	11,86bc
5	9,66c
1	4,66c

Aynı sütunda farklı harflerle gösterilen ortalamalar arasındaki fark istatistik açıdan önemlidir $p<0.05$).

Araştırmamızda farklı bitki büyüme düzenleyicilerinin vitrifikasyon oranı üzerine etkisi incelenmiş olup, ortamlar arasındaki farklar istatistiki olarak önemli bulunmuştur ($p<0.05$). En yüksek vitrifikasyon oranı 2 mg L^{-1} BAP+ 0.1 mg L^{-1} IBA+ 0.5 mg L^{-1} GA_3 içerikli ortamda gözlenmiştir. Diğer ortamlara göre daha fazla vitrifikasyon olmasının nedeninin bu ortam içeriğindeki yüksek BAP konsantrasyonundan kaynaklandığı düşünülmektedir. Nitekim 2 mg L^{-1} BAP+ 0.1 mg L^{-1} IBA içeren ortam vitrifikasyon oranı bakımından ikinci sırada gelmektedir. Yapılan benzer çalışmalarda da vitrifikasyon oranının, yüksek sitokinin seviyesiyle ilişkili

olduğu bildirilmektedir. Chawla (2002), vitrifikasyonu; yapraklarda ve bazen gövdelerde görülen camsılaşma, saydamlaşma, sukkulent veya ıslak ve genellikle şiş görünümlü olan *in vitro* dokuların istenmeyen fiziksel bozukluğu şeklinde tanımlamaktadır. Mikroçoğaltımda vitrifikasyonun oluşumu ve derecesinin birçok nedeni olup, ışık şiddeti, sıcaklık, BAP konsantrasyonu ve bitkinin fizyolojik yapısı örnek olarak gösterilebilmektedir (Özzambak vd., 2018).

Şekil 5. Eksplantların DKW 2 mg L^{-1} BAP+ 0.1 mg L^{-1} IBA+ 0.5 mg L^{-1} GA_3 (solda), MS 2 mg L^{-1} BAP+ 0.1 mg L^{-1} IBA+ 0.5 mg L^{-1} GA_3 (sağda) ortamlarındaki gelişimleri.

Figure 5. Development of explants in DKW 2 mg L^{-1} BAP+ 0.1 mg L^{-1} IBA+ 0.5 mg L^{-1} GA_3 (left), MS 2 mg L^{-1} BAP+ 0.1 mg L^{-1} IBA+ 0.5 mg L^{-1} GA_3 (right) media



Araştırmamızda DKW 2 mg L^{-1} BAP+ 0.1 mg L^{-1} IBA+ 0.5 mg L^{-1} GA_3 içeren ortamda ilk alt kültür sonrasındaki eksplant sayısının diğer ortamlara oranla daha yüksek olduğu görülmüştür. GA_3 konsantrasyonunun boğum sayısını arttırdığı bilinmektedir. Bazı kiraz anaçları üzerine yapılan bir çalışmada, çoğalma ve meydana gelen yeni sürgünlerin gelişmesi üzerine düşük konsantrasyonda GA_3 uygulamasının herhangi bir etkide bulunmadığı, buna karşılık konsantrasyonun arttırılması halinde çoğalmanın olumsuz yönde etkilendiği bildirilmiştir (Hepaksoy, 2004). Bizim çalışmamızda da DKW 2 mg L^{-1} BAP 0.05 mg L^{-1} GA_3 içeren ortamdaki birinci alt kültür sonundaki eksplant sayısının diğer ortamlara göre (1, 2 ve 3. çoğaltma ortamı) yüksek oranda fark görülmemesi bu çalışma ile uyumludur. Ayrıca MS 2 mg

L^{-1} BAP+ 0.1 mg L^{-1} IBA+ 0.5 mg L^{-1} GA_3 içeren ortamda eksplantların camsılaşma oranının yüksek olması da bu çalışmayı doğrular niteliktedir.

Reeves et al., (1992) şeftali (*Prunus persica*) üzerine yaptıkları çalışmada sürgün başlangıcı için (100%) en iyi ortam bileşiminin MS 1.0 mg/L BAP, 0.01mg/L IBA ve 0.5 mg/L GA_3 kombinasyonunun. Maksimum sürgün oluşturan ortamın sürgün başına 7.67 ile MS 2.0 mg/L BAP, 0.01mg/L IBA ve 0.5 mg/L GA_3 kombinasyonunda olduğu bulunmuştur. Bu çalışmanın sonuçları ile bizim sonuçlarımız ile uyumsuz olmasının nedeni *in vitro* sürgün büyümesi ve çoğaltılmasının birçok faktörden etkilenmesi olarak düşünülmektedir (Ahmad et al., 2007). Odunsu bitkilerin sürgün regenerasyonu üzerinde etkili olan faktörler, bitki türü-çeşidi, explant tipi, bazal ortamın bileşimi ve bitki büyüme düzenleyicileri ile büyüme katkı maddelerinin karışımıdır (Matt ve Jehle, 2005). *Prunus sp.* mikroçoğaltımında genellikle MS (Murashige ve Skoog, 1962) kullanılmaktadır (Ahmad et al., 2007; Fotopoulos ve Sotiropoulos, 2005; Kose ve Canli, 2015; Pruski et al., 2005; Sedlak et al., 2008; Shehata et al., 2013; Unek et al., 2011). Bununla birlikte, diğer ortamların kullanıldığı da bildirilmiştir (Arab et al., 2014; Matt ve Jehle, 2005; Rezaei ve Hosseipour, 2015). Bu çalışmamızda DKW ve MS besin ortamının Garnem çoğaltması üzerine etkisini araştırılmış, DKW besin ortam içeriğinin Garnem'in *in vitro* çoğaltımında daha etkili olduğu belirlenmiştir. Bitki doku kültüründe, özellikle çoğaltma aşamasında, sitokinin hormonları önemli bir faktördür. Sitokinlerin bitki gelişiminde hücre bölünmesini ve hücre genişlemesini teşvik etme, bitki protein sentezi ve bazı enzimlerin aktivitelerini artırma gibi çoklu rolleri olduğu bilinmektedir. 6-benzilamino purin (BAP), özellikle cevizin mikroçoğaltımında kullanılan bir sentetik sitokindir (Arab et al., 2014). Arab et al., (2014), MS ortamının ve BAP'ın G×N15 anaçlarının çoğalma hızı üzerinde etkili olduğunu fark etmiştir, ancak kültür ortamındaki yüksek NH_4NO_3 ve sitokinin miktarının sürgün büyümesinde inhibe edici etkiye neden olduğunu belirtmişlerdir (Erfani et al., 2017).

Bizim çalışmamızda da Garnem'in MS ortamında çoğalma katsayısının az ve vitrifikasyonun ise fazla olması bu bilgiyi doğrular niteliktedir.

4. SONUÇ

Geleneksel vegetatif çoğaltma yöntemleri olan çelikle çoğaltma, veya daldırma ile çoğaltma genellikle uğraştırıcı, zaman alıcı, mevsime bağlı, düşük çoğaltma oranına sahip ve özellikle şeftali üzerinde zordur. Doku kültürü, istenen özelliklere sahip dikim malzemesinin verimliliğini artırmak için kullanılabilmektedir. Bu çalışmanın amacı faklı besin ortamı ve bitki büyüme düzenleyicilerin Garnem'in *in vitro* çoğaltılması üzerine etkisini incelemektir. Yapılan çalışma sonucuna göre en etkili besin ortamının DKW olduğu, bitki büyüme düzenleyicileri açısından ise düşük oksin ve sitokininin sürgün çoğalması ve özellikle camsılaşmayı önleme açısından önemli olduğu görülmüştür.

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HİNDİSTAN CEVİZİ VE YULAF SÜTÜ İLE ELDE EDİLEN DONDURMALARIN FİZİKOKİMYASAL VE ANTİOKSİDAN ÖZELLİKLERİNİN BELİRLENMESİ

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ÖZET

Bitkisel sütler, fonksiyonel gıda ve vegan beslenme ürünlerinin geliştirilmesi kategorisinde en hızlı büyüyen gıda alanlarından biridir. Son araştırmalarda bitkisel sütlerin, bağışıklık sisteminin güçlenmesinde rol oynadığı, antimikrobiyal etkilerinin olduğu ve güçlü antioksidanlar içerdiği bildirilmektedir. İnek sütüne alternatif olarak değerlendirilen bitkisel sütler genellikle tahıllardan (pirinç, yulaf vb.) ve yağlı tohumlardan (badem, hindistan cevizi vb.) elde edilmektedir. Günümüzde farklı kaynaklardan elde edilen bitkisel sütlerden kefir, yoğurt, peynir, dondurma gibi alternatif süt ürünlerinin üretimi gerçekleştirilmektedir. Bu çalışmada, dondurmanın fonksiyonel gıda ve vegan beslenme tarzı için, inek sütü ile birlikte ve inek sütü alternatifi olarak tamamen bitkisel sütlerle üretilmesi araştırılmıştır. Araştırmada kullanılan yulaf sütü, çözünür lif içeriği, düşük yağ oranı, iyi bir antioksidan ve polifenol kaynağı olması nedeniyle son zamanlarda ilgi çeken bitkisel bir süt çeşididir. Aynı şekilde hindistan cevizi sütü de demir, kalsiyum, magnezyum gibi mineraller bakımından zengin olmasının yanında beyin gelişimi ve bağışıklık sisteminin güçlenmesinde etkili olan laurik asit içeriği gibi özelikleri ve duyusal nitelikleriyle tercih edilen bitkisel sütlerden birisidir. Bu kapsamda araştırmada; %100 yulaf, hindistan cevizi ve inek sütü (kontrol) ile yapılan dondurmaların yanında %50 + %50 bitkisel süt- inek sütü formülasyonlarıyla dondurma üretimi gerçekleştirilmiştir. Elde edilen dondurmaların fizikokimyasal özellikleri yanında renk değerleri, toplam fenolik madde miktarları ve antioksidan aktiviteleri belirlenmiştir. Sonuç olarak; üretilen dondurmalarda kuru madde oranları; % 24,195 - 29 58, pH değerleri; 6,54 - 7,30, yağ oranları, % 0,2 – 10,52, titrasyon asitliği % 0,02 - 0,18 ve renk değerleri L: 54.98, a: 0.10, b:8.16 - L: 78.99, a:-1.04, b:9,74 arasında tespit edilmiştir. Bunun yanında, toplam fenolik madde miktarları; 0,660 – 0,351 mg GAE/g KM, DPPH radikali ile gerçekleştirilen antioksidan kapasite değerleri, 3,573 – 1,710 mg GAE/g KM, ABTS radikali ile gerçekleştirilen antioksidan kapasite değerleri, 37,475 – 2,668 mg GAE/g KM arasında

bulunmuştur. Elde edilen sonuçlara göre, vegan ve fonksiyonel gıda üretiminde hindistan cevizi ve yulaf sütü ile üretilen dondurmaların alternatif bir gıda çeşidi olarak geliştirilebileceği düşünülmüştür.

Anahtar Kelimeler: fonksiyonel gıda, bitkisel süt, vegan, yulaf sütü, hindistan cevizi sütü, antioksidan, fizikokimyasal

DETERMINATION OF PHYSICOCHEMICAL AND ANTIOXIDANT PROPERTIES OF ICE CREAM WITH COCONUT AND OAT MILK

ABSTRACT

Plant milks are one of the fastest growing food areas in the category of functional food and vegan nutrition product development. Recent studies have reported that plant milks play a role in strengthening the immune system, have antimicrobial effects and contain powerful antioxidants. Plant milks, which are considered as an alternative to cow's milk, are generally obtained from cereals (rice, oats, etc.) and oilseeds (almonds, coconut, etc.). Today, alternative dairy products such as kefir, yogurt, cheese and ice cream are produced from plant milks obtained from different sources. In this study, the production of ice cream for functional food and vegan dietary style, together with cow's milk and as an alternative to cow's milk, entirely with plant milk was investigated. Oat milk used in the study is a plant milk that has recently attracted interest due to its soluble fiber content, low fat content, good source of antioxidants and polyphenols. Likewise, coconut milk is one of the preferred vegetable milks due to its rich in minerals such as iron, calcium, magnesium and lauric acid content, which is effective in brain development and strengthening the immune system, as well as its sensory qualities. In this context, ice cream production was carried out with 100% oat, coconut and cow's milk (control) as well as 50% + 50% vegetable milk and cow's milk formulations. The physicochemical properties, color values, total phenolic content and antioxidant activities of the ice creams were determined. As a result, the dry matter ratios of the ice creams were determined between 24.195 - 29.58%, pH values between 6.54 - 7.30, fat ratios between 0.2 – 10,52 %, titration acidity between 0.02 - 0.18% and color values between L: 54.98, a: 0.10, b: 8.16 - L: 78.99, a: -1.04, b: 9.74. In addition, total phenolic content values were between 0.660 - 0.351 mg GAE/g KM, antioxidant capacity values by DPPH radical were between 3.573 - 1.710 mg GAE/g KM, antioxidant capacity values by ABTS radical were between 37.475 - 2.668 mg GAE/g KM. According to the results obtained, it is thought that ice cream produced with coconut and oat milk can be developed as an alternative food type in vegan and functional food production.

Keywords: functional food, vegan, plant milk, oat milk, coconut milk, antioxidant, physicochemical

1. GİRİŞ

İnsanların beslenme konusunda bilinçlenmesi ile birlikte fonksiyonel gıdalara duyulan ilgi de giderek artmaktadır. Fonksiyonel gıdalar vücut fonksiyonlarının düzenlenmesi, hastalık kontrolü ve önlenmesinde olumlu etkileri olan gıdalar olarak tanımlanır (Coşkun, 2005; Ersan ve Topçuoğlu, 2019; Gökırmaklı vd., 2021). Fonksiyonel özelliklere sahip bileşenler, gıdalar içinde doğal olarak bulunabileceği gibi gıda üretimi sırasında gıdalara ilave de edilebilirler. Gıdalar, genellikle üretim sürecinde probiyotik mikroorganizmalar, prebiyotikler, vitaminler, yağ asitleri ve biyokaktif bileşikler gibi ilavelerle fonksiyonel özellik kazanırlar. Fonksiyonel gıdaların ortak özellikleri, sağlık üzerinde olumlu etki göstermesi, doğal olmaları ve günlük diyette güvenle tüketilebilmeleridir (Tetik ve ark., 2007; Yiğit ve Ay, 2016; Martins vd., 2017). Bunun yanında son yıllarda hayvansal gıda kaynaklı laktoz intolerans, süt alerjisi ve yüksek kolesterol gibi sağlık sorunlarının yanında, etik ve dini eğilimler gibi farklı nedenlerle vegan tarzı beslenme de giderek artış göstermektedir (Gökçen vd., 2019; Yazıcı ve ark, 2023; Göçer ve Koptagel, 2023). Vegan beslenme, genel olarak tüm hayvansal kaynaklı gıdalardan sakınmak anlamına gelmektedir. Vegan beslenmeyi benimseyen insanlar bal, süt ve süt ürünleri, yumurta ve kabuklu deniz ürünleri dahil tüm hayvansal gıdaları tüketmekten kaçınırlar (Erk vd., 2019; Akbulut ve Yeşilkaya, 2021; Bekiroğlu vd., 2022; Robinson, 2023;). Vegan bireylerde yetersiz ve dengesiz beslenme sonucu, enerji ve protein dengesinde bozulmalar, bazı vitamin ve minerallerin yeterince alınamaması gibi problemler nedeniyle birtakım sağlık sorunları oluşabilmektedir (Özcan ve Baysal, 2016; Gökçen vd., 2019). Bu nedenle vegan tarzı beslenenlerde besin ögesi alım düzeylerinin takip edilmesi, eksikliklerin günlük besin planlanması ile tamamlanması gerekmektedir (Gökçen vd., 2019).

Bitkisel sütler, fonksiyonel gıda ve vegan beslenme ürünlerinin geliştirilme kategorisinde giderek büyüyen gıda alanlarından birisidir (Göçer ve Koptagel, 2021; Arbağ, 2022). Son

araştırmalarda bitkisel sütlerin, bağışıklık sisteminin güçlenmesinde rol oynayabileceği, potansiyel antimikrobiyal etkilerinin olduğu ve güçlü antioksidanları içerdiği bildirilmektedir (Göçer ve Koptagel, 2021; Arbağ, 2022). Bunun yanında, bitkisel sütler, hayvan sütlerinde bulunan kolesterol, doymuş yağ asitleri ve laktoz gibi bileşikleri içermez ve esansiyel yağ asitleri ve minerallerce zengindir. Ancak hayvansal sütlere göre protein içerikleri ile bazı besin bileşenlerinin miktarı ve biyoyararlılıkları daha düşük orandadır (Erol, 2020; Brooker vd., 2023; Güngör, 2023). Bu kapsamda, gıda endüstrisi de tüketici taleplerini de dikkate alarak sağlık üzerinde olumlu etkileri olan ve inek sütü altenatifi olabilecek bitkisel sütlerin üretimi ve geliştirilmesi konusunda giderek çalışmalarını artırmaktadır (Berardy vd., 2022). Özellikle renk ve doku bakımından inek sütüne alternatif olarak değerlendirilen bitkisel sütler, genellikle tahıllardan (pirinç yulaf vb.) ve yağlı tohumlardan (badem, hindistan cevizi vb.) elde edilmektedir (Das vd., 2012; Göçer ve Koptagel, 2021; Rodriguez, vd., 2023). Günümüzde farklı kaynaklardan elde edilen bitkisel sütlerden kefir, yoğurt, peynir, dondurma ve sütlü tatlılar gibi alternatif süt ürünlerinin üretimi gerçekleştirilmektedir (Özcan vd., 2013).

Araştırmada; kullanılan yulaf sütü; çözünür lif, A, D, E, B1 vitaminleri ve mineral içeriği yanında, iyi bir antioksidan ve polifenol kaynağıdır (Göçer ve Koptagel, 2021; Arbağ, 2022). Yulaf sütü özellikle çözünür lif içeriği sayesinde, sindirim sisteminin düzenlenmesi, vücut ağırlığının korunması yanında LDL kolesterolü düşürme gibi özellikleriyle gıdaya işlevsellik sağlamaktadır (Yazıcı vd, 2023). Tüm bu özellikleriyle yulaf sütü son yıllarda oldukça ilgi çeken bir bitkisel süt çeşididir. Aynı şekilde hindistan cevizi sütü de demir, kalsiyum, magnezyum gibi minerallerin yanında E, C ve B kompleks vitaminleri bakımından zengindir (Yazıcı vd, 2023). Hindistan cevizi sütünün antibakteriyal ve antiviral etkiye sahip olduğu da bazı araştırmalarda bildirilmektedir (Göçer ve Koptagel ,2021; Tulashie vd., 2022). Bunun yanında Hindistan cevizi sütü, beyin gelişimi ve bağışıklık sisteminin güçlenmesinde etkili olan

laurik asit içeriği gibi özelikleriyle tercih edilen bir bitkisel sütlerden birisidir (Sezgin. 2021; Tulashie vd., 2022).

Bu araştırmada, en fazla tercih edilen süt ürünlerinden biri olan dondurmanın inek sütüne alternatif olarak ve inek sütü ile zenginleştirilerek fonksiyonel gıda arayışı içinde olan veya vegan beslenme gibi farklı beslenme şekillerini benimseyen bireyler için, bitkisel sütlerle üretim olanakları araştırılmıştır.

2. MATERYAL ve METOT

2.1. Materyal

Araştırmada yulaf sütü eldesinde kullanılan yulaf *Eti Gıda Sanayi ve Ticaret A.Ş. (Eskişehir, Türkiye)* firmasından, hindistan cevizi sütü eldesinde kullanılan hindistan cevizi rendesi ise *Bağdat Baharat Gıda Sanayi ve Ticaret Limited Şirketi (Kayseri, Türkiye)* firmasından temin edilmiştir. İnek sütü ise *Kayseri Üniversitesi Gıda Çalışmaları Uygulama ve Araştırma Merkezi (Kayseri, Türkiye) Döner Sermaye İşletmesinden* temin edilmiştir.

2.2. Metot

2.2.1. Bitkisel Süt Üretimi

Bitkisel süt ve bitkisel sütlerden dondurma üretimi Kayseri Üniversitesi Gıda Çalışmaları Uygulama ve Araştırma Merkezi laboratuvarlarında gerçekleştirilmiştir.

Bitkisel süt üretiminde Bensmira ve Jiang (2012)' de verilen metot modifiye edilerek, önce yulaf ve hindistan cevizi rendesi ön yıkama işlemine tabii tutulmuş daha sonra el blenderı ile 1:1 oranında içme suyu ile sulandırılarak homojenize edilmiştir. Elde edilen homojenat ince delikli bir süzgeç yardımı ile süzdürülmüş ve süzülen kısım bitkisel süt olarak kullanılmıştır (Göçer, 2023; Bensmira ve Jiang 2012).

2.2.2. Miks ve Dondurma Üretimi

Hazırlanan formülasyonlara ön ısıtma işleminden sonra, şeker ve stabilizör-emülgatör ilave edilerek 85 ºC' de 10 dk. pastörize edilmiştir. Daha sonra miksler +4 ºC'de 24 saat bekletilmiş ve dondurma makinesinde dondurma üretimi gerçekleştirilmiştir. Elde edilen dondurmalar ambalajlanarak -25 ºC'de depolanmıştır. Üretilen dondurma formülasyonları aşağıdaki gibidir.

A1: Yulaf sütü dondurması

B1: Hindistan cevizi sütü dondurması

C1: %50 yulaf sütü + %50 inek sütü dondurması

D1: %50 hindistan cevizi sütü + %50 inek sütü dondurması

E1: İnek sütü dondurması (kontrol)

2.2.3. Bitkisel Süt ve Dondurma Örneklerinin Fiziksel-Kimyasal Analizleri

Bitkisel sütler ve bitkisel sütlerden üretilen dondurmalarda; kurumadde tayini gravimetrik yöntemle, yağ tayini gerber yöntemiyle, pH Hanna marka pH metre ile, titrasyon asitliği alkali titrasyon yöntemiyle (% laktik asit cinsinden) gerçekleştirilmiştir (Metin, 2005).

2.2.4. Renk Tayini

Dondurma örneklerinde renk tayini, Hunter Lab Color Flex (4500L renk ölçer, HunterLab, Reston, VA) model renk ölçüm cihazı kullanılarak L* (siyahtan beyaza kadar olan açıklık-koyuluk renk geçiş değeri), a* (yeşilden kırmızılığa doğru renk geçiş değeri) ve b* (maviden sarıya doğru renk geçiş değeri) renk sistemi cinsinden belirlenmiştir.

2.2.5. Toplam Fenolik Madde Miktarı (Folin-Ciacalteu Yöntemi)

TFFM analizleri Singleton vd., (1999)'nin geliştirdiği, Çam ve İçyer, (2015) tarafından kısmen modifiye edilmiş metoda göre yapılmış, sonuçlar mg GAE/ 100 g KM cinsinden verilmiştir.

2.2.6. Toplam Antioksidan Kapasitesi

Antioksidan aktivitenin belirlenmesi çalışmaları iki farklı radikal (DPPH ve ABTS) ile gerçekleştirilmiş, sonuçlar mg trolox eşdeğeri (TE)/100 g KM birimi üzerinden ifade edilmiştir.

2.2.6.1. ABTS Radikali Kullanma Yöntemiyle Antioksidan Kapasitesi

ABTS radikali kullanılarak belirlenen antioksidan aktivite tayininde spektrofotometrik metot kullanılmıştır (Çam vd., 2009; Re vd., 1999).

2.2.6.2. DPPH Radikali Süpürme Yöntemiyle Antioksidan Kapasitesi

DPPH radikali süpürme yöntemi ile antioksidan kapasitesi, (Brand-Williams vd., 1995) tarafından geliştirilen Çam vd., (2009)'nin modifiye ettiği metoda göre yapılmıştır.

3. BULGULAR VE TARTIŞMA

3.1. Bitkisel Sütlerin Bazı Fiziksel ve Kimyasal Özellikleri

Yapılan analizler sonucunda inek sütü ve bitkisel sütlerin bileşimleri Çizelge 1. de verilmiştir.

Çizelge 1. Bitkisel Sütlerin Bazı Fiziksel ve Kimyasal Özellikleri

	pH	**Kuru madde(%)**	**Yağ (%)**	**Titrasyon(%)**
A	7,14±0,01	4,555±0,055	0,2±0	0,023±0,35
B	6,54±0,01	17,455±0,865	6,2±0,2	0,045±0,05
C	6,74±0	8,635±0,005	2,2±0,1	0,126±0
D	6,47±0,02	15,565±0,005	5,1±0,2	0,165±0,1
E	6,73±0,015	14,380±0,03	4,2±0,2	0,171±0,25

Sonuçlar ortalama ± standart sapma olarak verilmiştir. A: yulaf sütü B: hindistan cevizi sütü C: %50 yulaf sütü + %50 inek sütü karışımı D: %50 hindistan cevizi sütü + %50 inek sütü karışımı E: inek sütü. *Farklı harflerle gösterilen örnek ortalamaları arasında istatistiksel olarak fark vardır ($P < 0.05$).

3.2. Bitkisel Sütlerden Üretilen Dondurmaların Bazı Fiziksel ve Kimyasal Özellikleri

Yapılan analizler sonucunda üretilen dondurmaların bileşimleri Çizelge 2. de verilmiştir.

Çizelge 2. Bitkisel Sütlerden Üretilen Dondurmaların Bazı Fiziksel ve Kimyasal Özellikleri

	pH	**Kuru Madde (%)**	**Titrasyon (%)**	**Yağ (%)**
A1	7,30±0^{a}	24,195±0,005^{e}	0,02±0^{f}	0,15±0^{f}
B1	6,70±0,02^{d}	25,445±0,035^{d}	0,05±0^{e}	9,11±1^{b}
C1	6,96±0,01^{c}	26,725±0,005^{c}	0,05±0,1^{e}	1,20±0,2^{e}
D1	6,54±0^{d}	28,090±0,050^{b}	0,12±0^{e}	10,52±0,2^{a}
E1	6,59±0,02^{e}	29,580±0,070^{a}	0,18±0,05^{a}	4,40±0^{c}

Sonuçlar ortalama ± standart sapma olarak verilmiştir A1: Yulaf sütünden elde edilen dondurma B1: Hindistan cevizi sütünden elde edilen dondurma C1: %50 yulaf sütü + %50 inek sütünden elde edilen dondurma D1: %50 hindistan cevizi sütü + %50 inek sütünden elde edilen dondurma E1: %100 İnek sütünden elde edilen dondurma. *Farklı harflerle gösterilen örnek ortalamaları arasında istatistiksel olarak fark vardır (P <0.05).

Bitkisel sütlerden elde edilen dondurmaların kurumadde oranları; en yüksek E1 % 29,580 en düşük A1'de % 24,195, pH değerleri; en yüksek A1 pH 7,30, en düşük D1'de pH 6,54, yağ oranları; en yüksek D1 % 10,52 ve en düşük A1'de % 0,15, titrasyon asitliği ise en yüksek E1 % 0,18, en düşük, A1'de % 0,02 olarak tespit edilmiştir.

Yapılan literatür taramalarında, Kahraman (2011), farklı oranlarda (0, 15, 30,45 ve %50) yulaf sütü formülasyonlarından yaptığı kefirlerde kuru madde oranlarını, % 13,64 - 14,77 arasında, yağ oranını % 1,35 - 1,95 arasında, pH değerlerini pH 4,09- 4,28 arasında, titrasyon asitliğini % 0,62 - 0,82 arasında tespit etmiştir. Bir diğer çalışmada da Belewu vd., (2010), hindistan cevizi sütünden ve yer bademinden yoğurt üretmişler ve elde ettikleri hindistan cevizi yoğurdunda kuru maddeyi ortalama %18,5; yağ oranını %9,50; pH değerini; 6,11 ve titrasyon asitliğini % 0,18 olarak bildirmişlerdir.

3.3. Bitkisel Sütlerden Üretilen Dondurmaların Renk Değerleri

Yapılan analizler sonucunda, üretilen dondurmaların renk değerleri Çizelge 3. de verilmiştir.

Çizelge 3. Bitkisel Sütlerden Üretilen Dondurmaların Renk Değerleri

	L değeri	**a değeri**	**b değeri**
A1	54,980±0,2354^{e}	0,103±0,0047^{c}	8,163±0,0309^{b}
B1	71,587±0,1223^{b}	0,380±0,0^{b}	3,957±0,0330^{f}
C1	56,533±0,4260^{d}	-0,137±0,0047^{e}	8,120±0,0356^{b}
D1	70,490±0,1772^{c}	-0,430±0,0^{d}	5,610±0,0535^{e}
E1	78,990±0,2491^{a}	-1,037±0,0047^{e}	9,743±0,0249^{a}

Sonuçlar ortalama ± standart sapma olarak verilmiştir. A1: %100 Yulaf sütünden elde edilen dondurma B1:%100 Hindistan cevizi sütünden elde edilen dondurma C1: %50 yulaf sütü + %50 inek sütünden elde edilen dondurma D1: %50 hindistan cevizi sütü + %50 inek sütünden elde edilen dondurma E1: %100 İnek sütünden elde edilen dondurma. *Farklı harflerle gösterilen örnek ortalamaları arasında istatistiksel olarak fark vardır (P <0.05).

Dondurmalarda tespit edilen renk değerleri; en yüksek E1, L: 78,99 a: -1,04 ve b: 9,74 en düşük ise A1'de L: 54,98 a: 0,10 ve b: 8,16 olarak saptanmıştır. L değerinin en yüksek E1'de en düşük A1'de tespit edilmesi, bitkisel sütün elde edildiği kaynağa bağlı olarak dondurmaların beyazlıktan uzaklaştığı şeklinde ifade edilmektedir (Sezgin, 2021).

Demir vd. (2021), yulaf sütünden ürettikleri yoğurt örneklerinde renk değerlerini ortalama L: 67,6 a: -0,7 b: 8,2 olarak belirlemişlerdir. Aynı şekilde, çeşitli bitkisel sütlerin bazı özelliklerinin araştırıldığı bir çalışmada da hindistan cevizi sütünde renk değerlerini L: 67,04 a: 0,32 ve b: -1,76 olarak bildirilmiştir (Sezgin, 2021).

Literatürde, bitkisel sütler ve bitkisel sütlerden üretilen çeşitli ürünlerin araştırıldığı çalışmalarda, fiziksel, kimyasal ve diğer bazı özelliklerin değişkenlik gösterdiği görülmektedir. Bu farklılıkların bitkisel sütlerin hazırlanması sırasında, parçalama, yaş öğütme, kuru öğütme,

filtrasyon, homojenizasyon, ısıl işlem normları ve depolama gibi üretim proseslerindeki farklılıklardan kaynaklanabileceği düşünülmektedir.

3.4. Bitkisel Sütlerden Üretilen Dondurmaların Antioksidan Kapasitesi ve Toplam Fenolik Madde Miktarları

Yapılan analizler sonucunda üretilen dondurmaların antioksidan aktiviteleri ve toplam fenolik madde miktarı Çizelge 4. de verilmiştir.

Çizelge 4. Bitkisel Sütlerden Üretilen Dondurmaların Antioksidan Kapasitesi ve Toplam Fenolik Madde Miktarları

	TFMM (mg GAE/100g KM)	**DPPH (mg TE/100g KM)**	**ABTS (mg TE/100g KM)**
A1	0,348±0,0042^{d}	2,074±0,0009^{bc}	9,299±0,0052^{bc}
B1	0,660±0,0038^{b}	-	2,668±0,0050^{a}
C1	0,351±0,0026^{d}	2,424±0,0067^{bc}	12,048±0,0083^{b}
D1	0,405±0,0043^{d}	-	20,34±0,0099^{bc}
E1	0,421±0,0123^{cd}	1,710±0,0014^{b}	28,563±0,0124^{de}

Sonuçlar ortalama ± standart sapma olarak verilmiştir. A1: %100 Yulaf sütünden elde edilen dondurma B1: %100 Hindistan cevizi sütünden elde edilen dondurma C1: %50 yulaf sütü + %50 inek sütünden elde edilen dondurma D1: %50 hindistan cevizi sütü + %50 inek sütünden elde edilen dondurma E1: %100 İnek sütünden elde edilen dondurma TE: Trolox eşdeğeri, GAE: Gallik asit eşdeğeri TFMM: Toplam fenolik madde miktarı. *Farklı harflerle gösterilen örnek ortalamaları arasında istatistiksel olarak fark vardır (P <0.05).

Dondurmaların Toplam Fenolik Madde Miktarı (TFFM), mg GAE (gallik asit eşdeğeri) /100 g KM olarak; en yüksek B1, 0,660, en düşük A1'de 0,348 olarak tespit edilmiştir. Kahraman (2011), yaptığı çalışmada yulaf sütünden ürettiği kefir örneklerinde TFFM miktarını 197, 36 – 246,91 µg GAE/100 g KM olarak bildirmiştir.

Örneklerin antioksidan kapasitesi ise DPPH (2,2-difenil-1-pikrilhidrazil) (mg TE/ 100 g KM) yöntemine göre en yüksek C1, 2, 424 en düşük E1'de 1,710 olarak tespit edilmiş B1 ve D1'den sonuç alınamamıştır. ABTS (2,2'azinobis (etilbenzotiyazolin-6-sülfonik asit)) (mg TE/ 100g KM) yöntemine göre ise antioksidan kapasiteleri en yüksek E1, 28,563, en düşük B1'de 2,668 olarak tespit edilmiştir. Thuraisingan vd. (2023), hindistan cevizi sütü bazlı içecek üretttiği bir çalışmada DPPH radikal temizleme kapasitesi değerlerini 156,91–12,00 mg TE/100 g KM arasında tespit etmiştir.

Araştırmada örneklerin antioksidan kapasiteleri ve toplam fenolik madde değerleri arasında doğrusal bir ilişki tespit edilememiştir. Görgün, (2022) yaptığı benzer bir çalışmada, bu durumun antioksidan metabolitlerin polaritesinden, hidrojen bağlama kapasitelerinden ayrıca analiz ortamı, reaksiyon mekanizması gibi faktörlerden kaynaklanabileceğini bildirmiştir.

4. SONUÇ

Yapılan bu araştırmaya göre; son yıllarda oldukça trend olan bitkisel sütler ve bitkisel süt esaslı ürünlerin, fonksiyonel gıda ve veganlık gibi beslenme alışkanlıkları için ideal bir kaynak olabileceği düşünülmüştür. Ancak bu alanda uygun üretim prosesleri, ürünlerin formülasyonları, standardizasyonları ve optimizasyonları gibi konularda daha fazla araştırma yapılması gerekmektedir.

5. AÇIKLAMA

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KABA YEM KAYNAĞI OLARAK KULLANILAN BAZI TARLA TARIMI ATIKLARININ KALİTE DÜZEYLERİNİN BELİRLENMESİ

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ÖZET

Bu çalışma, Uşak ve çevresinde hayvan beslemede kullanılan bazı tarla tarımı artıklarının yem değerlerinin belirlenmesi amacıyla 2022 yılında yürütülmüştür. Çalışmada arpa, buğday, çörekotu, mısır ve nohudun biçerdöverle tane hasadından arta kalan samanları ile çerez amaçlı üretilen ayçiçeğinde kurutulmuş tanelerin elenmesi ile açığa çıkan boş veya çok küçük tanelerden ve bazı tabla parçalarından oluşan ayçiçeği atıkları incelenmiştir. Çalışma sonuçları incelenen tüm özellikler arasında istatistik açıdan P≤0.01 seviyede önemli farkların olduğunu ortaya çıkarmıştır. Araştırma sonuçlarına göre en yüksek ham protein oranı çörekotu samanı (% 7.53) ve ayçiçeği (% 7.24) artıklarında, en yüksek ham kül oranı % 11.20 ile nohut kesinde belirlenmiştir. En yüksek ham selüloz oranı % 42.50 ile arpa samanında belirlenirken, en yüksek ham yağ oranı % 8.29 olarak ayçiçeği artıklarında tespit edilmiştir. Nötr deterjanda çözünmeyen lif (NDF) oranı bakımından en düşük değerler sırasıyla çörekotu samanı (% 61.36) ve ayçiçeği artıklarında (% 61.57), en düşük asit deterjanda çözünmeyen lif (ADF) oranları ise % 41.35 nohut kesi ve % 41.62 ile çörekotu samanında belirlenmiştir. Nispi yem değeri (RFV) bakımından sırasıyla nohut kesi (80.41), ayçiçeği artıkları (81.57) ve çörekotu samanı (85.75) en yüksek değerlere sahip olmuşlardır. RFV değerlerine göre yapılan uluslararası kaba yem kalite sınıflamasına göre nohut kesi, ayçiçeği artıkları ve çörekotu samanı zayıf kaliteli kaba yemler sınıfına, diğer ürün artıkları ise çok kötü kalitedeki kaba yemler sınıfına girmişlerdir.

Anahtar Kelimeler: Tarla tarımı artıkları, kaba yem, ham protein, NDF, RFV

DETERMINATION OF FEED VALUES OF SOME FIELD CROP WASTES USED AS ROUGHAGE SOURCE

ABSTRACT

This study aimed to determine the feed value of various field crop wastes used for animal feeding in Uşak and the close areas in 2022. The study investigated the straw remaining after a seed harvest of barley, wheat, black cumin, corn, and chickpea, as well as sunflower waste consisting of empty or tiny kernels and some flower head fragments. The study results revealed that there were statistically significant differences at the P≤0.01 level among all examined parameters. According to the results, the highest crude protein content was determined in black cumin straw (7.53%) and sunflower (7.24%) waste, and the highest crude ash was determined in chickpea straw with 11.20%. While the highest crude cellulose rate was determined in barley straw at 42.50%, the highest crude oil rate was determined in sunflower wastes at 8.29%. The lowest values in terms of neutral detergent fiber (NDF) were determined in black cumin straw (61.36%) and sunflower wastes (61.57%), respectively. In comparison, the lowest acid detergent fiber (ADF) was determined in chickpea straw (41.35%) and black cumin straw (41.62%). In terms of relative feed value (RFV), chickpea straw (80.41), sunflower wastes (81.57), and black cumin straw (85.75) had the highest values, respectively. According to the international roughage quality classification based on RFV values, chickpea straw, sunflower wastes, and black cumin straw are included in the poor quality roughage class, and other product residues are in the very poor quality roughage class.

Keywords: Field crop wastes, roughage, crude protein, NDF, RFV

GİRİŞ

Hayvansal üretimde karlılığı belirleyen temel unsur yemdir, besi maliyetinin %70'lere varan oranını yem girdileri teşkil eder, dolayısıyla yemleme ne kadar düşük maliyetli olursa karlılık da o denli yüksek olmaktadır (Akmaz, 1998). Ülkemizde yetiştirilen hayvan ırklarının genetik potansiyeli her geçen gün yükselmekte, kaba yem üretimimiz ise bu yükselişle paralellik arz etmemektedir. Bu durum kalite kaba yem açığımızın artmasına neden olmaktadır. Ülkemizde 17.1 milyon BBHB'ne eş değer miktarda hayvan bulunmaktadır. Bu hayvanların yıllık kaba yem ihtiyacı 78.6 milyon ton kuru ot dolaylarındadır. Kaba yem üretim kaynaklarının dağılımına bakıldığında; yem bitkileri ekilişlerinden 7.5 milyon ton, silaj üretiminden 8.5 milyon ton ve çayır mera alanlarından 14 milyon ton olmak üzere toplam 29.6 milyon ton kuru ot üretimi söz konusudur. Yıllık kaliteli kaba yem açığımız ise 49 milyon ton dolaylarındadır (Yavuz ve ark., 2020). Hayvancılık sektöründe ortaya çıkan bu kaliteli kaba yem açığı üreticileri sap saman gibi, çeşitli tarla tarımı artıklarının kaba yem olarak kullanılmasına neden olmaktadır.

Ülkemizde pek çok işletmede tahıl üretiminden arta kalan saman gibi atıklar önemli kaba yem kaynağı olarak kullanılmakta, bu atıkların fiyatları zaman zaman kaliteli kaba yemlerden olan yonca, korunga ve fiğ+tahıl karışımları gibi kaliteli kaba yem fiyatlarına yakın düzeylerde olabilmektedir. Bu durumun bir nedeni de ülkemizde ekstantif besinin yani gelenek ve göreneklere dayalı bir anlayışın yaygın olmasıdır, bu tip besicilikten kar elde edilmesi tamamen tasadüflere bağlıdır, ekonomik şartlar bu tip besiciliğin yapılmasına ve kar edilmesine uygun değildir (Arpacık, 1999). Şartlar dikkate alındığında kalitesiz kaba yem olarak nitelendirilen sap, saman ve tarla artıkları günümüz hayvancılığında önemli bir yere sahip olmuştur.

Bu çalışma, Uşak ve çevresinde hayvan beslemede kaba yem kaynağı olarak yaygın bir şekilde kullanılan bazı tarla tarımı artıklarının besleyicilik düzeyleri belirlenmesi amacıyla yürütülmüştür.

MATERYAL VE YÖNTEM

Bu çalışma Uşak'ta endüstriyel amaçlı yetiştirilen bazı tarla bitkilerinin tarlada kalan artıklarının besleyicilik düzeylerinin belirlenmesi amacıyla 2021-2022 yılları arasında Uşak Üniversitesi Ziraat Fakültesinde yürütülmüştür. Çalışma kapsamında, arpa, buğday, mısır, çörek otu, nohut ve ayçiçeği gibi bitkilerin hasatlarından arta kalan atıkların kaba yem kaynağı olarak besleyicilik özellikleri ele alınmıştır.

Araştırma materyalini oluşturan söz konusu 6 tarla bitkisi ürün artığına ait örneklerden arpa, buğday, çörekotu, mısır ve nohudun biçerdöverle tane hasadından arta kalan samanları, çerezlik olarak yetiştirilen ayçiçeğinde kurutulmuş tanelerin elenmesi sırasında açığa çıkan boş veya çok küçük tanelerden ve bazı tabla parçalarından oluşan ayçiçeği atıkları incelenmiştir. Arpa ve buğday samanı örnekleri Muharremşah Köyü'nden, mısır samanına ait önekler Yapağılar Köyü'nden, çörek otu samanı ve nohut samanı örnekleri Ulubey İlçesi Avgan Köyü ve Merkez Kapaklar Köyü'nden toplanmıştır. Ayçiçeği ürün artıklarına ait örnekler ise Uşak İli Merkez Susuzören Köyü'nden temin edilmiştir.

Çalışma kapsamında her ürün artığı için yaklaşık 500 g olarak alınan örnekler laboratuvarda 105 °C'ye ayarlı etüvde 24 saat süreyle bekletilmiş ve ilk ağırlıklarına oranlanarak kuru madde oranları belirlenmiştir (Akyıldız, 1984). Kurutulup öğütülmüş örnekler üzerinden Kjeldahl yöntemine göre (Kacar ve İnal, 2008) azot analizi yapılarak elde edilen % N, 6.25 katsayısı ile çarpılarak örneklerin ham protein oranları belirlenmiştir. Örneklerin ham kül ve ham selüloz oranları Akyıldız (1984), tarafından belirtilen yönteme göre, ham yağ oranları ise AOAC

(1990)'a göre belirlenmiştir. NDF ve ADF oranları Ankom Technology tarafından belirtilen yönteme göre Ankom A220 cihazında F57 filtre torbaları kullanılarak yapılmıştır (Anonim, 2012). Sindirilebilir kuru madde (DDM), kuru madde alımı (DMI) ve nispi yem değerleri (RFV) Horrocs ve Vallentine (1999)'in bildirdiği eşitliklerden yararlanılarak hesaplanmıştır.

DDM=88.9 – (0.779 x ADF, kuru madde bazında)

DMI= 120 / % NDF kuru madde bazında

RFV= % DDM x % DMI x 0.775

Çalışmadan elde edilen veriler tesadüf parselleri deneme desenine göre JMP 11.0.0 istatistik paket programında varyans analizine tabi tutulmuş, ortalamaların karşılaştırılmasında LSD (0.05) testinden yararlanılmıştır (SAS, 2013).

BULGULAR VE TARTIŞMA

Çalışmada ele alınan tarla tarımı ürün artılarının bazı besin maddesi içeriklerine ilişkin ortalama değerler Çizelge 1 ve Çizelge 2'de gösterilmiştir. Tarla tarımı artıklarının besin maddesi içeriklerine ilişkin değerlerle yapılan varyans analizi sonuçlarına göre çalışmada ele alınan tüm özellikler arasında istatistik açıdan $P \leq 0.01$ seviyede önemli farklılıklar tespit edilmiştir.

Çalışmada kaba yemlerin kuru madde oranları % 88.41 ile % 93.27 arasında değişim göstermiştir. En yüksek kuru madde oranı ayçiçeği, mısır samanı ve arpa samanında, en düşük kuru madde oranı ise buğday samanında tespit edilmiştir (Çizelge 1). Yapılan çalışmalarda kuru madde oranlarının arpa samanında % 92.6, buğday samanında % 92.4, mısır samanında % 91.5 (Karabulut ve Filya 2012), ayçiçeği kabuklarında ise %92.1 olduğu (Petraru et al., 2021) bildirilmiştir. Bu çalışmada belirlenen kuru madde oranları araştırıcıların bir kısmı ile benzerlik gösterirken, buğday samanında belirlenen değerler bakımından farklılık göstermiştir. Bu durum kaba yemlerin saklama koşullarının farklı olmasından kaynaklanmış olabilir.

Çalışmadan elde edilen sonuçlara göre tarla tarımı artıklarının ham protein oranları % 7.53 ile % 4.01 arasında değişim göstermiştir. En yüksek ham protein oranı çörekotu samanı ve ayçiçeği artıklarında tespit edilmiştir. En düşük ham protein oranları arpa, buğday ve mısır samanlarında belirlenmiştir. Çalışmada genel olarak tahıl samanları ham protein oranları bakımından düşük seviyelerde kalırken çörekotu ve ayçiçeği artıklarındaki ham protein oranlarının yüksekliği dikkat çekicidir. Çörekotu samanı ve çerezlik ayçiçeği elek artıkları her ne kadar kolay temin edilebilen kaba yemler olmasa da bu atıkların kalite düzeyleri diğerlerine göre oldukça yüksek bulunmuştur. Daha önce yapılan çalışmalarda buğday samanının ham protein oranının Siirt'te % 0.24 ile 5.03 arasında değiştiği (Açıkbaş ve Özyazıcı, 2019), Hatay'da ise buğday samanındaki ham protein içeriğinin % 2.40 ile 4.47 arasında olduğu (Zahal ve Kaya, 2019) bildirilmiştir. Kırıkkale yöresinde yapılan bir çalışmada buğday samanındaki ham protein oranının % 3.43-3.78 arasında, nohut samanında ise % 4.90-6.45 arasında değiştiği bildirilmiştir (Güngör ve ark., 2008). Diğer taraftan kaba yemlerdeki ham protein oranlarını Şehu ve ark. (1998), arpa ve nohut samanlarında sırasıyla % 5.92 ile 4.69; Karabulut ve Filya (2012), arpa samanında % 4.5, buğday samanında % 4.1, mısır samanında % 4.3; Rodríguez et al. (2019), ayçiçeği kabuklarında çeşitlere göre % 5.36 ile 8.09 arasında; Petraru et al. (2021), ayçiçeği kabuklarında % 7.82 olduğunu bildirmişlerdir. Bu çalışmada belirlenen ham protein oranları yukarıda sıralanan araştırma sonuçlarının bazıları ile benzerlik gösterirken bir kısmı ile ayrışmaktadır. Bu farklar kaba yemlerin temin, muhafaza ve işlenmelerindeki farklılıklardan kaynaklanabileceği gibi çevresel faktörlerden de kaynaklanmış olabilir.

Çalışmada belirlenen ham kül oranları %3.63 ile % 11.20 arasında değişiklik göstermiştir. En yüksek ham kül oranı nohut kesinden elde edilmiştir. Çörekotu samanı ve mısır samanı ham kül içerikleri bakımından benzerlik gösterirken en düşük ham kül oranı ayçiçeği elek artıklarında tespit edilmiştir. Bitkilerdeki ham külün en fazla yapraklarda bulunduğu bilinmektedir. Çünkü

bitki tarafından alınan sudaki mineraller terlemenin daha fazla gerçekleştiği yapraklarda daha çok birikir. Yaprakta buharlaşma ile uzaklaşan su bünyesindeki mineralleri bırakır (Özyiğit ve Bilgen, 2006). Bu bağlamda, çalışmadaki en düşük ham kül oranlarının, içerisinde en az yaprak barındıran kaba yem olan ayçiçeği artıklarında belirlenmiş olması beklenen bir durum olarak değerlendirilebilir. Petraru et al. (2021), tarafından yürütülen bir çalışmada ayçiçeği kabuklarındaki ham kül içeriğinin %2.45 olduğu, Rodríguez et al. (2019)'nın yürüttükleri çalışmada ise % 2.92 ile 4.11 arasında değiştiği rapor edilmiştir. Bu sonuçlar bizim ayçiçeği artıklarına belirlemiş olduğumuz sonuçlar ile uyum içerisindedir. Güngör ve ark. (2008), nohut samanının ham kül oranlarının %5.93-8.56 arasında değiştiğini ortalamada ise %7.48 olduğunu; Şehu ve ark. (1998) ise %7.06 olduğunu tespit etmişlerdir. Bildirilen bu iki sonuç da bu çalışmada belirlenen sonuçlardan daha düşük bulunmuştur. Bu durum ekolojik koşulların yanı sıra hasattaki olgunluk ve yaprak/sap oranlarının farklı olmaları gibi sebeplerden kaynaklanıyor olabilir.

Çizelge 1. Bazı tarımsal atıklarının besin maddesi içeriklerine ilişkin ortalama değerler.

Yem Kaynağı	Kuru Madde Oranı (%)	Ham Protein Oranı (%)	Ham Kül Oranı (%)	Ham Selüloz Oranı (%)	Ham Yağ Oranı (%)
Ayçiçeği	93.27 a^{+}	7.24 a	3.63 e	39.30 b	8.29 a
Arpa Samanı	92.21 a	4.01 c	6.10 d	42.50 a	0.83 d
Buğday Samanı	88.41 c	4.32 c	6.94 b	35.10 c	1.40 c
Çörekotu samanı	90.76 b	7.53 a	6.67 c	39.40 b	3.83 b
Mısır samanı	92.66 a	4.29 c	6.67 c	33.40 d	0.87 d
Nohut samanı	89.85 b	5.91 b	11.20 a	34.00 d	0.98 d
P	**	**	**	**	**
LSD $_{0.05}$	1.28	0.34	0.15	0.76	0.33
V.K. (%)	0.78	3.40	1.24	1.45	6.90

**: P≤0.01 seviyede önemli. $^{+}$: Aynı sütunda benzer harf ile gösterilen ortalamalar arasındaki farklar P≤0.05 seviyede önemsizdir.

Araştırmada kaba yemlerin ham selüloz oranları %33.40 ile 42.50 arasında değişim göstermiştir. Arpa samanı %42.50 ile kaba yemler arasında en yüksek ham selüloz oranına sahip olurken en düşük ham selüloz oranları nohut ve mısır samanlarında izlenmiştir. Karabulut ve Filya (2012), tarafından yürütülen çalışmada arpa buğday ve mısır samanlarının ham selüloz oranları sırasıyla % 35.3, % 37.1 ve % 33.1 olduğu bildirilmiştir. Zahal ve Kaya (2019), buğday samanındaki ham selüloz içeriğinin % 36.05 ile % 61.40 gibi geniş bir aralıkta değişebileceğini bildirmiştir. Bu çalışmada belirlenen buğday ve mısıra ait sonuçları araştırıcıların sonuçları ile uyum içerisinde iken arpada belirlenen değerler daha yüksek bulunmuştur. Bu durum örnek alınan bitkinin hasat zamanı, gübrelenmesi, saklanması etkenlerin yanı sıra çevresel faktörlerden de kaynaklanmış olabilir.

Kaba yemlerin ham yağ oranlarına ait ortalamalar % 0.83 ile 8.29 arasında farklılık arz etmiştir. çalışmada en yüksek ham yağ oranı ayçiçeği artıklarında, en düşük ham yağ oranları ise arpa, mısır ve nohut samanlarında belirlenmiştir. Çörekotu samanı % 3.83 ham yağ oranı ile ayçiçeğinden sonra en fazla yağ içeriğine sahip olan ikinci kaba yem olmuştur. Bu itibarla ayçiçeği artıkları ve çörekotu samanı içerdikleri yüksek ham yağ oranları bakımından dikkat çekicidirler. Daha önce yapılan çalışmalarda ham yağ içeriğinin ayçiçeği atıklarında % 8.81 (Petraru et al., 2021), arpa samanında % 1.31 (Şehu ve ark., 1998), buğday samanında % 0.46 - 1.59, nohut samanında % 0.86 - 2.24 (Zahal ve Kaya, 2019), mısır samanında % 1.1 (Karabulut ve Filya, 2012) olduğu bildirilmiştir. Bu çalışmada belirlenen değerler de araştırıcılar tarafından rapor edilen sonuçlara yakın bulunmuştur.

NDF bir yemin toplam lif içeriği veya hücre duvarı fraksiyonu olarak tanımlanabilir. Kimyasal olarak NDF selüloz, hemiselüloz, lignin ve ısıdan zarar görmüş proteinleri içermektedir (Linn and Martin, 1989). Çalışmada yer alan kaba yemlerin NDF oranları arasında önemli farklılıklar ortaya çıkmıştır. En yüksek NDF oranı arpa ve mısır samanında sırasıyla % 77.14 ve % 79,26

olarak tespit edilmiştir. En düşük NDF oranı ise çörekotu ve ayçiçeği artıklarında belirlenmiştir. ADF oranları bakımından kaba yemler kıyaslandığında en düşük oranlar çörekotu ve nohut samanında tespit edilmiştir. Buğday samanı en yüksek ADF oranına (% 48.69) sahip olan kaba yem olarak belirlenmiştir (Çizelge 2). Amerikan yem ve mera konseyi (AFGC) tarafından yapılan kaba yem kalite sınıflamasına göre (Linn and Martin, 1989) çalışmada yer alan kaba yemler NDF oranları bakımından karşılaştırıldığında ayçiçeği artıkları ve çörekotu samanı 4 sınıf diğer kaba yemler 5. sınıf kaba yemler sınıfına dahil olmuşlardır. ADF oranlarına göre karşılaştırıldığında ise çörekotu ve nohut samanı 3. sınıf, ayçiçeği 4. sınıf diğer tahıl samanları ise 5. sınıf kaba yem sınıfına girmişlerdir.

Çizelge 2. Bazı tarla tarımı artıklarının NDF, ADF, DDM, DMI ve RFV değerlerine ait ortalamalar.

Yem Kaynağı	NDF (%)	ADF (%)	DDM (%)	DMI (%)	RFV
Ayçiçeği	61.57 d^{+}	44.95 c	53.89 b	1.95 a	81.57 a
Arpa Samanı	77.14 a	46.82 b	52.43 c	1.56 cd	63.21 b
Buğday Samanı	72.79 b	48.69 a	50.97 d	1.65 c	65.13 b
Çörekotu samanı	61.36 d	41.62 d	56.48 a	1.96 a	85.75 a
Mısır samanı	79.26 a	45.63 bc	53.35 bc	1.51 d	62.61 b
Nohut samanı	65.69 c	41.35 d	56.69 a	1.83 b	80.41 a
P	**	**	**	**	**
LSD $_{0.05}$	3.16	1.77	1.38	0.10	5.74
V.K. (%)	2.55	2.22	1.63	3.28	4.42

**: P≤0.01 seviyede önemli. $^{+}$: Aynı sütunda benzer harf ile gösterilen ortalamalar arasındaki farklar P≤0.05 seviyede önemsizdir.

Çalışmada en yüksek sindirilebilir kuru madde oranı çörekotu samanı ve nohut samanında tespit edilirken en yüksek kuru madde alımı değeri ayçiçeği artıkları ile çörekotu samanında

belirlenmiştir (Çizelge 2). Hayvan beslemede sinidirileblirliği düşük olan yemler hayvanların sindirim sistemlerini daha uzun süre işgal etmektedir. Bu durum o yemlerin kuru madde alımı (DMI) değerlerinin düşürmektedir (Mertens, 1994; Allen, 1996). Bu açıdan değerlendirildiğinden ayçiçeği artıkları ile çörekotu samanının diğer tarla tarımı artıklarına göre daha hızlı sindirilebilir oldukları söylenebilir.

Nispi yem değeri kaba yemlerin kalitelerinin derecelendirilmesinde başvurulan en önemli parametrelerden biri olup sindirilebilir kuru madde (DDM) ve kuru madde alımı (DMI) değerleri kullanılarak hesaplanmaktadır. Amerikan yem ve mera konseyini tarafından kullanılan baklagil, buğdaygil ve baklagil buğdaygil karışım yemlerinin sınıflamasına göre bir yemin RFV değeri 151'den büyükse o yemin en üstün kaliteli yem olduğu, 125-151 aralığında ise yüksek kaliteli, 103 - 124 aralığında iyi kaliteli, 87-102 aralığında ise orta, buna karşın 75-86 aralığında zayıf ve 75'den düşük ise o yemin çok kötü kalitede olduğu belirtilmektedir (Linn and Martin, 1989). Buna göre çalışmada yer alan kaba yemler RFV değerleri bakımından kıyaslandığında çörekotu samanı, ayçiçeği artıkları ve nohut samanı zayıf kaliteli kaba yemler sınıfına, diğer kaba yemler ise çok kötü kalitedeki kaba yemler sınıfına dahil edilebilir.

SONUÇ

Çalışmada yer alan tarla tarımı artıklarının kaba yem olarak besleme düzeylerinin düşük seviyelerde olduğu belirlenmiştir. Ancak kaliteli kaba yem üretimindeki açık ve tarla tarımı artıklarının ucuz oluşu üreticilerin bu atıklara olan talebini artırmaktadır. Sonuç olarak, Uşak ve çevresinde hayvan beslemede yaygın bir şekilde kullanılan tarla tarımı artıklarından ayçiçeği artıkları, çörekotu ve nohut samanının kaba yem olarak değerlendirilebileceği, buğday, arpa ve mısır gibi tahıl samanlarının ise besleyicilik düzeylerinin çok düşük seviyelerde olduğu, bu nedenle rasyonlarda mümkün olduğunca az yer almaları gerektiği sonucuna varılmıştır.

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EXAMINATION OF SOME ANATOMICAL FEATURES OF ENDEMIC *Lycium anatolicum* (SOLANACEAE)

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ABSTRACT

The Solanaceae family is globally significant for its diverse plant species used in nutrition, health, research, and ornamental purposes. This family comprises several genera and numerous edible species, including tomatoes, peppers, blackberry nightshade, and potatoes, commonly consumed for centuries. The Solanaceae family is renowned for its diverse range of phytochemicals like glycoalkaloids, capsaicinoids, and phenolic compounds, offering various health benefits with potential applications in pharmaceuticals and dietary supplements. Some species, however, contain toxic alkaloids, leading to severe side effects. The concentrations of these compounds vary based on factors like genotype, plant part, and growth conditions, determining a species' suitability for consumption or medicinal use. Understanding the anatomical structures of medicinal plants is of great importance for their effective use in herbal medicine. Anatomical structures help define the morphology, identity and characteristics of medicinal plants, and the anatomical studies play a crucial role in assessing the quality of medicinal plants, primarily through the use of light microscopy analysis, which serves as an important and effective method in these evaluations. In this study, the anatomical structures of *Lycium anatolicum* A.Baytop & R.R.Mill flowers and fruits were elucidated. For this purpose, sections were taken with the help of a razor blade and stained with Sartur solution.

Keywords: Solanaceae, *Lycium anatolicum*, Plant Anatomy, Pharmaceutical Botany

1. INTRODUCTION

The Solanaceae Juss. family is represented by approximately 101 genera in the world. The family has a wide distribution area from the tropical to the temperate zone. It has also been widely cultivated due to its species used for food, medicinal and ornamental purposes. Alkaloids detected in the Solanaceae family are tropane, alkaloidal amine, indole, isoquinoline, purine, pyrazole, pyridine, pyrrolidine, quinazolizidine, steroid alkaloids and glycoalkaloids. Apart from this, there are also steroidal saponins, withanolides, coumarins, cyclitols, pungent principles (in *Capsicum*), flavones, carotenoids and anthraquinones (Evans, 1999; POWO, 2023).

Lycium L. species grow naturally in a wide area around the world and are also cultivated in many places. In Türkiye, the *Lycium* is represented by 7 taxa (*Lycium anatolicum* A.Baytop & R.Mill, *L. barbarum* L., *L. chinense* Mill., *L. depressum* Stocks, *L. europaeum* L., *L. ruthenicum* Murray, *L. shawii* var. *leptophyllum* (Dunal) Tackholm & Boulos) (Güner et al., 2012). *Lycium* species contain alkaloids, glycerogalactolipids, phenylpropanoids, coumarins, lignans, flavonoids, amides, anthraquinones, organic acids, terpenoids, peptides, sterols, steroids, and their derivatives (Asano et al., 1997; Chiale et al., 1990; Gao et al., 2015; Gao and Khan, 2008; Han et al., 2002; Jeong et al.,1978; Jung et al., 2005; Li et al., 2013; Mocan et al., 2015; Qian et al., 2017; Qian and Huang, 2004; Sannai et al., 1984; Yang et al., 2017; Youn et al., 2016; Xie et al., 2001; Zhou et al., 2017). *Lycium* species also show antioxidant and free radical-scavenging, anti-aging, antitumor, antimicrobial and antifungal, antiviral, antidiabetic, hypolipidemic and anti-atherosclerosis, hypotensive, immunomodulation, hepatoprotective, neuroprotective activities (Luo et al., 2004; Wang et al., 2018; Yao and Weckerle, 2018; Yao et al., 2011).

Lycium anatolicum A.Baytop & R.R.Mill is endemic and is called "*tekedikeni*" in Turkish (Davis, 1978; Güner et al., 2012). *L. anatolicum* is a shrub that grows up to 1-2 meters tall. The branches are rigid, grayish and covered with stout spines. Leaves elliptic to oblanceolate, calyx campanulate, filaments hairy at base, dark reddish or brown fruit a berry (Davis, 1978).

Understanding the anatomical structures of medicinal plants is of great importance for their effective use in herbal medicine. Anatomical structures help define the morphology, identity and characteristics of medicinal plants, and the anatomical studies play a crucial role in assessing the quality of medicinal plants, primarily through the use of light microscopy analysis, which serves as an important and effective method in these evaluations (Hürkul and Yayla, 2021; İlhan and Hürkul, 2022; Yayla and Hürkul, 2023; Hürkul, 2021). In this study, the anatomical structures of *L. anatolicum* flowers and fruits were elucidated.

2. MATERIAL and METHOD

The specimens were collected from Ankara (Figure 1). It was stored in 70% alcohol to preserve the plant's tissues. Sections were obtained with the help of a razor blade. Tissues were stained with Sartur reagent (Çelebioğlu and Baytop, 1949). Anatomical details were captured using a digital camera compatible with a Leica DM 4000B microscope (Hürkul and Yayla, 2021; Hürkul, 2021).



Figure 1. General view of *L. anatolicum* (Photo: Ş. Yayla)

3. RESULT and DISCUSSION

The cross section of the fruit stalk is shown in figure 2. The fruit stalk has a disc appearance and is characterized by indistinct, slight collapse. The epidermis consists of single-row, square-oval cells with very thickened outer walls. The cuticle layer covers the epidermis. In the vascular bundle, xylem and phloem tend to merge and appear in the middle area of the fruit stalk in the form of a ring. Parenchymatous tissue consists of thin-walled cells with a fairly wide intracellular spaces. Sparse crystal-sand was observed in parenchymatous cells.

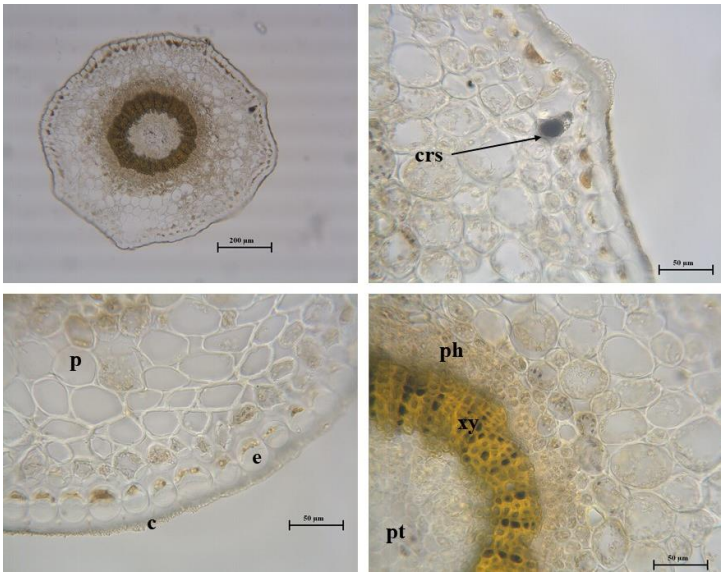


Figure 2. Anatomical features of the fruit stalk. c: cuticle, e: epidermis, pt: pith, p: parenchyma, ph: phloem, crs: crystal sand, xy: xylem

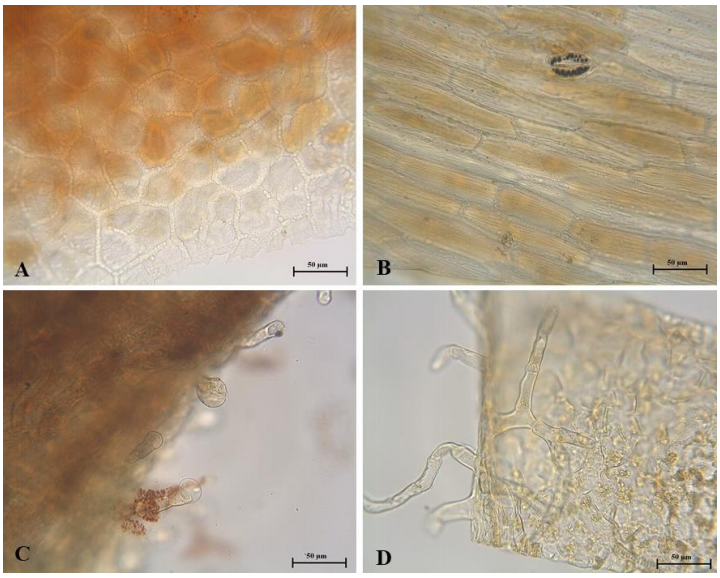


Figure 3. Some anatomical features of the fruit and flower of *L. anatolicum*. A: cells with intercellular passages in exocarp, B: stomata in the surface of the fruit stalk, C: glandular hairs on the inner epidermis of the calyx, D: covering hairs on the inner epidermis of the corolla

In the surface section of the fruit, passages between exocarp cells were clearly observed. In the surface section of the fruit stalk elongated, thin-walled epidermal cells and stomata were observed. The inner epidermis of the calyx is densely covered with glandular hairs. The inner epidermis of the corolla contains multicellular, branched covering hairs.

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LIGHT MICROSCOPY ANALYSIS OF SOME IMPORTANT ANATOMICAL CHARACTERS OF *PARONYCHIA ANGORENSIS*

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ABSTRACT

Paronychia angorensis Chaudhri (Caryophyllaceae) are endemic to Turkey and called as "*Ankara yaranı*". Paronychia species are traditionally used to treat eczema, febrifuge, urine retention, circulatory problems, blood pressure alterations, varicose veins, dermatitis, food poisoning, hypertension, circulatory problems, kidney stones, urinary tract infection, heart disease, diabetes, skin diseases, wounds urinary affections, influenza, colds and cough, bruises, hepatitis and abdominal ailments. It is very important to correctly describe and determine of the plants used in traditional folk medicine and have potential as drug candidates. Anatomical studies can simplify taxonomic separation of species. Light microscopy analysis is a common and effective method for the identification of medicinal plants. There is no comprehensive anatomical study on the *P. angorensis* until now. In this study some important anatomical characters of *P. angorensis* were examined in detail.

Keywords: Caryophyllaceae, *Paronychia angorensis*, Plant Anatomy, Pharmaceutical Botany

1. INTRODUCTION

Plants of the Caryophyllaceae are considered an important medicinal plant family with the saponins they contain. In addition, the family contains fatty acid derivatives, benzenoids, phenylpropanoids and isoprenoids (Böttger and Melzig, 2011; Chandra and Rawat, 2015; Evans, 2002; Lacaille-Dubois et al., 1995). The family has antioxidant, anti-inflammatory, antimicrobial, antifungal, antiviral and anticancer potential in terms of biological activity (Barakat et al., 2010; Galeotti et al., 2008; Karamian and Ghasemlou, 2013; Mamadalieva et al., 2010; Mutlu et al., 2016; Zhang et al., 2013; Zheng et al., 2008).

Members of Caryophyllaceae family are herbaceous or mostly in semi-shrub form. Leaves usually simple, entire and exstipulate. Flowers are actinomorphic and solitary or in cymes. Flowers have anthophore or perigynous. Fruits are baccate or opening capsule. Family contains 97 accepted genera worldwide. In previous studies on the Flora of Turkey, the *Paronychia* was included in the Illecebraceae. Today, is in the Caryophyllaceae with current developments and the Illecebraceae is a synonym of Caryophyllaceae (Bittrich, 1993; Cullen and Coode, 1967; Stevens, 2021; POWO, 2023).

Paronychia angorensis Chaudhri are endemic to Turkey and called as "*Ankara yaranı*" (Güner et al., 2012). *Paronychia* species are traditionally used to treat eczema, febrifuge, urine retention, circulatory problems, blood pressure alterations, varicose veins, dermatitis, food poisoning, hypertension, circulatory problems, kidney stones, urinary tract infection, heart disease, diabetes, skin diseases, wounds urinary affections, influenza, colds and cough, bruises, hepatitis and abdominal ailments (Hilgert, 2001; Abu-Irmaileh and Afifi, 2003; de Santayana et al., 2005; Aburjai et al., 2007; Ferreira et al., 2006; Kaileh et al., 2007; Hudaib et al., 2008; Benítez et al., 2010; Alzweiri et al., 2011; Nawash et al., 2013; Ali-Shtayeh et al., 2016). It is very important to correctly describe and determine of the plants used in traditional folk

medicine and have potential as drug candidates. Anatomical studies can simplify taxonomic separation of species. Light microscopy analysis is a common and effective method for the identification of medicinal plants (Alamgir, 2017). There is no comprehensive anatomical study on the *P. angorensis* until now. In this study, the anatomical features of *P. angorensis* were examined in detail.

2. MATERIAL AND METHOD

The plant material was collected from Beynam forest (Ankara/Turkey) (Figure 1). The samples for anatomical studies were protected in 70% alcohol. The sections were cut by hand with razor blade into microscopic preparation form. The Sartur solution (TF, 2017) was used in microscopic examinations. Leica DM 4000B microscope was used for anatomical analysis and micro photographing.



Figure 1. General view of *P. angorensis* (Photo: M.M. Hürkul)

3. RESULT AND DISCUSSION

The transverse-section of the stem was observed as in figure 2. The general view of the stem section is in the form of a circle with deep and irregular sinuously margin. A large hollow is observed in the middle of the stem. A thin layer of cuticle covers the epidermis. The epidermal layer cells are mostly oval shaped. The collenchyma tissue supports these sinus. The epidermal

layer bears stomata and non-glandular hairs. The hairs are simple and unicellular. Phloem are enclosed externally by pericyclic sclerenchymatous ring. The vascular bundle generally tends to fuse in the form of a wide arc, and the xylem and phloem united in a form as continuous ring. In the central area of stem, the walls of the parenchymatous pith cells fuse to form a hollow. In addition, solitary crystals may be found in the stem cortex parenchyma rare. The leaf transverse-section was observed as in figure 3. In general, the leaf exhibits doming in the midrib towards the lower surface. The leaf epidermal layer is covered with numerous simple, unicellular non-glandular hairs and rarely observed in unicellular glandular heads. Epidermal cells are square-oval shaped and a thin cuticle layer covers them. Stomata can be found in both epidermal layers and have 3-5 subsidiary cells. Leaf mesophyll consists of undifferentiated thin-walled parenchymatous cells of different sizes. Huge and dense solitary crystals are prominent in the parenchyma of the mesophyll.

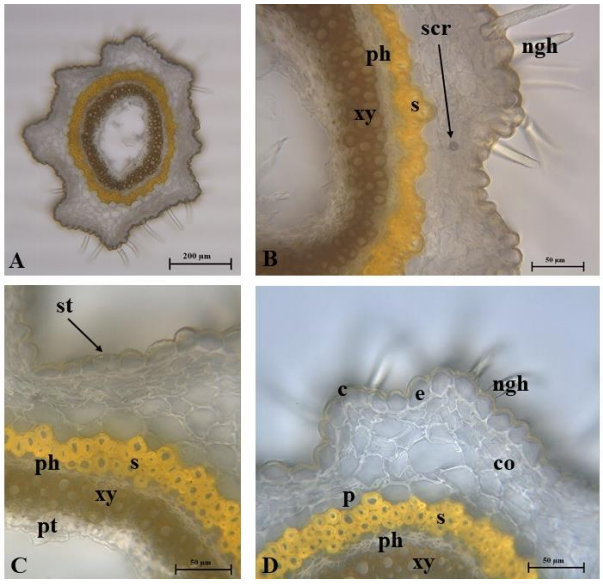


Figure 2. Anatomical features of the stem. A: general view, B-C-D: detail of the transverse section, c: cuticle, co: collenchyma, e: epidermis, ngh: nonglandular hair, pt: pith, p: parenchyma, ph: phloem, s: sclerenchyma, scr: solitary crystal, st: stomata, xy: xylem

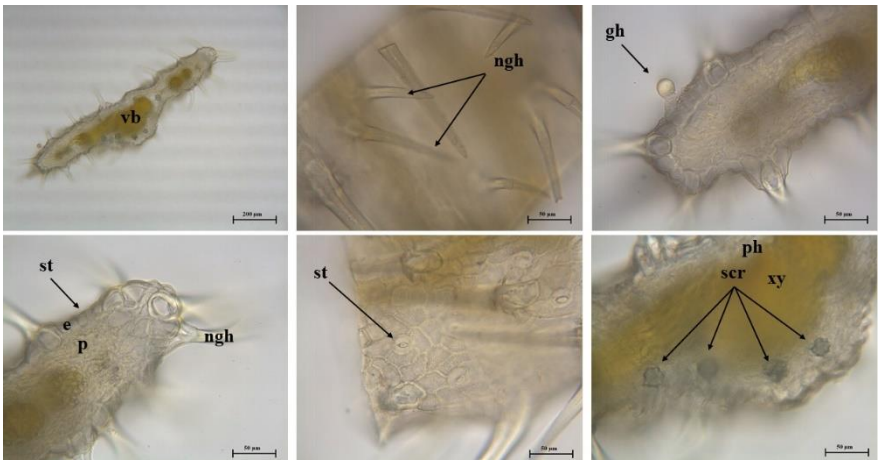


Figure 3. Anatomical features of the leaf. e: epidermis, gh: glandular hair, ngh: nonglandular hair, p: parenchyma, ph: phloem, scr: solitary crystal, st: stomata, vb: vascular bundle, xy: xylem

In previous studies, it was observed that the information about the anatomical features of the *Paronychia* genus was compatible with the data of this study. According to Metcalfe and Chalk (1965), simple, unicellular cover hairs and single-celled glandular hairs are the anatomical characters observed in the genus *Paronychia*. The presence of solitary crystals, a pericyclic sclerenchymatous ring surrounding the phloem, and xylem and phloem present in a continuous form are other anatomical characteristics of the genus.

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BAZI HORMON VE ORGANİK ASİTLERİN FARKLI BİTKİ ORGANLARINA GÖRE DEĞİŞİMİ: KİRAZ (0900 ZİRAAT) ÖRNEĞİ

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ÖZET

Kiraz, sahip olduğu tat ve aroma sebebiyle sevilerek tüketilen meyvelerdendir. Talebi üst düzeyde olan bu tür, sanayinin çok farklı kollarına entegre edilerek, katma değeri yüksek ürünlere dönüştürülmektedir. Zengin biyokimyasal içeriği sayesinde, tıbbı, farmakolojik ve gıda yönüyle meyve haricinde kalan kısımları da oldukça önem taşımaktadır. Kültüründe Dünya'ya liderlik ettiğimiz bu türün, farklı bitki kısımlarının, ürünlerde tat ve kalite üzerine önemli etkileri bulunan kimyasal özelliklerce karakterizasyonu oldukça kıymetlidir. Bu sebeple 2023 yılında yürütülen çalışmada, Isparta (Gönen) ekolojik koşullarında yetiştirilen, 0900 Ziraat çeşidine ait yaprak, sap ve meyve örneklemeleri yapılarak, bazı organik asitler ve hormonlarca miktar tayini yapılmıştır. İncelenen organik asitler ile hormonların tamamı miktar yönüyle; yaprak> sap> meyve şeklinde sıralanmıştır. Bu durum, yaprakların temel üretim merkezi konumunda olduğunu doğrularken, meyvelerin ise taşınım merkezi pozisyonunda olduğunu göstermiştir. Malik asit, hakim organik asit olarak öne çıkarken onu sırası ile suksinik asit, sitrik asit, okzalik asit, tartarik asit ve fumarik asit takip etmiştir. Malik asit miktarı yapraktan (53,4 g kg^{-}), sapa (26,7 g kg^{-}) taşınırken %50'den fazla azalırken, saptan, meyveye (16,5 g kg^{-}) taşınırken ise %40'a yakın azalma göstermiştir. Benzer durum diğer organik asitler içinde geçerlidir. Hormonlar açısından ise sıralama; giberellik asit> salisilik asit> indol asetik asit> absisik asit şeklinde belirlenirken, farklı organlara taşınım esnasında ki düşüş, organik asitlere nazaran nispeten daha düşük düzeylerde gözlemlenmiştir. Sonuç olarak, kiraz türüne ait farklı bitkisel kısımların zengin ve çeşitli biyokimyasal içeriğe sahip olduğu söylenebilir. Ayrıca, yaprak temel üretim pozisyonunda gözlemlenirken, sap iletim yolu, meyve ise taşınım noktası olarak gözlemlenmiştir.

Anahtar kelimeler: Prunus avium, bitki kısımları, biyokimyasallar, taşınım fizyolojisi

HORMONE AND ORGANIC ACID CHANGES ACCORDING TO DIFFERENT PLANT ORGANS: AN EXAMPLE OF CHERRY CV. 0900 ZİRAAT

ABSTRACT

Cherries are among the fruits that are consumed fondly due to their taste and aroma. This species, which has a high demand, is integrated into many different branches of the industry and transformed into products with high added value. Thanks to its rich biochemical content, different parts of the plant other than the fruit are also very important in terms of medicine, pharmacology and nutrition. The characterisation of various plant parts belonging to this species, which we lead the globe in terms of culture, with chemical properties that have significant effects on the taste and quality of products is very valuable. This is why several organic acids and hormones were identified in the study using leaf, stalk, and fruit of the 0900 Ziraat variety cultivated in the ecological conditions of Isparta (Gönen) in 2023. All quantitatively analyzed organic acids and hormones were ranked as follows: leaf > stalk > fruit. This confirms that the leaves are the main production center, while the fruits are the transportation center. Malic acid stood out as the dominant organic acid, followed by succinic acid, citric acid, oxalic acid, tartaric acid and fumaric acid, respectively. The amount of malic acid decreased by more than 50% while being transported from the leaf (53.4 g kg) to the stalk (26.7 g kg), while it decreased by nearly 40% when transported from the stalk to the fruit (16.5 g kg). A similar situation is valid for other organic acids. Hormone order was found to be gibberellic acid > salicylic acid > indole acetic acid > abscisic acid; nevertheless, the rate of reduction during transport to various organs was comparatively lower than that of organic acids. Therefore, it can be said that the diverse plant parts of the cherry species have a rich and diverse biochemical composition. Moreover, the leaf was considered to be the main manufacturing location, the stem the transmission route, and the fruit the transit terminal.

Key words: Prunus avium, plant parts, biochemicals, transport physiology

1. GİRİŞ

Meyvecilik tarihi ve kültürü açısından Anadolu'nun Dünya'da önemli bir yeri vardır. Bahçe tarımının doğuş yerlerinden olan Anadolu, birçok meyve türünün de anavatanı konumundadır (Özçağıran ve ark., 2005). Kirazın (*Purunus avium* L.) anavatanı Güney Kafkasya, Hazar Denizi ve Kuzeydoğu Anadolu arasındaki bölge olarak bilinmektedir. Görüldüğü üzere, ülkemiz de kirazın orjin merkezleri arasındadır (Ercisli, 2004).

Türkiye, bitkisel üretim için, dünya üzerinde sahip olduğu coğrafi konum, ülkenin topağrafik yapısına bağlı olarak bölge içinde rakım farklılıklarının olması, mikroklima alanların varlığı ve sahil kesimlerinin kıyı ve yayla şeklinde ayrılıyor olması gibi etkenlere, son dönemde muhafaza şartlarının iyileşmesi de ilave edildiğinde, kiraz meyvesini 4-5 ay raflarda taze olarak bulmak mümkün olmaktadır. Subtropik iklimin hakim olduğu yöreler de, erkenci çeşitlerle Mayıs sonu başlayan kiraz hasadı, karasal iklimin hüküm sürdüğü yüksek rakımlı yöreler de, geçci çeşitlerle Eylül ayında son bulmaktadır.

Son yıllarda Avrupa ülkelerin de şiddet ve sıklığını arttıran yaz yağışları, kiraz meyvelerinde çatlamalara sebep olmakta ve bu ülkelerde kiraz yetiştiriciliğinden kaçışlar görülmektedir (Quero-García ve ark., 2021). Nitekim, 2015 yılında (535. 000 ton), %20'sini tek başımıza karşıladığımız kiraz türünde, 2021 yılında Dünya üretimindeki payımız %25'e yükselmiş durumdadır (690 000 ton). Ancak, ihracat miktarımız henüz 70.000 ton dolaylarında olup, potansiyelimizin oldukça altındadır (FAO, 2021).

Kiraz üretiminde Dünya'ya liderlik eden ülkemizin, kiraz pazarında da lider olabilmesi için, üretilen kirazların taze olarak pazarlanmasına ek olarak, katma değer kazandırılmış formlarda da pazarlanması, kirazda arzu edilen dış gelirin yakalanmasında önemli olabilir. Bu bağlamda, meyve haricinde kalan kısımlarının da değerlendirilmesi ön plana çıkabilir. Kiraz bitkisine ait yapraklar sarma, sapları ise alternatif tıp olarak yıllardır değerlendirilmektedir (Faienza ve ark.,

2020; Maxiselly ve ark., 2022). Kirazın farklı kısımlarında, zengin ve çeşitli biyokimyasalların olduğuna dair çeşitli çalışmalar bulunmaktadır (Dziadek ve ark., 2019; Uysal, 2020; Ates ve Ozturk, 2023). Bu kimyasalların çok farklı hastalık veya rahatsızlıklara karşı etkili olduğuna dair çalışmalar rapor edilmiştir (Arbizu ve ark., 2023).

Bu çalışmada, ülkemizin en popüler, yerli ve dış pazarda "Türk kirazı" olarak tanınan 0900 Ziraat çeşidine ait meyve, sap ve yapraklarda bulunan bazı organik asitlerin ve hormonların belirlenmesi amaçlanmıştır.

2. MATERYAL ve METHOD

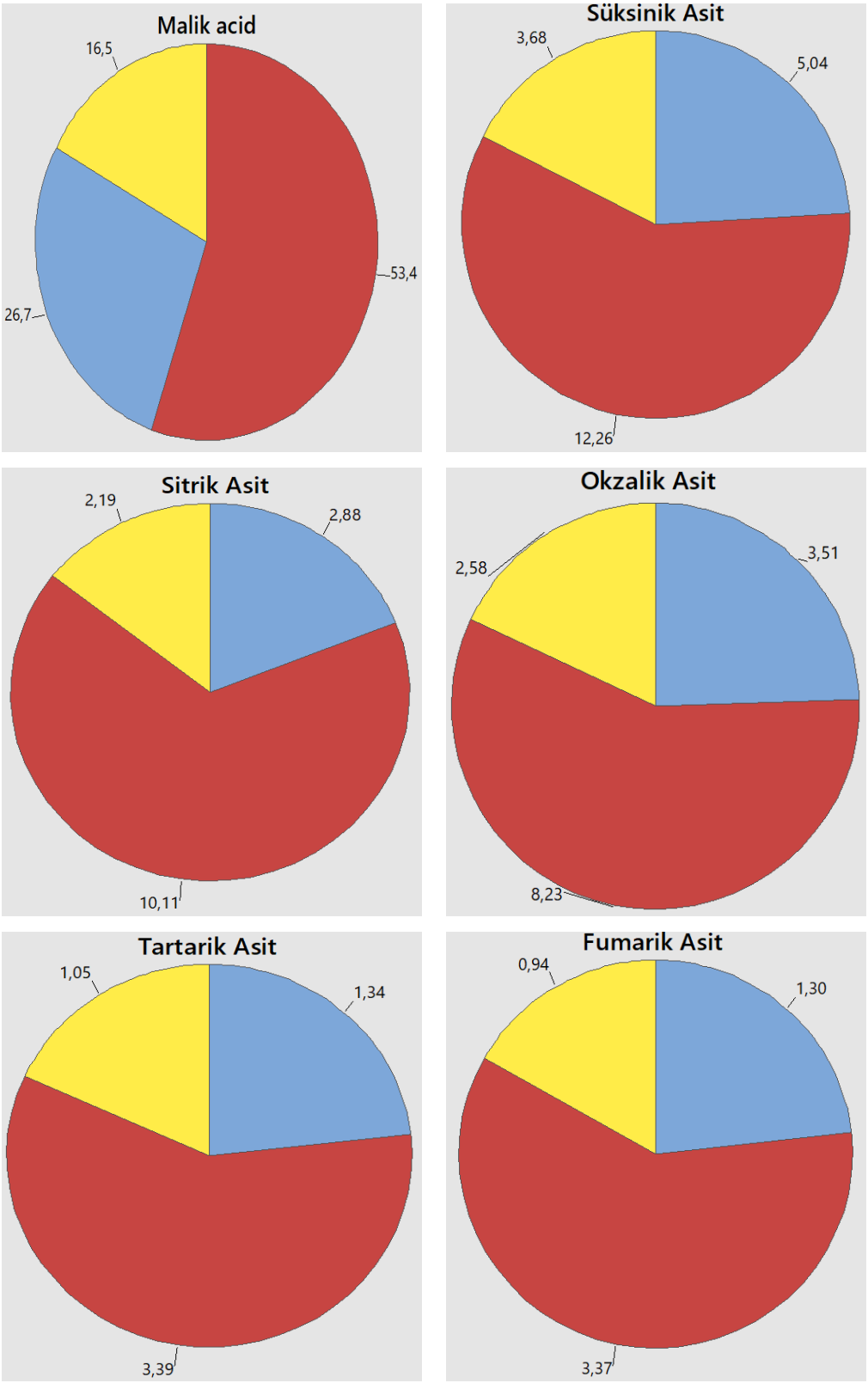
Çalışma 2023 yılında yürütülmüş olup, materyal olarak kullanılan bitkiler, Isparta (Gönen) ekolojik koşullarında yetiştirilmiştir. Örneklemeler, Meyvelerin olgunlaştığı Temmuz ayı içerisinde yapılmıştır. Farklı kısımların organik asit kompozisyonunu belirlemede Agilent marka 1260 model HPLC cihazı kullanılmıştır. Bu amaçla ACE 5 C18 kolonu (5 µm, 250 mm x 4.6 mm) ve UV Dedektör kullanılmıştır. İzokratik akışta gerçekleştirilen analizde mobil faz olarak ortofosforik asit ile pH'sı 2.3'e ayarlanmış % 2'lik KH2PO4 çözeltisi kullanılmıştır. 30 °C'de 0.9 mL/dak akış hızında ve 10 µl enjeksiyon hacminde gerçekleştirilen analizde organik asitler 210 nm dalga boyunda okunmuştur. Analiz süresi 20 dakikadır. Örneklerdeki organik asit bileşenlerinin miktarları standart organik asit analiz sonuçlarına göre hesaplanarak, g kg^{-} olarak verilmiştir (Fu ark., 2015). Hormon analizleri ücrete tabi şekilde gerçekleştirilmiştir.

Araştırma, tesadüf parselleri deneme desenine göre tasarlanarak, 2023 yılında, üç tekerrürlü olarak yürütülmüştür. İncelenen özelliklerin, farklı bitki kısımları arasında istatistiksel olarak önemli farklılıklar gösterip göstermediği Minitab-17 paket programında, one-way ANOVA

prosedürü kullanılarak tespit edilmiştir. Çeşitler arası farklılıkların ortaya çıkarılmasında, Tukey çoklu karşılaştırma testi kullanılmıştır (Zar, 2013).

3. BULGULAR ve TARTIŞMA

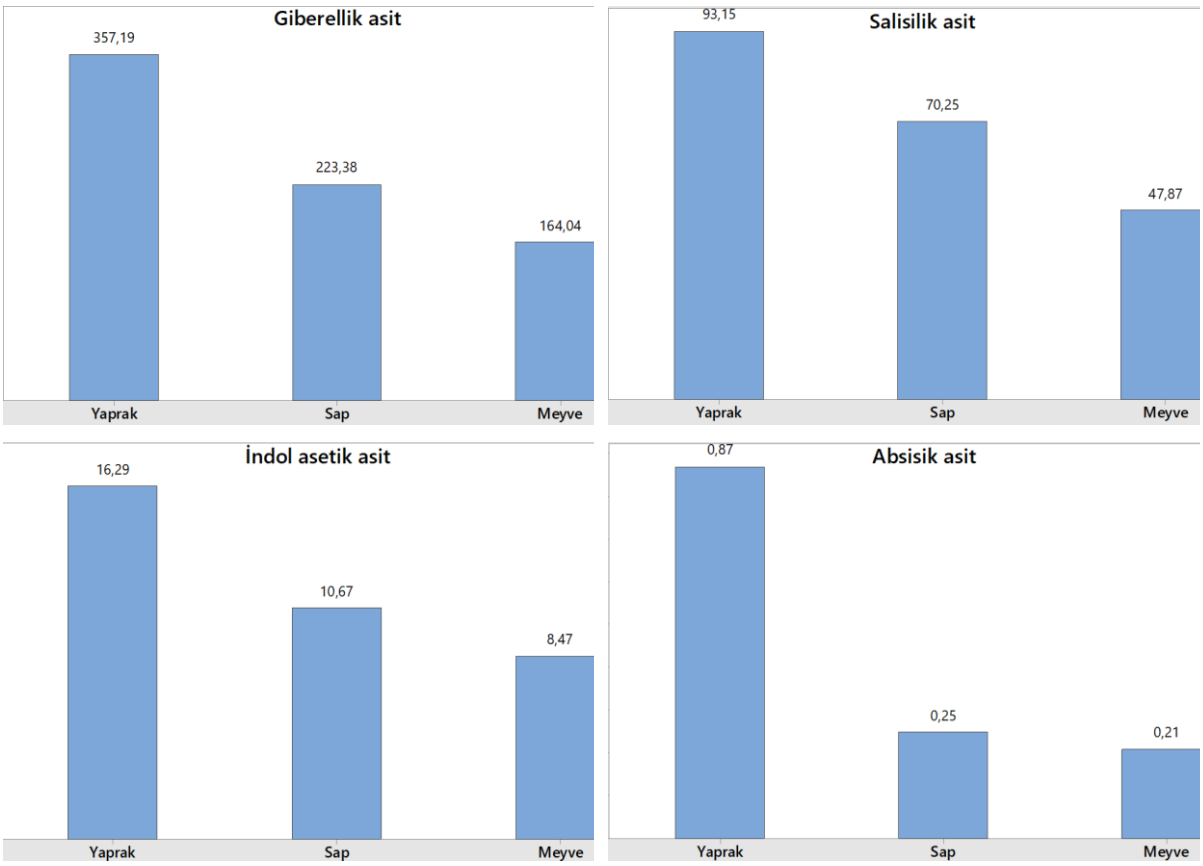
Kiraz bitkisine ait farklı kısımlardan elde edilen organik asit miktarlarına ilişkin sonuçlar Şekil 1'de verilmiştir. İncelenen organik asitlerin tamamı miktar yönüyle; yaprak> sap> meyve şeklinde sıralanmıştır. Bu durum, yaprakların temel üretim merkezi konumunda olduğunu doğrularken, meyvelerin ise taşınım merkezi pozisyonunda olduğunu göstermiştir (Golubkina ve ark., 2020). Malik asit, hakim organik asit olarak öne çıkarken onu sırası ile suksinik asit, sitrik asit, okzalik asit, tartarik asit ve fumarik asit takip etmiştir. Malik asidin, kiraz türüne ait hakim organik asit olduğu, Nawirska-Olszańska ve ark (2017), tarafından da rapor edilmiştir. Malik asit miktarı yapraktan (53,4 g kg^{-}), sapa (26,7 g kg^{-}) taşınırken %50'den fazla azalırken, saptan, meyveye (16,5 g kg^{-}) taşınırken ise %40'a yakın azalma göstermiştir. Benzer durum diğer organik asitler için de gözlemlenmiştir. 0900 Ziraat çeşidi ile yürütülen farklı çalışmalarda, meyveye ait malik asit miktarının, 8,54 g kg^{-} (Kelebek ve Selli, 2011) ile 23,61 g kg^{-} (Hayaloglu ve Demir, 2015) arasında değişim gösterdiği, çalışma sonucunun ise bu aralıkta olup literatür ile uyumlu olduğu söylenebilir. Çalışmamızla benzer şekilde, farklı organik asitlerin miktarı yapraktan meyveye doğru azalım göstermektedir (Golubkina ve ark., 2020; Wojdyło ve ark., 2021).



Şekil 1. 0900 Ziraat çeşidine ait farklı kısımlarda incelenen organik asitlerin değişimi (Kırmızı: Yaprak, Mavi: Sap ve Sarı: meyveyi temsil etmektedir)

0900 Ziraat çeşidinin farklı kısımlarında incelenen hormonların miktarlarına ilişkin sonuçlar Şekil 2 de verilmiştir. Organik asitlere benzer şekilde incelenen tüm hormonların konsantrasyonu en yüksek yaprakta belirlenirkenii en düşük ise meyvelerde birikim göstermiştir. İncelenen hormonlar miktar açısından açısından; giberellik asit> salisilik asit> indol asetik asit> absisik asit şeklinde belirlenirken, farklı organlara taşınım esnasında ki düşüş (özellikle saptan meyveye), organik asitlere nazaran nispeten daha düşük düzeylerde gözlemlenmiştir.

Organik asitler ve hormonlar farklı fizyolojik döngüleri ya direk organize eden ya da dolaylı olarak etkileyen önemli bileşenlerdir (Götz ve ark., 2023; Salehi Sardoei ve ark., 2023; Zhang ve ark., 2023). Bitkilerdeki rollerinin yanı sıra, bu moleküller insan beslenmesinde ve metabolik olayların döngüsünde de önemli görevler üstlenmekte olup, sağlıklı gelişim ve yaşam için son derece önemlidirler (Cheng ve ark., 2020). Bu sebeplere istinaden, tayinleri, miktarları ve değişimleri oldukça önemlidir.



Şekil 2. 0900 Ziraat çeşidine ait farklı kısımlarda incelenen içsel hormonların değişimi

SONUÇ ve ÖNERİLER

Çalışma sonucunda, biyokimyasal bileşiklerin yapraktan meyveye taşınım esnasında azalım gösterdiği tespit edilmiştir. Bu durum, meyve haricindeki kısımların da biyoaktif bileşenlerce zengin doğal ürünler olduğunu göstermiştir. Benzer çalışmaların, mevcut kiraz çeşitleri üzerinde yaygınlaştırılması gerekmekte olup, bu kimyasalların dahil olduğu fizyolojik döngülerin, iyi kurgulanmış çalışmalarla açıklığa kavuşturulması gerekmektedir.

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YEMEKLİK TANE BAKLAGİLLERDE PİŞME ÖZELLİKLERİNİN VİTAMİN İÇERİĞİ ÜZERİNE ETKİSİ

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ÖZET
Yemeklik tane baklagiller; insan beslenmesinde kritik bir rol oynayan yüksek protein, karbonhidrat, mineral, B grubu vitaminler ve lif içeriğine sahiptir. Özellikle gelişmekte olan ülkelerde bu besinler, düşük protein ve enerji içeren diyetlerin eksikliğini gidermek amacıyla geniş bir şekilde tüketilmektedir. Ayrıca bu baklagiller; yüksek lif içerikleri sayesinde kalp hastalıkları, kolon kanserleri, yüksek kolesterol, diyabet, gibi sağlık sorunlarını azaltmada ve önlemede etkili bir rol oynamaktadır. Yapılan araştırmalar, ısıl işlem sırasında B1, B2 ve B3 vitaminlerinin kaybının gözlemlenebileceğini göstermektedir. Ayrıca, C vitamini ve yağda çözünen vitaminlerin miktarı da pişirme sürecinde azalabilmektedir. Bu nedenle, baklagillerin pişirilmesi sırasında dikkatli olunmalı ve vitamin kayıplarını en aza indirmek için uygun pişirme yöntemleri tercih edilmelidir. Bu çalışma, vitamin açısından zengin baklagillerin sağlıklı bir beslenme için önemli bir kaynak olduğunu vurgulamakta, ancak uygun pişirme yöntemleri kullanarak besin değerlerinin korunmasının önemli olduğunu belirtmektedir.
Anahtar Kelimeler: Baklagiller, Vitamin, Pişme özellikleri

EFFECT OF COOKING CHARACTERISTICS ON VITAMIN CONTENT IN LEGUMES

ABSTRACT

Edible grain legumes have high protein, carbohydrate, mineral, B group vitamins and fibre contents which play a critical role in human nutrition. Especially in developing countries, these foods are widely consumed to compensate for the deficiency of low protein and energy diets. In addition, thanks to their high fibre content, these legumes play an effective role in reducing and preventing health problems such as heart diseases, colon cancers, high cholesterol, diabetes. In this article, the effects of cooking processes of edible grain legumes, especially on B group vitamins, were investigated. Studies show that loss of vitamins B1, B2 and B3 can be observed during heat treatment. In addition, the amount of vitamin C and fat-soluble vitamins may also decrease during cooking. Therefore, care should be taken when cooking legumes and appropriate cooking methods should be preferred to minimise vitamin losses. This study emphasises that vitamin-rich legumes are an important source for a healthy diet, but it is important to preserve their nutritional value by using appropriate cooking methods.

Keywords: Legumes, Vitamin, Cooking traits

1. GİRİŞ

Dünya üzerinde tarım, çok eski tarihlerden bu yana yapılmaktadır. Tarımın tarihi, insanlığın yerleşik yaşama geçişinin ardından başlamış ve tarım ürünleri, insanların temel besin kaynaklarını oluşturmuştur. *Leguminosae* (*Fabaceae*) ailesinde yer alan baklagiller, bitkilerin sınıflandırılmasında büyük bir öneme sahiptir. Bu aile, yaklaşık 750 cins ve 20.000'den fazla türle dünyanın en büyük bitki ailelerinden biridir. Bu ailede yer alan tane baklagiller, özellikle dünya gıda üretimine büyük katkı sağlamaktadır (Tan, 2010). Yemeklik tane baklagiller, dünyada tahıllardan sonra en fazla yetiştirilen tarla bitkilerindendir ve insan ile hayvan beslenmesinde önemli rol oynar. Bitkisel protein kaynağı olarak tanımlanan bu baklagiller; kalsiyum, fosfor, demir ve diğer mineraller açısından zengin bir içeriğe sahiptir. Ayrıca, antioksidan içermeleri nedeniyle kalp-damar hastalıkları, obezite, kanser riskini azaltma, yüksek tansiyon ve diyabet hastaları için uygun seçenekler sunar. Ekonomik ve kolay ulaşılabilir olmaları, hayvansal protein kaynaklarına kıyasla beslenmede protein eksikliğini gidermede önemli bir alternatiftir (Adak ve ark., 2015).

Gelişmekte olan ülkelerde yaşayan insanlar için yemeklik tane baklagiller, protein ihtiyacını karşılamak açısından büyük önem taşımaktadır. Dünya genelinde insan beslenmesinde kullanılan bitkisel proteinlerin %22'si ve karbonhidratların %7'si yemeklik tane baklagillerden gelirken, hayvan beslenmesinde kullanılan proteinlerin %38'i ve karbonhidratların %5'i de yemeklik tane baklagillerden sağlanmaktadır (Adak ve ark., 2010; Gülümser, 2016). Besin değerleri açısından zengin olmasının yanı sıra baklagiller; toprak verimliliği için de kritik bir rol oynamaktadır. Havada serbest azotu toprağa bağlama yetenekleri, bu bitkilerin çevre ve sürdürülebilir tarım açısından önemini artırır. Baklagiller, Rhizobium bakterileri ile iş birliği yaparak atmosferdeki serbest azotu toprağa bağlar ve böylece toprağı organik azotla zenginleştirir. Bu azot, hem bitkilerin ihtiyaçları için hem de toprak kalitesinin artırılması için

önemlidir. Yemeklik baklagillerin toprakta bağladığı azot miktarı, bitki türüne ve çevresel koşullara bağlı olarak yılda 5-20 kg/da arasında değişmektedir (Şehirali, 1988). Baklagiller aynı zamanda ilaç, hayvan yemi, kozmetik, mobilya, kâğıt ve süs bitkisi olarak da kullanılır. Bu çok yönlü bitkiler, farklı endüstrilerde önemli rol oynamaktadır (Önder, 2017).

2. Yemeklik Tane Baklagiller

Baklagil familyasına ait bitkiler, dünyanın hemen hemen her iklim koşulunda yetişebilen ve toplamda 12.000'den fazla türü içeren bir bitki grubunu kapsamaktadır. Ancak bu geniş aile içinde sadece yaklaşık 200 türün tarımı yapılmaktadır. Tarımı yapılan bu türlerin arasında yemeklik tane baklagil olarak sıkça kullanılanlar; fasulye (*Phaseolus vulgaris* L.), nohut (*Cicer arietinum* L.), mercimek (*Lens culunaris Medik*., *Lens esculenta Moench*.), bakla (*Vicia faba* L.), börülce (*Vigna sinensis* L.) ve bezelye (*Pisum sativum* L.) gibi türlerdir (Akçin, 1988).

2.1. Fasulye

Fasulye (*Phaseolus vulgaris* L.), baklagiller ailesine ait en çok tercih edilen bir türdür. Dünya genelinde en fazla ekim ve üretimi yapılan baklagil grubunu temsil etmektedir. Fasulye, özellikle Afrika, Amerika ve Asya'nın birçok gelişmekte olan ülkesinde yetiştirilen yemeklik tane baklagillerden biridir (Singh ve ark., 2007). Fasulye, gelişmekte olan ülkelerde yaşayan insanların gıda güvencesini artırmak açısından özellikle yetersiz beslenme ile mücadelede önemli rol oynamaktadır. Bu bitki, protein ve besin değeri açısından zengin bir kaynak olarak kabul edilir ve bu nedenle az gelişmiş ülkelerdeki insanlar için önemli bir ürün haline gelmektedir (Nadeem ve ark., 2021).

Fasulye, olgunlaşmamış taze bakla ve taneleri yaklaşık %10 oranında protein içerirken, olgunlaşmış taneleri %15-35 arasında protein içermektedir (Alzate-Marin ve ark., 2003). Bu baklagil aynı zamanda zengin miktarda vitamin (A, B ve C), kompleks karbonhidratlar ve mineral (Ca, Mg, K, Cu, Fe, Mg ve Zn) de içermektedir. Protein değeri, rutubet miktarı, kül

miktarı ve yağ miktarı, yetiştirme koşullarına ve çeşitlere bağlı olarak değişebilmektedir. Ayrıca, B1 vitamini, demir, diyet lifi ve fosfor açısından da oldukça zengindir (Cengiz, 2007). Fasulye, genetik çeşitliliği ve geniş üretim sahasıyla kuru baklagiller arasında öne çıkmakta ve içerdiği zengin vitamin, mineral ve yüksek protein miktarı, insan sağlığı için önemli bir besin kaynağı olmasını sağlamaktadır (Miklas ve ark., 2006; Marotti ve ark., 2007).

2.2 Nohut

Baklagiller familyasının *Viceae* alt familyasına bağlı *Cicer* genusunda yer almakta olan nohut (*Cicer arietinum* L.), besin değerleri bakımından oldukça zengin bir gıda maddesidir. Nohudun %19-25 arasında protein içermektedir. Aynı zamanda %7 nem içeriği, %2-3 arasında kül miktarı, %4-5 yağ içeriği ve %40-60 arasında karbonhidrat bulundurmaktadır (Çelebi, 2015). Nohudun sindirilebilirlik oranı %76-88 aralığındadır; bu da vücut tarafından kolayca sindirilebildiği anlamına gelmektedir. Ayrıca nohudun içeriği, çeşitli vitaminleri (A, B1, B2 ve D), mineral maddeleri (örneğin fosfor, kalsiyum, magnezyum, demir, bakır ve çinko) ve esansiyel amino asitleri içermektedir. Tüm bu bileşenler, nohudu insan beslenmesinde önemli bir besin kaynağı hâline getirmektedir (Smithson ve ark., 1985; Çelebi, 2015).

Dünya tarım coğrafyası içinde, kuru fasulyeden (*Phaseolus vulgaris* L.) sonra üretilen ikinci büyük baklagil, nohuttur. Nohut, atmosferde serbest hâlde bulunan (%79) ve diğer canlılar tarafından kullanılmayan azotu fikseleyerek, toprak verimliliğini artırmada önemli bir role sahiptir. Simbiyotik azot fiksasyonu yoluyla nohut, azot (N) ihtiyacının %80'den fazlasını karşılar ve yaklaşık olarak her hektar başına 140 kg azot kazandırmaktadır (Saraf ve ark., 1998).

2.3.Mercimek

Mercimek, baklagiller ailesine (*Fabaceae*) ait bir bitki türüdür. Bu bitki, genellikle 30.48-76.2 santimetre uzunluğunda, ince ve yarı-dik bir yapıya sahiptir ve tek yıllıktır. Mercimek bitkileri

tek gövdeli veya dallı olabilir. Yaprakları tüylüdür ve her biri yaklaşık 1.27-3.81santimetre uzunluğunda, sapsız, oval veya mızrak şeklinde yaprakçıklara sahiptir (Cash ve ark., 2001). Mercimek, içerdiği B grubu vitaminleri sayesinde sinir sisteminin sağlıklı işleyişine katkıda bulunmaktadır. Aynı zamanda, insan metabolizması için önemli olan demir (Fe) ile kan yapıcı özelliğe sahiptir ve kemik sağlığı ile onarımı için gereken kalsiyum (Ca) kaynağı olarak rol oynamaktadır (Roy ve ark., 2010). Özellikle yeşil mercimek, yüksek lif içeriği, tahıllarla birlikte tüketildiğinde amino asit düzeyini artırması, istenen vitamin ve mineral değerlerini içermesi, tahıllarla kıyaslandığında yüksek protein seviyesine ve çeşitli amino asit içeriğine sahip olması nedeniyle besin değeri yüksek bir kuru baklagil türüdür (Wang ve Daun, 2006). Ayrıca, istenmeyen maddelerin düşük düzeyde bulunması, kısa pişirme süresi ve yüksek protein içeriği; diğer baklagil türlerinden farklılaşmasını sağlayan özelliklerdendir (Hefnawy, 2011; Nikmaram ve ark., 2017).

2.4. Bakla

Bakla (*Vicia faba* L.), *Fabales* takımının *Fabaceae* familyasının *Vicia* cinsine ait olan, ekonomik değeri yüksek bir baklagildir. Bu bitki; böcekler, özellikle arılar aracılığıyla %40-50 oranında yabancı döllenmektedir ve diploid bir yapıda bulunmaktadır (2n=12) (Karaköy ve ark., 2015). Bakla, besin değeri yüksek bir bitki olarak önem taşır, çünkü yüksek oranda bitkisel protein içermektedir. Yeşil bakla yaklaşık olarak %5-7 oranında protein içerirken, kuru bakla tanesinde bu oran %20-36 arasında değişebilmektedir (Vural ve ark., 2000). Bakla, sürdürülebilir tarım uygulamaları ve çevresel değeri ile birlikte lezzeti nedeniyle dünya genelinde yaygın bir serin iklim bitkisidir. Yüksek protein içeriği, baklanın dünya çapında hem insan beslenmesi hem de hayvan yemi olarak kuru tohumlar şeklinde hasat edilmesine olanak sağlamaktadır (Zong ve ark., 2019). Bakla tohumlarının yağ içeriği %2'nin altındadır, bu nedenle bakla tüketimi kolesterol içermediğinden kalp sağlığı için önemli olmaktadır (Larralde

ve Martinez, 1991). Ayrıca, bakla A, B, C ve K vitaminlerini içerir ve özellikle B vitaminleri açısından zengindir. Bu vitaminler arasında Tiamin (B1), Riboflavin (B2), Niasin (B3), Piridoksin (B6) ve Folat (Folik Asit veya B9) yer almakta ve farklı vücut fonksiyonlarını desteklemektedir (TÜRKOMP, 2020).

2.5. Börülce

Börülce (*Vigna unguiculata* L.), birçok tropikal ve subtropikal bölgede önemli bir baklagil olarak yetiştirilir ve milyonlarca kişinin gelir, gıda ve beslenme güvencesini sağlamak amacıyla tüketilmektedir. Ayrıca, geviş getiren hayvanlara yem temin etmek ve çiftçiler için gelir kaynağı oluşturmak amacıyla da yetiştirilmektedir (Boukar ve ark., 2019).

Börülcenin kuru taneleri oldukça yüksek besin değerine sahiptir. Türe ve çevre koşullarına bağlı olarak, börülce %20-25 arasında protein, %1.3-1.5 arasında yağ ve %5.1-5.8 arasında lif içermektedir (Tshovhote ve ark., 2003). Ayrıca, börülce karbonhidrat içeriğiyle de zengindir (%57) ve 100 gramı 350 kalorilik enerji sağlamaktadır (Özdemir, 2002). Buna ek olarak, börülce, folik asit ve mikro elementler açısından zengin bir kaynaktır (Boukar ve ark., 2011). Börülce taneleri aynı zamanda karoten ve vitamin B1 bakımından da zengin içeriğe sahiptir (Çiftçi ve Adak, 2009).

2.6. Bezelye

Bezelye, insan ve hayvan beslenmesinde önemli rol oynayan bir baklagil türüdür. Bu bitki, *Leguminosae* (baklagiller) familyasına, *Faboideae* alt familyasına, *Fabeae* takımına ve *Pisum* cinsine aittir. Bezelye, *Pisum sativum* L. türü altında toplanır ve genellikle iki alt türe ayrılır. Beyaz çiçekli ssp.sativum, yeşil ve kuru taneleri için yetiştirilen yemeklik bezelyeyi veya bahçe bezelyesini temsil ederken, mor çiçekli ssp.arvense, ot ve tane yemi amaçlarıyla yetiştirilen yem bezelyesini ifade eder. Ancak bazı ülkelerde yem bezelyesi, sadece hayvan beslenmesinde değil, aynı zamanda insan beslenmesinde de kullanılmaktadır (Açıkgöz, 2001).

Bezelye, baklagiller arasında en fazla kullanım çeşitliliğine sahiptir. Bezelyenin kuru taneleri, doğrudan yemek olarak tüketilirken, son yıllarda konserve üretiminde, unları ise çorba yapımında ve çocuk mamalarında kullanılmaktadır. Ayrıca, süt olumu döneminde taze bezelyeler sebze olarak tüketilirken, taze tohumları konserve yapımında ve dondurulmuş ürün olarak gıda sanayisinde değerlendirilmektedir (Akçin, 1988). Kuru bezelye tohumları, %23-33 oranında protein, %58.5 oranında karbonhidrat, %1 oranında yağ, %4.4 oranında selüloz ve %3.3 oranında kül içermektedir. Bezelye ayrıca B1 (Tiamin), B2 (Riboflavin), B3 (Niasin), B6 (Piridoksin), B9 (Folik Asit), C vitamini, K vitamini, A vitamini gibi çeşitli vitaminleri de içermektedir (Özdemir, 2002).

3. Baklagillerde su tutma kapasitesi

Baklagillerin pişirilmesini kolaylaştırmak amacıyla sıkça ıslatma işlemi uygulanmaktadır. Ancak farklı baklagil türleri, farklı ıslatma koşullarında bekletildiğinde su tutma kapasitelerinde değişiklik gösterebilmektedir. Bu değişiklikler, suyun sıcaklığına ve bekletme süresine bağlı olarak meydana gelebilmektedir. Baklagillerin pişirilmeden önce ıslatılmasının ve sıcak su kullanmanın su tutma kapasitesini artırarak, baklagillerin daha kolay pişmesini ve istenen sonuçların elde edilmesini sağlamak için belirli yemeklerde veya tariflerde tercih edilen bir uygulamadır (Shafaei ve ark., 2016).

Kesici (2019); çalışmasında nohut, fasulye ve mercimek örneklerinin pişme öncesindeki ıslatma sonrası su tutma kapasitesi değerleri sırasıyla %106.6, 109.2 ve 115,6 olarak belirtmiştir. Baklagil örneklerinin farklı yöntemlerle pişirme sonrası sırasıyla (haşlama, mikrodalga ile pişirme, basınçlı pişirme) su tutma kapasitesi değerleri nohut için %108.3, 108.6,145,9 fasulye için % 127.8, 112.4 ve 138,8 mercimeğin değerlerini ise %188.6, 167.7 ve 185.8 olarak tespit etmiştir.

Sayar ve ark. (2001) tarafından yapılan bir çalışmada, nohudun farklı sıcaklıklarda su tutma kapasitesi ölçülmüş ve 20°C'de bekletilen nohutlarda su tutma miktarının %102 olduğu bulunmuştur. Başka bir araştırmada, farklı fasulye ve mercimek çeşitlerinin su tutma kapasitesi incelenmiş ve ham örneklerde 100 gramda 135-182 g su, pişirildikten sonra ise 100 gramda 181-263 g su tutma kapasitesine sahip oldukları belirlenmiştir (Elhardallou ve Walker, 1993). Corrêaa ve ark. (2010) tarafından gerçekleştirilen bir çalışmada ise 7 farklı fasulye çeşidinin 16 saatlik ıslatma sonrasında su tutma kapasitesinin %100,3 ile %112,0 arasında değiştiği ve ortalama olarak %107,5 olduğu rapor edilmiştir. Bu bulgular, farklı baklagil türlerinin su tutma kapasitelerinin çeşitlilik gösterebileceğini ve ıslatma süresi ile sıcaklığının bu kapasite üzerinde etkili olduğunu göstermektedir.

Baklagillerin pişmesini kolaylaştırmak amacıyla pişirmeden önce genellikle suda bekletme işlemi gerçekleştirilmektedir. Faklı tanelerin farklı ıslatma koşullarında bekletilmeleri sonucunda su tutma kapasitelerinde de farklılıklar olabilmektedir. Tanenin su tutma miktarı suyun sıcaklığı ve bekletme süresine göre değişmektedir. Sıcaklığın artması ile suyun difüzyonu artacağından genellikle ılık su kullanılarak su tutma miktarını artırma yoluna gidilmektedir (Shafaei ve ark., 2016).

Yapılan literatür çalışmaları gösteriyor ki, baklagillerde farklı taneler, farklı ıslatma koşullarında bekletildiğinde su tutma kapasitelerinde değişiklikler gözlenmektedir. Bu durum, tanenin suyun sıcaklığına ve bekletme süresine duyarlılığına bağlı olarak değişebilmektedir. Bekletme süresinin de su tutma kapasitesini etkilediği, tanelerin suyla temas süresi arttıkça daha fazla su çekebildiği görülmektedir.

4.Farklı pişirme yöntemlerinin etkileri

Baklagillerin pişme süresi, bu bitkilerin insan gıdası olarak kullanımında önemli bir kalite kriteri olarak karşımıza çıkmaktadır. Baklagiller genellikle "pişirilmesi zor" olarak kabul edilen

ürünlerdir. Bu nedenle, baklagillerin pişirilmesi sırasında dikkate alınması gereken önemli özellikler vardır. Baklagillerin pişirilmesi, besin değerini artırmak, lezzetli bir sonuç elde etmek, sindirilebilirliği artırmak ve besin maddelerinin sindirimini kolaylaştırmak için kullanılan yaygın bir yöntemdir. Bu, baklagillerin daha kolay tüketilebilir hâle gelmesini sağlamaktadır. Bu nedenle, baklagilleri yemeden önce ıslatmak ve kaynar su içinde pişirmek genellikle tercih edilen yöntemdir. Bu işlem, baklagillerin daha kolay pişmesini ve tüketilmesini sağlamaktadır. Ayrıca, pişirme sırasında besin maddelerinin kaybını en aza indirir ve lezzetli bir sonuç elde etmeye yardımcı olmaktadır (Taiwo ve ark., 1997).

Yemeklik baklagiller, günlük B vitamini folat ihtiyacının ortalama olarak yarısını karşılayabilen önemli bir kaynaktır. Baklagiller, B kompleks grubu vitaminlerini içerir, bunlar arasında niasin, riboflavin, folik asit ve tiamin bulunmaktadır. Ancak, C vitamini ve yağda çözünen vitaminler bakımından yetersizdir (Dias, 2012). Özellikle çiğ baklagiller, B grubu vitaminler açısından oldukça zengin; A, C ve E grubu vitaminleri açısından ise yetersizdir. Baklagillerin kabuklarının soyulması, vitamin içeriğini artırmaktadır. Pişirme işlemi, özellikle B1, B2 ve B3 vitamini miktarını azaltmaktadır. Aşırı pişirme bu vitaminleri olumsuz etkilemektedir; çünkü B grubu vitaminler suda çözünürler ve pişirme sırasında kaybolmaktadır (Devos, 1988).

B grubu vitaminler esas olarak baklagil tohumlarında bulunur. Vitaminler ısıl işlem sırasında kaybolsa da, bu kayıplar bir sızıntı, kimyasal tahribat veya her ikisinin kombinasyonundan kaynaklanabilmektedir. Diğer işlemlerle karşılaştırıldığında mikrodalga pişirme vitaminlerin korunmasını artırmaktadır. Sebzelerde geleneksel pişirme; tiamin, riboflavin ve askorbik asit gibi vitaminlerin daha fazla kaybına neden olmaktadır (Uherova ve ark., 1993).

Ada (2020); yılında yapmış olduğu bir araştırmada dört farklı kuru baklagil türü olan kuru fasulye, nohut, kırmızı mercimek ve yeşil mercimek hem çiğ halde hem de tencere ve düdüklü tencere gibi farklı pişirme yöntemleriyle işleyerek B1, B2 ve B3 vitamin değerlerini ölçmüştür.

Düdüklü tencereyle pişirilen kuru baklagillerde B1, B2 ve B3 vitaminlerinin ortalama kayıpları sırasıyla %20,3, %13,5 ve %59,7 olarak bulunmuştur. Tencereyle pişirildiklerinde ise bu kayıplar sırasıyla %30,3, %38,6 ve %67,7 olmuştur.

Kim ve arkadaşlarının (2023) yaptığı çalışmada; Kore'de yaygın olarak tüketilen baklagil ve sebzelerde pişirme yönteminin E ve K vitamini içeriği ve gerçek kalıcılığı üzerindeki etkisi araştırılmıştır. E vitamininin sekiz izomerinden α- ve γ-tokoferol, nohut, barbunya, mercimek, bezelye ve kılıç fasulyesi gibi baklagillerde sırasıyla 0.44-1.03 ve 2.05-2.11 mg/100 g olarak tespit edilmiş ve haşlama sonrasında azalmıştır. Filokinon (K1 vitamini) baklagillerde 31.33 ila 91.34 µg/100 g aralığında bulunmuş ve kaynatma sonrasında azalmıştır. Bu çalışma, pişirmenin baklagil ve sebzelerin E ve K vitamini içeriklerini değiştirdiğini ve değişikliklerin gıdanın türüne ve pişirme yöntemine bağlı olduğunu ortaya koymuştur.

Maškova ve arkadaşlarının (1996) yaptığı çalışma, baklagillerin mutfak işlemleri sırasında riboflavin (B2 vitamini) kaybının yaşandığını ve bu kaybın özellikle ıslatma ve pişirme işlemleri sırasında suya geçtiğini ortaya koymaktadır. Araştırma sonuçlarına göre, baklagillerin mutfakta işlenmesi sırasında riboflavin kaybı %72 ila %111 arasında değişebilmektedir. Bu kayıp, özellikle düdüklü tencere gibi hızlı pişirme yöntemlerinin kullanıldığı işlemlerde daha fazla gözlemlenmiştir. Özellikle soya fasulyesi üzerinde yapılan işlemlerde riboflavin kaybı en yüksek seviyeye ulaşmıştır.

Villota (1989) kurutulmuş baklagillerin yemek hazırlanması sırasında biyotin kaybının, suda çözünen diğer vitaminlere kıyasla, süzülme ve ısı tahribatından çok daha az etkilendiğini ifade etmiştir.

Kuru baklagillerin içerdiği tiamin (B1 vitamini) miktarı, türlerine, hazırlama yöntemlerine ve pişirme süreçlerine bağlı olarak değişkenlik gösterebilmektedir (Rockland ve ark.,1977). Augustin ve ark., (1981)'nın yaptığı çalışmada fasulye (*Phaseolus vulgaris*) türünün çiğ halinde

100 gramında 0.99 mg tiamin tespit etmişler ve bu baklagillerin pişirilmesi sonucunda tiamin kaybı yaşandığı ve pişmiş örneklerin ortalama olarak tiamin içeriğinin çiğ hâle göre %73 oranında azaldığını belirtmişlerdir.

Yapılan başka bir araştırmada (Rumm-Kreuter ve Demmel 1990) nohudun hem çiğ hem de farklı pişirme yöntemleriyle işlendiğindeki tiamin (B1 vitamini) miktarları ölçülmüştür. Çiğ, haşlanmış ve basınçlı pişirilmiş (120°C) nohut örneklerinde tiamin miktarı sırasıyla 0.66, 0.20 ve 0.14 mg/100 g olarak bulunmuştur. Bu sonuçlar, haşlamanın, basınçlı pişirmeye göre tiamin kaybının daha az olduğunu göstermektedir.

Pişirme, kuru baklagilleri yenebilir hale getiren ve duyusal kalitenin kabul edilebilir olmasını sağlayan bir işlemdir. Tüketime hazırlama aşamasında, tanelerde nişastanın jelleşmesi ve şişmesi, proteinin denatürasyonu, bazı polisakkaritlerin çözünmesi, yapının yumuşaması gibi önemli fizikokimyasal değişimler ile diğer fiziksel ve kimyasal değişiklikler meydana gelmektedir. Pişirme, tanenin yumuşamasını sağladığı gibi bazı tripsin inhibitörleri ve gaz oluşumuna neden olan oligosakkaritler gibi bileşenleri de inaktive eder veya miktarlarını azaltmaktadır. Pişme süresi, pişme kalitesinin belirlenmesinde kullanılan en önemli ayırıcı özelliklerden birisidir. Uzun pişme süresi, baklagillerin daha geniş kullanımı ve daha çok kabul edilebilirliği önündeki en önemli engeldir. Ayrıca aşırı bir pişirme işleminin, proteinler ve vitaminler gibi besleyici değerlerin azalmasına sebep olacağı belirtilmiştir (Wang ve ark., 2003).

5.SONUÇ

Yemeklik tane baklagillerin pişirme işlemleri, özellikle B grubu vitaminler üzerinde olumsuz etkilere neden olabilmektedir. Uygulanan ısıl işlem esnasında B1, B2 ve B3 vitaminlerinin kaybı gözlemlenmektedir. Ayrıca, C vitamini ve yağda çözünen vitaminlerin miktarı da pişirme sürecinde azalmaktadır. Bu nedenle, baklagillerin pişirilmesi sırasında dikkatli olunmalı ve

vitamin kayıplarını en aza indirmek için uygun pişirme yöntemleri tercih edilmelidir. Vitamin açısından zengin baklagiller, sağlıklı beslenme için önemli bir kaynaktır, ancak uygun pişirme yöntemleri ile besin değerlerini korumak önemli olmaktadır.

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Melissa officinalis L. BİTKİSİNİN ANTİOKSİDAN ÖZELLİKLERİ BAKIMINDAN DEĞERLENDİRİLMESİ

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ÖZET

Günümüzde, oksidatif stresin neden olduğu hücresel hasara karşı etkili bir koruma sağlamak amacıyla kullanılan bitkisel antioksidanlar, biyomedikal araştırmalarda önemli bir konu haline gelmiştir. Oksidatif stres, serbest radikallerin aşırı üretimi sonucu hücre zararına yol açan bir durumdur. Bu zararlar, çeşitli hastalıkların patogenezinde rol oynayabilir. Bitkisel antioksidanlar, içerdikleri fenolik bileşenler, flavonoidler, karotenoidler ve diğer biyoaktif maddeler sayesinde serbest radikalleri nötralize ederek hücresel bütünlüğü koruma potansiyeline sahiptir. *Melissa officinalis L. Lamiaceae* familyasına ait, ılıman iklimlerde yetişen, özellikle Avrupa, Asya ve Kuzey Amerika bölgelerinde doğal olarak bulunan bir bitki türüdür. *Melissa officinalis*, zengin uçucu yağ içeriğiyle dikkat çeker ve bu yağda bulunan bileşenler arasında sitronelal, geraniol, ve linalool gibi biyoaktif maddeler yer alır. Bu bileşenler, bitkiye çeşitli biyolojik aktiviteler kazandırır. Modern araştırmalar, *Melissa officinalis*'in antiinflamatuar, antiviral, anksiyolitik ve kognitif fonksiyonları iyileştirici özelliklere sahip olabileceğini göstermektedir. Ayrıca, bu bitkinin içeriğindeki fenolik bileşenlerin serbest radikallerle savaşarak hücresel hasarı azaltabileceği ve dolayısıyla oksidatif stresle mücadelede etkili olabileceği öne sürülmektedir. Bu çalışmada *Melissa officinalis L.* bitkisinin antioksidan özellikleri incelenerek, sağlık sektöründe hangi amaçlarla kullanıldığına değinilmiştir.

Anahtar Kelimeler: *Melissa officinalis L.,* antioksidan, flavonoid

EVALUATION OF *Melissa officinalis* L. PLANT IN TERMS OF ANTIOXIDANT PROPERTIES

ABSTRACT

Today, herbal antioxidants, which are used to provide effective protection against cellular damage caused by oxidative stress, have become an important topic in biomedical research. Oxidative stress is a condition that causes cell damage as a result of excessive production of free radicals. These damages may play a role in the pathogenesis of various diseases. Herbal antioxidants have the potential to protect cellular integrity by neutralizing free radicals, thanks to the phenolic compounds, flavonoids, carotenoids and other bioactive substances they contain. *Melissa officinalis* L. is a plant species belonging to the *Lamiaceae* family, growing in temperate climates and found naturally especially in Europe, Asia and North America. *Melissa officinalis* attracts attention with its rich essential oil content, and the components found in this oil include bioactive substances such as citronellal, geraniol, and linalool. These components provide the plant with various biological activities. Modern research shows that *Melissa officinalis* may have anti-inflammatory, antiviral, anxiolytic, and cognitive function-improving properties. It is also suggested that the phenolic components contained in this plant can reduce cellular damage by fighting free radicals and therefore be effective in combating oxidative stress. In this study, the antioxidant properties of the *Melissa officinalis* L. plant were examined and the purposes for which it was used in the health sector were mentioned.

Keywords: *Melissa officinalis L.,* antioxidant, flavonoid

GİRİŞ

Antioksidanlar, "Reaktif Oksijen Türlerinin" (ROS) veya serbest radikallerin hücrelere zarar vermeden önce nötralize edilmesine veya yok edilmesine yardımcı olmaktadır. Reaktif oksijen türlerinin (ROS) neden olduğu oksidasyon, hücre zarı parçalanmasına, zar protein hasarına ve yaşlanmada önemli rol oynayan DNA mutasyonlarına neden olabilir ve ayrıca damar sertliği, kanser, şeker hastalığı, karaciğer hasarı, iltihaplanma, cilt hasarları, koroner kalp hastalıkları ve artrit gibi birçok hastalığın gelişimini başlatabilir veya ilerletebilir (Gupta, 2014). Bitkiler, doğal antioksidan bileşiklerin başlıca kaynağını oluşturmaktadır. Bundan dolayı bitkiler süper antioksidanlar olarak bilinmektedir (Deveci ve ark., 2016).

Melissa officinalis L. Bitkisi ve Kimyasal Bileşenleri

Melissa officinalis L. bitkisi limon otu, arı otu, bal otu olarak da adlandırılmaktadır. *Lamiaceae* ailesine ait çok yıllık bir bitki türüdür. Güney Avrupa, kuzey Afrika, Kafkasya, kuzey İran, Doğu Akdeniz bölgesi, Batı Asya ve ayrıca Brezilya gibi tropikal ülkeler dahil olmak üzere birçok bölgede doğal olarak bulunur (Miraj ve ark., 2016). Melisa otu, botanik adıyla *Melissa officinalis*, *Lamiaceae* (*Ballıbabagiller*) ailesine ait bir bitki türüdür. Melisa otu, Güney Avrupa'nın yanı sıra Orta Asya ve Akdeniz bölgelerine endemik olarak bulunur. Bu bitki, ılıman iklim bölgelerinde yetişir ve bahçelerde, tarlalarda ve orman kenarlarında sıklıkla görülmektedir (Başkal ve ark., 2017). *Melissa officinalis* türüne ait üç alt tür bulunmaktadır. (*subsp. İnodora Bornm.,subsp. Altissima Arcangeli, subsp. officinalis*) ve bunlardan sadece *subsp. officinalis* limon kokulu olup tedavi ve diğer amaçlarla kullanılmaktadır. Diğer iki alt tür kokusuz veya kötü kokulu olduklarından tedavi alanında kullanılmamaktadır (Başkal ve ark., 2017).

Melissa officinalis, tıbbi ve aromatik özellikleri ile bilinen bir bitki türü olup, tarih boyunca insanlar tarafından çeşitli amaçlarla kullanılmıştır. Bu bitkinin tarihi, binlerce yıl öncesine

dayanmaktadır ve çeşitli medeniyetler tarafından keşfedilip kullanılmıştır. *Melissa officinalis*'in tarihi hakkında daha fazla bilgi edinmek için antik dönemlerden başlayarak Ortaçağ'a kadar uzanan birçok yazılı kaynak ve tıbbi eser incelenmiştir. Antik Yunan ve Roma dönemlerinde, *Melissa officinalis*'in tıbbi ve aromatik özelliklerine dair yazılı kayıtlar bulunmaktadır. Antik Yunanlı filozof ve tıp bilgini *Theophrastus*, bu bitkinin ilaç yapımında kullanılmasını önermiş ve melisa yapraklarının sakinleştirici etkilere sahip olduğunu vurgulamıştır. Roma İmparatorluğu döneminde ise melisa, tıbbi amaçlar için yaygın olarak kullanılmıştır. Ortaçağ Avrupa'sında, melisa bitkisinin manastır bahçelerinde yetiştirilmesi ve tıbbi kullanımı sıkça görülmüştür. Melisa, Ortaçağ Avrupa'sının önemli tıbbi eserlerinden biri olan "Physica" adlı kitapta da özellikle sakinleştirici özellikleri için önerilmiştir (Başkal ve ark., 2017; Ghazizadeh ve ark., 2022).

Melissa officinalis L. bitkisinin uçucu yağları, zengin ve kompleks bir kimyasal bileşen profiline sahiptir. Bu uçucu yağların ana bileşenleri bitkinin özgün aromasını ve terapötik etkilerini belirleyen faktörlerdir. *Melissa officinalis L*. uçucu yağlarının başlıca bileşenleri şunlardır:

Sitral: Sitral, melisa uçucu yağının belirgin bir bileşenidir ve bitkinin karakteristik limon kokusuna katkı sağlar. Aynı zamanda sitral, uçucu yağın antimikrobiyal özelliklerini destekler.

Sitronellol: Sitronellol, melisa uçucu yağının diğer önemli bir bileşenidir ve bitkinin hoş bir limon kokusuna sahip olmasını sağlar. Aromaterapi uygulamalarında sakinleştirici etkileri nedeniyle tercih edilir.

Geraniol: Geraniol, uçucu yağın bir diğer temel bileşenidir ve bitkinin aromatik profilini zenginleştirir. Ayrıca anti-enflamatuar ve antioksidan özelliklere sahip olduğu için sağlık yararlarına katkıda bulunabilir.

Nerol: Nerol, melisa uçucu yağının bileşenlerinden biridir ve bitkinin tatlandırıcı ve aroma verici olarak kullanılmasını destekler. Ayrıca sakinleştirici etkilere sahip olabilir.

Limonen: Limonen, uçucu yağın bileşiminde bulunan bir diğer bileşendir ve bitkinin aromasına tazelik katar. Ayrıca antioksidan özelliklere sahiptir.

Linalool: Linalool, melisa uçucu yağlarının bileşenlerinden biridir ve bitkinin terapötik kullanımında rol oynar. Özellikle stres azaltma ve gevşeme amacıyla kullanılır.

Rosmarinik Asit: Rosmarinik asit, melisa bitkisinin uçucu yağlarında bulunan fenolik bir bileşen olup, antioksidan özelliklere sahiptir ve sağlık yararlarına katkı sağlar.

Melissa officinalis L. bitkisinin uçucu yağlarının bu karmaşık bileşimi, bitkinin yaygın kullanım alanlarını destekler. Bu uçucu yağlar, aromaterapi, gıda katkı maddesi, kozmetik ürünler ve tıbbi amaçlar için popülerdir ve bitkinin sağlık potansiyelini vurgular (Carnat ve ark., 1998; Dastmalchi ve ark., 2007; Bounihi ve ark., 2013; Adinee ve ark., 2008; Alp, 2020).

Melissa officinalis'in tarihi, modern tıpta da kullanımını sürdürmektedir. Bitkinin uçucu yağları, aromaterapide ve alternatif tıpta popülerdir. Ayrıca günümüzde, çeşitli ürünlerde aroma ve lezzet verici olarak da kullanılmaktadır. Tarihsel olarak değerli olan bu bitki, günümüzde de sağlık ve zindelik alanlarında önemli bir rol oynamaya devam etmektedir (Zarei ve ark., 2015).

Melissa officinalis L. bitkisinin kimyasal bileşenleri, bitkinin tıbbi, aromatik ve farmasötik alanlarda kullanımını destekleyen önemli özellikler sunmaktadır. Bu bitkinin kimyasal bileşenleri oldukça zengin ve çeşitlidir. Başlıca kimyasal bileşenleri arasında uçucu yağlar, fenolik bileşikler, flavonoidler, triterpenler ve tanenler bulunmaktadır (Adinee ve ark., 2008).

Melissa officinalis, terapötik etkileri nedeniyle dünya genelinde kullanılan biyolojik olarak aktif bileşikler açısından zengin bir tıbbi bitkidir. Kimyasal çalışmalar, bu bitkinin başlıca flavonoidler, terpenoidler, fenolik asitler, tanenler ve uçucu yağ içerdiğini göstermektedir. *Melissa officinalis*'in başlıca aktif bileşenleri, uçucu bileşikler (geranial, neral, sitronelal ve

geraniol), triterpenler (ursolik asit ve oleanolik asit), fenolik asitler (rozmaring asit, kafeik asit ve klorojenik asit) ve flavonoidler (kuersetin, ramnositrin ve luteolin) içermektedir. Biyolojik çalışmalara göre, *Melissa officinalis*'in uçucu yağı ve ekstreleri, potansiyel tıbbi kullanımları olan birçok farmakolojik etkiyi belirleyen aktif bileşiklere sahiptir (Petrisor ve ark., 2022).

Melissa officinalis (limon otu), *Lamiaceae* ailesine ait bir bitki olup geleneksel tıpta birçok hastalığın tedavisinde uzun süredir kullanılan bir bitkidir (Little ve ark., 2004). Bitkinin uçucu organik bileşikleri ve terpenoidler, flavonoidler, kuersetin, rutin, kuersitrin, galik asit gibi aktif bileşenleri ve yüksek antioksidan kapasitesi nedeniyle bitkinin özütü, sağlığın sürdürülmesinde ve hastalıkların tedavisinde önemli bir rol oynamaktadır.

Bitkinin özütünün bir dizi antioksidan, anti-enflamatuar, ağrı giderici, spazm giderici ve anti-kanser özelliklerinin yanı sıra kolinesteraz reseptör aktivasyonunun davranışsal semptomları, bilişsel bozuklukları, uykusuzluğu, anksiyete ve stresi iyileştirme üzerinde yüksek derecede önemli etkilere sahip olduğunu göstermektedir (Bağdat, 2006; Dastmalchi ve ark., 2008).

Bitkinin uçucu yağları, sitral ve sitronellol gibi bileşenler içerir ve melisa otuna limon benzeri hoş bir koku ve lezzet kazandırır. Ayrıca bu uçucu yağlar, aromaterapi uygulamalarında sakinleştirici etkileri nedeniyle popülerdir. Fenolik bileşikler, bitkinin antioksidan özelliklerine katkıda bulunur ve sağlık yararlarına ilişkilendirilir. Flavonoidler ise bitkinin anti-enflamatuar ve antimikrobiyal özelliklerini destekler. Triterpenler, bitkinin farmakolojik etkilerini güçlendirir ve tanenler, bitkinin tanenik asit içeriğini artırarak tıbbi kullanımlarını zenginleştirir. (Miraj ve ark., 2016)

Melissa officinalis L.'nin bu zengin kimyasal bileşenleri, geleneksel tıpta, modern ilaç endüstrisinde, aromaterapide, kozmetik ürünlerde ve gıda katkı maddesi olarak çeşitli amaçlarla değerlendirilir. Bu bitkinin kimyasal bileşenleri, sağlık ve refah alanında birçok uygulama ve araştırma fırsatı sunmaktadır. Birçok çalışma, Melissa officinalis'in yüksek antioksidan

kapasiteye sahip olduğunu göstermiştir. Örneğin, melisa yapraklarının etanol ekstraktının antioksidan kapasitesinin yüksek olduğunu ve DNA hasarını önlediğini bulmuştur. *Melissa officinalis* ekstreleri, serbest radikal türlerini etkili bir şekilde inhibe ettiği için hücresel oksidatif hasarı azaltabilir. Bu, bitkinin antioksidan potansiyelinin bir göstergesidir (Meftahizade ve ark., 2010; Zeraatpishe ve ark., 2011).

Antioksidan özellikleri sayesinde, melisa otu enflamasyonu azaltabilir ve bağışıklık sisteminin dengesini koruma konusunda olumlu etkilere sahip olabilir. Bazı araştırmalar, melisa otunun antioksidan bileşenlerinin nörolojik sağlık üzerinde olumlu etkileri olabileceğini öne sürmektedir. Özellikle stres ve anksiyeteyi azaltıcı etkileri üzerine çalışmalar yapılmıştır. *Melissa officinalis L.* bitkisi, zengin antioksidan içeriği ile dikkat çekmektedir. Yapılan araştırmalar, bitkinin antioksidan kapasitesinin yüksek olduğunu ve bir dizi sağlık yararı sunabileceğini göstermektedir. Ancak, daha fazla klinik çalışma ve daha geniş çaplı araştırmaların yapılması gerekmektedir. *Melissa officinalis*'in antioksidan özelliklerinin daha iyi anlaşılması, bitkinin sağlık ve tıp alanlarındaki potansiyel kullanımlarını daha da açığa çıkarabilir. Antioksidanlar, hücresel oksidatif stresi azaltabilen ve serbest radikallerin zararlı etkilerini önleyen bileşiklerdir. *Melissa officinalis L.* bitkisi, yüksek antioksidan içeriği ile bilinir ve bu özelliği nedeniyle tıbbi, aromatik ve gıda katkı maddeleri olarak kullanımı yaygındır (Pereira ve ark., 2009; Köksal ve ark., 2011).

***Melissa officinalis L.* Bitkisinin Kullanım Alanları**

Melissa officinalis L. bitkisi, dünya genelinde birçok alanda kullanılmaktadır. Başlıca kullanım alanları şunlardır:

Tıbbi Kullanım: Melisa otu, geleneksel tıpta sakinleştirici ve rahatlatıcı etkileri nedeniyle yaygın olarak kullanılır. Çaylar, tentürler ve uçucu yağlar şeklinde kullanılarak sinir sistemi rahatsızlıkları, uykusuzluk, anksiyete ve sindirim problemlerinin tedavisine katkı sağlar.

Aromaterapi: *Melissa officinalis*'in uçucu yağları, aromaterapide sakinleştirici ve stres azaltıcı etkileri nedeniyle kullanılır. Masaj yağları, banyo tuzları ve aromatik lambalarda bu uçucu yağlar terapötik amaçlarla kullanılmaktadır.

Gıda Katkı Maddesi: Bitkinin limon benzeri hoş bir kokusu ve lezzeti, gıda endüstrisinde tatlandırıcı ve aroma verici olarak kullanılmasını popüler kılar. Yemekler, içecekler ve tatlılar için kullanılan bu bitki, birçok ülkede gıda ürünlerine lezzet katmak amacıyla kullanılır (Moradkhani ve ark., 2010; Bağdat ve Coşge., 2006).

Türkiye'de de *Melissa officinalis L.* bitkisi yaygın olarak kullanılmaktadır. Ülkemizdeki kullanım alanları şunlardır:

Geleneksel Tıp: Melisa otu, geleneksel Türk tıbbında yüzyıllardır kullanılan bir bitkidir. Özellikle mide problemleri, uykusuzluk ve sinirsel rahatsızlıkların tedavisinde tercih edilir.

Bitki Çayları: Türk mutfağında çeşitli bitki çayları oldukça popülerdir. Melisa otu da bu çaylardan biridir ve hoş kokusu ve sakinleştirici etkileri nedeniyle tercih edilir.

Baharat ve Aroma: Melisa otu, Türk mutfağında bazı yemeklerin lezzetini artırmak için baharat olarak kullanılır. Ayrıca bazı tatlıların aromatik bileşeni olarak da kullanımı yaygındır.

Kozmetik ve Kişisel Bakım Ürünleri: *Melissa officinalis*'in uçucu yağları, Türkiye'de kozmetik ürünlerinde ve kişisel bakım ürünlerinde yaygın olarak kullanılır. Özellikle cilt bakım ürünleri ve parfümlerde tercih edilen bir bileşen olabilir. *Melissa officinalis L*. bitkisi hem dünya genelinde hem de ülkemizde çeşitli kullanım alanlarına sahiptir. Bu bitkinin tıbbi, aromatik, gıda ve kozmetik sektörlerdeki çok yönlü kullanımı, onun önemli bir bitki türü haline gelmesini sağlar (Bağdat ve Coşge., 2006; Başkal ve ark.,2017).

Melissa officinalis L. bitkisi, halk arasında farklı amaçlarla kullanılan ve geleneksel olarak değerli bir bitki olarak kabul edilmektedir. Bu bitkinin halk arasında yaygın kullanımları, tıbbi,

aromatik ve kültürel bağlamlarda çeşitlilik gösterir. İşte *Melissa officinalis L.*'nin halk arasında yaygın kullanımları:

Sakinleştirici ve Rahatlatıcı Etkiler: Melisa otu, halk arasında özellikle sakinleştirici ve rahatlatıcı etkileri nedeniyle değerli bir bitki olarak kabul edilir. Melisa çayı veya tentürleri, uykusuzluk, anksiyete, stres ve sinirsel rahatsızlıkların hafifletilmesi amacıyla sıkça tüketilir.

Sindirim Sorunlarının Tedavisi: *Melissa officinalis*, halk arasında mide ve sindirim problemlerini hafifletmek için kullanılır. Özellikle hazımsızlık, gaz ve mide krampları gibi rahatsızlıkları gidermeye yardımcı olabileceğine inanılmaktadır.

Soğuk Algınlığı ve Grip Tedavisi: Melisa otu, geleneksel tıpta soğuk algınlığı ve grip belirtilerini hafifletmek amacıyla kullanılır. Çay veya inhalasyon yoluyla tüketilen melisa buharları, solunum yollarını rahatlatıcı etkilere sahip olabilir.

Cilt Bakımı: Melisa uçucu yağları, halk arasında cilt bakımı için kullanılır. Melisa içeren losyonlar veya yağlar, ciltteki tahrişi azaltmaya yardımcı olabilir ve cilt sağlığını destekleyebilir.

Aromaterapi: *Melissa officinalis L.* bitkisi, aromaterapi uygulamalarında sıkça kullanılır. Melisa uçucu yağları, aromaterapinin sakinleştirici ve rahatlatıcı etkilerini vurgular.

Geleneksel Tatlandırıcı: Bazı bölgelerde melisa yaprakları, yiyeceklere ve içeceklere hoş bir limon aroması ve tatlandırıcı olarak eklenir.

SONUÇ

Melissa officinalis L. bitkisi, halk arasında yaygın olarak kullanılan çok yönlü bir bitkidir. Bu kullanımların birçoğu geleneksel bilgi ve tecrübeye dayanmaktadır. Ancak, bitkinin tıbbi ve aromatik özelliklerine yönelik bilimsel çalışmalar devam etmektedir ve bu çalışmalar, melisa otunun sağlık yararları hakkında daha fazla bilgi sağlayabilir. *Melissa officinalis L.* bitkisi, geleneksel tıp ve modern tıpta birçok farklı uygulama alanına sahip olmasına rağmen, ilaçlarla

kullanımı ve potansiyel toksik etkileri hakkında dikkatli bir değerlendirme gerektiren bir bitkidir. Ancak, Melissa officinalis'in tıbbi kullanımıyla ilgili olarak daha fazla klinik araştırmaya ihtiyaç duyulmaktadır. Bu bitkinin potansiyel terapötik etkileri, dozaj, güvenilirlik ve yan etkiler gibi konular daha detaylı bir şekilde incelenmelidir. Bu bağlamda, Melissa officinalis, farmasötik ve klinik uygulamalarda potansiyel bir doğal kaynak olarak ele alınabilir, ancak daha fazla bilimsel araştırmaya ihtiyaç duyulmaktadır (Moradkhani ve ark., 2010; Başkal ve ark., 2017; Świąder ve ark., 2019).

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ATTITUDE, MOTIVATION AND ACADEMIC PERFORMANCE OF HIGH ACHIEVING JUNIOR SECONDARY SCHOOL STUDENTS IN SOCIAL STUDIES IN OYO EAST LOCAL GOVERNMENT, NIGERIA

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ABSTRACT

Education is one of the most essential tools for the development of any society. It is expected that the more educated the people of a society are, the more civilized and well-disciplined that society would be. Every society strives to provide its citizens with quality education with the hope that such individuals will develop and make significant and outstanding positive contributions to their society. This study examined the attitudes, motivation and academic performance of high achieving Junior secondary school students in social studies in Oyo East Local Government Area of Oyo State, Nigeria. Hence, one hundred (100) high ability junior secondary school students in social studies were selected from five secondary schools in Oyo East Local Government Area of Oyo State. The purposive sampling technique was used in selecting these students. Data were analysed using descriptive statistics of percentage and frequency count and inferential statistics of Pearson Product Moment Correlation and Multiple

Regression Analysis. The results from the study shows that there was a significant relationship between academic performance of students in social studies and attitudes of teachers (r = .622, N= 100, P >.05), there was a positive significant relationship between academic performance and motivation (r = .471*, p <0.05) and there was a positive significant relationship between gender and academic performance of students (r = .639*, P <0.05). Among others, it was recommended that Counselling services should be provided often to students in order to aver the incidence of poor academic performance in social studies in secondary schools.

Keyword: Counselling, Motivation, Attitudes, High achieving students, Academic performance

INTRODUCTION

Education is one of the most essential tools for the development of any society. It is expected that the more educated the people of a society are, the more civilized and well-disciplined that society would be. Every society strives to provide its citizens with quality education with the hope that such individuals will develop and make significant and outstanding positive contributions to their society. This is why many nations of the world place much emphasis on literacy programmes. That is why a positive atmosphere is essential in every school in order to achieve the aims and objectives for which schools are established. At times, it might be quite difficult to achieve teaching goals if some rudiments are lacking in the classroom. Nigeria as a country is greatly concerned with the education of her citizens. Consequently, government's major objective with respect to education is directed at providing equal opportunities for all citizens to learn and become useful members of the nation. The Federal Government of Nigeria (2013) in The National Policy on Education (NPE) clearly states that education is an instrument par excellence for effecting National development. By this statement, it is meant that education is the single most powerful means through which the development of the Nigerian society can be achieved.

Academic achievement of students is a major concern of parents, teachers and all other stakeholders in the educational system. Every student wants to achieve at high levels. Parents too wish that their wards have outstanding performance in examinations as this brings pride and a hope for future accomplishments. Student's level of achievement in education plays a significant role in determining the academic standard of any school. Gutman and McLoyd (2000) in Aikomo (2016) in their submission also confirm this fact in their observation that schools and teachers are generally graded qualitatively by the achievement gained, based on the performances of their products. The general impression is that the higher the level of

achievement of students in a particular school, the better the standard of the school and the quality of teachers.

Traditionally, high ability students are students with superior cognitive abilities who attain above average scores in achievement test and other tests of cognitive abilities. Included in this group are the gifted and talented students. It should however be noted that though gifted students are among the high ability students, not all high ability students are gifted. Also, there is an added emphasis on identifying students who may not score high on relevant tests, but show superior talent and creative abilities in other areas valued by the society as high ability students. These groups of students are found in all ethnic, racial, social and economic groups.

High ability can be perceived as students who are potential outstandingly ability to their peers, matters related to intellectuals and endeavors which could affect the society positively. In the view of this, there is no doubt that for a student to fall within the high ability group such a student's level of performance must be highly exceptional when compared with individuals of his or her age group. Furthermore, for a better understanding, high ability students are those individuals who show very distinctive signs of superior ability and intelligence and who learns very rapidly and displays knowledge of many things at a surprisingly high level of competence for his or her age and expected experience. Quoting Marland (1972), Ufford, (2019) notes that these children require differentiated educational programmes and/or services beyond those normally provided by the regular school programmes in order to realize their contributions to self and society.

The typical picture of the highly able student is of a hard working student who diligently completes work, and is perhaps known as the "brain box" of the class. Mapp (2002) also defines a high ability student as "one who achieves or has the ability to achieve, at a level significantly in advance of the peer group. This may be in all areas of the curriculum or in a limited range".

From these definitions, two points are obvious, firstly, the high ability student may have his/her ability demonstrated, or may have potential (yet to be developed) abilities. Secondly, the level of performance of high ability students must be significantly advanced when compared to that of the peer group. In other words, if the level of ability is not different from that of the peer group, then there is nothing special about the student.

Fakolade and Adeoye (2007) in Aikomo (2016) maintain that the use of differentiated educational strategies by educators for high ability students in secondary schools is concerned with the sustainability of the programmes which can be given to this group of students, especially in sustaining their academic achievement. These authors further observe that majority of secondary schools in Nigeria presently lack appropriate educational provisions that can challenge the innate abilities of their high ability students. These seem responsible for the seemingly poor academic performance of most high ability students, thus resulting in underachievement.

As high achievers grow to be leaders of the future, it is of utmost importance to ensure their psychological well-being and life satisfaction. Well-being is multi-dimension and among different factors interacts to determine the well-being of individuals. These factors include: personal and environmental stressors and resources, coping styles as well as demographic variables such as race, gender, and socio-economic class. As asserted by Miller and Hinshaw (2012), adolescents with high levels of subjective well-being develop fever internalizing problems in the work of stressful events than those with low levels of subjective well-being.

It is generally recognized that one of the major important functions of the school system is to produce the pool of skilled manpower which a nation needs to grow. To this effect countries all over the world depend on their educational systems for the development of their future workforce (Ekeh, 2013). Thus education is an important instrument through which human

resources development is achieved without gender discrimination. Gender education according to Kano (2004) refers to instructional sensitization practices devoid of cultural bias and prejudice and as a process; it employs equity in the specification of subject matter, methodology, strategy and evaluation as regards the students irrespective of their sex. Role expectations are not stereotype but based on the ability of each student. Kano (2004) in Aikomo (2016) further ascertain that the major sources of data for planning gender education are the positive and progressive factors or attributes of the society which are the student and the subject matter.

The sociological and psychological screening of the society for instance is usually employed in the selection of educational objectives. Therefore those attributes that intervene with positive instructional practices are subdued, ignored, and side-tracked, if not entirely eliminated or discarded. Gender education emphasizes the non-recognition of cultural biases and prejudices in the role specification of students in the school (Kano, 2004). It advocates equity in the provision of learning opportunities, content, strategies and textbook pictorial illustrations through motivation, and positive attitudes.

In the motivational spheres, parents attitude towards the education, future employment of the children together with the degrees of encouragement of the children which they offered towards school work where all the significantly related to the intelligence quotient (IQ) and the performance of the students. When an experience teacher is asked to state his major concern regarding his students learning the overwhelming response will be geared towards how to get his students involved in learning and how to keep them interested. Differently put how to motivated students or increase students desire to learn.

The word motivation is derived from Latin word “movers” which means “to move to action”. This word is what initiates and sustain a students’ involvement in the act of learning. To a large extent, it determines the direction and efficiency of his learning. It can also offset

fatigue and even lack of interest for learning motives are internal factors related to energizing a person for action, providing direction to a person's behaviors, and sustaining the level of activities. Motivation can be said to be a socially learned behavior. An individual who is not motivated can learn to be motivated. Therefore, motivation is essential in any set up either in school or industry or family for students to be motivated to learn, the teachers must make students see the need for the lecture. In essence, motivation can be in form of learn pattern of behavior which involves situation. It is not all situations that motivate. While balance and convenience situation does because it allows the brain to reason on what to do, therefore, the best time for motivation is the incontinence and needy periods. However, care must be taken with the dosage of inconvenience.

Motivation is a desire to achieve a global, combined with the energy to work towards the goal. Students who are motivated have a desire to undertake their study and complete the requirement of their courses. The act of motivating learners is one of the most pressing problems of teachers. To approach this problem constructively, there is needed to be aware of several things. As a teacher in learning process, there are many human needs motives and emotions that can be appealed to in an attempt to motivate students.

In the teaching-learning process, motivation can be thought of as being on a continuum from intrinsic to extrinsic. However, intrinsic motivations are those that are naturally related to learning, they are inherent either in the learning process itself or in the organism, individual or in the knowledge or behavior acquired. There is no outside contribution at all. Extrinsic motivation techniques have an artificial connection with learning. They are not part of the learning process itself, but are imposed from outside by some authorities such as teachers, parents, relatives or siblings. Each motivating techniques can be also thought of as appealing to a certain need or other motivating force within the person.

The availability of learning facilities in the school which are part of motivation for students especially the high achieving students could be of great help to the psychological well-being of high achieving children (Aikomo, 2016). Such facilities include, well-developed communication gadgets, visual aids like overhead projectors. A precondition for learning is a positive school climate which is built upon caring relationships among all – students, teachers, staff, management, parents and community members. A warm morning greeting from the custodian can help determine a child's mood for the day, just as a teacher's cheerful send-off at day's end can help motivate the child to do homework. Learning requires a personal touch, and teaching depends on interpersonal communication.

Miller and Hinshaw (2012) opined that attitude is the psychological tendency to view a particular object or behavior with a degree of favor or disfavor. It is also an individual's predisposed state of mind reading a value and it is precipitated through a responsive expression toward a person, place, thing or event which in turn influences the individual's thought and action. Attitude has three components – affective, emotional and behavioral components. It is a predisposition or a tendency to respond positively or negatively towards a certain idea, object, person or situation. Attitude influences an individual's choice of action and responses to challenges, incentive and reward.

Teachers' attitude is an important part of the child's positive school outcomes especially among the high achieving students (Aikomo, 2016). It means that when the students believe that their teachers care about them, see them as competent, respect their views and desire their success, they tend to work towards living up to high expectations. However, many schools have not fostered such positive students – teacher relationships. More than one student in six felt their teachers did not respect them. More than a third believed their teachers did not care

whether or not they were successful. Such discouraging results are a recipe for individual and social disaster.

School is the primary social structure for children. Friendships and social relationships with peers are a central part of students' lives. A positive school climate encourages communication and interaction and does not tolerate harassment, bullying or violence of any kind. Social norms are often established and spread by members of the popular crowd, who tend to have a disproportionate influence on school climate. When students get good grades, the general sense of school attachment is strong, and more students emulate these qualities. If however, the popular cliques favour fun over future, sports over studies or popularity over inclusiveness, they will undermine a positive learning environment. Because student leaders have a powerful impact on school culture, adult educators pay close attention to the messages and attitudes conveyed from student to student.

School attachment is particularly difficult for transfer students, who are concerned about making new friends and being included in extracurricular school activities. In addition, when friendship networks are disconnected, stratified or segregated by race, student relationships and school attachment both suffer. Positive relationships based on trust, respect and support among schools adults are essential to professional fulfillment and school success. An atmosphere of collegiality influences teachers' efficacy, satisfies emotional needs, and leads to personal and professional learning. Teachers and staff need to enjoy their work and be willing to contribute to the school's learning environment. Furthermore, teachers cannot create a democratic classroom in an autocratic school. They cannot teach interpersonal respect when they are treated disrespectfully by administrators, and they cannot set high standards for students if otherwise from the subordinate.

Sometimes, high achieving students might include students who have not achieve high in Intelligent Quotient scores, but who demonstrate above – average ability in an area, combined with task commitment and creativity. Hallahan and Kauffman (2006) in Ajayi (2019) described it as a multifaceted combination of different types of abilities. The person who is achieving high always show analytical understanding, which allows for dividing problems into their critical components, insightful by showing intuitive ability to cope with novel situations to solve problems with their analytical and synthetic skills. There are many variables that interplay with psychological wellbeing of high achieving secondary school students, the researcher has interest in the attitude, motivation and academic performance of high achieving students.

Statement of the Problem

Many high achieving students might often exhibit element of under-achievement or poor academic grades as a result of negative attitudes and motivations by school, parents and most especially the teachers. The school as well as home environment may not be cordial enough to the full development of high achieving students both academically and psychologically, thus affecting their level of performance.

In the same vein, the erroneous belief that high ability students are capable of performing up to their optimal level devoid of any external influence has been the conception of educators. This has led to many cases of high ability students being denied the needed stimulating environment both at school and in the home. When there is no enough motivation and negative attitudes towards the existence of these lads, there is tendency of underachieving among the high achieving students.

Several studies in high achieving children have focused on the academic performance, but the researcher observed that little attempt have been made to study about the influence of attitudes and motivation on the academic performance of these students especially in the junior

secondary schools. This study therefore examines how attitudes and motivations can predict the academic performance of the high-achieving secondary school students in social studies in Oyo East Local Government Area of Oyo State.

Purpose of the Study

The study examined the attitude, motivation and academic performance of high achieving junior secondary school students in social studies in Oyo East Local Government Area of Oyo State, Nigeria.

Specifically, this study:

1. Determined the influence of attitudes on the academic performance of high achieving junior secondary school students in social studies
2. Determined the influence of motivation on the academic performance of high achieving junior secondary school students in social studies
3. Determined the academic performance of high achieving junior secondary school students in social studies

Research Questions

1. What is the relationship between attitudes of teachers and the academic performance of high achieving students in social studies?
2. What is the relationship between motivation and the academic performance of high achieving students in social studies?
3. What is the relationship between gender and academic performance of high achieving students in social studies?

Research Hypotheses

The following hypotheses will be tested as 0.05 level of significance

HO1: there will be no relationship between attitudes of teachers and the academic achievement of high achieving students in social studies

HO2: There will be no significant relationship between motivation and the academic achievement of the high achieving students in social studies

HO3: There will be no significant relationship between gender of students and the academic achievement of the high ability students in social studies

METHODOLOGY

Research Design

The study adopted the descriptive survey research design. The use of descriptive survey design is relevant because the researcher did not intent to manipulate any variable in the study.

Population of the Study

The population for the study comprises all high ability Junior Secondary School Students in Oyo East Local Government Area of Oyo State, Nigeria.

Sample and Sampling Techniques

The sample for this study consisted of one hundred (100) high ability junior secondary school students in social studies from five selected secondary schools in Oyo East Local Government Area of Oyo State. The purposive sampling technique was used in selecting these students.

Research Instrument

The use of self-designed questionnaire was used for the study. The questionnaire contained two sections, namely; section A and Section B. Section A consisted of the demographic information of the respondents while the section B will contain two items which elicited information on the variables under study. The criteria for selection were based on those who were able to make A in Social Studies in the examinations.

Procedure for Data Collection

The researcher personally visited the selected schools for the study to explain the purpose of the research and to seek the permission of the Principals to meet with the respondents. After obtaining the permission, the concerned students were met individually. After this preliminary arrangement, dates will be extracted and the students will be met on the appointed date where the instrument will be administered. After the administration of the instrument on the respondents, the research instruments were retrieved for data analysis.

3.6. Method of Data Analysis

The data collected in this study was analysed using descriptive statistics of percentage and frequency count and inferential statistics of Pearson Product Moment Correlation and Multiple Regression Analysis.

RESULTS

Testing of Hypotheses

Hypothesis One: there will be no relationship between attitudes of teachers and the academic achievement of high achieving students in social studies

Table 1 Showing the Relationship between Attitude of Teachers and the Academic Performance of High Achieving Students in Social Studies

Variable	N	Mean	Std. Dev.	R	p	Remark
Academic Performance	100	110.61	20.31			
Attitude	100	11.58	00.49			

Table 1 shows that there was a significant relationship between academic performance of students in social studies and attitudes of teachers (r = .622, N= 100, P >.05). Thus, the hypothesis is rejected

Hypothesis Two: There will be no significant relationship between motivation and the academic achievement of the high achieving students in social studies

Table 2 Showing the Relationship between Motivation and Academic Performance of Students in Social Studies

Variable	N	Mean	Std. Dev.	R	P	Remark
Academic performance	100	110.61	20.31			
Motivation	100	63.45	09.36			

* Sig. at .05 level

It is shown in table 2 that there was a positive significant relationship between academic performance and motivation (r = .471*, p <0.05). Thus, it could be infer that motivation enhanced academic achievement of the respondents in social studies in the study. Thus null hypothesis is rejected.

Hypothesis Three: There will be no significant relationship between gender of students and the academic achievement of the high ability students in social studies

Table 3 Showing the Relationship between Gender and Academic Performance of Students in Social Studies

Variable	N	Mean	Std. Dev.	R	P	Remark
Psychological Well-	100	110.61	20.31			
	100	56.60	07.89			

* Sig. at .05 level

Table 3 reveals that there was a positive significant relationship between gender and academic performance of students (r = .639*, P <0.05).

Thus, it could be infer that gender determines academic performance of the respondents in the study. Thus null hypothesis is rejected.

Discussion of Findings

The outcome of the study shows that both gender, motivation and attitudes of teachers determines the academic performance of Junior Secondary School Students in social studies. The outcome of the study therefore corroborate the findings of Miller and Hinshaw (2012) who asserted that motivation is an integral part of enhancing the academic performance in secondary schools. The author was of the opinion that academic performance of students in secondary school can be enhanced through token reinforcement. However, the study by Aikomo (2016) negates the outcome of the present study on gender issue. According to the author, gender was not part of the variable that determines academic performance and psychological wellbeing of high achieving students.

Attitude was found out to be one of the predictors of academic performance of students in secondary schools. However, the findings of the study negate the findings by Gutman, and McLoyd (2018) who found out that attitudes of teachers at time do not contribute to the attentiveness of students as study might not consider the attitude of their teachers paramount in the classroom except such teacher is wicked and stern.

CONCLUSION

The study has been able to provide empirical evidences on attitude, motivation and academic performance of junior secondary school students in social studies. Specifically, it revealed that attitudes of teachers in the classroom predict the academic performance of students. Furthermore, it was obvious from the study that motivation is an integral part of academic performance

Recommendations

Based on this result, the following recommendations are made;

Motivations should be introduced in teaching social studies to students as this will elate their willingness to learn. Furthermore, appropriate motivation should be used as and when due.

Teachers should be guided in discharging their duties in the classroom. They must be aware that whatever attitude shown in the classroom are capable of influencing the academics of their students.

Counselling services should be provided often to students in order to aver the incidence of poor academic performance in social studies in secondary schools.

Efforts should be intensified by government in the provision of textbooks for students in the junior secondary schools as this will assist in motivating them to learning.

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EFFECTIVENESS OF MODELLING ON THE VERBAL AND ARITHMETIC SKILLS OF CHILDREN WITH INTELLECTUAL DISABILITY IN AKURE SOUTH LOCAL GOVENRMENT OF ONDO STATE, NIGERIA

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ABSTRACT
Education is not about teaching in a four walled classroom alone without rightful steps and methods that can instill proper learning but includes devising technology, methods, medium and steps to instill proper education in students regardless of abilities and disabilities. For the education of persons with intellectual disabilities, there is no doubt, teaching is more challenging to teachers that taught in their schools. Having a background knowledge about these set of students therefore requires that a methods that can be more productive is used in teaching; hence, modelling as a more appropriate methods of inculcating right education in their minds. This study dwelled on the effectiveness of modelling on the verbal and arithmetic skills of children with intellectual disabilities in Akure South Local Government Area of Ondo State, Nigeria. Fifty (50) teachers of children with intellectual retardation were randomly selected from the school under the study area. Purposive sampling technique was used to select the school for the study using a self-structured questionnaire with alternative responses. The study found out that modelling method of teaching improves the verbal communication of children with intellectual disabilities more than other methods. However, one of the hindrances to

effective use of modelling method to teaching children with intellectual disabilities is the poor orientation of teachers about the educational management of these children, hence, it was recommended among others that, regular seminar be organized for teachers in service through which different strategies can be taught.

Keywords: Modelling, Verbal communication, Arithmetic skills, Children with intellectual disabilities

INTRODUCTION

The education of the intellectual disabled children should receive attention of all and sundry. Just like other children in the society we all have the responsibility of making life meaningful to live for these greatly disadvantaged children. Stakeholders such as government, teachers, specialist, parents, policy makers etc. should all rally round the intellectually disabled children towards making them useful adults through properly monitored teaching learning process.

Modelling according to Adebimpe, Maduagwu and Quadri, (2000) is a fashion or shape. A three-dimensional figure or object in a material such as clay or wax. The use of object to teach concept formation to the intellectually disabled children is effective thus, may help improve verbal and communication skills of these children. Play-way method of teaching touches all aspects of human internally thus, affecting every child's personally which verbal and communication skills are part of. In view of this, it should be accepted that play-way method can serve as a great source of help in improving verbal and communication skills of intellectually disabled children. There is no doubt therefore, intellectually disabled children improve orally when a model is involved. This is so as it requires application of transfer of knowledge to help better the lots of these children.

Modelling method of teaching emerged from educational reforms like Forebel and Montessori who appreciated the part severed by play in learning. It helps feebleminded children to learn so well such that they out stripped normal children in public examinations. This method reveals the truth of the theory of Newcomb et al, (2014) who claimed that a person remembers 90% of what they say as they perform an activity purposefully during teaching-learning periods. In such periods, the teacher engages the students to perform an activity that will concretize the subject matter that is being introduced to them. This helps the students or pupils to learn and be

independent to work harmoniously with other students in the class to express him and gain experience, simultaneously. This method can be used in the teaching of many concepts in mathematics like fractions, equations, permutations and combinations etc. this method is well used will sure go a long way in effective teaching and learning even for the hearing impaired children.

However, mastery of the subject matter plays a great role both in the teacher's attitude towards the students and the teaching methodology. It is advised that teachers consult several texts on the topic to be taught. This will enable the teacher to draw similarity and differences in approach which will help him to device a good method of teaching and a better way explaining each step of the teaching which will make learning to take place and permanent in students.

Non-projected media according to Akanbi (2003) are method that can be used without having to resort to any projection process unlike the project media. Hardware include sad gargets like the television set, monitors, projectors, all kind of disc player compare, computer etc. software are also use to describe all the materials which includes video tapes, cartridges, audio tapes, films, slide diskette.

Salami (2011) stress that factors like familiarity to the topic and concreteness or abstractedness of teaching coupled with scope of teaching are to serve as guide to modelling. Learner's factorial so need to be considered in the choice of modelling. There are certain media that are best suited for large audience while there are some that are for small audience or even individuals. Salami (2011) also said that selection criterion should include such variable like quality of production ease of use, compatibility and availability. The source of play-way method could be viewed against the background of design and utilization. Modelling by utilization however refers to those devices which are not provided for instructional purpose but which teacher makes use in the process of instruction. According to Oluwole (2017) there are several

source of obtaining play-way among which are direct purchase, improvisation, loan and through donation. Babatunde (2012) categorize play-way as audio, visual materials. Visual aids are play-way method that could be seen with our eyes. They help to clarify our message to the learner. They are devices used in presenting knowledge through the seeing co-experience, factor influencing the effectiveness of visual aids are familiarity, scale and color.

Audio aids are teaching devices which can be heard and it includes records players, tape recorders and radio. He explains that audio-visual media are devices which can for active use of five senses of learning. According to Bryen and Dicasmirr (2017) they opined that modelling method is a positive approach for people with development disabilities. there is no gainsaying therefore that

Statement of the Problem

There are growing problems of accessing materials on the education of children with intellectual disabilities. Furthermore, identifying the proffer sample to be used for data collection is also a problem, reaching out to the stakeholders in the education of the children living with intellectual disability for data collection to be analyzed in the course of the reach also was a little but difficult.

There is no doubt, the education of the children with intellectual disabilities has been facing challenges for decades such as the methods that can best fits the teaching and learning environment. Learners with intellectual disabilities are supposed to be cater for in every facet of education in Nigeria but with the challenges of teaching methods that could best describe their reasoning faculty still remains. These are some of the unanswered questions which the present study set out to address.

Purpose of the Study

The study will:

i. expose the effectiveness of modeling and play-way method in improving verbal and communication skills of children living with intellectual disabilities.
ii. enumerate the challenges and the benefits there in using modeling and playing method techniques towards developing verbal and communication skills of intellectually disable children
iii. assist the teacher of children with intellectual disability cope with the challenges of verbal and communication skills of this category of children.
iv. make available reasonable suggestions and recommendations in improving the educational development of intellectually disabled children in general.

Research question

i. Does the use of modelling method enhance functional mathematics for children with intellectual retardation?
ii. Does the use of modelling method enhance social skills in intellectually retarded children.
iii. does the use of modelling method implies a a mere waste of time with children with intellectual disabilities?

Research Design

This is descriptive research using survey design. Descriptive research involves collecting data in order to answer research questions raised in the study. Using the method of design, questionnaire was design as instrument to collect data; the use of sample survey as a type of descriptive design was adopted as a result of population size which requires sample selection.

Population of the Study

The population for the study consist of all teachers of children with intellectual retardation in the primary school in Akure South Local Government area of Ondo State were used in the study

Sample and Sampling Techniques

Fifty (50) teachers of children with intellectual retardation were randomly selected from the school under the study area. Purposive sampling technique was used to select the school for the study.

Research Instrument

The instrument adopted for this study was structured questionnaire with alternative responses. The questionnaire is divided into two sections; 'A' and 'B'. Section 'A' deals with personal information about the respondents. Section B however, consisted of twenty-five items relevant to the variables under the study.

Method of Data Analysis

The data collected after administering the questionnaire were analyzed and interpreted by the researcher using frequency distribution tables and simple percentage method.

RESULTS

Question 1: Does modelling method make teaching and learning of verbal communication skills to primary school?

Response	Frequency	Percentage
Yes	48	96%
No	2	4%
Total	50	100%

The result shows that 48(96%) of the respondents believed that play-way methods makes teaching and learning of functional arithmetic to be more effective in the primary school. 2(4%)

of the respondents choose NO. this reveals that the use of play-way method to teach aid teacher effectiveness in functional arithmetic class.

Question 2: Does the use of modelling method enhance social skills in intellectually retarded children.

Response	Frequency	Percentage
Yes	43	86%
No	7	14%
Total	50	100%

The result above shows that 43(86%) majority of the respondents agreed that modeling method enhance social skills in intellectually disabled children while 7(14%) of the respondents disagreed. This implies that modelling is a method that can be used to enhance social skills in children with intellectual disabilities.

Question 3: does the use of modelling method implies a a mere waste of time with children with intellectual disabilities?

Response	Frequency	Percentage
Yes	12	24%
No	38	76%
Total	50	100%

The result from the table above shows that 12(24%) of the respondents believed that the use of play-way method is a mere waste of time while the remaining 38(76%) of the respondents disagreed. This reveals that the use of play-way is generally believed to be necessary for effective teaching and learning of functional arithmetic in the school

Question 4: Play-way method amuse the interest of children with intellectual retardation in learning verbal communication skills

Response	Frequency	Percentage
Yes	41	82%
No	9	18%
Total	50	100%

The result above shows that 41(82%) of the respondents believed that modelling method arouse the children with intellectual retardation interest in learning functional arithmetic while 9(18%) deferred in opinion. This indicates that the interest of children with intellectual retardations in learning are aroused by the teacher's effective use of modelling method enhances children which intellectual retardations academic performance in functional arithmetic

CONCLUSION

Based on the findings and the held experience of the researcher, it is concluded that the effectiveness of modelling method is essential for effective teaching and learning of basic subjects from the findings. It was found that teaching is made to be interesting, concrete and permanent when teacher make effective use of modelling method to teach basic subject. Children with intellectual retardation were found to respond more incomparably to learning when the teachers use modelling method to teach basic subjects. According to the result, classrooms are more lively to the children with intellectual retardation by teacher effective of play-way method.

Also, for teachers having a positive attitude towards the students enables the students to communicate freely in the classroom and participate fully in all aspect. He should also try to have a good mastery of the subject matter. When these are put in place, using any of the above teaching method will yield desired results. The teachers should also derive joy in the success of their students.

For the teachers to discharge their duty effectively, government also have significant role to play. The government need to employ more qualify mathematics teachers so that the teacher student's ratio will be the maximum. Incentive should also be given to the best mathematics teacher of the year and the best mathematics students of the year. This will enable

the teacher to put in their best to make their class students oriented and the students will then work harder in order to achieve good performance in mathematics.

Recommendations

Based on the results of the study, it is strongly recommended that:

1. There should be regular seminar for teachers on effective utilization of modelling method teaching arithmetic in primary school
2. There should be usage of play-way method in schools for effective teaching and learning of functional arithmetic.
3. Government should establish resources in schools for safe keeping of modelling method
4. Teachers are to be encouraged to improve when there is inadequate availability of modelling method
5. Parent-Teacher Association are to support in the provision of enabling environment for effective teaching and learning of arithmetic in the primary schools.
6. The headmasters or headmistress of primary schools must ensure that arithmetic skills teachers use appropriate modelling method.

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ECONOMIC THOUGHT OF CONTEMPORARY MUSLIM SCIENTISTS

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ABSTRACT

Muslim scholars today have been instrumental in developing a framework of economic thought that reflects Islamic values and is relevant to the global context. They emphasise the importance of ethics, justice and social welfare in economics, in line with Islamic principles. Contemporary Islamic scholars' economic thinking covers various aspects, such as Islamic financial systems, zakat, waqf, and trade based on Islamic principles. They also explore concepts such as distributional justice, poverty alleviation, and corporate social responsibility within the framework of Islamic economics. The purpose of writing this article is to describe the Economic Thought of Contemporary Muslim Scientists from the Figures Ahmad Adzhar Basyir, K.H. Sahal Mahfud, K.H. Abdullah bin Nuh, Muhammad Amin Azis. This writing method uses a literature review approach sourced from various articles, journals and books relevant to the research topic. This research brings together the contributions of several prominent Muslim scientists in the development of Islamic economic thought, such as Ahmad Adzhar Basyir, K.H.

Sahal Mahfud, K.H. Abdullah bin Nuh, Muhammad Amin Azis. In addition, this article also discusses the challenges and opportunities faced by contemporary Muslim economic thought in disseminating their ideas in a diverse global society. Based on the description that has been presented, it can be concluded that the economic thought of contemporary Islamic science has an important value in creating a more just and sustainable economic system based on Islamic principles. Their efforts in combining religious values with economic science can provide valuable insights for the development of an inclusive and sustainable global economy.
Keywords: Muslim scholars, global economy

INTRODUCTION

The nature of Islamic economics has various points of view on Islamic economics Despite the differences of opinion, all Muslim scientists have agreed that Islamic economics always puts forward the benefit in all units of activity The presence of schools or schools in the history of economic thought generally aims to criticise, evaluate, and correct previous economic schools that are considered less able to solve economic problems. Islamic economics is also not spared from the schools of Muslim scientists.

Indonesia's presence of Islamic economics as a daily practice is assumed to coincide with the arrival of Islam through Arab, Persian and Indian traders. The science of Islamic Economics itself has a different perspective from various Muslim scientists in Indonesia such as the thoughts of Ahmad Adzhar Basyir, K.H. Sahal Mahfud, K.H. Abdullah bin Nuh, Muhammad Amin Azis.

MATERIALS and METHODS

The method used in this research is the literature review method. The literature review method or literature study is carried out by searching for research data or information through reading scientific journals, reference books and publication materials available in libraries and the internet. The nature of this research is descriptive analysis, namely the regular description of the data that has been obtained, then given an understanding and explanation so that it can be understood properly by the reader. To obtain data or issues the author processes data from a variety of internet issue sources. The various variations and reference sources available create the writing of this scientific article goes well.

RESULTS and DISCUSSION

A. K. H. Ahmad Azhar Basyir

1. Biography of K. H. Ahmad Azhar Basyir

Azhar Basyir, as Kyai Haji Ahmad Azhar Basyir, MA is often called. This intellectual scholar was born in Yogyakarta, 21 November 1928. His childhood grew and was raised in a society that strongly adheres to religious values. That is, in Kauman village. For 34 years, Azhar Basyir pursued his formal studies in the country and abroad. The son of Haji Muhammad Basyir and Siti Djilalah, he began his education at Muhammadiyah Suronatan Lower School, Yogyakarta. After graduating, Azhar Basyir then enrolled in Madrasah Salafiyah, Salafiyah Tremas Islamic Boarding School, Pacitan, East Java. A year later, Azhar Basyir moved to Madrasah Al-Fallah Kauman and completed his junior high school education in 1944. He then continued his education at Madrasah Mubalighin III (Tabligh School) Muhammadiyah Yogyakarta and completed it in two years[1].

In addition to traditional Islamic education, Azhar Basyir also studied at several modern schools owned by Muhammadiyah. Before achieving his position as a philosopher and expert on Islamic law, Azhar Basyir studied at Baghdad University in Iraq and Cairo University in Egypt. Having joined the combat troops of Battalion 36 Laskar Hizbullah and the Sabil War Force during the Dutch military aggression, Azhar Basyir's journey in Muhammadiyah was inseparable from the invitation of his father, Muhammad Basyir, when he served as Chairman of the Tarjih Assembly in 1949 so that his 19-year-old self joined the Assembly. "My father did not go to school, but was good at reciting the Koran. Latin writing is self-taught, but my father's Arabic writing is better than mine," said Azhar Basyir,

[1] Redaksi Muhammadiyah, "Kyai Haji Ahmad Azhar Basyir, MA (Ketua 1990 – 1995)," 2020.

recorded in the interview section of Muhammadiyah and the Journey of the Nation Volume IV by the Tempo Data and Analysis Centre (2019) [2].

2. Economic Thought of K. H. Ahmad Ahzar Basyir

According to Ahmad Azhar Basyir, Indonesia is currently entering the beginning phase, the phase of the emergence of Muslim awareness of Islamic principles, one of which is in the Islamic economic sector. This can be observed by the proliferation of Islamic banking services and various financial products labelled as sharia. The understanding and application of Islamic principles in Indonesia is still not evenly distributed, only in one group or one place Even so, there is still hope for the future that the values of Islamic economics can be applied as a whole for Muslims in Indonesia. Ahmad Azhar Basyir often raises two concepts of thought in reviewing science in the field of fiqh, namely the importance of tajdid in various contemporary issues and the idea of firm rules in Islamic economics that are in harmony with time and place. Ahmad Azhar Basyir's framework in Islamic economic fiqh in Indonesia mentioned above has been widely used and used as a guide in various Islamic economic practices. Furthermore, it is our duty as Muslims to perpetuate the principles of sharia that have been broadcast by scholars and make it a guide to life. [3].

B. K.H. Sahal Mahfud

1. Biography K.H. Sahal Mahfud

Muhammad Ahmad Sahal Mahfud, his full name, was born in Kajen, Margoyoso District, Pati Regency, Central Java on 17 December 1937. Sahal grew up in a strong pesantren tradition. His father was the leader of the Maslakul Huda Islamic Boarding School

[2] Afandi, "Kiai Ahmad Azhar Basyir: Sosok Di Balik Tajdid Organisasi Persyarikatan Muhammadiyah," 2021.

[3] Januariansyah Arfaizar, "Pemikiran Fikih Ekonomi Syariah Ahmad Azhar Basyir," 2022.

which was founded by his grandfather K.H.Abd.Salam in 1910 and his mother, Mrs Hj. Badriyah. The doctoral degree (doctor honoris causa he got from UIN Syarif Hidayatullah) is an honorary degree for his work in developing pesantren and society, especially in the field of fiqh through his phenomenal ideas, social fiqh. Furthermore, Kiai Sahal devoted himself as a teacher. He became a teacher at the Sarang Rembang Islamic boarding school (1958-1961), lecturer in specialised fiqh lectures in Kajen (1966-1970), lecturer at the Faculty of Tarbiyah Uncok Pati (1974-1976), lecturer at the Sharia faculty of IAIN Walisongo Semarang (1982-1985)[4].

When he was 29 years old, he was trusted to lead the Maslakul Huda Islamic Boarding School in North Polgarut. At the same time, he was appointed Director of the Matha'liul Huda Islamic College replacing K.H. Abdullah Salam. Through this pesantren institution, Sahal articulated his social ideas. Through pesantren, Sahal believes that the problems of the people can be resolved. Therefore, since he received the relay of pesantren leadership, he began to make structural and discourse improvements.

This is intended to make the structure and discourse of pesantren, which has been monotonous, become constructive so that later it can accommodate and absorb new things in society with all the solutions. As a Muslim intellectual, Sahal has a high concern for the problems that arise in society. His expertise in the fields of fiqh, language and society is socialised through various opportunities including seminars, halaqah, bahtsul masâil, or presented in the form of writings published in the mass media. In NU organisational institutions, Sahal is noted as a very calculated cadre so that he is often given strategic

[4] "Pemikiran Ekonomi Ilmuwan Muslim Indonesia," studocu.com, 2020, https://www.studocu.com/id/document/institut-agama-islam-negeri-pekalongan/sejarah-pemikiran-ekonomi-islam/pemikiran-ekonomi-ilmuwan-muslim-indonesiakelompok-12/44331468.

positions. For example, Sahal has served as Khatib PC NU Pati, Ra'is Syuriah NU Central Java Region, Deputy Ra'is Am PBNU and was elected as Ra'is Am PBNU at the 30th Congress in Kediri[5].

2. **Economic Thought of K.H. Sahal Mahfud**

In his view regarding zakat and its management mechanism, zakat is an institution to achieve justice in the sense that it is a mechanism to suppress capital accumulation in a small group of people. He said that zakat is one way to narrow the social gap that has the potential to cause chaos and disrupt the harmony of society. His opinion was not only rhetorical. Through the Pesantren and Community Development Agency (BPPM), Kyai Sahal has done many things about alleviating the problem of poverty, one of which is done through a programme to use zakat funds for productive activities. In this regard, it is interesting to pay attention to zakat funds for productive activities. The way he manages zakat (including infaq and sadaqah). First, Kyai Sahal inventoried or recorded the economic potential of Muslims to identify aghniya' and dhuafa groups. In its operation, Kyai Sahal involved experts in the field of research. After the mustahik and muzakki data is obtained, a committee is formed from people who are professionals in the field of economic development.

This committee is in charge of managing zakat from the muzakki. The funds are then given to the poor through the basic needs approach. This method is intended to find out the basic needs of the poor as well as trace the background of their poverty. So the committee's task is not only to provide capital to the poor, but also to equip them with skills and

[5] Muhammad Sultan Mubarok, *BUKU AJAR SEJARAH PEMIKIRAN EKONOMI ISLAM*, ed. Muhammad Taufiq Abadi (EUREKA MEDIA AKSARA, 2021).

motivation. Apart from the basic need approach capital, Kyai Sahal also institutionalised daa zakat through cooperatives[6].

C. K.H. Abdullah bin Nuh

1. Biography K.H. Abdullah bin Nuh

K.H. Raden Abdullah bin Nuh was a figure of ulama, warrior, reporter, and educator who totally devoted himself to the interests of the people. Mama Abdullah, his nickname, was born in Bojong Meron Village, Cianjur City, on 30 June 1905 AD. Her father was Raden K.H. Mohammad Nuh bin Idris and her mother Nyi Raden Aisyah bin Raden Sumintapura. It is from this lineage that he belongs to the blue blood of the palace family.

In 1926, at the age of 22, his intelligence and ability to speak Arabic led him to study at Al-Azhar University in Cairo in the field of Jurisprudence, Faculty of Shari'ah and Madrasah Darul Ulum Al Ulya (Al-Adaab)[7].

While studying in Egypt, K.H. Abdullah Bin Nuh was a very intelligent person in managing his study time and independent.K.H.Abdullah Bin Nuh also studied the rules in the Shafi'i Mazhab because of his ability to speak Arabic. Day and night K.H. Abdullah bin Nuh almost no stop to learn, after learning from Jami'atul Azhar, back home only change clothes, then out again wearing pantolan, tie and wear torbus to follow the recitations outside Al Azhar[8].

He passed away at the age of 84. There was practically no time wasted in his life. Everything was spent for the benefit of the people, nation and state. This charismatic Kiai

[6] "Pemikiran Ekonomi Ilmuwan Muslim Indonesia."

[7] Budi, "Biografi KH. Raden Abdullah Bin Nuh (Mama Abdullah)," laduni.id, 2022, https://www.laduni.id/post/read/74169/biografi-kh-raden-abdullah-bin-nuh-mama-abdullah#.

[8] Mubarok, *BUKU AJAR SEJARAH PEMIKIRAN EKONOMI ISLAM*.

passed away on 26 October 1987. His body was buried in the Al-Ghazali Bogor Islamic Boarding School complex[9].

2. K.H. Abdullah bin Nuh

As an economic thinker as well as a scholar, he wrote a journal entitled "Zakat and the Modern World", where through his journal "Mama" as he is often called, he provides solutions to the problems of the third world, namely poverty through zakat. Where the zakat system based on the principles of the Koran is the way to achieve a prosperous society without poverty, and also the best way compared to capitalism and socialism. This zakat has been recognised by H.G. Weels-a British novelist, journalist, historian, and teacher through his words, "Islam has created a society more free from widespread cruelty and social oppression than any society had ever been in the world before" ("Islam has created a society free from widespread cruelty and social oppression, more free than any society had ever been in the world before") H.G. Weels. London, 1890 in this case, he mentions the moral spirit of zakat, as written in the biography of Mama Abdullah Bin Nuh by Syafii Antonio[10].

D. Muhammad Amin Aziz

1. Biography Muhammad Amin Aziz

Muhammad Amin Aziz was born in Lhokseumawe Aceh on 117 December 1936 and passed away on Wednesday, 23 July 2014 at 03.00 WIB at the age of 78 at his residence in Jakarta. He was educated at the University of the Philippines Los Banos, Philippines and held a PhD in agricultural economics at IOWA State University, USA in 1978. He is known as one of the founders of Bank Muamalat Indonesia as the first Islamic bank in the country.

[9] Budi, "Biografi KH. Raden Abdullah Bin Nuh (Mama Abdullah)."

[10] Mubarok, *BUKU AJAR SEJARAH PEMIKIRAN EKONOMI ISLAM*.

At that time he was the Chairman of the Fundraising Team for the establishment of Bank Muamalat Indonesia. Bank Muamalat Indonesia (BMI) was established on 24 Rabius Tsani 1412 H or 1 November 1991, initiated by the Indonesian Ulema Council (MUI) and the Government of Indonesia. BMI began its operations on 27 Syawal 1412 H or 1 May 1992 AD. The presence of Bank Muamalat paved the way for the growth of the Islamic financial industry in the country.

Apart from being the founder of Bank Muamalat, Amin Aziz is also listed as the founder of the Indonesian Ulema Council's Institute for Food, Drug and Cosmetics Assessment (LPPOM MUI). In addition, he also co-founded the Indonesian Muslim Intellectuals Association (ICMI) and established the Small Business Incubation Centre (PINBUK), which was involved in the establishment of thousands of Baitul Mal wa Tamwil (BMT) in various regions across the country. It was in this latter organisation that he spent much of his contribution in advancing the Islamic microfinance industry in the country. He also wrote the book "The Power of Al-Fatihah" (2012), on the grounds that he was concerned about the condition of the social life of Muslims, especially the quality of their faith and worship, which is lacking so that they are unable to achieve noble believers. According to him, most Muslims do not understand the verses in the Quran[11].

2. Economic Thought Muhammad Amin Aziz

Prof Amin Aziz is one of the figures who played a major role in the history of the development of Islamic economics in Indonesia. He was among the scholars who helped fight for the establishment of the first Islamic bank in the 1990s. This includes being the

[11] "Mengenang Prof. Dr. M Amin Aziz, Pelopor Ekonomi Syariah Di Indonesia," mysharing.co, 2014, https://mysharing.co/amin-aziz/.

initiator of the Bank Interest and Banking Workshop in Cisarua, Bogor, which managed to raise funds of Rp 125.5 million as capital to hold the workshop at that time.

Amin Aziz has developed an Islamic economic theory that attempts to integrate Islamic economic principles with modern economic concepts. He focuses on the importance of social justice, sustainable development, and poverty alleviation in the Indonesian economic context. Amin Aziz has advocated for the development of the Islamic financial system in Indonesia, including Islamic banking, Islamic insurance, and Islamic capital markets. He is of the view that the Islamic financial system can support equitable and sustainable economic development. [12].

Based on M. Amin Aziz's ideas and thoughts above, he has smart strategies and thoughts on how to pioneer sharia banking as well as raise it to what it is today. When compared to other Islamic economic thinkers, M. Amin Aziz believes that in forming an Islamic economy, in this case Islamic banking, it must be formed from the grassroots, through the BMT movement. This became one of the references for Islamic banking to be formed in Indonesia, especially in the formation of Bank Muamalat Indonesia as the first Islamic bank. This is what interests the author to conduct more in-depth research on the thinking of M. Amin Aziz in the development strategy of Islamic Banks in Indonesia which is researched and studied into a thesis entitled "Analysis of M. Amin Aziz's Thoughts and Strategies in the Development of Islamic Banks in Indonesia" (Study of the Founding Figures of Bank Muamalat Indonesia)[13].

[12] "Mengenang Prof. Dr. M Amin Aziz, Pelopor Ekonomi Syariah Di Indonesia."

[13] Mubarok, *BUKU AJAR SEJARAH PEMIKIRAN EKONOMI ISLAM*.

CONCLUSION

According to the intellectual pioneers of Islamic economics in Indonesia, there are at least three foundations of Islamic economics, namely the aqidah foundation, moral foundation, and juridical foundation. The principle of Islamic economics according to KH Ahmad Adzar Basyir is that God is the absolute owner of everything, there is a difference between halal and haram in seeking and utilising wealth and natural resources, the prohibition of accumulating wealth and not spending it or neglecting it, social security, zakat, the prohibition of usury, the principle of balance, the principle of equalising the role of government and regulating the economy in an effort to achieve social justice. K.H. Sahal Mahfud's view regarding zakat and its management mechanism is that zakat is an institution to achieve justice in the sense that it is a mechanism to suppress capital accumulation in a small group of people. He said that zakat is one way to narrow the social gap that has the potential to cause chaos and disrupt the harmony of society. As an economic thinker and scholar, K.H. Abdullah bin Nuh wrote a journal entitled "Zakat and the Modern World", which through his journal provides solutions to the problems of the third world, namely poverty through zakat. Where the zakat system based on the principles of the Quran is the way to achieve a prosperous society without poverty, and also the best way compared to capitalism and socialism. Muhammad Amin Aziz believes that in forming an Islamic economy, in this case Islamic banking, it must be formed from the grassroots of the economy, through the BMT movement. This became one of the references for Islamic banking to be formed in Indonesia, especially in the formation of Bank Muamalat Indonesia as the first Islamic bank.

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TÜRKİYE'DE ÖRTÜALTI MEYVE YETİŞTİRİCİLİĞİNİN GÜNCEL DURUMU

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ÖZET

Tarım tarihi boyunca gelişen yeni stratejiler ve teknolojiler hem tarımın ilerlemesine katkı sağlamış hem de uygun olmayan ekolojik koşullarda ve dönemlerde ürün yetiştirme imkanı sunmuştur. Örtüaltı yetiştiriciliği bu ilerlemelerin en önemli örneklerinden birisidir. Türkiye'de örtüaltı meyve yetiştiriciliği çok eski tarihlere dayanmamakla birlikle tüm dünyada olduğu gibi her geçen gün yaygınlaşmaktadır. Bunun en önemli nedenleri türlerde sağladığı erkencilik ile üreticilere yüksek gelir sağlaması ve açıkta yetiştiriciliği yapılamayan türlerin yetiştiriciliğine olanak sağlamasıdır. Bu çalışmada, Türkiye'de son yıllarda örtüaltı meyve üretimindeki gelişmeler detaylı bir şekilde değerlendirilmiş ve sunulmuştur. 2010 yılı verilerine göre Türkiye'de 57.588 dekar alanda örtüaltı meyve üretimi yapılırken bu değer 2022 yılında 179.401 dekara yükselmiştir. Bu yıllarda kaydedilen üretim değeri ise 271.899 tondan 1.151.293 tona artış göstermiştir. Bu üretimin neredeyse tamamı muz ve çilek üretimi olup üzüm, kayısı, nektarin, erik ve maviyemiş gibi türlerinde yaygın olarak yetiştiriciliği yapılmaktadır. Özellikle Akdeniz bölgesi uygun ekolojiye sahip olması nedeniyle örtüaltı meyve üretiminde oldukça önemli bir yere sahiptir. Nitekim 2022 verilerine göre Türkiye'de alan bazından örtüaltı meyve yetiştiriciliğinin %91,4'ü Akdeniz Bölgesinde gerçekleştirilmektedir. Hem üretim miktarı hem de üretim alanı bazından Mersin ve Antalya illeri örtüaltı meyve yetiştiriciliğinin yoğun olarak yapıldığı illerdir. Türkiye özellikle Akdeniz bölgesi örtüaltı meyve yetiştiriciliği konusunda oldukça önemli bir potansiyele sahiptir. Bu mevcut potansiyeli, sürdürülebilir tarım uygulamalarıyla birleşerek, dünya meyve üretimindeki yerini daha da güçlü bir potansiyele eriştirebilir ve ülkenin tarım sektöründe ekonomik kalkınmasına önemli katkı sunabilir.

Anahtar Kelimeler: Örtüaltı, Meyve, Sera, Tünel, Üretim

CURRENT STATUS OF PROTECTED FRUIT CULTIVATION IN TÜRKİYE

ABSTRACT

Throughout the history of agriculture, evolving strategies and technologies have not only contributed to the progress of farming but also provided the opportunity to cultivate crops in unfavorable ecological conditions and periods. Protected cultivation, particularly greenhouse cultivation, stands out as one of the most significant examples of these advancements. Although protected fruit cultivation in Türkiye does not have a long history, it is becoming increasingly widespread, following the global trend. The most important reasons for this are that it provides high income to producers due to the earliness it provides in the species and that it enables the cultivation of species that cannot be grown in the open fields. In this study, recent developments in protected fruit cultivation in Türkiye have been thoroughly evaluated and presented. According to data from 2010, protected fruit cultivation covered an area of 5.758,8 ha in Türkiye, this value rose to 17.940,1 ha in 2022. The recorded production value also saw a remarkable increase, rising from 271.899 tons in those years to 1.151.293 tons. The majority of this production consists of banana and strawberry, while grape, apricot, nectarine, plum, and blueberry are also commonly grown. Especially due to the favorable ecological conditions in the Mediterranean region, protected fruit cultivation holds a crucial place in Türkiye. According to 2022 data, 91,4% of protected fruit cultivation in Türkiye is concentrated in the Mediterranean region on an area basis. Mersin and Antalya provinces stand out as the leading regions for protected fruit cultivation in terms of both production quantity and cultivation area. Türkiye, particularly with its potential in the Mediterranean region protected fruit cultivation, can strengthen its position in global fruit production through the combination of this existing potential with sustainable agricultural practices, contributing significantly to the country's economic development in the agricultural sector.

Keywords: Protected cultivation, Fruit, Greenhouse, Tunnel, Production

1. INTRODUCTION

Türkiye, due to its geographical location, possesses a rich climate and soil potential. This allows for the cultivation of numerous fruit species within the country's ecology. It is known that the cultivation of 75 of the commonly grown fruit species worldwide takes place in Türkiye. The high temperatures in the southern regions during summer and the cold winter months in the northern regions provide farmers with the opportunity to successfully produce various fruit species. Thanks to this production potential, Türkiye holds a significant position in the global production of many fruit species. Furthermore, the ecological diversity it possesses enables the cultivation of both early- and late-maturing varieties (Bayazıt et al., 2021).

Protected cultivation is defined as the cultivation of vegetables, fruits, and ornamental plants under low and high systems by eliminating the impact of external climate factors and creating the necessary specific environmental conditions (Bayazıt et al., 2021). In Türkiye, protected vegetable cultivation has been ongoing for a long time. However, protected cultivation of fruits has become widespread in recent years due to the significant potential for producers. The increasing world population, decreasing agricultural areas, and growing pressure on agricultural production are intensifying day by day. Additionally, climate change, which we have been feeling more and more in recent years, further increases the importance of controlled production techniques. Depending on these situations, efforts to increase productivity and ensure fruit supply outside the season by taking advantage of technological innovations have become inevitable. The most crucial technology with this potential is protected cultivation. The aim of protected cultivation is to control the microenvironment surrounding the plant, allowing the plants to achieve maximum yield. The advantages of this system include facilitating cultural practices (such as irrigation, weed control, pest management, harvest, etc.), reducing yield losses due to environmental factors, enabling cultivation in different ecological conditions,

obtaining high-quality products, achieving high yields, and most importantly, providing early harvest and thus high profitability (Jat et al., 2020).

In addition to the positive effects of protected cultivation of fruits, there are important considerations that need attention. The high installation cost is the most significant limiting factor in the widespread adoption of protected fruit cultivation. Due to the high crown of fruit species, except for strawberries, the use of plastic greenhouses and high tunnels is a necessity in protected fruit cultivation. This situation further increases installation costs even more for other fruit species. Additionally, another crucial consideration in protected fruit cultivation is that the fruit species, and even varieties, grown under cover may not meet the chilling requirement. The accumulation of high temperatures within the protected area during the summer months, along with the associated increase in disease and pest populations, is another important aspect that needs attention in protected fruit cultivation.

Banana production began in 1935, strawberry cultivation in the 1970s, and the first study on protected cultivation of temperate climate fruit species started in 1986 with the cultivation of peaches in pots in Türkiye (Küden et al., 2001; Pınar et al., 2007; Nacar, 2012). Since those years, significant developments have taken place in protected fruit production in Türkiye. Furthermore, the number of fruit species grown under cover in Türkiye has been increasing every day and continues to do so. This study evaluates the current state of protected fruit cultivation in Türkiye and provides information about its existing potential.

1. MATERIAL and METHOD

In this study, data obtained from the Turkish Statistical Institute sources for the years 2004-2022 have been utilized (TÜİK, 2023).

2. FINDINGS and DISCUSSION

Protected cultivation began in Türkiye in the 1940s in Antalya, initially focused on vegetable cultivation due to favorable climate conditions. In the subsequent years, it showed limited expansion in the province of İzmir. With the introduction of plastic as a covering material, there was a rapid increase in both greenhouse and tunnel areas. Particularly between 1975 and 1985, significant growth was observed in protected cultivation. After 1990, the cultivation of bananas and strawberries gained momentum, especially in the provinces of Mersin and Antalya (Bayazıt et al., 2021).

Low tunnels are the commonly used type of protected cultivation in strawberry cultivation. According to the 2022 data, 6.389,5 ha were dedicated to protected strawberry cultivation in Türkiye, with low tunnels constituting approximately 49% of this area. Fluctuations in low tunnel areas were observed in Türkiye between 2010 and 2016. The low tunnel area, which was 340,1 ha in 2010, increased to 1.041,2 ha in 2013 but subsequently decreased significantly in the following years. The most significant factor behind these fluctuations has been price fluctuations. Since 2017, there has been a substantial increase in the low tunnel area used in fruit cultivation in Türkiye. The low tunnel area, which was 1.167,9 ha in 2017, increased by approximately 268% to reach 3.135,7 ha in 2022 (Table 1).

There has not been a significant increase in fruit cultivation under high tunnels in the period between 2010 and 2022. In 2010, Türkiye had 2.783 ha of high tunnel areas, and this had risen to 3.356,8 ha in 2022 (Table 1). According to the statistics for this year, strawberry production was recorded at 2.218,3 ha under high tunnels, while banana production was documented at 1.136,5 ha.

Glass greenhouses generally have disadvantages when compared to plastic greenhouses. The material used in glass greenhouses is heavier and more fragile than other covering

materials, making them more susceptible to natural disasters such as earthquakes, storms, excessive snowfall, and hail. Additionally, the installation and repair of glass greenhouses are more challenging and costly compared to plastic greenhouses. Glass does not have insulation properties like plastic, which can result in the greenhouse requiring more energy for temperature control, leading to increased energy costs. Also, glass greenhouses pose security risks in the event of breakage. Considering these factors, while there has been a significant increase in the use of plastic greenhouses for protected fruit cultivation in Türkiye, there has been a gradual decrease in the area covered by glass greenhouses. Over the past 12 years, the area covered by glass greenhouses for protected fruit cultivation in Türkiye had decreased from 32,6 to 14,7 ha. During the same period, there has been a notable increase in plastic greenhouses area. In 2010, protected fruit cultivation was conducted on 2.603,1 ha in plastic greenhouses in Türkiye. This value increased to 3.508,6 ha in 2015, 7.560,8 ha in 2020, and finally reached 11.432,9 ha in 2022 (Table 1).

The protected fruit cultivation was conducted on a total of 5.758,8 ha in 2010 in Türkiye. This was increased nearly threefold to reach 17.940,1 ha in 2022. As seen in Table 1, the area for protected fruit cultivation in Türkiye has shown a consistent increase during these years.

Table 1. Fruit production area under protected cultivation in Türkiye by year (ha)

Years	Low Tunnel	High Tunnel	Glass Greenhouse	Plastic Greenhouse	Total
2010	340,1	2.783	32,6	2.603,1	5.758,8
2011	331,5	2.844	32,6	2.813,7	6.021,8
2012	990,3	2.938,5	21,6	2.836,9	6.787,3
2013	1.041,2	2.992,8	17,1	3.035,1	7.086,2
2014	813,3	3.176,8	17,2	3.156,5	7.163,8
2015	753,9	3.325,4	15,2	3.508,6	7.603,1
2016	757,0	3.180,6	16,2	4.319,4	8.273,2
2017	1.167,9	2.805,7	170,4	4.909,9	9.053,9
2018	2.287,4	2.688	17,2	5.541,5	10.534,1
2019	2.407	2.650,8	3,2	6.069,5	11.130,5
2020	2.713,7	2.781	18,2	7.560,8	13.073,7
2021	2.750,4	3.1214	21,3	9.481,9	15.375
2022	3.135,7	3.356,8	14,7	11.432,9	17.940,1

In Türkiye, the vast majority of protected fruit production, both in terms of production area (≈91%) and quantity (≈94%), is concentrated in the Mediterranean region. The Aegean region follows, contributing to 4% of the production quantity and 6% of the production area (Figure 1). Although in small quantities, protected fruit production also takes place in the Western Marmara and Central Anatolia regions, with strawberries being the main fruit produced in these two regions.

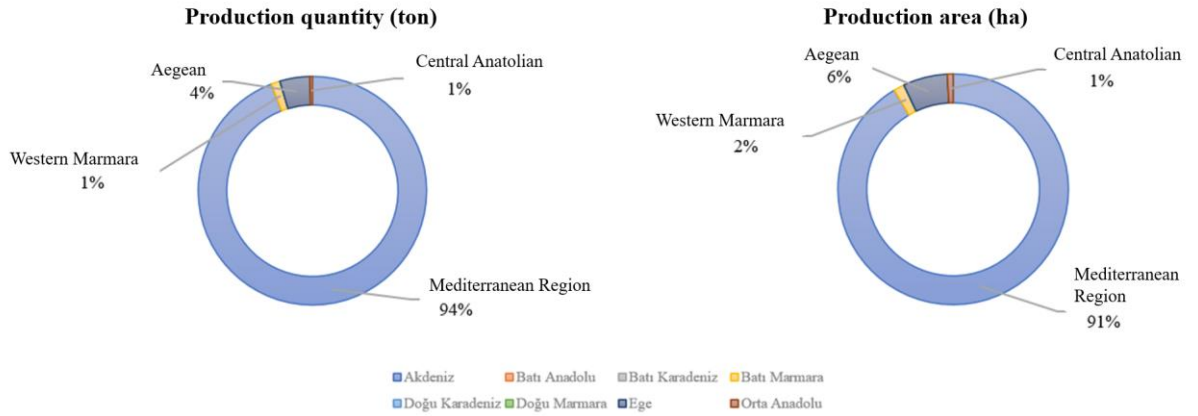


Figure 1. Proportional distribution of protected fruit production quantity and areas by regions in Türkiye

In 2010, the areas for fruit production under high tunnels and plastic greenhouses were recorded at similar levels in Türkiye. However, especially from the year 2016 onwards, there was a rapid increase in the use of plastic greenhouses in fruit cultivation. In 2022, it is calculated that 64% of protected fruit cultivation in Türkiye takes place in plastic greenhouses, 19% in high tunnels, and 17% in low tunnels. As seen in Figure 2, the area covered by glass greenhouses had a considerably low share.

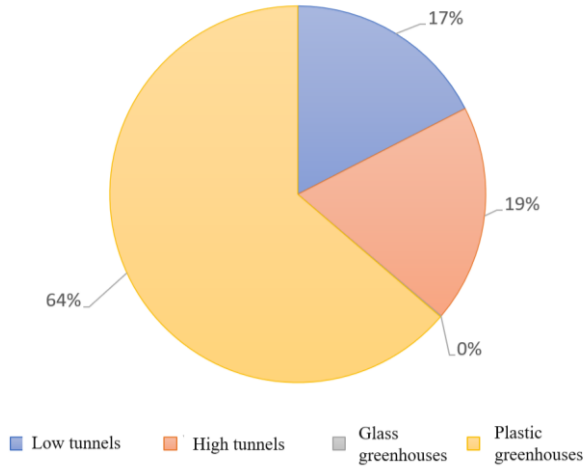


Figure 2. Area-based distribution of the cover type used in protected fruit cultivation in Türkiye in 2022 (ha)

According to the 2022 data, fruit cultivation under cover was recorded in 31 different provinces in Türkiye. Based on the data for the same year, both in terms of production area and quantity, Mersin was the province where the highest fruit production under cover takes place. With 10.616,6 ha of protected fruit production area, Mersin holds a 59,18% share in Türkiye's total production area in 2022. Additionally, this province, with 714.748 tons of production, single-handedly contributes to 62,08% of Türkiye's total protected fruit production. Noteworthy districts for protected fruit production in Mersin include Anamur, Silifke, and Bozyazı, where banana and strawberry cultivation is widespread. Another influential province in protected production is Antalya, which, according to the 2022 data, had a production area of 4.697,1 ha and a production quantity of 305.333 tons. Prominent districts for protected production in Antalya include Manavgat, Alanya, Serik, and Gazipaşa. Following these provinces, Adana, Aydın, and Balıkesir are the next provinces in terms of protected fruit production in Türkiye. The values for production area and quantity for provinces with protected fruit production in Türkiye are presented in Table 2.

Table 2. Protected fruit production values by provinces in Türkiye for 2022

Provinces	**Protected fruit production area (ha)**	**Protected fruit production quantity (tons)**
Mersin	10.616,6	714.748
Antalya	4.697,1	305.333
Adana	909,6	53.016
Aydın	898,4	36.328
Balıkesir	256,3	13.713
Hatay	167,8	9.919
Kırşehir	143,9	3.957
Muğla	130,3	8.194
İzmir	65,1	3.005
Manisa	12	714
Türkiye	17.940,1	1.151.293

Between the years 2004 and 2022, the low and high tunnel areas for Türkiye and the major protected fruit-producing provinces are presented in Figure 3. As observed in the figure, there is a general increase in the low tunnel areas in Türkiye and, consequently, in the provinces known for significant protected fruit production over the years. Although there was a slight decrease in these areas between 2014 and 2017, there was a significant increase, especially from 2017. Through provincial evaluation, it has been determined that Mersin is the province with the most intensive fruit production in low tunnels. In contrast to low tunnels, there was no significant increase in the fruit production areas in high tunnels between the years 2004 and 2022. It was seen that Mersin has higher values in high tunnel areas than other provinces (Figure 3).

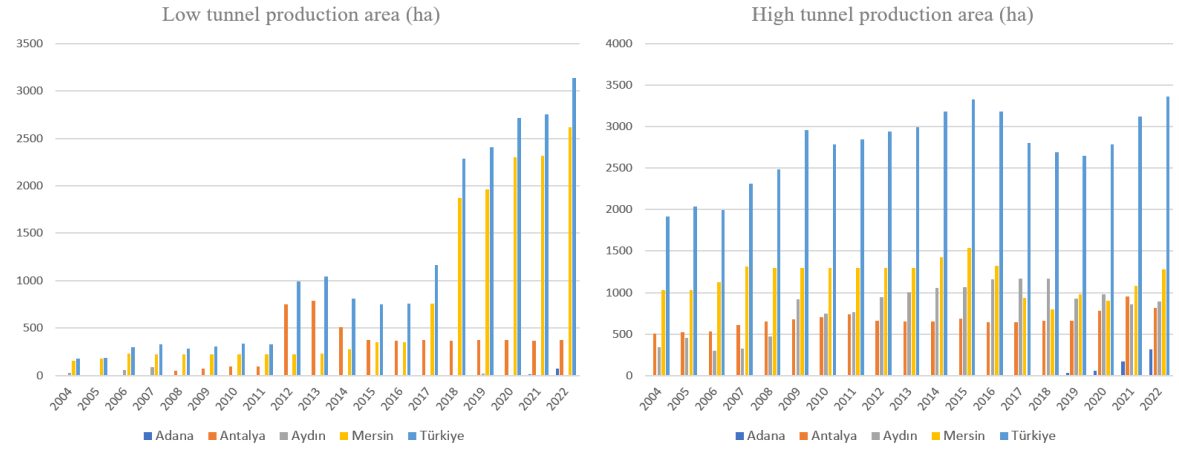


Figure 3. The change in low and high tunnel areas over the years in Türkiye and some important provinces engaged in protected cultivation (ha)

Between the years 2004 and 2022, fluctuations were observed in the annual use of glass greenhouse areas for fruit cultivation in Türkiye; however, it can be confidently stated that, in general, the use of this type of covering material had decreased. Factors contributing to this decline include the high installation cost of glass greenhouses, their sensitivity to adverse environmental conditions such as hail, storms, and the high maintenance expenses. In 2004,

fruit production was carried out on a 44,8 ha area of glass greenhouses, but this value had decreased to 14,7 ha in 2022. It was recorded that bananas and strawberries are produced in existing glass greenhouses. In contrast to glass greenhouses, plastic greenhouse areas have shown a consistent increase in Türkiye. While fruits were grown in a plastic greenhouse area of 1.517,9 ha in 2004, this value increased to 3.165,6 ha in 2013 and to 12.453,7 ha in 2022. According to the data from 2022, protected fruit cultivation was carried out on a 3.496,9 ha area in Antalya and 6.721,3 ha area in Mersin under plastic greenhouses (Figure 4).

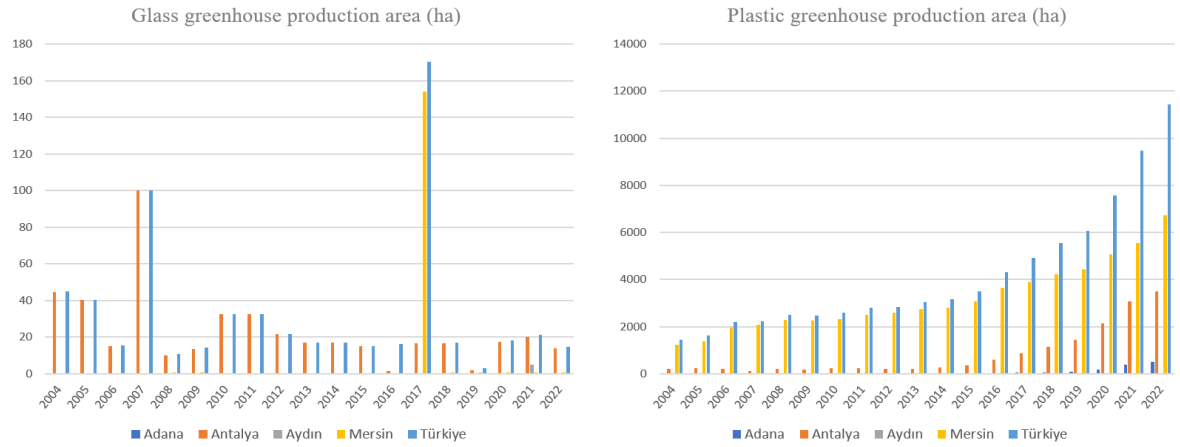


Figure 4. The change in glass and plastic greenhouse areas over the years in Türkiye and some important provinces engaged in protected cultivation (ha)

The most produced products recorded under protected conditions in Türkiye are bananas, strawberries, grapes, plums, apricots, blueberries, nectarines, and respectively. It is known that new species are added to these fruit species every day. In recent years, there has been a growing interest in alternative fruit production, leading to the initiation of protected cultivation for various fruit species. These are fruit species such as papaya, dragon fruit, mango, passiflora, guava, pineapple, pepino, avocado, mango, loquat, and almond. According to the 2022 data, a large proportion of the total protected fruit production in Türkiye consisted of bananas (approximately 75%) and strawberries (approximately 25%) (Figure 5). In the same

year, recorded production quantities were 1.411 tons of grapes, 827 tons of plums, 477 tons of apricots, 33 tons of blueberries, and 10 tons of nectarines. The production quantities of fruit species cultivated under cover over the years are presented in Table 3, and visuals of some fruit species produced under protection are shown in Figure 6.



Figure 5. Distribution of fruit species produced protected cultivation in Türkiye in 2022, based on production quantity (tons)



Figure 6. Visuals of some fruit species produced under protected cultivation

Table 3. Production quantity of fruit species cultivated under protected cultivation in Türkiye by year (tons)

Years	Banana	Strawberry	Grape	Plum	Apricot	Nectarine	Blueberry	Total
2010	149.233	122.316	350					271.899
2011	161.875	125.004	351					287.230
2012	161.511	152.162	348		600			314.621
2013	172.006	160.026	451		627	60		333.170
2014	180.088	158.564	378		646	66		339.742
2015	200.244	166.321	897		775	60		368.297
2016	252.149	168.191	918	110	728	60		422.156
2017	321.815	155.059	964	166	794	60		478.858
2018	353.227	180.378	1.121	167	602	20		535.515
2019	424.837	195.206	1.184	264	562	20		622.073
2020	542.809	203.206	1.114	336	513	10		747.988
2021	722.703	253.153	1.214	366	479	10	33	977.958
2022	866.366	282.169	1.411	827	477	10	33	1.151.293

Banana production in Türkiye began in 1935 when it was introduced from Egypt to Alanya and then to Anamur. Since those years, banana production in Türkiye has shown a consistent increase each year. In the beginning, production was carried out in the open fields, but damage was observed due to the low temperatures that occurred over the years, and in the face of these consecutive cold damages, growers started to grow bananas in plastic, glass greenhouses, and high tunnels instead of open fields (Pınar et al., 2007). While protected banana production in Türkiye was 149.233 tons in 2010, this value increased to 252.149 tons in 2016. In 2022, compared to 2010, there was an increase of approximately 580% and increased to 866.366 tons. According to 2004 data, banana production in Türkiye was carried out in glass (577 tons) and plastic (90.351 tons) greenhouses, but especially after 2018, glass greenhouses were replaced by high tunnels. Of the total protected banana production of 866.366 tons in 2022, 791.690 tons were made in plastic greenhouses, while 74.676 tons of production was made in high tunnels. The amount of banana production between 2004 and 2022 according to cover type is presented in Figure 7.

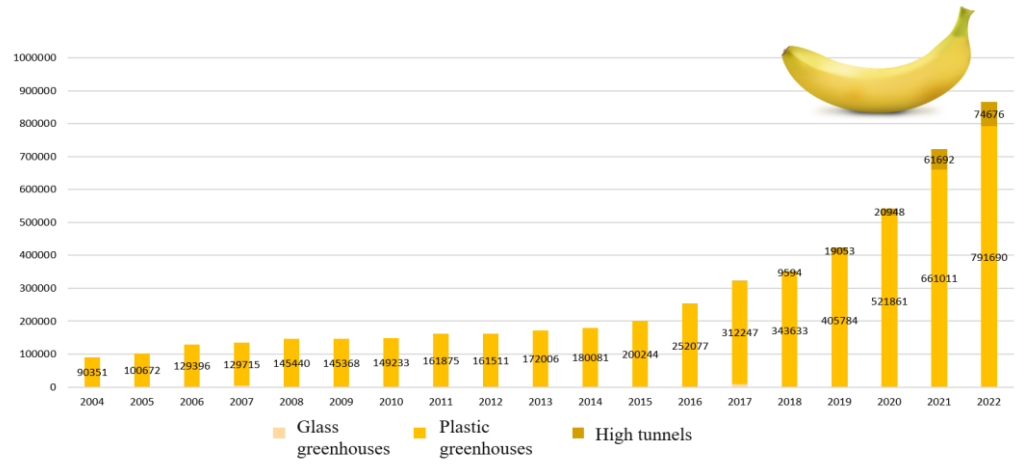


Figure 7. Protected banana production quantity in Türkiye by year (tons)

Strawberry, whose origin is stated as South America (Chile), has been gaining increasing importance in production due to its economic value. Strawberry cultivation in Türkiye is

reported to have started in the 1970s, with a total production of 16.000 tons in 1975 (Nacar, 2012). According to data from 2010, the quantity of strawberries produced under cover in Türkiye was 122.316 tons, and this value rose to 282.169 tons in 2022. In 2004, 2.773 tons of strawberry production was made in plastic greenhouses, 6.244 tons in low tunnels, and 71.070 tons in high tunnels. In 2013, the total protected strawberry production value increased to 160.026 tons. 5.492 tons of this production was made in plastic greenhouses, 39.565 tons in low tunnels, and 114.285 tons in high tunnels. Over the years, there have been significant developments in strawberry production in low tunnels and plastic greenhouses. However, there was a proportional decrease in strawberry cultivation in high tunnels. In 2022, of the 282.169 tons of greenhouse strawberry production, 137.296 tons were made in low tunnels, 96.339 tons in high tunnels, and 48.016 tons in plastic greenhouses (Figure 8).

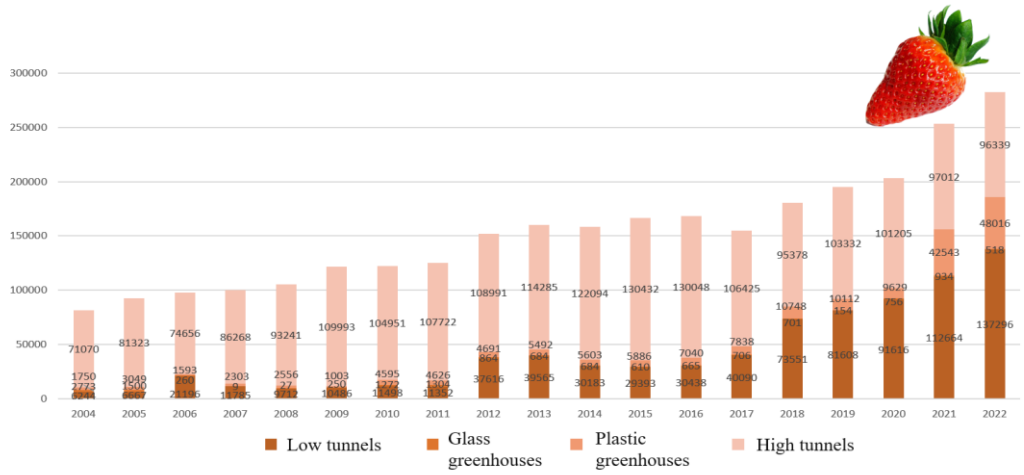


Figure 8. Protected strawberry production quantity in Türkiye by year (tons)

Greenhouse grape cultivation in Türkiye started to be recorded in 2010 by the Turkish Statistical Institute. All protected grape production is done in plastic greenhouses. Türkiye, which had a grape production of 350 tons in 2010, produced 918 tons of grapes in plastic greenhouses in 2016. This value increased to 1.411 tons in 2022. It is noted that the province

that stands out in grape production in Türkiye was Mersin with a production value of 1.317 tons. The amount of grapes produced in plastic greenhouses by year is presented in Figure 9.

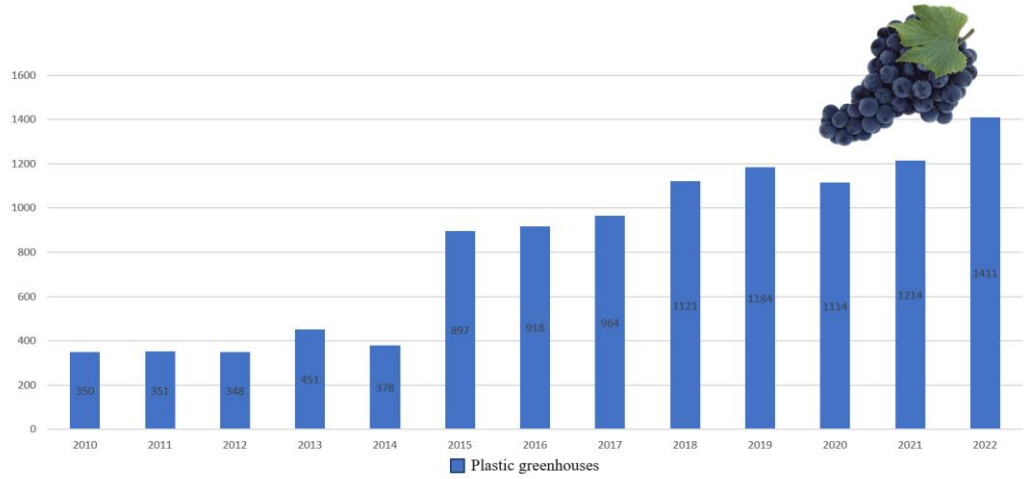


Figure 9. Grape production quantity in Türkiye by year in plastic greenhouses (tons)

Other important fruit species produced in the plastic greenhouse are apricot and nectarine. It is observed that there has been a decrease in the greenhouse production values of both fruit species over the years. Greenhouse production values for apricots were first recorded in 2012 and for nectarines in 2013 by the Turkish Statistical Institute. In 2013, 627 tons of apricots were produced under greenhouse cultivation in Türkiye, while 60 tons of nectarines were produced. Close production values were recorded in nectarine production until 2017. There was a slight increase in apricot production until 2017. However, after 2017, there was a significant decrease in the production values of both apricots and nectarines. It was recorded that 477 tons of apricots and 10 tons of nectarines were produced in 2022 (Figure 10; Figure 11). The entire production of these species is recorded in Mersin. In addition to this province, it is known that temperate climate fruit species such as apricots, peaches, and nectarines are grown under greenhouse conditions in provinces such as Adana and Antalya, but these data have not been recorded yet.

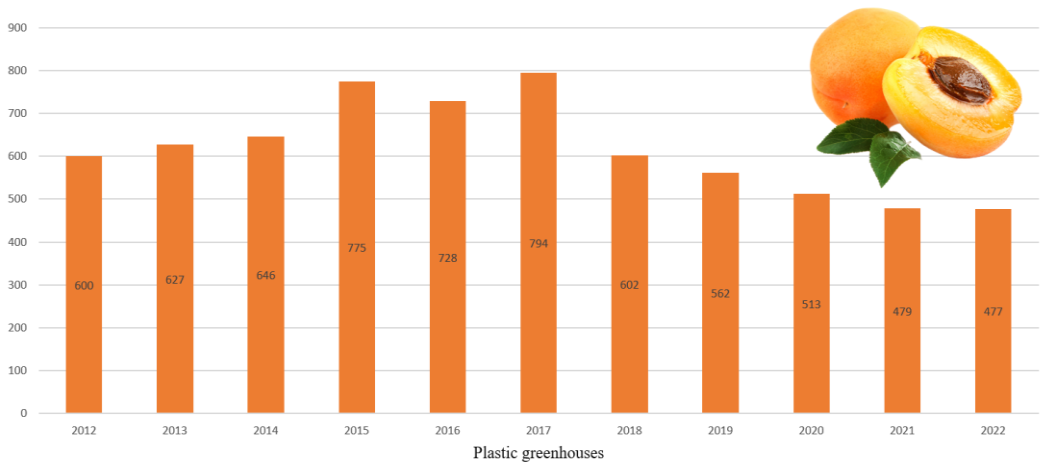


Figure 10. Apricot production quantity in Türkiye by year in plastic greenhouses (tons)

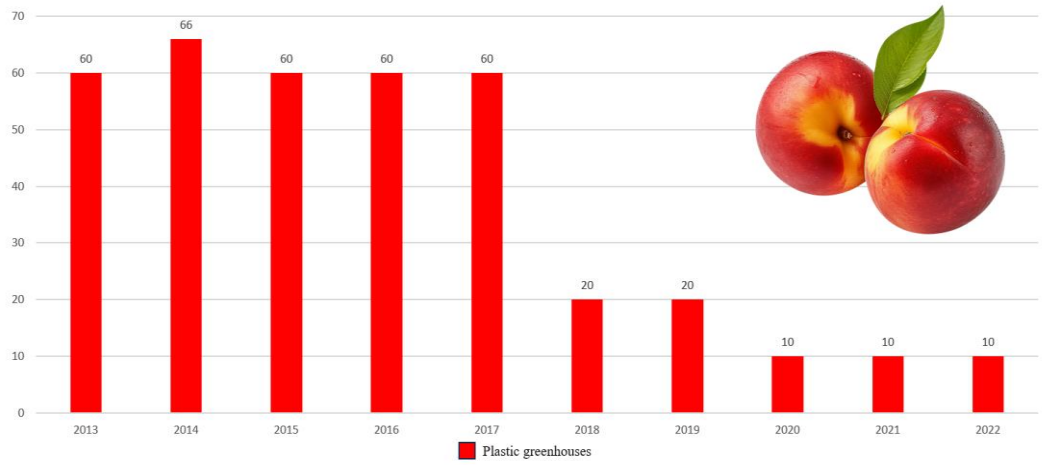


Figure 11. Nectarine production quantity in Türkiye by year in plastic greenhouses (tons)

Protected plum production shows an increasing trend day by day. Protected plum production in Türkiye was first recorded in 2016. It is seen that most of the plum production is in plastic greenhouses, and a small amount is produced in low tunnels. In 2016, 94 tons of plum production was made in plastic greenhouses and 16 tons in high tunnels. In 2022, 811 tons of plums were produced in plastic greenhouses, and 16 tons of plums were produced in high tunnels, as in 2016 (Figure 12).

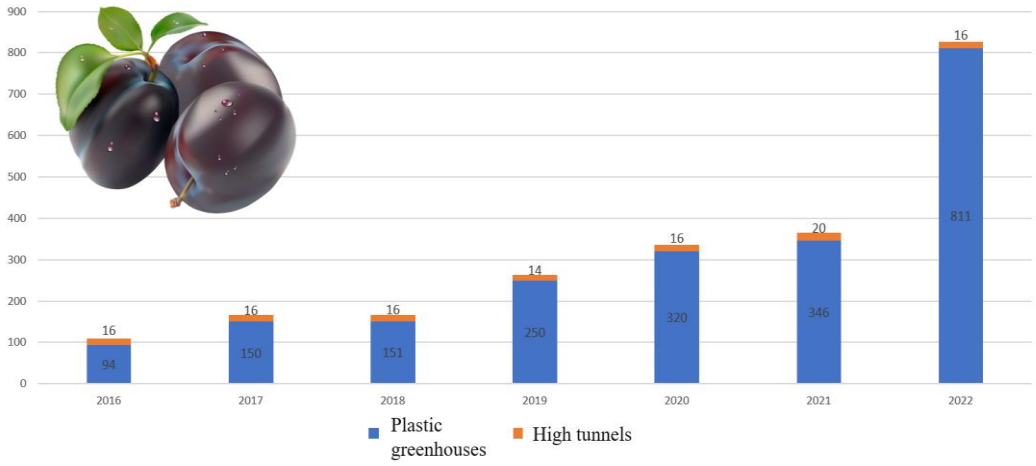


Figure 12. Protected plum production quantity in Türkiye by year (tons)

In addition to these fruit species, there are significant developments in greenhouse blueberry production, especially in Antalya. The first greenhouse blueberry production value was recorded in 2021 by the Turkish Statistical Institution. This year, 33 tons of blueberry production was recorded. This value remained current in 2022.

3. CONCLUSION

Türkiye, given its location, boasts a rich ecological diversity, providing opportunities for the cultivation of various fruit species. In particular, the use of protected cultivation systems, especially in the Mediterranean region, has led to the increasing prevalence of controlled conditions for fruit cultivation. According to the data from 2010, fruit cultivation under protected cultivation covered an area of 5.758,8 ha, and in 2022, this value rose to 17.940,1 ha. The significant increase in fruit production is largely attributed to the cultivation of fruits in plastic greenhouses.

In parallel with the greenhouse production area, there has been a significant increase in the amount of production. The fruit production value, which was 271.899 tons in 2010, increased to 1.151.293 tons in 2022. The largest share in the total production amount was banana,

followed by strawberry. In addition, significant increases are observed in the number of species cultivated under greenhouse cultivation in Türkiye.

Both in terms of cultivation area and production quantity, the provinces of Mersin and Antalya play a leading role in fruit production compared to other provinces. Protected fruit production, which is becoming more widespread day by day thanks to the earliness and controlled production it provides, creates a great potential for the Turkish economy if it is done consciously.

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STUDIES ON SOME HEAVY METALS AND USING OF SOME SELECTED PHYCO-CHEMICAL PARAMETER IN ZURU DAM, KEBBI STASTE, NIGERIA.

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ABSTRACT
The study was conducted to assess the levels of concentration and apportionment of Pb, Cr, Fe, Cd, Co, Ni, Zn and Cu and some physicochemical parameters include Temperature, pH, DO and TDS of Zuru dam were assessed for 8 months (January, 2019-August, 2019). The main acquired data was the water from the lower and the upper regions of the dam. The samples were collected and prepared in the laboratory according to standard method, Atomic Absorption Spectrophotometer (AAS) technique was used to analyze the data. The results showed concentration of Pb, Cr, Fe, Cd, Co, Zn and Cu at various levels. The results also showed the distribution of these elements at lower and upper regions of Zuru dam. The enrichment of these heavy elements in the dam could be due to loading of the dam with scattered materials and effluents generated by various human activities within the dam feature area through overland and base flows and the release of elements from geologic processes. The concentration of Pb, Cr and Fe were observed to be slightly above. The parameters fluctuated throughout the study period with maximum values recorded mostly hermatan and rainy season. Temperature was negatively correlated to TDS and increase in pH was observed to moderately reduced. To minimize pollution of the dam, it is strongly recommended that there should be reduction in levels of some unhealthy practices such as making release of effluents like, engine oil; lubricants, used batteries, any electric wastes; electronic and electrical appliances and high level use of chemicals on the farms are suggest to be disheartened.
Keywords: Zuru dam, Concentration, Heavy elements, Human activities, Lower region, Upper region

INTRODUCTION

Heavy elements are those metallic elements with high atomic weight that is at least five times greater than that of water (Ada *et al.,* 2012). Heavy elements include; lead (Pb), cadmium (Cd), zinc (Zn), mercury (Hg), arsenic (As), silver (Ag), chromium (Cr), copper (Cu), iron (Fe) and the platinum group elements (Dorherty *et al.,* 2012). They are non-biodegradable and persistent environmental contaminants which may be deposited in water bodies. The presence of heavy metals in the aquatic environment in trace concentration is important for normal development of the organism (Kosi – Siakpere and Ubogu, 2008). They could be detected in the aqueous medium and in the bottom. Some heavy metals are completely toxic and need to be monitored continuously in the bodies of organisms as they are capable of bioaccumulation, resulting to mobility and often mortality of the organisms (Ayotunde *et al.,* 2011)

Ayotunde *et al.,* (2011) observed that when heavy metals enter aquatic environment a great portion settles and is absorbed by the bottom mud (sediment). They could also be recycled by chemical and biological processes such that some quantities remain dissolved in the water column and some part is being absorbed by the inhabitants (Ada *et al.,* 2012). Interest in the environmental levels of heavy elements is a global one because of the potential hazards of these metals to the health of humans, animals and plants when they exist at elevated levels. Sawyer et al*.,* (2006) is of the opinion that heavy elements are dangerous because they bioaccumulation and interfere with biochemical processes in the living issues.

High levels of heavy metals in soil, water and atmosphere vis-à-vis the biota are often related to industrial activities, burning of fossil fuels, chemical dumping, application of agro-allied chemicals such as fertilizer and certain pesticides (Oyekunle *et al.,* 2012). The knowledge of the levels of heavy elements in our environment is necessary for the purposes of setting background values of these elements, monitoring their accumulation in the biota regularly and

estimating the amount of the metals that may possibly get translocated across the compartments in the entire ecosystem (Oyekunle *et al.,* 2012). Harrison (1996) observed that with increasing industrial activities, what were once pristine habitats of organisms are becoming increasingly exposed to environmental pollution by heavy metals. Long human-induced generation of heavy metals continues in industrial and domestic activities, sustained measurement will be needed to assess the effectiveness of the set limitation standards and facilitate the identification and quantification of the state of environmental degradation attributable to the discharged-heavy metals.

The quality of water is of vital concern for mankind because it directly linked with human health (Abdulazeez, 2015). Freshwater has become a scare commodity due to over exploitation and pollution (Muhammad and Saminu, 2012). Pollution is caused when a change in the physical, chemical or biological condition in the environment harmfully affect quality of human life including other animals and plants' life (Oketola *et al.,* 2006). Industrial, sewage municipal wastes are been continuously added to water bodies hence affect the physiochemical quality of water making them unfit for use of livestock and other organism (Abubakar and Abdullahi, 2015). According to Ibrahim (2009) Water resources are of critical importance to both natural ecosystem and human development. It is essential for agriculture, industry and human existence. The healthy aquatic ecosystem is depended on the physicochemical and biological characteristics (Verma *et al.,* 2012). The quality of water in any ecosystem provides significant information about the available resources for supporting life in that ecosystem (Ibrahim, 2008). Good quality of water resources depends on a large number of physic- chemical parameters and biological characteristics to assess the monitoring of these parameters is essential to identify magnitude and source of any pollution load (Adesalu*et al.,*2010). Due to increased population and use of fertilizers in agriculture and man-made activities, the natural aquatic environment is

increasingly polluted leading to depletion of aquatic biota and water quality (Adakole *et al*., 2008 and Kawo *et al*., 2008). Impairment of water quality in reservoirs arises largely from anthropogenic contamination and natural mineralization (APHA, 1995 and Adamu *et al.,* 2014).The physical and chemical parameters serve as pollution indicators in water quality monitoring which is a fundamental tool in the management of fresh water resources (Balarabe 2001).

MATERIALS and METHODS

Study area Zuru is located on latitude 11.447616 N longitude 5.230179° E.

Water sampling

Water samples were collected for 8 months from the 3 sampling stations and taken to the Agriculture Physical laboratory of Usmanu Danfodio University Sokoto, Sokoto State, for some of the physico-chemical parameters and heavy metal concentration analysis. Each sample was filtered in the laboratory using Watman Brand filter paper of 0.45um to remove clay and other suspended colloids in the water sample. 100ml of the filtered sample was collected and stabilized with Nitric acid in each sample. The standard curves of Pb, Cr, Fe, Cd, Co, Ni, Zn and Cu were prepared bearing in mind that these elements occur in trace concentration. Standard solutions were prepared from 1000 parts per million (ppm) stock solutions. 1ml of the 1000 ppm was pipette into 100ml volumetric flask and made up with distilled water. This solution was 10 ppm of the solution. Temperature, dissolved oxygen and pH were measured *in-situ*.

Statistical analysis

Data collected was subjected to analysis of variance (ANOVA) and Duncan Multiple Range Test was used to separate the means where there was significant difference.

RESULTS and DISCUSSION

The results of the analysis as shown on Tables 1 and 2 showed the levels of concentration and distribution of some heavy elements in Zuru dam. The result showed that the levels of concentration of Pb at the lower and upper regions of the dam are both high with low standard deviation, Water quality as shown on Table 3. Lead is a chemical element in the carbon group. Immoderate intakes of Pb can intact nervous system and cause brain disorder. Pb is a neurotoxin that proliferates both in soft tissues and the bones (Wikipedia, 2013).

The level of mixture of Cr in the entire Zuru dam is high as shown on Tables 1 and 2, both the standard in the upper region are low, however they are high in the lower region.

Table 3: Cr is one of the trace elements that found as an exuberant element in the earth crust, its lexemes are found in the ecosystem due to erosion of chromium containing rocks and from other man made sources. Excessive exposure to Cr is suspected to be carcinogenic because of it bioaccumulation nature.

The concentration of Fe in Zuru dam is high, both the standard deviation at the lower region are low, but high at the upper region. The Zuru area contained a lot of biotitic rocks which release Fe through weathering into the drainage basin. High concentration of Fe in drinking water may cause turbidity, laundry and cooking materials; Fe has little direct and adverse health implications to humans but rather plays an important role in biology (Butu, 2012).

The concentration of Cd in the entire dam occurs as a minor component in most Zn ores and therefore a by-product of Zn production. It is a rare element, it is used as pigment and corrosion resistant plating, and it could also be used as nickel-cadmium batteries. Cd has no biological function in humans, but it could be toxic to the kidney when consumed in quantities above permissible limits (Wikipedia, 2013).

The level of concentration of Co in the dam is relatively high considering the fact that Co is a trace element that occurs only in combination with other minerals in the soil. Both the standard deviation and the coefficient of variation at the lower region are high, but low in the upper region. Although there are no guidelines limits for Co in drinking water, MOE (2001) reports that the toxicity of Co is quite low compared to other elements in the soil, however exposure to higher levels can be carcinogenic to humans because of the bioaccumulation nature of Co in the human tissues.

Table 4: The result of the study indicated maximum temperature and dissolved oxygen during dry and rainy seasons respectively. Highest biological oxygen demand was recorded after the rainy season while maximum value for hydrogen carbonates was obtained both during and after the rainy season. Meanwhile the highest concentrations after the rainy season perhaps due to excessive run-off into the dam, although the values still fall within the permissible levels as reported by. Temperature was negatively correlated to TDS, Increase in pH was also observed to moderately decrease the levels.

The level of concentration of Ni in Zuru dam is far below detectable level. Therefore, the dam is free of Ni contamination. The results of the analysis showed a low concentration of Zn with low standard deviation in entire Zuru. The level of concentration of Cu in Zuru dam is low with low standard deviation in the lower region, but higher standard deviation in the upper region.

Table 1: Concentration of Selected Heavy Elements in the Lower Region of Zuru Dam

Heavy elements	Highest Concentration (ppm)	Lowest Concentration (ppm)	Mean Concentration	Standard Deviation
Lead (Pb)	0.271	0.100	0.217	0.050
Chromium (Cr)	0.583	0.004	0.286	0.066
Iron (Fe)	2.641	0.557	1.112	0.305
Cadmium (Cd)	0.003	0.001	0.0005	0.0001
Cobalt (Co)	0.061	0.029	0.051	0.034
Nickel (Ni)	-0.0020	-0.0002	-0.003	-0.0001
Zinc (Zn)	0.168	0.010	0.121	0.0021
Copper (Co)	0.174	0.058	0.108	0.053

Table 2: Concentration of Selected Heavy Elements in the Upper Region of Zuru Dam

Heavy elements	Highest Concentration (ppm)	Lowest Concentration (ppm)	Mean Concentration	Standard Deviation
Lead (Pb)	0.221	0.042	0.160	0.050
Chromium (Cr)	0.834	0.039	0.340	0.208
Iron (Fe)	6.836	0.588	2,730	1.794
Cadmium (Cd)	0.001	0.000	0.0001	0.00001
Cobalt (Co)	0.957	0.002	0.169	0.142
Nickel (Ni)	-0.029	-0.010	-0.021	-0.004
Zinc (Zn)	0.450	0.011	0.126	0.048
Copper (Cu)	0.322	0.038	0.139	0.085

Table 3: Comparison of observed values of concentration of selected Heavy elements in Zuru Dam

Heavy elements	Lower Region	Upper Region
Lead (Pb)	0.119	0.121
Chromium (Cr)	0.216	0.310
Iron (Fe)	2.117	2.320
Cadmium (Cd)	0.0001	0.0001
Cobalt (Co)	0.161	0.165
Nickel (Ni)	-0.012	-0.022
Zinc (Zn)	0.160	1.36
Copper (Cu)	0.219	0.129

Table 4: Mean physico-chemical parameters of Zuru Dam.

Parameter	Jan,2019	Feb,2019	March,2019	April,2019	May2019	June,2019	July,2019	Agust,2019
Temp	23.27±0.06	24.22±0.01	25.35±0.01	25.52±0.01	27.65±0.50	26.76±0.50	28.54±0.10	25.67±0.50
pH	5.51±0.01	6.35±0.110	6.57±0.10	6.70±0.10	6.75±0.50	6.34±0.50	6.46±0.50	6.21±0.10
DO	6.57±0.12	6.11±0.10	6.54±0.10	6.65±0.15	6.75±0.10	7.11±0.10	6.52±0.50	6.27±0.10
BOD	25.00±0.01	23.45±0.50	18.57±0.50	21.15±0.10	19.55±0.10	20.47±0.50	20.27±0.50	22.56±0.50
TDS	6.67±0.56	5.44±0.50	6.43±0.50	5.21±0.50	5.77±0.10	4.78±0.10	4.81±0.10	3.25±0.50

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EFFECTS OF TWO MODELS INSTRUCTIONAL STRATEGIES ON STUDENTS' KNOWLEDGE OF CLIMATE CHANGE CONCEPTS IN SOCIAL STUDIES FOR SUSTAINABLE DEVELOPMENT

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ABSTRACT

In recent times, human activities have resulted into various climate change and environmental disasters such as drought and deforestation, depletion of ozone layer, flood and global warming as well as industrial pollution. In a sustainable development ideology, the use of natural resources and ecosystem is pivotal to our ways of life through planning, organization, and controlling available resources meaningfully, hence the need to empower human being with behaviour modelling, information acquisition and sharing to ensure desirable change. Therefore, this study determined the effects of mentoring and field study instructional strategies on students' Knowledge of climate change concepts in social studies in Lagos State, Nigeria. It also determined the moderating effects of gender and school location on Students' Knowledge of climate change. The pretest-posttest, control group, quasi-experimental design with a 3 x 2 x2 factorial matrix was used. Participants were 284 Junior Secondary II students (143 males and 141 females).The multi-stage sample procedure was used to purposively select sample for this study in Lagos - Island and Lagos Mainland (Education District III and V). Participants were randomly assigned to Mentoring (100), Field study (96) and Conventional strategies (88). Treatment lasted ten weeks. Four instruments were used: Student Knowledge of Climate Change Test (SKCCT)(r=0.96),Teachers' Instructional Guides for Mentoring, Field study and Conventional Strategies. The SKCCT was validated using the Kuder-Richardson formula (K_r 20) and a coefficient of 0.77 was obtained at 0.05 level of significance. Treatment had significant main effects on students' knowledge of climate change concepts ($F_{(2,271)}$ =11.86, η^2=0.08). Students in mentoring strategy group had highest mean knowledge score ($\bar{x}$=12.35), followed by their counterparts in field study ($\bar{x}$=11.88) and control group ($\bar{x}$=10.67). Therefore,

the finding of this study affirmed the fact that a person's appraisal of a situation is likely to be influenced by personal characteristic and influences to which such a person is exposed, for example, his/her knowledge about the environment may affect his/her view of the seriousness of climate change and the norms of people with what he associates may influence his/her appraisal of his/her responsibility for helping solve such problems that demand environmental friendliness, preservation, conservation and sustainability, since the descriptive statistic for the knowledge posttest scores show that the treatment has significant main effect. While gender and school location has no significant main effect on students' knowledge of climate change concepts. However, teachers should adopt mentoring, field study and conventional instructional strategies for effective teaching and learning outcomes on climate change concepts in social studies in Lagos state, Nigeria.

Keywords: Mentoring and Field-study strategies, Students knowledge, Climate change concepts, Social studies, Lagos State, Nigeria, Sustainable development

INTRODUCTION

Social Studies is concerned mainly with the reciprocal relationship between human, social and physical environment, which encompasses climate and weather. Climate and weather are important natural phenomena. The study of climate and weather involves a number of elements such as the earth's energy, temperatures, wind systems and rainfall patterns. Human activities have an increasingly important impact on the environment, such as climate change, urban climates and the destruction of the ozone layer. Climate change is one of the most topical issues in the world today. Scientific evidence has revealed that it is an all-encompassing threat; it is considered the most serious threat to the survival and sustainable development of humanity, because of the human activities that release large volumes of gases (particularly carbon dioxide) into the atmosphere which cause changes in the earth's climate. Its impact is real and is being felt globally. Climate change as defined by UNCCC is a change of climate attributed directly or indirectly to human activities that alter the composition of the global atmosphere; observed over time (Mings, 2008, Oyekanmi, Amosun and Adelekan, 2018).

Intergovernmental Panel on Climate Change (2007) Fourth Assessment Report (AR4) and Intergovernmental Panel on Climate Change (2014)Fifth Assessment Report (AR5) gave one of the most acceptable definitions of climate change, as the mean and/or the variability of properties that persists for an extended period typically decades or a time. Climate change is a phenomenon that threatens human existence such as sea level rise, high temperatures, and changes in the frequency and intensity of tropical storms. These are the concerns and interest of Social Studies; the study of human being in totality. Also, it is the study of human being's influence on the physical and social environments and vice-versa (Akinlaye, Mansaray and Ajiboye, 1996). Human being's activities directly and indirectly influence the eco-system resul`ting in climate change. Climate changes are already having or are likely to have, effects that can cause serious harm to humans and the planet - including rising seas that can flood low-lying areas, droughts, increased diseases, and extinction of many animal species. The fact that climate change is occurring as a result of human actions; coupledwith serious dangers, urgently calls for a change in people's behaviour.

The causes of climate change are as a result of anthropogenic factors. Research has shown that in the past few decades, anthropogenic factors like urbanisation, deforestation, population explosion, industrialisation and the release of greenhouse gases (GHGS) are the major contributing factors to the depletion of the ozone layer, its associated global warming and climate change (Buba, 2004; Odjugo, 2007).The on-going climate change and its associated global warming are expected to cause distinctive climate patterns in different climatic zones, which will impact negatively on the ecosystem (Mshelia, 2005). Perhaps this is the reason Ojo (1991) and Clerk (2002) advised that weather and climate should not be taken for granted in the pursuit of technological development, exploration and processing of environmental resources. Available evidences show that climate change is global, likewise its impact, but the biting effects will be felt more by the developing countries especially those in Africa due to their low level of coping capabilities (Nwafor, 2007). The greenhouse effect is a naturally occurring phenomenon, actually useful as it regulates atmospheric temperature to keep the temperature on our planet suitable for living things. However, the increase in the amount of GHGS is not good; it can cause the temperature of the earth to increase out of control (Papadimitriou, 2004; Odjugo, 2009; Oladipo, 2012).

Studies have shown that Nigeria is already being plagued with diverse ecological problems, directly linked to the ongoing climate change (NEST, 2003; Ikhile, 2007). These studies focused more on climatic impact. Studies that addresses climate trend in Nigeria cover either short period or small area (Oladipo, 2012, Oyekanmi, Amosun and Adelekan, 2018). Singer and Avery (2007) reveal that it takes at least a century of weather data to evaluate climate trend for appropriate conclusion to be drawn. Nigeria has a total area of 924,000 sq km and occupies about 14% of land area in West Africa. The country lies between 4°N and 14°N, and between 3°E and 15°E. Nigeria is located within the tropics and therefore experiences high temperatures throughout the year. Average maximum temperatures vary from 32°C along the coast to 41°C in the far North, while mean minimum figures range from under 13^0C in the costal area to 21°C in the North. The weather of the country varies from a very wet coastal area with annual rainfall greater than 3,500 mm to the Sahel region in the North-West and North-East parts, with annual rain1fall less than 600mm. With respect to the geographical features of Nigeria, and the

country's high vulnerability index as a developing nation, the adverse impact of climate change will affect the core areas of our national circumstances (Adefolalu, 2007; Oladipo, 2012).

The most crucial things about the concept of climate change is not only the time or periods involved but also the degree of variability that the change is subjected to as well as the duration and impact of such variability on man and the ecosystem. Consequently, Nigeria's efforts and actions must be informed by these realities. For example, it is estimated that in the Sudan-Sahel area of Nigeria, between 89,297 and 133,944 square kilometers of arable land would be at risk. It is estimated that the capital value at risk stands at about US$6.4 billion for the current level of development, (NCCC, 2003). Faced with such a threat, collective action among countries has become a necessity. Notably, a number of countries have been working together to reduce emissions: Vienna Convention in 1985, Montreal Protocol in 1987, Rio Declaration in 1992, Kyoto Protocol in 1997, Buenos Aires Climate Summit in 1998, Marrakesh Agreement in 2001, Bali-Climate Change Conference in 2007, and Ponzan Climate Conference in 2008. In December 2009, Nigeria like many other countries had the opportunity to address its climate change issues at Copenhagen, Denmark and recently, in Paris from November 30th to December 11th, 2015 (Oyekanmi, Amosun and Adelekan, 2018).

Theoretical Framework

In Bruner's constructivist theory, students' engage in discovery learning obtaining knowledge by them. They select and transform information, construct hypotheses and make decisions, relying on a cognitive structure to do so. In order for discovery to occur, students' require background preparation in the form of a cognitive structure that provides meaning and organisation to experiences and allows the individual "go beyond the information given ".Bruner emphasized teaching as a means of enhancing cognitive development; hence the task of the teacher is to translate information to be learned into a format appropriate to the students' current state of understanding. The instructor should try and encourage students' to discover principles by themselves, and students' and teachers should engage in an active dialogue (Socratic learning). Curriculum should be organised in a spiral manner so that students continually builds upon what they have already learned.

Bruner (1973) stated that most constructivists, call for instructional intervention, that is, for teachers to provide learning activities designed not only to match but to accelerate movement through developmental stages. They also feel education should provide learners with more

opportunities for cognitive growth through exploration, unstructured learning and problem-solving, since teachers could encourage active participation of students' in the teaching and learning process. Active- participation of students' was best achieved by providing discovering-learning environment that would let students' explore alternatives and recognise the relationship between ideas and skills (Oyekanmi, Amosun and Adelekan, 2018, Oyekanmi, 2019).

Hypotheses

The following null hypotheses were tested at 0.05 level of significant;

H_{O1}: There is no significant main effect of treatment on students' knowledge of climate change.

H_{O2}: There is no significant main effect of gender on students' knowledge of climate change.

H_{O3}: There is no significant main effect of school location on students' knowledge of climate change.

Methodology

For the purpose of data analysis, a 3x2x2 factorial design was adopted in the study.

The population of this study comprised all secondary school students' in Lagos State, Nigeria. The participants of the study were made up of 284Junior Secondary School students' from Education Districts III and V, consisting of 143 males and 141 females. The Multistage sampling procedure was used to select the sample for the study. First, Lagos State schools were stratified into six education districts (Education Districts I to VI) .Second, based on location, the researcher purposively selected education districts III and V to represent Lagos Island and Mainland schools, using the random sampling technique to identify the sample for this study through balloting. The Junior Secondary Two(JSS2) Social Studies students' were sampled and selected, as intact classes for this study. The criteria for selection of participating schools include: (a) Schools that have presented candidates for the Junior Secondary Schools (JSS) Certificate Examination in Social Studies for ten-years. (b) Schools that have qualified Social Studies teachers with at least Bachelor's Degree in Social Studies Education (B.Ed).(c) Schools in which all the topics to be covered in this study had not been taught. The researcher personally discussed with the Social Studies teachers in these schools. The criteria for participating in the study were spelt-out to them in form of questions which the teachers

answered**.** Student Knowledge of Climate Change Test (SKCCT); were made to undergo a two-phase validation test. The SKCCT was validated using the Kuder-Richardson formula (K_r 20) and a coefficient of 0.77 was obtained

RESULTS

Section A: Testing the Null Hypotheses

H_{O1} : There is no significant main effect of treatment on students' attitude to climate change concept.

Table 1. Summary of 3 X 2 X 2 Analysis of Covariance on Students' Knowledge of Climate Change

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	192.751[a]	12	16.063	3.036	.001	.118
Intercept	3130.308	1	3130.308	591.598	.000	.686
Preknow	15.559	1	15.559	2.940	.088	.011
Trtmt	125.452	2	62.726	11.855	.000	.080
Gender	1.977	1	1.977	.374	.542	.001
Schlloc	14.447	1	14.447	2.730	.100	.010
trtmt * Gender	10.445	2	5.222	.987	.374	.007
trtmt * Schlloc	36.523	2	18.262	3.451	.033	.025
Gender * Schlloc	.830	1	.830	.157	.692	.001
trtmt * Gender * Schlloc	6.397	2	3.198	.604	.547	.004
Error	1433.936	271	5.291			
Total	39995.000	284				
Corrected Total	1626.687	283				

. R Squared=. 118 (

Table 1 reveals there is a significant main effect of treatment on students' attitude to Table1 reveals there is a significant main effect of treatment on student knowledge on climate change ($F_{(2, 271)} = 11.86$; $p<0.05$; $\eta^2= 0.08$). Therefore, H_{01a} is rejected. Table 2 presents the estimated marginal means that reveal the magnitude of performance across the groups.

Table 2: Estimated Marginal Means on Student Knowledge of Climate Change

Variable	N	Mean	Std.Error
Intercept			
Pre score	284	8.651	-
Post score	284	11.631	.142
Treatment			
Control	88	10.665	.262
Experimental I (Mentoring)	96	12.354	.241
Experimental II (Field study)	100	11.875	.239
Gender			
Male	143	11.718	.198
Female	141	11.544	.203
School Location			
Mainland	123	11.867	.215
Island	161	11.395	.187

Table 2 shows that students exposed to mentoring had the highest knowledge mean score (12.35), followed by those exposed to field study strategy (11.88), while those in control group who were exposed to conventional strategy had the least knowledge mean score (10. 67). Table 3 presents the Scheffe's Pairwise post hoc test in order to detect the source of the significant difference.

Table 3: Scheffe's Pairwise Comparison on Student Knowledge of Climate Change

Treatment Group	Control	Experimental I	Experimental II
Control		*	*
Experimental I	*		
Experimental II	*		

Table 3 reveals that the significant effect revealed in Table 1 is due to the significant differences between:

Control group and experimental group I

Control group and experimental group II

But there is no significant difference between those exposed to experimental groups I and II in their knowledge. This implies that those exposed to experimental groups I and II performed significantly better than those exposed to the conventional strategy.

H_{02}: There is no significant main effect of gender on students' knowledge of climate change concepts.

Table.1 reveals there is no significant main effect of gender on student knowledge of climate change ($F_{(1, 271)} = 0.37$; $p>0.05$; $\eta^2= 0.00$). Therefore, H_{02} is not rejected. This implies that student gender had no significant effect on their knowledge of climate change concepts.

H_{03}: There is no significant main effect of school location on students' knowledge of climate change concept.

Table 1 reveals there is no significant main effect of school location on student knowledge of climate change ($F_{(1, 271)} = 2.70$; $p>0.05$;$\eta^2= 0.01$), therefore, H_03 is not rejected. This implies that school location had no significant effect on students' knowledge of climate change concept.

DISCUSSION OF FINDINGS

Effects of Treatment on Students' Knowledge of Climate Change Concepts

In Table 1 and 2, the success of the Experimental groups 1 and 2 over their counterparts in the Control group may not be unconnected with the level of their participation in the learning process. It should be noted that while Mentoring and Field study instructional strategies emphasized participatory teaching and learning process based on positive forms of interdependence, interaction, individual and collaborative accountability as well as development of practices, the Conventional method of teaching and learning process did not favour nor allow the pattern of teaching and learning process called participatory learning or active learning rather the learners were usually passive. The result empirically supports other earlier findings on students' knowledge of environmental issue, especially climate change (Gbadamosi, 2012;Adelekan, 2009;Ajiboye 2008;Ajiboye and Silo, 2008;Adelekan and Gbadegesin, 2004; Okebukola, 2001). Mentoring and Field study instrumental strategies directly contribute to teaching and learning and provide a good support function to learners of climate change concepts in social studies because of active learners participation, and interaction of learners that Conventional method which does not provide such experiences (Salako, 2014; Gbadamosi, 2012; Bradfield and Hudson, 2011; Hudson, 2010;Snowman,

Dobozy, Scevak, Bryer, Barlett and Biehier, 2009;Ajiboye and Silo, 2008; Olatundun, 2008; Ajiboye, 2006; Adekunle, 2005; Ajitoni, 2005;Bruner, 1973).

A person's appraisal of a situation is likely to be influenced by personal characteristic and influences to which such a person is exposed, for example, his/her knowledge about the environment may affect his/her view of the seriousness of climate change and the norms of people with what he associates may influence his/her appraisal of his/her responsibility for helping solve such problems (Kolmuss and Agyeman, 2002).The lower knowledge score recorded in Conventional method group, reinforced the opinion of Olatundun (2008); Ajitoni (2005); and Kola- Olusanya (2006) as minimal student participation usually found in traditional classroom where teachers' dominate classroom interaction, where the learners are inactive or passive listeners in the study, which implied that the treatment has significant main effect: Ho1a is rejected.

Effects of Gender on Students' Knowledge of Climate Change.

In Table 2, the result of this study shows there was no significant main effect of gender on students' knowledge of climate change. Apparently, there were differences in the students' knowledge score on climate change. It's obvious therefore, that H02 is not rejected, which implied that students' gender had no significant main effect on their knowledge, The findings of this study is in line with Falaye and Okwilagwe (2016); Gbadamosi (2012) and Salako (2014) that certain variables such as gender does not capably influence learning outcomes but in conflict with MacDonald and Hara (2010); Olatundun (2008) and Adekunle (2005) who affirm that females had higher environmental knowledge and attitude mean score compare to their male counterparts. From the non- rejection of Ho2 above, it means gender has no significant influence on students knowledge, attitude and practices towards climate change irrespective of instructional strategy adopted.

Effects of School Location on Students' Knowledge of Climate Change.

Table 1 and 3, it was obvious that there is no significant main effect of school location on students' knowledge of climate change; therefore, Ho3 is not rejected. The non- rejection of Ho3 implies that school location had no significant main effects on students' knowledge and

attitude to climate change. Schools in Lagos Mainland area of this study had post knowledge mean score (11.86) and schools in Lagos Island area of this study had post knowledge mean score (11.40).The results might be attributed to the fact that Lagos Mainland students' might have been confronted with more of climate change issues and problems in their areas than their Lagos Island counterparts. Also, it is probable that the mastery of the climate change concepts were better understood by Lagos Mainland students than Lagos Island students. Students' living within Lagos Mainland area had higher climate change knowledge and positive attitude than students within Lagos Island area, these differences are not significant. This finding might be as a result of individual differences in behaviour of students, tropological variability of learning environment, students level of understanding coupled with the monthly sanitation programme' in Lagos State, constantly monitored by the Lagos State Ministry of Environment (MoE) to ensure environmental friendly culture among her citizens. The findings corroborate Oladipo (2012);Adelekan (2009); Ajiboye (2008); Ajiboye and Silo (2008);Adefolalu (2007);Nwafor (2006); Adelekan and Gbadegesin (2004)that education leads to informed and reformed actions. Therefore, students' awareness of climate change resulted in right action practices across the study areas.

Implication of findings

The findings of this study had shown that Social Studies as a school subject is better taught using mentoring and field study instructional strategies than the conventional instructional strategy in Junior Secondary Schools. The higher learning outcomes of students exposed to mentoring and field study instructional strategies have implications for teaching of climate change concepts which suggests a paradigm shift from teacher-centred-teaching and learning process to child-centred-teaching and learning process. The teaching and learning strategies that allow critical thinking, problem-solving skills acquisition, enhance contextual learning skill, promote good communication skill, ensure information and media literacy skill, inculcate creative and innovative skill, as well as collaborative skill coupled with sense of responsibility in learners should be encouraged.

CONCLUSIONS

These strategies generally enable the students' to benefit from experiences of adults who are specialists and experts in Social Studies, who encourage them to develop their own creative and innovative skills focused on problem –solving, for a better-friendly and sustainable

environment. Also, gender and school location had no significant effect on students climate change KAP in Social Studies, therefore, mentoring and field study instructional strategies are effective for teaching and learning of climate change concepts in Social Studies in schools in Lagos State.

Recommendations

In course of the findings of this study, the following recommendations are made:

1. Mentoring instructional strategy boost students' learning outcomes in climate change concepts in social studies.
2. Field study instructional strategy enhanced students' attitude and reduction practices towards climate change better than the mentoring and conventional instructional strategies
3. Activity–based strategies have great potentials at enhancing students' learning outcomes in climate change concepts in Social Studies.
4. Campaign and advocacy are needed to improve students' attitude towards greener behaviour.
5. Students should take advantage of the greener environment to enhance entrepreneurial skills for job creation.

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ECONOMIC THOUGHT OF INDONESIAN MUSLIM SCIENTISTS (COKROAMINOTO, SYFRUDIN PRAWIRANEGARA, MOH. HATTA, H. ABDUL MALIK KARIM AMRULLAH)

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ABSTRACT
Islamic economic philosophy has a unique style of thought that changes with the times and eras. The style of Islamic economic philosophy during the Pre-Independence and Old Order eras was distinct from that of Islamic economic thought during the New Order era. Islamic economic thinking, which first appeared during the New Order, has a different approach. The Islamic economic ideas that developed under the New Order were also distinct from those that developed following the New Order's demise. Finding out the economic beliefs of Indonesian Muslim scientists Cokroaminoto, Syafruddin Prawiranegara Moh. Hatta, and H. Abdul Malik Karim Amrullah is the goal of this study. This paper was written using a library research strategy that drew from books and journals on the economic theories of Indonesian Islamic academics. According to the study's findings, there are disparities between each figure in terms of the degree of practical experience and actual application of Indonesian Muslim scientists' economic activities.
Keywords: Thoughts, Economy, Scientists, Difference

1. INTRODUCTION

As far as is known, economic thought first appeared in Ancient Greece. The Greek words oikos and nomos, which imply the organization or management of a household, combined to form the English word economy. Philosophy still includes discussions about economics in ancient Greece. In those days, ideas about economics were often connected to a sense of justice, worthiness, or appropriateness that should be taken into account to build a fair and evenly prosperous society. (Deliarnov : 2015, 11-12) One aspect of economic philosophy that is sometimes overlooked by academics is the contribution of Muslim intellectuals. This is due to the fact that economists in the West rarely clearly acknowledge their borrowings from the canonical works of Islamic science. This "great gap" in 500 years of economic thought is what Josep Schumpeter referred to (Euis Amalia: 2005, 69). The history of economic theory first appeared in the fourth century BC and was revived when Thomas Aquinas of the Scholastic school debuted in the thirteenth century AD.

The "Great Divide" has made the economic theories of Muslim scholars less well known, even though the peak of Islamic civilization, from the sixth to the twelfth centuries AD, produced many works from Muslim scholars in various scientific fields, including in philosophy, state, medicine, and economics. Islamic figures are credited with the creation of many works in the field of economics between the sixth and thirteenth centuries CE. Take Abu Yusuf, who lived between 731 and 798 CE. His contribution in the field of taxation is considered the canon of taxation as he established the principles of taxation that are still used today, and another example is Ibn Taiymiyah, who in his book, Majmu' Fatawa (1263-1328 CE), outlined the workings of markets and prices. The collapse of Islamic economic theory was caused by colonialism in addition to the Great Divide discussed above. Muslim countries experienced significant political and social difficulties in the early 19th and 20th centuries, especially in their efforts to free themselves from colonialism. The main movements and ideas that developed were how to fight colonialism and achieve independence as the growth of thought in the field of economics was not a major issue. Given the prevailing circumstances, current thinking and theories in economics are focused on political ideologies and societal goals. No attempt was made to develop an all-encompassing Islamic economic philosophy. In that period, Islamic economic theory was pragmatic and compulsive. When the International Conference on Islamic

Economics was held in Jedah in 1976, a new chapter in the evolution of Islamic economic thought was opened. The conference, attended by leading Muslim figures, sought to examine how Islamic principles could advance global trade. It is believed that Arab, Persian and Indian traders brought Islam to Indonesia with them, and made Islamic economics a common practice (Hukum & Syariah, n.d.).

2. RESEARCH METHOD

The research method for this article uses the literature method or literature study. Literature studies are used to study reading sources that can provide information that has to do with the problem being studied. Reading, jotting down, and processing research materials are all part of the literature study process, which also involves looking for research information by reading academic texts like encyclopedias and scientific publications. Reading scientific journals, reference books, and published materials that are available in libraries and on the internet to find research data or information. Publication materials are accessible online and in libraries. The descriptive analysis method used in this study evaluates the data before providing readers with an explanation and knowledge of the article's content. Relevant to the article's subject matter for readers.

3. RESULTS AND DISCUSSION

1. Islamic Economic Thought of H.O.S Cokroaminoto

1) Biography

On August 16, 1882, Raden Mas Hadji Oemar Said Cokroaminoto was born in Bakur. A village that is part of East Java's Madiun district. The fabled Mount Krakatau eruption occurred in the same year. Many ancient Javanese communities believed that infants born during Mount Krakatoa's eruption would be capable of accomplishing great things in the future. a hopeful notion that initially looks lofty but later turns out to be true. This was demonstrated by the emergence of Sarekat Islam, which developed rapidly under the direction of HOS Cokroaminoto. SI became the biggest mass organization at that time as a result.

Before becoming known as HOS Cokroaminoto, his family called him Oemar Said. HOS Cokroaminoto has the genetics of a scholar and a bureaucrat, according to his family tree. He

was R.M. Tjokroamiseno's son. a Wedana-level government employee in Kleco, Madiun. The R.M. Adipati Tjokronegoro was his grandfather. He had been the Ponorogo Regent. In Ponorogo, his great-grandfather was a well-known academic. Kyai Hasan Besari was his name. Tegalsari Ponorogo is the school's caretaker at Gebang Tinatar Islamic Boarding School. Given his family genealogy, it is not unexpected that HOS Cokroaminoto developed into a successful politician and dependable religious leader. Hos Cokroaminoto was the second of twelve kids to be born. He was married off by his parents to R. A. Soeharsikin when he was twenty (about 1902). a descendant of R. M. Mangoensoemo, who at the time was Ponorogo's deputy regent. HOS Tjoroaminoto was fortunate to have five children from this union. The individuals in question are Siti Oetari, Oetarjo alias Anwar, Harsono alias Moestafa Kamil, Siti Islamijah, and Soejot Ahmad (Mahardi, 2020).

2) Economic Thought

Tjokroaminoto is renowned as a national leader in religious (Islamic) socialism. He introduced the concept of socialism based on Islam for two reasons. The socialism started by Karl Marx differs from the Islamic socialism started by Tjokroaminoto in its foundation. Marx's scientific socialism was built on his historical materialism theory. The word "Islam" is used in his thought process not just for pragmatic-empirical reasons but also to give the principles of religious socialism a deeper meaning, namely the strengthening of the moral foundation of social objectives. Tjokroaminoto's perspective on ownership differs significantly from socialism's definition of ownership. There are two laws governing property ownership in socialism, according to Tjokroaminoto. The first is that the ownership (eigendon) of the means of production should be transferred to the gemeenschap.Second, the gemeenschap should decide what should be released or distributed as far as the products are concerned. Tjokroaminoto disagreed with the above-mentioned socialism concept of property ownership, because, in his view, Islam-based socialism does not regulate private property ownership. Islam strictly controls how people acquire property and how they use it. The maxim "the greatest security for the greatest number of people" thus becomes the guiding philosophy. In short, everyone has the right to own property, but when it comes to land ownership, things are different. For Tjokroaminoto, the existence of land served as the foundation for all output and all significant industrial operations. Therefore, the State should have authority over land ownership. He

claimed that this was in line with the example set by the Prophet when he held state power. Tjokroaminoto was an outspoken opponent of usury. Usury, in Tjokroaminoto's view, is the act of taking advantage of other people's earnings (meewaarde), and was not just confined to woeker, a high interest rate. Meewaarde includes doing things like taking advantage of others' hard work, not giving them their fair portion of the rewards, and engaging in other similar behavior. From the foregoing argument, it is clear that Tjokroaminoto took the prohibition of usury a step further by viewing it as a means of exploitation of others as well as an addition to the loan (interest). Tjokroaminoto attempted to explain usury by fusing the Islamic notion of usury with Karl Marx's meewaardee to criticize capitalism. He claimed that because meewaarde earnings constitute a component of eating usury, they are categorically forbidden by Islam.

Tjokroaminoto derived the idea of meewaarde and usury and came to the conclusion that Islam opposes capitalism from its "seed" forward. The application of the fundamental principle, or principle of brotherhood, is shown by the prohibition of usury. Islam categorically forbids usury and the collection of rent (interest) in any way, as it is based on the idea that all of God's creatures are brothers and must support one another. The root of capitalism, "meewaarde" or usury, which unmistakably leads to the extinction of humanity and the devastation of the planet. By forbidding it, Islam stops the rise of capitalism, battles it from the start, and eradicates it from the ground up. Tjokroaminoto provided an explanation of zakat and alms as the application of the values of generosity and fraternity. He claims that the socialistic foundation of the Islamic rule of generosity is as follows: First, it fosters a sense of self-sacrifice and a preference for the needs of the community above one's own. Second, distributing money evenly in the Islamic World because it elevates zakat giving to a fundamental Islamic principle. Thirdly, it influences people's emotions to make them less ashamed of poverty and to make them prefer it to crime. In Islam, certain saints favor a life of squalor.

2. Islamic Economic Thought of Syafrudin Prawiranegara

1) Biography

On February 28, 1911, Syafruddin Prawiranegara was born in Anyer Kidul, Serang. Syafruddin is referred to as "Kuding" by his minangkabau and bantense mixed ancestry.196 An authority in law, finance, and religion, Syafruddin Prawiranegara is an Indonesian National Hero. Syafruddin Prawiranegara is a Muslim statesman who made significant contributions to the

Republic of Indonesia's independence and governmental structure. On February 5, 1989, Syafruddin Prawiranegara passed away.Arsyad Prawiraatmadja and Noeraini gave birth to Syafruddin Prawiranegara. The mixed blood of Banten flowed in Syafruddin Prawiranegara. His father was a descendant of Patih Haji Raden Haji Chatab Aria Prawiranegara, who had ruled Serang Regency as patih in 1879-1884. His father was still a descendant of an influential nobleman known as the Sultan of Banten, who ruled Banten in the 1890s. Sutan Alam Intan, his maternal great-grandfather, was a devout priayi and descendant of the King of Pagaruyung in West Sumatra; his ancestors came from Minangkabau. Syafruddin Prawiranegara's parents split when he was a year old, and his father later remarried Raden Suwela. When Syafruddin Prawiranegara was seven years old, he met his original mother, but as he was still a kid, he was unaware of it. He got to know the family from his biological mother's side through this encounter. such as Moehammad Mangoendiwirja, his mother's older brother and the sub-district chief at the time in Carenang, Banten. However, his stepmother was friendly to him, and his older sister Siti Maria raised him until they were grown ups, treating them as his own biological children rather than as stepchildren. in order to prevent Syafruddin Prawiranegara from feeling that the mother who had been raising him all this time was not his biological mother.

Syafruddin Prawiranegara and his sister Siti Maria came to understand that they had two mothers who loved them both deeply as they grew older. Syafruddin Prawiranegara was raised in a religious household. Beginning at a young age, he studied the Koran. His father worked as a prosecutor in Serang and was related to Raden Aria Adipati Achmad Djajadiningrat, the Regent of Serang during the Dutch era. Syafruddin Prawiranegara was of noble descent in Banten. Tengku Halimah Syehabuddin, often known as Lily, was Tengku Syafruddin's wife. She was Radja Sahaboeddin's daughter. The union of Syafruddin and Liliy finally produced eight children, four boys and four girls. Aisyah, Salvyah, Chalid, Farid, Chalidah, Faridah, Rasyid, and Yazid were the names given to the first child. Syafruddin decided to become a preacher or da'i in his elderly age. On February 15, 1989, Syafruddin passed away in Jakarta at the age of 77.

2) Economic Thought

Between the capitalist and socialist economic systems, Sjafruddin Prawiranegara positions the Islamic economic system in the middle. According to Sjafruddin Prawiranegara, the fundamentals of the Islamic economic system are the same as those of the economic systems that are dominant in non-Islamic nations. First, both individuals and the community as a whole have the same goal, which is to satisfy life's many requirements. Second, there are shared values, also known as economic motives, according to which no person or group wants to put in more effort than is necessary to meet their requirements. Numerous elements, including geographical conditions, customs, and religion, have an impact on the difference. He defines the Islamic economic system as one that follows the economic principles that direct its operation and is inspired by and constrained by Islamic teachings. According to Sjafruddin Prawiranegara, ownership in Islam serves the aim of seeking Allah SWT's pleasure rather than pursuing the prosperity of possessions and objects. According to Islamic economic theory, humans are both homo economicus and homo religiosus (Sjafruddin Prawiranegara: 2011, 136). In other words, property rights have a societal purpose in addition to being personal rights. Islam recognizes both individual and collective property rights equally, but does not permit the use of a right in a way that disregards the interests of those who are less capable. Islam therefore does not offer a defense for the rise of a brutal capitalism that does not value humanity. Sjafruddin Prawiranegara holds views on usury and interest that diverge from those of economists and Muslim academics in general. In his opinion, bank interest is not usury. He contends that if anyone holds the view that interest is usury, it is because experts are unaware of the role interest plays in boosting local output. Usury was seen as an exploitative system by Sjafruddin Prawiranegara in the areas of production, distribution, and consumption.According to Sjafruddin Prawiranegara (2011: 375), this interpretation of QS. Al-Baqarah 275 assumes that all forms of trade are permissible. Sjafruddin Prawiranegara believes that although trade is a halal activity, it becomes illegal when it is done under duress. Allah justifies making Money through commerce, but only if it is done voluntarily and with good faith on the part of both parties.

He holds that transactions based on mutual consent between sellers and buyers, which do not seek to take other people's rights against their will or permission, and which avoid batil

and fraudulent behavior are permitted by Allah. These transactions must also be free of any elements of fraud or abuse of power, including political, economic, and other types. Usury, according to Sjafruddin Prawiranegara, is defined as any benefit made via a deal or agreement in which one party takes unfair advantage of his or her strong financial position to push his or her weak rival's financial limits. Therefore, the profit made by the robust economy becomes usury if a transaction is not based on mutual consent but rather because one side is obliged to comply since there is no other option (Sjafruddin Prawiranegara: 2011, 320). Riba is any form of profit that, on the surface, complies with the law but, in reality, is "exploitation de l'home par l'home" done covertly rather than by coercion.

Sjafruddin Prawiranegara began his ideas on zakat by analyzing the class structure. He questioned the Marxist and socialist theories that called for the abolition of class distinctions through revolution. According to Sjafuddin, there will always be rich and poor in this world as long as there are people. Islam does not support escalating social tensions and class disputes. Islam acknowledges social class disparities, but it also promotes giving through zakat. Thezakat problem that needs to be addressed today is that the zakat laws that were established in the 7th century AD may not be suitable for the circumstances of modern society. Such zakat laws, in Sjafruddin Prawiranegara's opinion, are only appropriate for a basic society with a manageable population and a primarily agricultural and zoological-based economy. Additionally, they only recognize a small amount of silver and gold currency at this time (Sjafruddin Prawiranegara: 2011, 238). Due to the fact that situations in modern society are different from those of the people who lived in the 7th century AD, it is important to open a fresh interpretation of zakat (Mubarok, 2021).

3. Islamic Economic Thought of Moh. Hatta

1) Biography

Mohammad Hatta was born on August 11, 1902, in Bukittinggi, according to the Ministry of Education and Culture's (Kemdikbud) official website. A popular comparison between Soekarno and the Indonesian independence fighter known as Bung Hatta is made. Bung Hatta is renowned for being a liberation warrior as well as an organizer, political party activist, statesman, proclaimer, cooperative pioneer, and Indonesia's first vice president. Hatta was Muhammad Djamil and Siti Saleha's second child. Heikh Abdurrachman or Sheikh Batu Hampar, a sizable and well-respected scholar in West Sumatra at the time, was his grandfather.

Hatta departed Minang during his adolescent years to finish his education at the Prins Hendrik School of Commerce in Batavia. Hatta relocated to the Netherlands in September 1921 to enroll at Handels Hogeschool, which is today known as Erasmus University Rotterdam. Hatta was familiar with and had led organizations in the Netherlands that sought independence from colonization.

Hatta was imprisoned because of his political actions. While in Europe, Hatta not only concentrated on the movement but also expanded his understanding of cooperation. According to reports, he traveled to several Scandinavian nations, notably Denmark, to learn more about the five economic tenets that the Indonesian Association in the Netherlands had established under Hatta's direction. "Advancing agricultural cooperatives and people's banks" is one of them. After that, Hatta came back to the nation in July 1932. He continued to be enthusiastic about politics and even increased it.

Hatta was imprisoned by the Dutch colonial administration several times before being sent into exile. The constant effort was successful. On August 17, 1945, Hatta and Soekarno declared Indonesia's independence. In addition, he was chosen to serve as President Soekarno's First Vice President of the Republic of Indonesia (Detik.com, 2023). Hatta was involved in politics but also kept an eye on the economy. The cooperative movement is being supported by one of them. He gave several seminars, produced scholarly articles and books on economics and cooperatives as a result of his background, which is still tied to economics. On July 17, 1953, at the Indonesian Cooperative Congress in Bandung, West Java, Hatta received the honorary title "Father of Indonesian Cooperatives" even in Exchange for his contributions.

In 1951, Moh. Hatta spoke on the radio to commemorate Cooperative Day. The 1971 book "Building Cooperatives and Building Cooperatives" presented one of his ideas on cooperatives. At the Indonesian Cooperative Congress in Bandung in 1953, Moh Hatta was given the honorary title "Father of Indonesian Cooperatives." Although Moh. Hatta is referred to as the "Father of Indonesian Cooperatives," he did not create the country's first cooperative. The first cooperative in Indonesia was established in 1886 by R. Aria Wiraatmadja, a Purwokerto patih. Under the name Hulf Sparbank, this cooperative operated as a savings and loan institution.

After spending 11 days in the hospital at Cipto Mangunkusumo Hospital, Moh. Hatta passed away on March 14, 1980. He was laid to rest at Tanah Kusir Cemetery in Jakarta during a state

funeral presided over by Adam Malik, who was Indonesia's vice president at the time. President Soeharto named Moh Hatta an Indonesian proclamator hero in 1986 and a National hero in 2012 in recognition of his tremendous contributions to achieving Indonesian independence. (Parasati, 2023).

2) Economic Thoughts

Personally Hatta was not only a politician but more than that he was a genuine scholar, especially in the fields of economics and constitutional law. As for Hatta's thoughts on Islam, including Islamic economics, although not many. Hatta revealed that Muslims who perform worship, read Surah Al-Fatihah no less than 17 times a day, who understands the content and meaning of Surah Al-Fatihah in depth, there is guidance on what the purpose of his life should be and how he must fight on the path of Allah and where he gets the strength to fight. The Indonesian people call Muhammad Hatta, also known as Bung Hatta, the father of the country's economic development. Bung Hatta's influence on Indonesia's economic growth cannot be dissociated. One of the proclamators of Indonesian independence is Bung Hatta. His ideas gave rise to a number of ideas, such as populist economics, political economic sovereignty, and the cooperative movement. The concept, guiding principles, and objectives of Indonesia's economic path were significantly influenced by Bung Hatta. The popular sovereignty advocated by Bung Hatta is very dissimilar from the popular sovereignty practiced in the West. Hatta stressed that individualism and liberalism were at the heart of popular sovereignty in the West. In contrast, the foundation of popular sovereignty in Indonesia is a sense of kinship-based community. Both of these are pertinent to Indonesia's social and cultural landscape.

Hatta's idea of democracy in Indonesia emphasises the common interest while also being concerned with cohesion and the common interest. Article 33 of the 1945 Constitution (UUD), which is a cornerstone of nationality and applies the concept of democracy, was later changed from 3 points to 5 points as the document evolved. Hatta's theory of Islamic economics is not a compromise between the capitalist and communist economies, which have started to be abandoned and questioned by international economists since the idea is ultimately harmful to the populace. Hatta vehemently opposed both capitalist and communist economic theories from the start. Hatta hoped that his approach to economics would serve as a compromise in Indonesia's economic transformation.

The third path in the economy is anticipated to be Hatta's economic theory with this grasp of Islamic Economics. In constructing the national economy, Hatta has stated that the prosperity of the people, not just a select few, is given priority. Everyone is expected to participate in production and own all assets in the prosperity that is envisioned. It relates to the first sentence of Article 33 of the 1945 Constitution, which states that all economic containers must be included in the economy, including cooperative businesses as well as state owned enterprises (BUMN) and privately owned commercial units. Hatta's ideas are the concept of populist economy where the economic concept offered and implemented in the 1945 Constitution contains the values of Pancasila and is largely the concept of Islamic economics. First, it firmly upholds the values of justice and prosperity in society where economic activities must be carried out by all Indonesian citizens by fostering a sense of kinship, reciprocal cooperation, and no interference from the colonial nation. This is intended to free the Indonesian people from the shackles of the colonizers. Second, because this idea derives from ancestral culture, which becomes the soul of every grain in Pancasila, and the opening of the 1945 Constitution, the people's economy is in accordance with Pancasila, which is the foundation of the state. Third, the people's economy as it is implemented and grown through cooperatives is still important because cooperatives' function as the foundation and backbone of the national economy plays a crucial strategic role in reviving the country's economic conditions.

Additionally, there is the idea of kinship, or the spirit of ukhuwah, which places a shared responsibility on progress, interests, and success. This is in accordance with Article 33, Paragraph 1 of the 1945 Constitution, which states that "the economy is structured as a joint effort based on the principle of kinship," i.e., that the economy is not to be allowed to develop on its own as in the concept of a capitalist economy. Due to the way it governs and values congregational work, or mutualism, Article 33 of the 1945 Constitution is distinctly Islamic. The concept of kinship is also frequently referred to as ukhuwah. Additionally, Article 34 of the 1945 Constitution states that "The State is responsible for the care of the destitute and abandoned children. Bung Hatta wanted the Islamic principles he incorporated into the 1945 Constitution for the general populace, allowing them to be practiced by everybody. Islamic principles must also serve to advance human welfare. The Indonesian economic system must also contribute to the general well-being of the populace.

4. Islamic Economic Thought of H. Abdul Malik Karim Amrullah

1) Biography

Haji Abdul Malik Karim Amrullah was born on February 17, 1908, in the Indonesian village of Molek, Mininjau, West Sumatra. He is more well known by the nickname HAMKA, which stands for his name. He passed away on July 24, 1981, in Jakarta. Later, he was given the nickname Buya, which is derived from the Arabic word abi, abuya, which means "my father" or "someone who is respected," and is used for Minangkabau people. Haji Abdul Malik Karim Amrullah (HAMKA) is the son of Dr. Syaikh Abdul Karim Amrullah (W. 1945 AD), also known as Haji Rasul, who is a lineal descendant of Abdul Arif, also known as Haji Abdul Ahmad and known as Tuanku Pauh Pariaman Nan Tuo, one of the Paderi heroes. After returning from Makkah in 1906, Syaikh Abdul Karim Amrullah founded his movement, which is considered to be the forerunner of the Islamic Movement (Tajdid) "Young People" in Minangkabau. In his movement, Syaikh Abdul Karim Amrullah fought against the teachings of Rabithah, which is a movement that portrays the instructor in memory as one of the systems or ways believers of tarekat will adopt when they begin conducting suluk. In addition, he offered further viewpoints on the subject of khilafiyah.2 While Siti Safiyah binti Gelanggar, his mother, who held the title of Bagindo Nan Batuah, passed away in 1934. On April 5, 1929, Hamka wed Siti Rahma binti Endah Sutan. His relationship with Siti Rahma went smoothly and joyfully. He had twelve kids in total. Among them were Hasyim, Husna, Fatiyah, Helmi, Syakib, Azizah, Fachry, and Zaki. They also included Rusydi, Irfan, Aliyah, Afif, Hasyim, Husna, and Syakib. Hamka and Siti Rahma were married when Hamka was 21 and Rahma was 15. Eight months after the passing of his first spouse, on August 19, 1973, Hamka remarried Hj. Siti Khadijah from Cirbon, West Java. He had no offspring from his second marriage because of his advanced age. Hamka started his schooling as a young child by studying the Qur'an at his parents' home until he was proficient. The family next relocated to Padang Panjang, the hub of the Minangkabau youth movement in 1914, from Maninjau. Hamka began attending a local school when he was seven years old, as did the majority of kids his age. Hamka was enrolled by his father in the Diniyah (afternoon) school that Zainuddin Labay el-Yunusi opened in Pasar Usang Padang Panjang in 1916. Hamka attended the local school in the morning, the newly opened Diniyah school in the afternoon, and the Koran study class in the evening. Hamka spent his childhood engaging in similar regular routines.

When his father returned from his first trip to Java in 1918 AD, when he was 10 years old and had just had his circumcision in his hometown of Maninjau, the surau Jembatan Besi where his father had previously taught religious lessons under the previous system was changed into a madrasa that would later be known as the "Thawalib School." Hamka has since observed his father's efforts to disseminate his views and beliefs. Hamka's father yearned for him to become a scholar like him, which gave rise to his desire. Hamka left the rural school after being accepted to Thawalib School. Here, Hamka pursued his Arabic and religious studies. Hamka also attended sermons delivered by eminent experts like Syaikh Ibrahim Musa at Bukit Tinggi in surau or mosques.8 Buya Hamka, at 16 years old, left Yogyakarta for Java at the end of 1924. He met HOS Tjokroaminoto, Ki Bagus Hadikusumo, R.M. Soerjopranoto, and H. Fakhruddin there, who were holding movement cases at Gedong Abdi Dharmo in Pakualaman, Yogyakarta, and studied the modern Islamic movement with them. From these, Buya Hamka was able to draw parallels between the Islamic Union and the Muhammadiyah Social Movement, two prominent Islamic political movements.

After spending some time in Yogyakarta, Hamka traveled to Pekalongan to visit her teacher and A. R. Sultan Mansur, who at the time served as chairman (Voorzitter) of the Muhammadiyah branch in Pekalongan. In addition to meeting Citrosuarno, Mas Ranuwiharjo, and Mas Usman Pajutomo there, Hamka learned about the work of a young man by the name of Mohammad Roem.10 So, between 1916 and 1924, Buya Hamka's total time spent in formal schooling was just around seven years longer (Iv et al., 2016).

2) Economic Thoughts

The following researchers have undertaken many investigations that are linked to Hamka's ideas regarding Islamic economic values: In his 2010 essay, Abdul Hafiz bin Hj Abdullah makes a case for social justice and Islam. Focus on the Importance of Zakat with Special Attention, Per Hamka's Opinion in Tafsir Al-Azhar. In particular, this study aims to provide light on Hamka's perception of the recipient categories, particularly the muallaf, musafir, and fi sabilillah, in terms of their zakat obligations and significance. The definition of zakat and the urgency of zakat in the context of social justice are a few of the topics that are covered. In conclusion, it is claimed that the role of zakat is crucial for social justice since it reduces inequality, apostasy, and concepts that are contrary to Islam.

In Hamka's Thought on Moral, Sudin (2011) attempted to illuminate Hamka's understanding on morality. Hamka allegedly avoided using the word "morals" in his books in favor of phrases like moral science, character science, ethics, and other synonyms. Sudin claims that Hamka employs terminology inconsistently, leading to a range of possible interpretations. Hamka does, as previously mentioned, occasionally generalize about moral philosophy, morality, and ethics. He asserts that all of Hamka's ideas, even those in the area of moral philosophy, are based on religious principles, with a focus on the necessity of preserving tawhid, the doctrine of the unity of God. However, Hamka does not approach religious texts in a doctrinal-normative manner; rather, he examines religious doctrine rationally, including how it appears to be both religious and moral. This distinguishes Hamka's moral philosophy from those of other philosophers, particularly those in the West. In his 2015 essay, "Muhammad Yusry Affandy Bin Md Isa: Appreciating Fiqh Zakat in Waking Up the Ummah," According to Hamka's perspective, the execution of zakat, as required by Allah SWT, will result from a comprehensive understanding of fiqh zakat and have a significant impact on the perpetrators. In his writings, particularly Tafsir al-Azhar, Hamka is said to have emphasized the demand for worship responsibilities, including zakat. This qualitative study intends to clarify and examine HAMKA's viewpoint on the value of fiqh zakat and how it contributes to the development of the ummah. According to the study that has been done, Hamka strongly encourages Muslims to investigate the commandment of zakat with social awareness and science. He also questioned the practice of performing zakat without showing gratitude, saying that it violated the intent of a religious act. According to Hamka, if the zakat requirements are interpreted in accordance with the Qur'anic teachings, they will have a variety of beneficial effects on the ummah.

In HAMKA's (Haji Abdul Malik Karim Amrullah) 2009 ethical theory, Zainuddin Arifin stated: The goal of this study, which is a contribution to Indonesian Islamic education, is to identify and rephrase the ethical framework developed by Hamka. Hamka's ethical perspective was formed as a result of at least two internal and external sources. Internal factors include direct influences from the Minangkabau culture, society, and familial environment. While outside forces—including his professors, prominent Indonesian Muslim thinkers, and other contemporary Muslim reformers—have a significant influence. It is then claimed that the four ethical concerns Hamka brought up—religious ethics, personal ethics, social ethics, and

happiness ethics—can reveal the essence of his ethics. Additionally, it is discovered that Hamka made a significant and dominant ethical contribution to Indonesian Muslims in the area of Islamic education. Hamka contributed to the reconstruction of the educational infrastructure in the sphere of Islamic education, moving from traditional education to modern education. In Ethics in Modern Life: A Study of Hamka's Sufistic Thought, Novi Maria Ulfah & Dwi Istiyani (2016) claim that Sufism in the modern sense for Hamka is the application of various attributes, specifically: qanaah, sincerity, readiness to be impoverished but still joyful in working. A Sufi in the current era must also put in a lot of effort with Allah SWT's goal. This study also outlines the ethical requirements for a variety of occupations, including those in law, medical, education (for both instructors and students), government, business, and economics. According to Hamka, someone in the crowd has genuinely become a Sufi if certain virtues in various sectors can be upheld. This study explores Hamka's writings on ethics and the establishment of manners (Hakim, n.d.).

4. CONCLUSIONS

Islamic philosophical ideas are present in the economic thinking of Indonesian Muslim leaders from various periods, although there are differences. Tawhid then becomes the basis of all values, with intellectual principles governing all economic activity. These numbers form the principles of Islamic philosophy, which serve as standards or reference points for achieving the goals of Islamic economics. Brotherhood, equality and unity, justice, and salvation are values derived from the four numbers in the diagram mentioned above. These principles come together to form a value system that influences how people respond in economic situations. In the direct economic activities of Indonesian Muslim scholars, the differences between the thought of the figures are more apparent. The atmosphere of the times and the background of each figure are influential in this regard. The ideas that developed were a reaction to the sociopolitical environment of the time, and subsequently impacted on a number of forms of Islamic economic theory. While there are many different schools of thought, it is important to remember that they all share the same goal of achieving maslahah. These variations actually expand the scientific toolkit of Indonesian Islamic economics.

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ÜRE İLAVESİNİN ŞEKER PANCARI YAPRAKLARI SİLAJLARININ HAM BESİN MADDE İÇERİKLERİ VE BAZI FERMENTASYON ÖZELLİKLERİNE ETKİSİ

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Özet
Bu çalışma, şeker pancarı yapraklarına farklı düzeylerde üre katkısının silajların bazı kalite özelliklerinin belirlenmesi amacıyla yapılmıştır. % 0 (kontrol), % 0.5, % 1 ve % 2 düzeylerinde üre ilave edilmiştir. Silolama 90 gün devam etmiştir. 90 gün sonunda silajlar açılmıştır ve ham besin madde içerikleri ve bazı fermentasyon özellikleri belirlenmiştir. Araştırmadan elde edilen veriler değerlendirilmiş, üre katkısıyla şeker pancarı silajlarının kuru madde, ham kül, ADF, laktik asit ve propiyonik asit içerikleri değişmemiş ($P>0.05$), bununla birlikte pH ($P<0.001$), asetik asit ($P<0.01$), ham protein ($P<0.001$) ve NDF ($P<0.01$) içerikleri yükseltmiştir. Silajların bütirik asit içeriği, üre muamelesiyle azalmıştır ($P<0.001$). Araştırma sonucunda, şeker pancarı yapraklarına herhangi katkı maddesi kullanmadan silolanabileceği sonucuna varılmıştır.
Anahtar Kelimeler: Şeker pancarı yaprağı, silaj, üre, katkı, kalite.

THE EFFECT OF UREA SUPPLEMENTATION ON NUTRIENT CONTENTS AND SOME FERMENTATION CHARACTERISTICS OF SUGAR BEET LEAVES SILAGES

ABSTRACT
This study was carried out to determine some quality characteristics of sugar beet leaves ensiled with different levels of urea. Urea was added at 0% (control), 0.5%, 1% and 2% levels. Ensiling period continued for 90 days. At the end of 90 days, the silages were opened, and nutrient contents and some fermentation characteristics were determined. The data obtained from the study were evaluated and the dry matter, crude ash, ADF, lactic acid and propionic acid contents of sugar beet silages did not change ($P>0.05$), but pH ($P<0.001$), acetic acid ($P<0.01$), crude protein ($P<0.001$) and NDF ($P<0.01$) contents were increased with urea supplementation. Butyric acid content of silages decreased with urea treatment ($P<0.001$). As a result of the study, it was concluded that sugar beet leaves can be ensiled without using any additives.
Keywords: Sugar beet leaf, silage, urea, additive, quality.

1. GİRİŞ

Silaj, suca zengin yeşil yemlerin oksijensiz ortamda saklanması sonucu elde edilen fermente bir sulu kaba yem çeşididir. Hayvanların severek tükettikleri silaj, taze yeşil ot bulunmayan mevsimlerde işletmeler için ucuz ve tatminkar bir yem kaynağıdır. Silaj, yapımının kolay ve yatırım maliyetinin az olması hemen her türlü bitkisel materyalden yapılabilmesi yüksek iş gücü gerektirmemesi ve özellikle besin madde kayıplarının az olması avantajıyla ot kurutmaya kıyasla tercih edilebilecek iyi bir alternatiftir (Filya, 2001).

Şeker pancarının hasat döneminde elde edilen yaprakların bir kısmı taze kaba yem kaynağı olarak değerlendirilirken, önemli bir kısmı ise tarlada bırakılmakta ve organik gübre olarak toprağa karışmaktadır. Kaliteli kaba yem açığı bulunan ülkemizde, protein ve şeker bakımından zengin olan ve hayvanlar tarafından sevilerek tüketilen şeker pancarı yapraklarından yeterince yararlanılmamaktadır (Pimlott, 1991).

Şeker pancarının dekara kök veriminin %80-85'i kadar şeker pancarı baş ve yaprakları elde edildiğini, ancak elde edilen pancar baş ve yapraklarının yaklaşık %80'inin tarlada kaldığını ve sadece %2'sinin silolandığını bildirmektedir (Przybyl, 1994).

Hasat yöntemine bağlı olarak değişmekle birlikte şeker pancarı yapraklarının tarlada organik gübre olarak bırakılması yerine silajının yapılmasının daha avantajlı olduğunu (Pimlott, 1991) ve şeker pancarı yapraklarından yapılan silajın üretim maliyetinin, silajın yem değerinin yarısından daha az olduğu bildirilmektedir.

Bu çalışmada, şeker pancarı yapraklarına farklı düzeylerde üre ilavesinin silajların ham besin madde içerikleri ve bazı fermentasyon özellikleri üzerine etkilerinin araştırılması amaçlanmıştır.

2. MATERYAL VE YÖNTEM

Silajların hazırlanması ve silolama dönemi: Araştırma, Uşak Üniversitesi Ziraat Fakültesi Yemler ve Hayvan Besleme Laboratuvarında yürütülmüştür. Silolamada kullanılan taze şeker pancarı yaprakları, Uşak ilinde şeker için yetiştiricilik yapan bir şeker pancarı üreticisinden temin edilmiştir.

Deneme dizaynı belirtilen şekilde oluşturulmuştur: (i) Kontrol (üre katkısız); (ii) % 0.5 üre; (iii) % 1 üre; (iv) % 2 üre içermektedir. Satın alınan üre, parçalanan şeker pancarı yapraklarına belirtilen düzeylerde homojen olarak muamele edilmiştir. 90 gün boyunca oda sıcaklığında 4

paralel olacak şekilde 1 lt'lik plastik anaerob kavanozlarda silaj örnekleri fermentasyona maruz bırakılmıştır.

Kimyasal analizler: 90.gün sonunda silajlar açılmış ve alınan örnekler sirkülasyonlu etüvde 60 ºC'de 48 saat kurutularak kuru madde düzeyleri saptanmıştır (AOAC, 1999). Örneklerin kurutulmasından sonra 1 mm elek çapında öğütülmüştür. % kuru madde esasına göre, silajların ham protein ve ham kül içerikleri saptanmıştır (AOAC, 1999).

Örneklere ait NDF ve ADF düzeyleri, Fiber Analyzer (Ankom Technology Corp. Fairport, NY, USA) cihazı kullanılarak belirlenmiştir (Van Soest, 1982). Silajların pH'sı, masa tipi dijital pH metreyle ölçülmüştür (Polan ve ark., 1998). Açılan silajlardan 40 g örnek alınmış ve 360 ml saf su ilave edilerek 5 dakika çalkalanmış ve Whatman no:1 kağıdından süzülmüştür. Süzükten örnekler, eppendorf tüplerine alınarak analiz gününe kadar derin dondurucuda -18 °C'de analiz gününe kadar muhafaza edilmiştir. Analiz gününde çözdürülen silaj örneklerinin laktik asit, asetik asit, propiyonik asit, asetik asit ve bütirik asit içeriği HPLC cihazında analiz edilmiştir.

3. ARAŞTIRMA BULGULARI VE TARTIŞMA

Şeker pancarı yapraklarına farklı düzeylerde üre ilavesinin silajların kuru madde, ham protein, ham kül, NDF ve ADF içeriklerine etkisi Çizelge 1'de verilmiştir.

Çizelge 1. Silajların ham besin madde içerikleri

Parametreler	Kontrol	% 0.5 Üre	% 1.0 Üre	% 2.0 Üre	P
Kuru Madde, %	15.17±0.89	14.90±0.56	14.84±0.74	14.92±0.91	0.89
Ham Protein, %KM	22.75±1.01^{b}	22.87±2.29^{b}	24.80±3.76^{b}	30.18±1.56^{a}	0.0001
Ham Kül, %KM	14.37±0.51	15.39±0.45	15.12±0.46	15.20±0.90	0.11
NDF, % KM	22.29±0.26 ^{b}	28.35±1.29 ^{a}	27.32±2.02 ^{a}	27.93±0.49 ^{a}	0.003
ADF, % KM	11.90±0.70	11.81±0.17	11.43±0.65	11.06±1.08	0.51

$^{a-b}$ Aynı satırda farklı harfleri taşıyan gruplar içerisindeki farklılıklar istatistiki olarak önemlidir (P<0.05).

Çizelge 1'e göre, üre ilavesi şeker pancarı yaprakları silajlarının kuru madde ve ham kül içeriklerinde önemli bir değişikliğe neden olmamıştır (P>0.05). Şeker pancarı yaprağı, kuru madde ve selüloz değeri düşük, kül içeriği yüksek bir yem kaynağıdır. Silolamanın temel amaçlarından biri, silolanacak materyaldeki kuru madde kayıplarını mümkün olduğunca en aza indirmektir. Mevcut çalışmanın silajlarının kuru madde içeriğinde kayıp olmaması olumsuz

yönde bir fermentasyon şekillenmediğini göstermektedir. Bu çalışmaya benzer bulgular Can ve ark. (2003) ve Canbolat ve ark. (2014) tarafından da rapor edilmiştir.

Kül içeriği, yaprakların toprakla buluşma düzeyine bağlı olarak değişiklik göstermektedir. Yaklaşık %10 olan ham kül içeriğinin %2'sini mineral maddeler % 8'ini yapraklara bulaşmış olan toprak oluşturmaktadır. Makro ve iz elementler orta ya da yüksek düzeyde bulunmaktadır. Kuru madde de % 2'den fazla saponin bulunması zararlı etkide bulunmaktadır. Şeker pancarı yaprağında bulunan oksalik asit miktarı kurak yıllarda artmakta ve hayvanlara fazla miktarda şeker pancarı yaprağı yedirildiğinde kuvvetli ishale ve diğer sorunlara neden olmaktadır (Akyıldız, 1983). Şeker pancarı yapraklarının pancar başı içeriğine ve toprakla bulaşma düzeyine bağlı olarak yem değeri ve lezzeti değişmektedir. Yapraklar toprakla ne kadar fazla bulaşırsa silolama sırasında fermantasyonda o düzeyde olumsuz etkilenir (Kılıç, 1986). Araştırma silajlarının kuru madde içeriği, üre ilavesi arttıkça sayısal olarak azalmıştır. Uludağ (2011) şeker pancarı yapraklarının ham kül içeriğinin % 19.70 olduğunu bildirmiştir. Çalışmaya benzer şekilde, Arslan Duru ve Aksu Elmalı (2020), şeker pancarı yaprağı silajlarına defne yaprağı ilavesiyle ham kül içeriğinin düştüğünü ifade etmişlerdir.

Araştırma silajlarının ham protein içeriği, % 2 üre ilavesiyle artmıştır ($P<0.001$). Şeker pancarı yapraklarına azot kaynağı olarak kullanılan ürenin içeriğindeki azottan dolayı (Filya ve ark., 2004), silajların ham protein içeriğini önemli düzeyde artırmıştır. Şeker pancarı yapraklarına üre ilavesinin ham protein düzeyini yükseltmesi, Canbolat ve ark. (2014) ve Denek ve ark. (2004) bulgularıyla benzerlik göstermektedir. Şeker pancarı yaprağı silajlarına üre ilavesiyle NDF içeriği yükselmiş ($P<0.01$) bununla birlikte ADF içeriği ise değişmemiştir ($P>0.05$). Ürenin NDF ve ADF içeriği bulunmamaktadır. Bu durum, ayrıca laktik asit bakterilerinin fermentasyonun yeterince hızlı şekillenmemesine de bağlanabilir. Üre ilavesiyle Çelik ve ark. (2009) ve Demirel ve Yıldız (2001) benzer bulgular elde etmişlerdir.

Üre ilavesinin şeker pancarı yapraklarının pH, laktik asit, asetik asit, propiyonik asit, bütirik asit içeriklerine etkisi Çizelge 2'de sunulmuştur.

Çizelge 2. Silajların bazı fermentasyon özellikleri

Parametreler	Kontrol	% 0.5 Üre	% 1.0 Üre	% 2.0 Üre	P
pH	3.48±0.09^{c}	5.65±1.12^{b}	7.67±0.27^{a}	8.23±0.12^{a}	0.0001
Laktik asit,%	1.38±0.29	0.83±0.83	0.72±0.16	1.53±0.41	0.30
Asetik asit, %	0.00±0.00^{b}	0.21±0.02^{a}	0.15±0.05^{a}	0.17±0.04^{a}	0.002
Propiyonik asit, %	0.16±0.04	0.57±0.35	0.60±0.24	0.44±0.36	0.49
Bütirik asit, %	0.017±0.04^{a}	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{b}	0.0001

$^{a-c}$ Aynı satırda farklı harfleri taşıyan gruplar içerisindeki farklılıklar istatistiki olarak önemlidir (P<0.05).

Çizelge 2 incelendiğinde, şeker pancarı yapraklarına farklı dozlarda üre ilavesiyle pH değeri önemli düzeyde yükselmiştir (P<0.001). Silajlarda suda çözünebilen karbonhidrat içeriği, laktik asit gelişiminde etkili olduğundan, fermentasyon koşulları iyi olmadığında silajların pH'sının düşük olması zorlaşmaktadır (Bolsen ve ark., 1996). Üre katkısı, silajlarda amonyak azot üretimini teşvik ettiğinden silo ortamındaki pH'nın nötre yaklaşmasına sebep olmuştur. Üre ilave edilen gruplarda pH'nın artması, silajlarda laktik asit fermentasyonunun gerçekleşmesi için gerekli olan suda çözünebilen karbonhidrat içeriğinin de yetersiz olması nedeniyle üre muamelesiyle artan ham protein içeriğindeki artış ve dolayısıyla amonyak düzeyindeki artıştan kaynaklanmış olabilir. En yüksek pH % 2.0 üre içeren silaj grubunda tespit edilmesi de bu durumu destekler niteliktedir. Benzer şekilde, Canbolat ve ark. (2014), Filya ve ark. (2004) ve Çelik ve ark. (2009) üre katkısının silajlarda pH değerini artırdığını ifade etmişlerdir. Şeker pancarı yapraklarına farklı katkı maddesi ilavesinin bazı bulguları incelendiğinde, Alhan ve Can (2017) ise şeker pancarı yapraklarına inokulant ilavesinin silajların pH'sını etkilemediğini tespit etmişlerdir. Arslan Duru ve Çolak (2019) goji berry yaprağı ilavesiyle silajların pH'sının düştüğünü; Arslan Duru ve Aksu Elmalı (2020) defne yaprağı ilavesiyle değişmediğini bildirmişlerdir.

Farklı dozlarda üre katkısı, şeker pancarı yaprakları silajlarının laktik asit ve propiyonik asit içeriklerinde önemli bir farklılığa neden olmazken (P>0.05), asetik asit içerikleri artmış (P<0.01) ve bütirik asit içeriği düşmüştür (P<0.001). Üre ilavesiyle silajların azot içeriğini artmasına rağmen organik asit içeriğinde istenilen düzeyler yakalanmıştır. Şeker pancarı yaprakları silajlarına, Arslan Duru ve Çolak (2019) goji berry yaprağı ilavesiyle silajların laktik

ve bütirik asit içeriğinin değişmediğini; Arslan Duru ve Aksu Elmalı (2020) defne yaprağı ilavesiyle laktik asit, propiyonik asit ve bütirik asit içeriklerinin değişmediğini bildirmişlerdir.

4. SONUÇ

Araştırma sonunda, kaba yem açığının kapatılması açısından yeterince değerlendirilemeyen şeker pancarı yapraklarının herhangi bir katkıya gerek duyulmadan silolanabileceği ve elde edilen silajların kaliteli olduğu tespit edilmiştir. Şeker pancarı yapraklarına herhangi bir katkı maddesi olmadan silolama yapabileceği, eğer üre takviyesi yapılacaksa ancak şeker pancarının başlı aksamını yüksek düzeyde içerdiği ve ham protein düzeyinin yükseltilebilmesi için kullanılmasının önerilebileceği sonucuna varılmıştır.

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TÜRKİYE FLORASINDA YAYGINLIK GÖSTEREN BAZI ÖNEMLİ YABANİ YENİLEBİLİR ÜZÜMSÜ MEYVE TÜRLERİ

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Özet
Yabani yenilebilir meyve türleri son yıllarda küresel iklim değişikliği karşısında tarımda sigorta olarak görülen meyve türlerini oluşturmaktadır. Bu türlerin en önemli özellikleri biyotik ve abiyotik stres faktörlerine karşı oldukça dayanıklı olmaları ve iklim değişikliği konusunda da daha fazla adaptasyon kabiliyetine sahip olmalarıdır. Bu türleri öne çıkaran diğer bir faktörde biyoaktif içeriklerinin oldukça yüksek olması ve yüksek kabuk/meyve eti oranından dolayı antioksidan özelliğe sahip maddeleri daha fazla içermeleridir. Ülkemiz sahip olduğu birbirinden oldukça farklı iklim ve toprak koşullarından dolayı çok sayıda yabani yenilebilir üzümsü meyve türlerine ev sahipliği yapmaktadır. Ülkemiz florasına büyük ölçüde zenginlik katan yabani yenilebilir üzümsü meyve türleri konusunda önemli türleri bir arada gösteren ve inceleyen yayın bulunmamaktadır. Bu çalışmanın amacı ülkemizin sahip olduğu yabani yenilebilir önemli üzümsü meyve türü zenginliğini ortaya koymaktır.
Anahtar kelimeler: Yabani meyve, üzümsü, biyoçeşitlilik, biyokimya

SOME IMPORTANT WILD EDIBLE BLUE FRUIT SPECIES WIDELY IN THE FLORA OF TÜRKİYE

Abstract
Wild edible fruit species have been seen as insurance in agriculture against global climate change in recent years. The most important features of these species are that they are highly resistant to biotic and abiotic stress factors and have greater adaptability to climate change. Another factor that makes these species stand out is that their bioactive content is quite high and they contain more substances with antioxidant properties due to their high shell/flesh ratio. Our country is home to many wild edible fruit species due to its very different climate and soil conditions. There is no publication that shows and examines the important species of wild edible fruit species that enrich our country's flora to a great extent. The aim of this study is to reveal the richness of important wild edible fruit species that our country has.
Keywords: Wild fruit, berry, biodiversity, biochemistry

GİRİŞ

Bahçe bitkileri tarımsal üretimde dünya genelinde önemli bir yere sahiptir. Diğer bitkisel üretim kolları ile karşılaştırıldığında, bahçe bitkilerinde birim alandan elde edilen gelirin nispeten daha yüksek düzeylerde olduğunu söylemek mümkündür. Bahçe ürünleri kendine has görünüş ve tatlarıyla tüketiciler arasında oldukça popüler olup, yetiştirme alanları yıldan yıla dünya genelinde artış göstermektedir. Bahçe bitkileri içerisindeki farklı ve çok sayıdaki tür, çeşit, genotip zenginliği oldukça dikkat çekicidir.

Bahçe bitkileri içerisinde bir kısmı ekzotik meyve olarak ta bilinen doğada daha az bulunan veya keşfedilmemiş durumdaki yabani yenilebilir meyveler son yıllarda oldukça popülarite kazanmıştır. Tüketici tercihlerine paralel olarak bilim dünyasında da yabani yenilebilir meyve türleri üzerinde yapılan çalışmalar artmış ve bu çalışmalarla yabani yenilebilir meyve türlerinin biyoaktif bileşikler yönünden (polifenoller, flavonoidler, şekerler, tanenler, stilbenler, fenolik asitler, yağ asitleri vs.) oldukça zengin olduklarını ortaya koymuştur (Neri-Numa vd., 2018; Venancio vd., 2018; Ortega vd., 2019).

Türkiye'deki yabani meyvelerin biyoçeşitliliği, gelecekte insan yaşamı, biyolojik ve tarımsal kalkınma için gerekli olan önemli bir biyo-gen havuzunu oluşturmaktadır. Türkiye'de yabani meyve alanları ağırlıklı olarak Akdeniz, Karadeniz, Orta, Doğu, Kuzey Doğu ve Güney Doğu Anadolu bölgelerinde yoğunlaşmaktadır (Ercişli, 2004).

Türkiye, biyolojik çeşitlilik açısından büyük bir yabani meyve zenginliğine sahiptir. Yabani meyveler, çok çeşitli formları ile farklı bölgelerin eşsiz doğasında çok güzel manzaralar oluşturmakta ve doğal peyzajında önemli bir parçası olarak karşımıza çıkmaktadır. Bazı bölgelerde (Kuzey Doğu Anadolu, Karadeniz Bölgesi) arazinin elverişsizliği nedeniyle, meyve üretiminde yabani meyveler yoğunluk kazanmıştır. Bu bölgelerde yabani meyvelerin toplanması meyvecilik açısından önem kazanmış ve özellikle kırsal alanda yaşayan insanlar için önemli bir gelir kapısını oluşturmaktadır.

Yabani yenilebilir meyve türlerinden özellikle üzümsü grubunda yer alan meyveler kolay çoğaltma ve yetiştirme teknikleri ve renkli göz alıcı meyveleri ile son yıllarda tüketiciler arasında oldukça popülarite kazanmışlardır. Üzümsü meyveler, besin içerikleri (vitaminler ve mineraller) ve biyoaktif bileşikler (polifenoller, flavonoidler, şekerler, tanenler, stilbenler, fenolik asitler, yağ asitleri vs) yönünden oldukça zengindir. Zengin biyolojik aktif madde içeriklerinden dolayı literatürlerde sıklıkla antioksidan, antikanser, antimikrobiyal,

antiproliferative, antineurodegenerative, antiglycemik olarak ve ayrıca kilo kontrolünde, kalp ve sinir hücrelerinin korunmasında etkin oldukları tespit edilmiştir (Bowen-Forbes vd., 2010; Giampieri vd., 2012; Nile ve Park, 2014).

Yalancı iğde (*Hippophae rhamnoides* L)

Yalancı iğde (*Hippophae rhamnoides* L), Kafkaslar, Orta Asya, Çin, Moğolistan, Sibirya ve Baltık Denizi etrafındaki ülkelerde doğal olarak yayılış göstermekte ve günümüzde Rusya, Çin, Finlandiya, Polonya, Litvanya, Almanya, Letonya ve Estonya'da endüstriyel ölçekte yetiştirilmektedir (Malinowska ve Olas, 2016). Ülkemizde ise 2000 m yükseltilere kadar olan alanlarda doğal yayılışa sahip olup, Ordu, Giresun, Trabzon, Samsun, Çankırı, Kastamonu, Kayseri, Nevşehir, İçel, Sivas, Kahramanmaraş, Erzurum, Erzincan, Ağrı, Van, Bayburt ve Gümüşhane gibi çok farklı ekolojilerde nehir kenarlarındaki kumlu alanlarda doğal olarak bulunmaktadır (Aras, 1995). Yalancı iğde (*Hippophae rhamnoides* L.) akrabası olan normal iğde (*Elaeagnus angustifolia* L.) ile birlikte havanın serbest azotunu kökleri vazifesiyle tespit eden ender bir meyve türüdür. Meyvelerinin besleyici özelliği yüksek olup, geleneksel tıpta da uzun yıllardır kullanılmaktadır. Son yıllarda bu özellikleri bitkiyi oldukça popüler hale getirmiştir. Yalancı iğde diyabet (Kim, 2013), mide ülseri (Huff vd., 2012), kardiyovasküler hastalıklar (Sayegh vd., 2014) yanında, yaraların hızla iyileşmesine (Edraki vd., 2014) ve tümör oluşumunu karşı (Chakraborty vd., 2015) koruyucu olarak etkili bir şekilde kullanılmaktadır. Yalancı iğde meyvesinin aktif bileşenleri potansiyel olarak kanser oluşumuna engel olabilecek aktiviteye sahiptir (Zeb, 2006). Yalancı iğde meyvelerinden elde edilen ürün yelpazesi oldukça geniş olup meyve suyu, şurup, marmelat olarak ve yine meyve veya tohumlarından elde edilen yağlar yaşlanmaya, mide ülseri ve metabolik bozuklukların tedavisinde, analjezik olarak soğuk algınlığı, ateş ve halsizliğe karşı kullanılmaktadır (Bal vd., 2011).Yalancı iğde meyveleri fenolik bileşikler (rutin, kuarsetin, kamferol, mirsetin) (Christaki, 2012), çeşitli vitaminler (tokoferoller, askorbik asit, B1 ve B2 vitamini), karotenoidler gibi pek çok biyoaktif bileşiklerin kaynağıdır (Malinowska ve Oals, 2016). Ayrıca, organik asitler, yağ asitleri (oleik asit, linoleik asit, linolenik asit) ve fitosteroller içermektedir (Patel vd., 2012). Yalancı iğde meyveleri yüksek biyolojik aktivitelerinden dolayı son yıllarda 'süper meyve' kategorisinde yer almaktadır (Redei vd., 2018).

Karadut (*Morus nigra* L.)

Karadut (*Morus nigra* L.), orijini Transkafkasya ve Kuzey İran olup Akdeniz ülkelerinde doğal olarak yetiştirilmekte ve ülkemizin hemen hemen bütün bölgelerinde geniş dağılım göstermektedir (Ercişli 2004). *Morus nigra* L., iri ve siyaha yakın renkli meyveleri ile antosiyaninler, fenolik asitler ve organik asitler yönünden oldukça zengindir. Şeker/asit oranı en uygun dut türü olduğu için işleme sanayinde en yaygın kullanılan Morus türüdür. Karadut meyveleri sadece gösterişli iri meyveleri ile değil, yüksek biyoaktif madde içeriği ile de dikkat çekmektedir (Hojjatpanah vd., 2011). Karadut meyvesine koyu rengini veren antosiyaninler, bu meyvelerdeki ana flavonoid grubunu oluşturmaktadır (Özgen vd., 2009). Daha önce yapılan çalışmalar, antioksidan aktivite ile karadut meyvelerinin antosiyanin içeriği arasında doğrudan bir ilişki olduğunu göstermiştir (Thomas vd., 2015). Karadut tıbbi ve ekonomik anlamda büyük öneme sahiptir (Andreoni, 2005). Karadut geleneksel olarak birçok ülkede ağız lezyonlarını tedavi etmek için ve kansızlığı gidermek için kullanılmaktadır. Karadut meyveleri yüksek antioksidatif, antienflamatuvar, antitümör ve antidiyabetik etki yanında, kardiyovasküler, hepato ve nöro-koruyucu etkilerinin olduğu da tespit edilmiştir (Huang vd., 2008; Isabelle vd., 2008).

Gilaburu (*Viburnum opulus* L.)

Gilaburu (*Viburnum opulus* L.), Dünya'da özellikle Avrupa ve Avrasya'da ormanların çevresinde, nehir yataklarının yakınlarında 10-1600 m rakımlarda doğal olarak yetişen bir meyve türüdür (Zarifikhosroshahi, 2009). Gilaburu ülkemizde ise Tokat, Artvin, Samsun, Trabzon, Sivas, Erzurum, Bursa, İzmit, Sakarya, İstanbul, İzmir, Kırşehir, Ankara, Kahramanmaraş ve özellikle Kayseri çevresinde doğal olarak yetişmektedir (Sagdic ve ark., 2006) Gilaburu meyvesinin yüksek miktarda fenolik asitler ve antosiyanidin içerdiği (Velioglu vd., 2006) ve bunun yanı sıra askorbik asit (Rop vd., 2010) ve malik asit gibi organik asitler bakımından zengin olduğu (Çam ve Hışıl, 2007) ve kendine özgü tadını veren valerik asit (Dinç vd., 2012) içeriğine sahip olduğu tespit edilmiştir. Meyveleri taze olarak tüketimi buruk tadından dolayı sınırlı olup, genelde meyve suyu olarak, kurutularak, reçel ya da konserve olarak tüketilmektedir (Cesoniene˙ vd., 2010). Gilaburu meyvesinin A ve E vitamini, β-karoten ve likopen yönünden çok zengin olduğu ve bu maddelerin insan sağlığı açısından büyük önem

taşıdığı bilinmektedir. Gilaburu meyvesinin suyunda bulunan flavonoidlerin ise antiproliferatif, antialerjik, antiviral, antienflamatuvar etki göstermektedir (Zarifikhosroshahi, 2009).

Kırmızı ahududu (*Rubus idaeus* L.)

Kırmızı ahududu (*Rubus idaeus* L.), anavatanı ülkemizdeki Kaz dağları olup, dünya genelinde çok geniş bir yayılım alanına sahiptir. Asya, Avrupa ve Amerika'da ılıman iklim bölgelerinde doğal olarak bulunmaktadır. Türkiye'de ahududu bitkileri, Güney ve Doğu Marmara bölgesinden bütün Karadeniz Bölgesi'nde Artvin'e kadar 1000 metrenin üzerinde yükseklikleere sahip, genellikle kuzeye bakan alanlarda görülmektedir. Yetiştiricilikte toprak ve hava oransal neminin yüksek olmasını istemesi Karadeniz Bölgesi'nde doğal olarak yabani olarak yayılmasına neden olmuştur. Ülkemizde kültürü Bursa civarında yapılmaktadır. Kırmızı ahududu meyveleri biyoaktif maddeler yönünden (antosiyaninler, fenolik bileşikler, vitaminler, organik asitler) çok zengin olup, özellikle meyvelerinde bulunan elajik asit, antioksidan, anti-mutajen ve anti-kanser özelliklere sahiptir. Elajik asit üzerinde yapılan çalışmalar meme, yemek borusu, cilt, bağırsak, prostat ve pankreas kanserlerinde anti-kanser özelliğini göstermiştir. Elajik asit kansere neden olan moleküllere bağlanarak onları çok önemli bir oranda etkisizleştirir. Elajik asit yaşlanmayı geciktirici etki de göstermektedir. Elajik asitin, DNA' da oksidatif zararların çoğunluğunu engelleyerek kanser gelişimini önemli ölçüde durdurduğu belirtilmektedir (Kresty vd. 2001). Kırmızı ahududu meyveleri gıda sektöründe oldukça geniş bir alanda kullanılmaktadır. İşlenmiş gıda olarak marmelat, reçel, meyveli yoğurt ve tatlıların üretiminde kullanılmaktadır. Son yıllarda dondurularak yıl boyu pazarda bulunan en önemli meyvelerden birisi olup, bu bitkiye Türkiye'de duyulan ilgi her geçen gün hızla artmaktadır.

Böğürtlen (*Rubus fruticosus* L.)

Böğürtlen (*Rubus fruticosus* L.) Kuzey Batı Asya'da ılıman bölgelerde, Kuzey Afrika, Avrupa, Kuzey Amerika ve Güney Amerika'da doğal olarak bulunmaktadır. 8000 yıllık bir geçmişe sahip olup aynı zamanda tıbbi bir bitki olan böğürtlenin ülkemizde birçok yerde doğal florada yabanisine rastlanmaktadır. Orta Anadolu, Akdeniz ve Karadeniz Bölgelerinde daha yoğun olarak yetişmektedir. Ülkemiz böğürtlenin anavatanı olan bölgeler içerisinde yer almaktadır. Böğürtlen, taze meyve olarak veya işlenmiş olarak tüketilebilir. İşlenmiş olarak

reçel, jöle, şurup, meyve suları ve tatlı gibi ürünlerde kullanılmaktadır (Zia-Ul-Haq vd., 2014). Bu üzümsü meyve, özellikler mineraller, vitaminler ve şekerlerin yanı sıra fitokimyasal bileşikler, fenolik bileşikler (fenolik asitler, antosiyaninler ve tanenler) açısından oldukça zengindir. (Skrovankova vd., 2015; Yang ve Choi, 2017). Böğürtlenler taze meyve veya işlenmiş olarak tüketildiğinde iltihaplanma, kardiyovasküler hastalıklar ve kanserin önlenmesinde uzun yıllardır koruyucu olarak kullanılmaktadır (Paredes-López vd., 2010; Skrovankova vd., 2015).

Mürver (*Sambucus nigra* L.)

Mürver (*Sambucus nigra* L.) anavatanı Batı Asya, Kuzey Afrika ve Avrupa'dır. Türkiye'nin değişik bölgelerinde özellikle Batı ve Kuzey Anadolu'da rastlanır. Mürverin tüm bitki kısımlarında özellikle meyve ve çiçeklerinde bulunan karbonhidratlar, lipidler, flavonoidler, fenolik asitler, terpenoidler, alkaloidler bitkiye yüksek bir ticari değer kazandıran fitokimyasallarının kaynağıdır (Finn vd., 2008) Avrupa'da mürverler taze tüketimin yanında, gıda endüstrisinde jöle, reçel, dondurma, yoğurt ve çeşitli alkollü içeceklerin içeriğinde kullanılmaktadır (Senica vd., 2016). İçeriğinde bulunan antioksidanlar sayesinde, anti-kanserojen, bağışıklık uyarıcı, antialerjik, antiviral ve antibakteriyel özellikler sayesinde birçok hastalık ve rahatsızlığın geleneksel olarak tedavisinde koruyucu olarak kullanılmaktadır (Oniszczuk vd., 2016). Mürverin özellikle yüksek antioksidan kapasitesi gıda takviyeleri için son zamanlarda dikkat çekmiştir (Ribeiro vd., 2019). Mürver meyvelerinin antosiyanin ve polifenolik bileşikler içeriği çok yüksektir.

Vaccinium spp.

Vaccinium türleri Dünya'da geniş bir dağılım alanına sahip olup, ilk olarak meyvelerinde bol miktarda bulunan polifenolik bileşiklerin yüksek *in vitro* antioksidan kapasitesi göstermesinden dolayı "süper meyve" olarak popüler hale gelmiş ve yetiştiriciliği tüm dünyada yaygınlaşmıştır. Vaccinium türleri ülkemizde genel anlamda maviyemiş olarak bilinmektedir. Ülkemiz doğal florasında özellikle Doğu Karadeniz ormanlarında en yaygın bulunan Vaccinium türü çay üzümü olarak ta bilinen *Vaccinium arctostaphylos* türüdür. Karadeniz yaylalarında çoban üzümü olarak bilinen *Vaccinium myrtillus* türü de yaygındır. Her iki türde de geniş bir tür içi fenotipik varyasyon söz konusudur. Vaccinium türleri meyve türleri

içerisinde en zengin antosiyanin kaynaklarından birisidir (Wu vd., 2006). Vaccinium meyvelerinde polifenolik maddelerin %60 kadarını antosiyanin flavonoidler oluşturur (Kalt vd., 2003). Vaccinium meyvelerindeki kırmızı, mavi ve mor rengin kaynağı antosiyaninler insan sağlığına en büyük katkıyı sağlar. Vaccinium meyveleri oksidatif strese karşı oldukça etkilidir (Soltani vd., 2014). Vaccinium türlerine ait meyveler içerdikleri yüksek biyoaktif bileşiklerden dolayı klinik araştırmalarda en fazla kullanılan türlerin başında yer almaktadır. Vaccinim meyveleri polifenolik bileşikler olarak hem flavonoid hem de flavonoid olmayan türleri içerir. Vaccinium meyvelerinde flavonoid olmayan polifenolik bileşikler hidroksisinnamik asit esterleri (özellikle klorojenik asit) yaygın olarak bulunur (Rodriguez-Mateos vd., 2012).

Ribes spp.

Dünya üzümsü meyve üretiminde frenk üzümleri tüketici tercihleri açısından çilekten sonra yer almaktadır. En önemli frenk üzümü türleri *Ribes nigrum* L., (siyah frenk üzümü) ve *Ribes rubrum* L. (kırmızı frenk üzümü)' dür (Djordjevic vd., 2014). Frenk üzümü (özellikle siyah ve kırmızı) meyveleri biyolojik olarak aktif bileşikleri yüksek oranda içermektedir. Frenk üzümü meyvelerinde yüksek seviyelerde antosiyaninler, proantosiyanidinler, kuersetin, mirisetin, fenolik asitler ve izorhamnetin bulunur. Bunlara ek olarak, frenk üzümü meyveleri biyoaktif fenolikler ile birlikte meyvelerin yüksek antioksidan aktivitesine katkıda bulunan yüksek C vitamini içeriğine sahiptir (Karjaleinen vd., 2009). Siyah frenk üzümü fenoliklerinin sağlık açısından birçok yararı özellikle belirli kanserlerin, kardiyovasküler ve iltihaplanma ile ilgili hastalıkların gelişiminin engellenmesi dahil olmak üzere bir dizi yeni çalışmada tespit edilmiştir (Paunovic vd., 2017; Kim vd., 2020). Fenolikler arasında, antosiyaninler, üzümsü meyvelerde bulunan en güçlü nöroprotektif bileşikler olarak kabul edilir. Frenk üzümü ayrıca myricetin, quercetin ve isorhamnetin gibi geniş bir flavonol yelpazesi içerir, bu flavonollerin nöroprotektif aktiviteye sahip olduğu gösterilmiştir. Frenk üzümü Avrupa'da gıda endüstrisi için önemli bir meyvedir

Sonuç

Ülkemiz florasında yaygın olarak bulunan yabani yenilebilir üzümsü meyve türleri yüzyıllardan beri özellikle gıda ve geleneksel tıpta ilaç olarak kullanılmaktadır. Ayrıca yaban hayatı için de bu meyve türleri önemli bir gıda zincirini oluşturmaktadır. Farklı bölgelerimizde bulunan bu

türler daha çok kırsal alanda temsil edildikleri için kırsal yaşamın ve peyzajın önemli bir kısmını oluşturmakta ve yine kırsalda yaşayan insanlar için önemli bir gelir kaynağını oluşturmaktadır. Bu türler üzerinde yapılacak bilimsel çalışmalarla birçok genotipin seleksiyonla seçilip kültüre alınarak çeşit adayı ve sonrasında da yapılacak çalışmalarla çeşit olarak kısa sürede üretime kazandırılması ülkemiz açısından büyük önem taşımaktadır. Ülkemiz florasına adapte olmuş bu çeşitlerle iklim değişikliğine karşı daha güvenli bir üretim de söz konusu olabilecektir.

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ÇİFTLİK HAYVANLARINDA TİROİT HORMONLARININ ÜREME ÜZERİNE ETKİSİ

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Özet
Bu çalışmada tiroit hormonlarının çiftlik hayvanlarında üreme performansı üzerine etkisi incelenmiştir. Yapılan araştırmalar, tiroit hormonlarının dişi üreme sistemi homeostazı için hayati öneme sahip olduğunu göstermiştir. Tiroit hormonları, ovaryum, uterus ve plasenta dokularının metabolizmasını ve gelişimine etki etmelerinden dolayı özellikle dişi üreme sisteminin işlevini devam ettirmesi için büyük öneme sahiptir. Tiroit bezi, her ikisi de esas olarak tiroit foliküler epitel hücreleri tarafından üretilen triiyodotironin (T3) ve tiroksin (T4) dahil olmak üzere tiroit hormonlarının salgılanmasından sorumludur. Tiroit hormonlarının sentezi ve salgılanması, hipofiz bezi tarafından salınan tiroit uyarıcı hormon tarafından düzenlenir. Evcil hayvanlarda üretken performansın (büyüme, süt veya kıl lifi üretimi) sürdürülmesi için uygun tiroit bezi işlevi ve tiroit hormon etkinliğinin çok önemli olduğu düşünülmektedir. Kan tiroit hormonu konsantrasyonlarındaki değişiklikler, tiroit bezi aktivitesindeki değişikliklerin dolaylı bir ölçüsüdür ve dolaşımdaki tiroit hormonları, hayvanların metabolik ve beslenme durumunun göstergeleri olarak kabul edilebilir. Tiroit hormonları üreme hormonlarının sentezini, salgılanmasını ve etkisini dolaylı olarak etkilemekle kalmaz, aynı zamanda bu hormonların düzenlenmesinde de etki etmektedirler. L-tiroksin ve L-triiyodotironin, üreme organların gelişimini ve metabolizmasını modüle eden spesifik nükleer reseptörler aracılığıyla doğrudan ovaryum, uterus ve plasenta dokularına etki eder. Ek olarak, östrojen, prolaktin ve insülin benzeri büyüme faktörü gibi diğer hormonlar ve büyüme faktörleriyle çoklu etkileşimler yoluyla ve hipotalamik hipofiz gonadlarında gonadotropin salgılayan hormonun salınımını etkileyerek dolaylı olarak dişi üreme organlarına etki etmektedirler. Bu nedenle, hipotiroidizm ve hipertiroidizm gibi tiroit hormonlarının serum seviyelerindeki değişiklikler hem kadınlarda hem de hayvanlarda subfertilite veya infertilite ile sonuçlanabilir. Tiroit bozukluklarının her iki cinsiyette de doğurganlık üzerinde büyük etkisi vardır. Hipertiroidizm ve hipotiroidizm, cinsiyet hormonu bağlayıcı globülin, prolaktin, gonadotropin salgılatıcı hormon ve seks steroid serum düzeylerinde değişikliklere neden olur. Dişilerde, tiroit hormonlarının oositler üzerinde doğrudan bir etkisi olabilir, çünkü tiroksin için spesifik bağlanma bölgelerinin fare ve insan oositlerinde bulunduğu bilinmektedir. Sonuç olarak dolaşımdaki tiroit hormonlarının yeterli seviyeleri, normal dişi üreme sistemlerinin işlevlerinin en iyi biçimde yerine getirilmesi için birincil öneme sahiptir.
Anahtar Kelimeler: Çiftlik Hayvanları, Tiroit Hormonları, Üreme

EFFECT OF THYROID HORMONES ON REPRODUCTION IN FARM ANIMALS

Abstract
In this study, the effect of thyroid hormones on reproductive performance in farm animals was investigated. Studies have shown that thyroid hormones are vital for female reproductive system homeostasis. Thyroid hormones are of great importance especially for the maintenance of the female reproductive system, since they affect the metabolism and development of ovarian, uterus and placental tissues. The thyroid gland is responsible for the secretion of thyroid hormones, including triiodothyronine (T3) and thyroxine (T4), both of which are mainly produced by thyroid follicular epithelial cells. Synthesis and secretion of thyroid hormones are regulated by thyroid stimulating hormone released by the pituitary gland. Proper thyroid gland function and thyroid hormone activity are thought to be crucial for maintaining productive performance (growth, milk or hair fiber production) in pets. Changes in blood thyroid hormone concentrations are an indirect measure of changes in thyroid gland activity, and circulating thyroid hormones can be considered indicators of the metabolic and nutritional status of animals. Thyroid hormones not only indirectly affect the synthesis, secretion and effect of reproductive hormones, but also affect the regulation of these hormones. L-thyroxine and L-triiodothyronine act directly on the tissues of the ovary, uterus and placenta through specific nuclear receptors that modulate the development and metabolism of reproductive organs. In addition, they act indirectly on the female reproductive organs through multiple interactions with other hormones and growth factors such as estrogen, prolactin and insulin-like growth factor, and by influencing the release of gonadotropin-releasing hormone in the hypothalamic pituitary gonads. Therefore, changes in serum levels of thyroid hormones such as hypothyroidism and hyperthyroidism can result in subfertility or infertility in both women and animals. Thyroid disorders have a major impact on fertility in both sexes. Hyperthyroidism and hypothyroidism cause changes in serum levels of sex hormone-binding globulin, prolactin, gonadotropin-releasing hormone, and sex steroid. In females, thyroid hormones may have a direct effect on oocytes because specific binding sites for thyroxine are known to be found in mouse and human oocytes. Consequently, adequate levels of circulating thyroid hormones are of primary importance for optimal functioning of the normal female reproductive systems.
Keywords: Livestock, Thyroid Hormones, Reproductive

GİRİŞ

Dişi hayvanlarda üreme ve metabolizma sıkı bir şekilde bağlantılıdır ve karşılıklı olarak düzenlenir. Yaşamın üreme döneminde, cinsiyet hormonlarının döngüsel üretimi ile gonadların fizyolojik aktivitesi, enerji metabolizmasının sürekli olarak düzenlenmesini sağlar (Della ve ark., 2014, Mircea ve ark. 2007). Tiroit hormonlarının dişi üreme sistemi homeostazı için hayati öneme sahiptir **(**Silva ve ark., 2018). Tiroit hormonları, ovaryum, uterus ve plasenta dokularının metabolizmasını ve gelişimine etki etmelerinden dolayı özellikle dişi üreme sisteminin işlevini devam ettirmesi için büyük öneme sahiptir (Silva ve ark., 2018). Bu nedenle, hipotiroidizm ve hipertiroidizm hem kadınlarda hem de hayvanlarda kısırlığa veya kısırlığa neden olabilmektedir. Maternal tiroit disfonksiyonlarının iyi belgelenmiş diğer sekelleri arasında menstrüel/estral düzensizlik, anovulasyon, kürtaj, erken doğum, preeklampsi, intrauterin büyüme geriliği, doğum sonrası tiroidit ve çocuklarda zeka geriliği yer alır (Silva ve ark., 2018). Tiroit hormonları (TH'ler), insan ve hayvanların normal üreme işlevi için hayati öneme sahiptir. L-tiroksin (3,5,3',5'-tetraiyodotironin, T4) ve L-triiyodotironin (3,5,3'-triiyodotironin, T3), modüle eden spesifik nükleer reseptörler aracılığıyla doğrudan ovaryum, uterus ve plasenta doku ve organların gelişimi ve metabolizmasına etki eder (Japan, 1992; Galton ve ark., 2001; James ve ark., 2007).

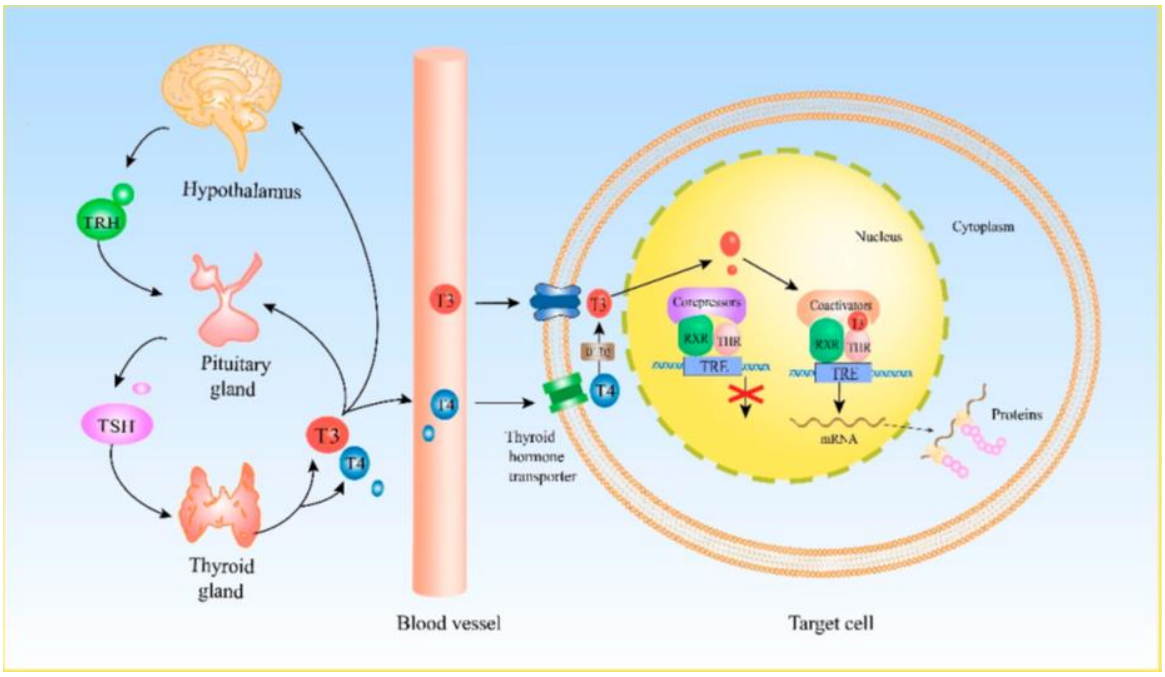
Tiroit hormonlarının hem kuşlarda hem de memelilerde üreme fonksiyonunu düzenlediği onlarca yıldır bilinmektedir **(**Dawson ve ark., 2001). Hem tiroit hormon sentezi hem de tiroit hormonunun dolaşıma salınması, hipofiz bezi kaynaklı tiroit uyarıcı hormon (TSH) tarafından klasik bir negatif geri besleme döngüsünde yürütülür **(**Chiamolera ve Wondisford, 2009). T3 biyolojik olarak aktif hormondur, tiroid tarafından salgılanan ana hormon olan T4 ise T3'ün öncüsü veya bir prohormon olarak kabul edilir. T3, T4'ten yaklaşık dört kat daha güçlüdür, ancak dolaşımdaki konsantrasyonu ve plazma yarı ömrü T4'ten çok daha düşüktür. Deiyodinazların (D1, D2 ve D3) etkisiyle periferik dokularda (örneğin karaciğerde) T4'ün deiyodinasyonu, T3 ve/veya ters T3 (rT3) üretimine yol açar (Silva ve ark., 2018). İnsan tiroidi ağırlıklı olarak biyolojik olarak aktif olmayan prohormon tiroksin (tetraiyodotirozin, T4) ve sadece az miktarda biyoaktif hormon triiyodotironin (T3) üretir. Dolaşımdaki tiroid hormonunun (T4 ve T3) toplam miktarının %0,1'inden azı, plazma zarından bir hedef hücreye aktarılabilen serbest veya bağlı olmayan formdadır (Vissenberg ve ark. 2015). Uzun zamandır tiroit hormonlarının plazma zarlarından pasif olarak yayıldığı düşünülüyordu (Tagawa ve ark.

1994). Şu anda, tiroit hormonunun hücreye monokarboksilat taşıyıcılar (MCT) 8 ve 10 ve çözünen taşıyıcı organik anyon taşıyıcı aile üyesi 1C1 veya OATP1C1 dahil olmak üzere tiroit hormonu taşıyıcıları sayesinde girdiğini biliyoruz (Visser ve ark., 2008).

TH'nin salgılanması ve hedef hücreler üzerindeki genomik etkisi. Tiroid bezinden salgılanan T3 ve T4 kana karışarak hipofiz ve hipotalamusa taşınır. T3 ve T4, TH taşıyıcı yoluyla hedef hücrelere girer. TH çekirdeğe girdikten sonra, T4, D1/D2 tarafından T3'e dönüştürülür. T3'ün çekirdeğe girmesinden önce, THR, RXR ile heterodimerize olur ve DNA üzerindeki TRE'ye bağlanır ve daha sonra transkripsiyonu inhibe ederek ortak baskılayıcıları devreye alır. T3 çekirdeğe girdikten sonra, THR'lerin ligand bağlama alanına bağlanarak, koaktivatör bağlanmasını desteklerken yardımcı baskılayıcı bağlanmasını bozar. Sonra transkripsiyonu başlatır (Ren ve Zhu 2022) (Sekil 1).

Memeli türleri arasında tiroit bezinin ve tiroit sisteminin yüksek oranda korunmuş doğası, türlerin hayatta kalması için kritik öneme sahip olduğunu göstermektedir **(**Choksi ve ark. 2003). Çalışmalar, tiroit sisteminin üreme sistemi de dahil olmak üzere çeşitli organ sistemlerinin gelişiminde kritik bir rol oynadığını göstermektedir. Yüksek oranda korunmuş doğasına rağmen, tiroit sistemi farklı türlerde üreme ve üreme sistemi gelişimi üzerinde çok farklı etkilere sahip olabilir (Choksi ve ark. 2003). Tiroit disfonksiyonu genellikle edinseldir ve yaşamın herhangi bir döneminde ortaya çıkabilir. Üreme çağındaki kadınlarda ve gebelik sırasında klinik ve subklinik hipotiroidizm görülebilmektedir (Idris ve ark., 2005).

Keçiler, köpekler ve atlar gibi evcil hayvan türlerinde hipotiroidizm de ana endokrinopatilerden biri olarak kabul edilir (Piosik ve ark., 1997; Dixon ve ark., 1999; Frank ve ark., 2002).



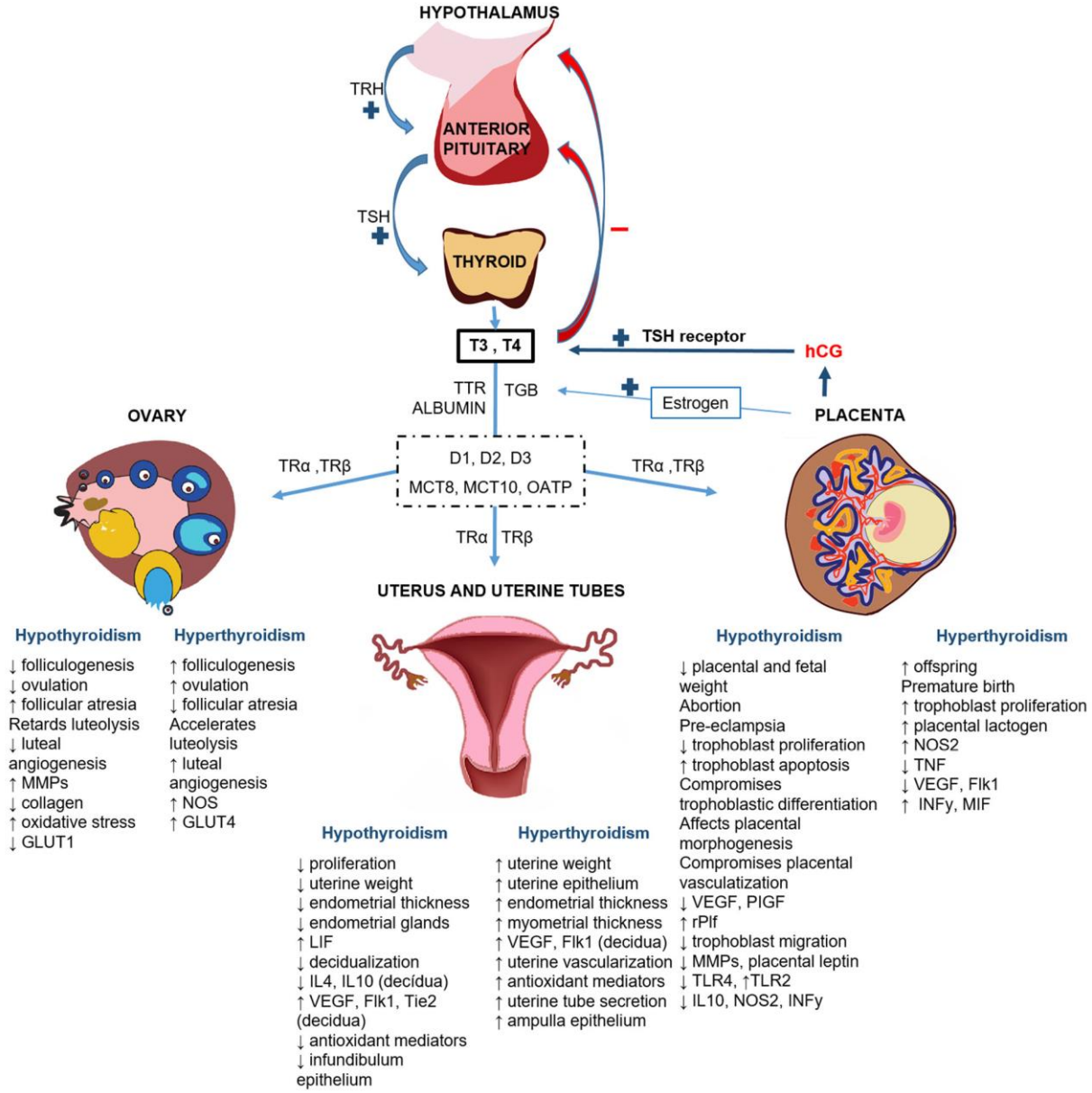
Şekil 1: TH'nin salgılanması ve hedef hücreler üzerindeki genomik etkisi. (Ren ve Zhu 2022).

BULGULAR VE TARTIŞMA

Yapılan araştırmalara bakılarak, kadın ve hayvanlardaki TH'lerin plazma seviyelerinin adet/östrus döngüsü kontrolünü, cinsel olgunlaşmayı ve davranışı, ovulasyonu, annelik yeteneğini, fetal büyüme, hamilelik, doğum sonrası bakım ve emzirmeyi etkileyen moleküler mekanizmaları etkilediği bilinmektedir (Silva ve ark., 2012; Freitas ve ark., 2007; Leite ve ark., 2008). Bu etkiler hem TH'lerin üreme organlarındaki doğrudan etkisinden hem de TH'lerin dişi üreme sisteminin düzgün çalışması için gerekli olan diğer hormonların ve büyüme faktörlerinin biyoyararlanımı üzerindeki etkisinden kaynaklanmaktadır (Dittrich ve ark., 2011; Forhead ve Fowden, 2014).

Dişilerde tiroit işlev bozukluklarının neden olduğu üreme davranışı ve siklus döngüsü bozuklukları, seks steroidleri ve bunların taşıma proteinleri gibi diğer hormonların biyoyararlanımı ve metabolizmasındaki değişikliklerle ilişkilidir (Duarte-Guterman ve ark., 2014). Seks steroidlerinin sentezi, taşıma ve eliminasyon hızı tiroit hormonlarından direkt olarak etkilenmektedir. Bu nedenle tiroit hiperfonksiyonu, artan androstenedion ve testosteron

sentezinin neden olduğu östrojen, androstenedion ve testosteronun artan plazma seviyeleri ve 17β estradiol klerensinin azalması ve androstenedionun estrona ve testosteronun estradiole metabolizmasının artması ile ilişkilidir (Dittrich ve ark., 2011).



Şekil 2. Hipotalamus-hipofiz-tiroid ekseni ve hipo ve hipertiroidizmin yumurtalık, uterin tüp, uterus ve plasentanın morfofizyolojisi üzerindeki etkileri. TH'lerin düşük kan seviyeleri hipotalamus ve hipofiz tarafından tespit edilir. Tirotropin salgılatıcı hormon (TRH), hipotalamus tarafından salınır ve hipofizi tiroid uyarıcı hormon (TSH) salması için uyarır. TSH tiroidi TH üretmesi için uyarır ve kandaki TH seviyesini normale döndürür. Buna karşılık,

TH'lerin yüksek kan seviyeleri, TRH ve TSH salınımını inhibe eder. Hamilelik sırasında, plasenta tarafından üretilen insan koryonik gonadotrofin (hCG), TSH reseptörüne bağlanır ve TH sentezini uyararak maternal HPT eksenini aktive eder. Gebelik sırasında artan östrojen seviyeleri ayrıca karaciğer tarafından TBG ekspresyonunu uyararak toplam TH serum konsantrasyonlarını arttırır. T4, L-tiroksin. T3, L-triiyodotironin. TBG, tiroksin bağlayıcı globulin. TTR, transtiretin. D, deiyodinaz. MCT8, MCT10 ve Oatp1a2, zar taşıma proteinleridir. TRα ve TRβ tiroid nükleer reseptörleridir. (Silva ve ark., 2018).

Tiroit disfonksiyonlarından kaynaklanan serum steroid düzeylerindeki bu değişiklikler, kadın ve dişi hayvanlarda cinsel davranışı etkileyebilmektedir. Bazı araştırmalar ergenlik öncesi kadınlarda hipertiroidizmin adet gecikmesine ve oligomenore veya amenore insidansında artışa neden olduğunu göstermektedir (Krassas ve ark., 2010). Hipotiroidizm de cinsel olgunlukta gecikmeye neden olmaktadır. Ancak bazı olgularda hipotiroidizmin erken puberte ve galaktore ile ilişkili olabileceği bildirilmiştir (Krassas ve ark., 2010). Hayvanlarda mevsimsel olarak üreyen türlerde östrus fazından anöstrusa geçiş için T3 gereklidir (Nakao ve ark., 2008). Koyunlarda, anöstrusun başlaması için üreme mevsiminin sonunda T3 bulunmalıdır. Ancak bu hormonun anöstrusun sürdürülmesinde veya süresinde hiçbir rolü olmadığı belirtilmektedir (Webster ve ark. 1991).

Tiroit hormonlarının ovaryum morfofizyolojisi üzerine etkisi

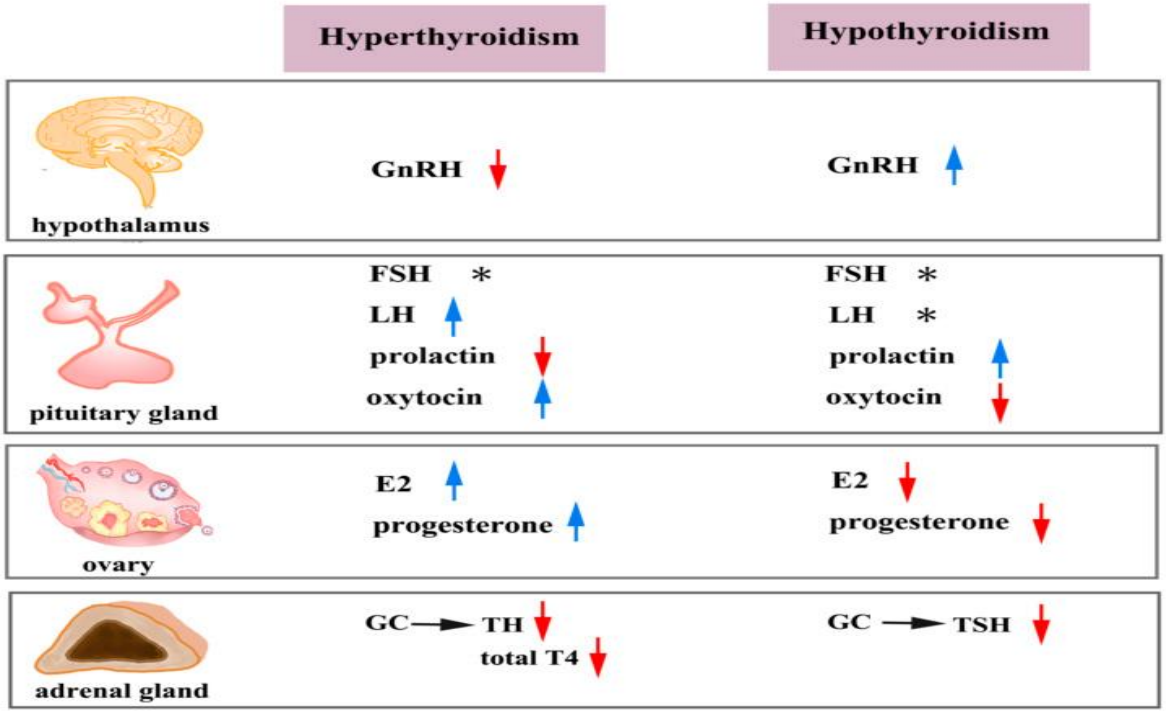
Dişi doğurganlığı, gonadların yeterli gelişimine, oosit olgunlaşmasına, granüloza hücrelerinin çoğalmasına ve farklılaşmasına ve folikülogenez sırasında siklik ovaryum değişikliklerini koordine eden çeşitli hormonlar ve büyüme faktörleri arasındaki etkileşime bağlıdır. Foliküler gelişimin her aşamasında, foliküllerinin foliküler sıvısında tanımlanan T3 ve T4 foliküler büyüme veya atrezi için foliküler hücrelerde doğrudan veya dolaylı olarak etki eder (Costa ve ark., 2015) (Şekil 2, Şekil 3). Bu iki hormonun (FSH ve T3) küçük preantral foliküllerdeki granüloza hücrelerinin apoptozunu sinerjistik olarak inhibe ederek etkileştiğine inanılmaktadır (Asahara ve ark., 2003). Oositler ve granüloza, ovaryum stroma ve kümülüs hücreleri, Tiroit hormonları için reseptörleri bulundurmaktadır ki bu da T3 ve T4'ün doğrudan yumurtalık dokusu üzerinde etkili olduğunu gösterir (Aghajanova ve ark., 2009; Mahmud ve ark., 2021).

T3 hormonu gonadotropik hormonlarla birlikte teka hücreleri tarafından aşırı androjen üretimini engeller ve granüloza hücreleri tarafından östrojen üretimi ile aromatizasyonu uyarır

(Spicer ve ark., 2001). Tiroit hormonları preovulatuar foliküllerin, sığır oositlerinin mayotik olgunlaşmasında da önemli görevlere sahiptir (Kor, 2014).

Tiroit hormonlarının uterus ve tuba uterina üzerindeki etkisi

Tiroit hormonlarının uterusta ve tuba uterinada ki etkisi, hücre içi reseptörleri aracılığıyla organların östrojene yanıtını düzenler (Santin ve Furlanetto, 2011) (Şekil 2, Şekil 3). T3 ve T4 hormonlarının serum seviyelerindeki değişikliklerin, östrus veya menstrüel siklus boyunca reseptörlerini uygun şekilde aktive etmeyerek ve seks steroidlerinin plazma konsantrasyonlarını etkileyerek bu hormonların genital sistem üzerinde trofik etkisini etkileyerek uterus ve uterus tüpü morfofizyolojisini etkileyebilmektedir (Redmond, 2004).



Şekil 3. Kadınlarda hipertiroidizm ve hipotiroidizmin serum hormon düzeyleri üzerindeki etkileri. Tiroid disfonksiyonu, üreme hormonu salgılanmasında değişikliklere neden olabilir. Yatay ok yukarı regülasyonu temsil ederken, aşağı ok hipertiroidizm ve hipotiroidizmin serum hormon seviyelerini düşürdüğünü gösterir. Yukarı ok, hipertiroidizm ve hipotiroidizmin serum hormon düzeylerini artırdığını gösterir. Yıldız işareti, hormon seviyelerindeki değişikliklerin literatürdeki çeşitli kaynaklar arasında tutarsız olduğunu gösterir. GnRH, gonadotropin salgılatıcı hormon; FSH, folikül uyarıcı hormon; LH, lüteinizan hormon; E2, estradiol; GC, glukokortikoid; TH, tiroid hormonu; T4, tiroksin; TSH, tiroid uyarıcı hormon. Kırmızı ok

azalmış hormon seviyelerini gösterir. Mavi oklar artan hormon seviyelerini gösterir. Yıldız işaretleri literatürdeki tutarsızlıkları gösterir (Ren ve Zhu 2022).

SONUÇ VE ÖNERİLER

Tiroit hormonları, çeşitli fizyolojik süreçlerin düzenlenmesinde yer alır ve serum konsantrasyonlarındaki değişiklikler, tüm organizmanın, özellikle üreme sisteminin düzgün işleyişini tehlikeye atar. Hipotiroidizmin sadece fetal-plasental büyüme geriliği ile değil aynı zamanda preeklampsi oluşumu ile de ilişkili olduğu ileri sürülmüştür. Tiroit hormonlarının dişi üreme sistemindeki tüm bu etkilerinin esas olarak kadınlarda yapılan araştırmalar sonucu ortaya konmuştur. Benzer bir durumun yani tiroit hormon işlev bozukluklarının evcil hayvan türlerinde ne gibi etkiler gösterdiği ve en önemliside üreme işlevi üzerindeki etkisine ilişkin çok sayıda araştırma yapılması gerekmektedir.

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TÜRKİYE'NİN YILLARA GÖRE KANATLI HAYVAN VARLIĞI VE DEĞERLENDİRİLMESİ

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Özet
Bu çalışmanın amacı; son senelerde artış gösteren kanatlı hayvanlarımızın sayısı ve bu hayvanlardan elde edilen ürünlerin miktarının yıllara göre dağılım düzeyini ortaya koymak olmuştur. Ülkemiz sahip olduğu çok çeşitli ve geniş iklim şartlarına sahiptir. Ülkemiz sahip olduğu arazi yapısı ve buralarda yetişen çok çeşitli bitki örtüsüyle hayvancılığın yoğun olarak yapıldığı yerlerden birisidir. Anadolu coğrafyası kanatlı hayvan yetiştiriciliğine uygun bir yapıya sahiptir. Ülkemizin neresine gidilirse gidilsin kanatlı hayvan yetiştiriciliği yapılmaktadır. Kanatlı hayvan yetiştiriciliği çiftçilere ekonomik katkılarının yanında köylerde olduğu gibi şehir merkezlerinde de insanımızın vazgeçemediği kültürel değerlerden birisi olmuştur. Gerek yumurta gerekse eti için yetiştiriciliği yapılan tavukçuluk, kümes içerisinde olduğu gibi serbest şeklinde de olmaktadır. Ticari olarak ta küçük işletmeler şeklinde veya büyük ve çok sayıda kümes tavukçuluğu yapılmaktadır. Kanatlı hayvan sayısı insanların ekonomik ve tüketim alışkanlıklarına göre çok hızlı bir değişkenlik gösterebilmektedir. 2000 ve 2011 ekonomik krizleri sırasında hem yumurta hem de et tavuğu sayılarında belirgin bir azalma olmuştur. 1999 yılında 50.826.656 olan yumurtacı tavuk sayısı 1999 yılında 71.885.207 sayısına ulaşmış, 2005 yılında ekonomik krizlerin etkisiyle 60.275.674 sayısına gerilemiş, 2021 yılında 121.000.775 sayısına ulaşmış fakat daha sonra tekrar ekonomik kriz ve yem maliyetlerinin artması sebebiyle 2022 yılında 109.806.327 sayısına gerilemiştir. Hindi ve kaz sayısı 2011 yılına kadar tedrici bir azalmadan sonra bu tarihten sonra her iki cinsinde sayıları artmaya başlamıştır. 1991 yılında 3.132.676 olan hindi sayısı 2011 yılına gelindiğinde 2.563.330 sayısına kadar düşmüş 2021 yılında ise 4.703.797 sayısına ulaşmıştır. Ülkemizde yetiştirilen kaz sayısı da ekonomik göstergelere göre farklılıklar arz etmektedir. 1991 yılında 1.599.831 olan kaz sayısı 2011 yılına gelindiğinde 679.516 sayısına kadar düşmüş 2021 yılında ise 1.477.569 sayısına ulaşmıştır. Ördek sayısı ise günümüzde bile hala azalmaya devam etmektedir. 1991 yılında 1.112.015 ördek sayımız 2022 yılına geldiğimizde çok büyük bir düşüş göstererek 432.457 sayısına kadar gerilemiştir. Hindi ve kaz sayısındaki bu artışın en büyük nedeni devlet desteğinin artması ve tüketim alışkanlığıdır. Hayvancılık sektöründe yeni teknolojilerinde kullanıldığı her türlü ıslah işlemlerinin bu hayvanlardan alınan verimi artıracağı aşikârdır. Daha önemlisi ise bu ıslah konusunun yetiştiricilerimiz tarafından benimsenmiş olmasıdır.
Anahtar Kelimeler: Türkiye, Kanatlı, Yıl, Miktar

POULTRY AVAILABILITY AND EVALUATION OF TURKEY BY YEARS

Abstract
The aim of this study; The aim of this study is to reveal the number of our poultry, which has increased in recent years, and the distribution level of the amount of products obtained from these animals over the years. Our country has a wide variety of climatic conditions. Our country is one of the places where animal husbandry is intense with its land structure and a wide variety of vegetation that grows there. Anatolian geography has a structure suitable for poultry farming. Wherever we go in our country, poultry farming is carried out. Poultry breeding has become one of the cultural values that our people cannot give up in city centers as well as in the villages, in addition to its economic contributions to the farmers. Poultry, which is grown for both eggs and meat, is in the free form as well as in the hen. Commercially, poultry farming is carried out in the form of small enterprises or large and many poultry. The number of poultry can vary very rapidly according to the economic and consumption habits of people. During the 2000 and 2011 economic crises, there was a marked decrease in both egg and broiler numbers. The number of laying hens, which was 50,826,656 in 1999, reached 71,885,207 in 1999, decreased to 60,275,674 in 2005 with the effect of economic crises, reached 121,000,775 in 2021, but then again to 109,806 in 2022 due to the economic crisis and the increase in feed costs. It dropped to 327. After a gradual decrease in the number of turkeys and geese until 2011, the numbers of both breeds started to increase after this date. The number of turkeys, which was 3,132,676 in 1991, decreased to 2,563,330 in 2011 and reached 4,703,797 in 2021. The number of geese reared in our country also differs according to economic indicators. The number of geese, which was 1,599,831 in 1991, decreased to 679,516 in 2011 and reached 1,477,569 in 2021. The number of ducks continues to decrease even today. Our number of 1,112,015 ducks in 1991 decreased to 432,457 by showing a great decrease in 2022. The biggest reason for this increase in the number of turkeys and geese is the increase in government support and consumption habits. It is obvious that all kinds of breeding processes used in new technologies in the livestock sector will increase the yield of these animals. More importantly, this breeding issue has been adopted by our breeders.
Keywords: Türkiye, Poultry, Year, Amount.

1. GİRİŞ

Ülkemiz gerek toprak yapısı gerek bitkisi ve gerekse hayvan yapısı bakımından oldukça zengin bir yapıya sahiptir. Türkiye sahip olduğu doğal ve çeşitli bitki örtüsüyle büyükbaş ve küçükbaş hayvan yetiştiriciliğinde olduğu kadar kanatlı hayvan yetiştiriciliği içinde çok elverişli topraklara sahiptir. Özellikle dağlık, tepelik ve orman bölgeleri kanatlı hayvan özelliklede serbest tavuk yetiştiriciliği için oldukça uygun yapıya sahiptir. İnsanımızın ucuz ve kaliteli ete ulaşması önemlidir. Günümüzde yaşanan pandemi süreci, gerekse çevremizde meydana gelen savaşlar gıda üretiminin önemini bir kez daha ortaya koymuştur. İnsan beslenmesinde önemli bir yere sahip olan hayvansal proteinin temininde stratejik bir konuma sahip olan kanatlı eti, istikrarsız kırmızı et üretiminden kaynaklanan açığın kapatılmasında ayrı bir öneme sahiptir. Anadolu'da kanatlı hayvan yetiştiriciliği uzun bir geçmişe ve köklü bir geleneğe sahiptir. Kanatlı hayvan yetiştiriciliği, özellikle yumurtacı tavuk yetiştiriciliği, kırsal kesimde yaşayan insanlarımız için önemli bir geçim kaynağı olmuştur. Orman köylüsünün geçimini temin etmede oldukça önemli bir yere sahiptir. Ülkemizde kanatlı hayvan sayısında son yıllarda artış kaydedilmiştir. Türkiye'de son yıllarda, devlet destekleri artmış, vatandaşların besin gereksinimini temin etmek ve yüksek değere sahip hayvansal protein kaynaklarını artırmak için kanatlı hayvan yetiştiriciliğine önem vermeye başlamıştır. Son senelerde yaşanan gerek salgın hastalıklar gerekse çevremizde çok yoğun olarak görmeye başladığımız ülkeler arası savaşlar ülkemizin kendine yetecek hatta daha fazlasını üretecek kapasiteye ulaşması gerekliliğini ortaya koymaktadır. Yaşanan bu durumlar göstermiştir ki insanını besleyebilen devletler artık güçlü devlettir. Bizimde yapmamız gereken her türlü teknolojik gelişmeyi tarım ve hayvancılık alanında kullanmamız kaçınılmaz bir gerçek olarak karşımıza çıkmıştır.

Kanatlı Hayvan grubuna hobi veya ticari amaçla yetiştirilen tavuk, hindi, kaz, ördek, devekuşu, keklik, sülün ve bıldırcın gibi çeşitli kanatlı türler girmektedir (Eşidir ve Pirim). Bu hayvanlardan ülkemizde en fazla yetiştiriciliği yapılan hem eti hem de yumurtası için yetiştirilen tavuklardır. Ülkemizde keklik, sülün ve bıldırcın türleri yetiştiriciliği özellikle kene vb gibi zararlılarla mücadele etmek amacıyla Bahri Dağdaş Uluslararası Tarımsal Araştırma Enstitüsü'nde yapılmaktadır. Bu türler bazı özel işletmelerde de üretilmesine rağmen sayıları çok fazla değildir. Temel besinler arasında hayvansal kaynaklı olanlar çok önemli bir yer tutar.

2. YILLARA GÖRE KANATLI HAYVAN VARLIĞI

Türkiye'de 1991-2022 yılları arasında ülkemizin kanatlı hayvan varlığında kayda değer değişimler meydana gelmiştir. Kanatlı hayvan sayısı insanların ekonomik ve tüketim alışkanlıklarına göre çok hızlı bir değişkenlik gösterebilmektedir. 2000 ve 2011 ekonomik krizleri sırasında hem yumurta hem de et tavuğu sayılarında belirgin bir azalma olmuştur. Yine son dönemlerde yaşanan pandemi süreci ve sonrasında yaşanan ekonomik kriz kanatlı eti ve yumurta fiyatlarındaki artışla beraber tüketim miktarı 2022 yılında düşüş göstermiştir. Bu durum üretim miktarını da etkilemiştir (tablo 1). 1999 yılında 50.826.656 olan yumurtacı tavuk sayısı 1999 yılında 71.885.207 sayısına ulaşmış, 2005 yılında ekonomik krizlerin etkisiyle 60.275.674 sayısına gerilemiş, 2021 yılında 121.000.775 sayısına ulaşmış fakat daha sonra tekrar ekonomik kriz ve yem maliyetlerinin artması sebebiyle 2022 yılında 109.806.327 sayısına gerilemiştir. Hindi ve kaz sayısı 2011 yılına kadar tedrici bir azalmadan sonra bu tarihten sonra her iki cinsinde sayıları artmaya başlamıştır. 1991 yılında 3.132.676 olan hindi sayısı 2011 yılına gelindiğinde 2.563.330 sayısına kadar düşmüş, 2021 yılında ise 4.703.797 sayısına ulaşmıştır. Ülkemizde yetiştirilen kaz sayısı da ekonomik göstergelere göre farklılıklar arz etmektedir. 1991 yılında 1.599.831 olan kaz sayısı 2011 yılına gelindiğinde 679.516 sayısına kadar düşmüş, 2021 yılında ise 1.477.569 sayısına ulaşmıştır. Ülkemizin kaz varlığı 2022 yılında pandemi sürecinin etkisiyle 1.385.507 sayısına kadar gerilemiştir. Ördek sayısı ise günümüzde bile hala azalmaya devam etmektedir. 1991 yılında 1.112.015 ördek sayımız 2022 yılına geldiğimizde çok büyük bir düşüş göstererek 432.457 sayısına kadar gerilemiştir (tablo 1).

Tablo 1. Tür ve ırklarına göre kanatlı hayvan sayısı (Kaynak TÜİK).

Yıl	Yumurta tavuğu (adet)	Et tavuğu (adet)	Hindi (adet)	Kaz (adet)	Ördek (adet)
1991	50.826.656	88.379.548	3.132.676	1.599.831	1.112.015
1993	58.179.047	120.080.935	3.340.241	1.687.596	1.171.961
1995	57.324.654	71.689.773	3.291.000	1.745.163	1.199.925
1997	61.401.783	104.870.702	5.327.501	1.794.610	1.828.792
1999	71.885.207	167.862.730	3.762.516	1.670.916	1.294.824
2001	55.675.750	161.899.442	3.254.018	1.397.560	913.748
2003	60.399.520	217.133.076	3.994.093	1.336.775	810.910
2005	60.275.674	257.221.440	3.697.103	1.066.581	656.409
2007	64.286.383	205.082.159	2.675.407	1.022.711	481.829
2009	66.500.461	163.468.942	2.755.349	944.731	412.723
2011	78.956.861	158.916.608	2.563.330	679.516	382.223
2013	88.720.709	177.432.745	2.925.473	755.286	367.821
2015	98.597.340	213.658.294	2.827.731	850.694	398.387
2017	121.556.027	221.245.322	3.872.460	978.384	491.561
2019	120.725.299	221.841.860	4.541.102	1.157.049	519.575
2021	121.000.775	270.393.122	4.703.797	1.477.569	539.897
2022	109.806.327	251.289.799	3.669.726	1.385.507	432.457

Dünya tavuk eti ihracatında Brezilya ve ABD başta gelmektedir ve küresel ihracatın %39'unu bu iki ülke gerçekleştirmektedir (Erişir ve Pirim; 2011). Türkiye ise Dünya ihracatında 21. sırada yer almaktadır (Erişir ve Pirim; 2011). Ülkemiz tavukçuluk sektöründe çok büyük gelişmeler katetmesine rağmen tavuk eti üretim ve ihracatı hususunda istediğimiz noktadan çok uzakta kalmaktayız. 1995 yılında kesimi yapılan 215.280.442 tavuktan 282.038 ton tavuk eti elde edilmiştir. Tavuk eti ve kesilen tavuk miktarı yıllar içerisinde hızlı bir şekilde artış göstermiştir. 2022 yılında kesimi yapılan 1.347.726.670 tavuktan 2.417.995 ton tavuk eti elde edilmiştir. 1995 yılında kesimi yapılan tavuklardan ortalama 1.31 kg et elde edilirken bu miktar 2022 yılına gelindiğinde tavuk başına elde edilen verim miktarı artmış ve 1.79 kg ulaşmıştır (tablo 2). İnsanımızın tüketim alışkanlıklarının değişmesi dolayısıyla hindi eti üretim ve tüketimi özellikle 2003 yılından itibaren hızlı bir artış göstermiştir. 1999 yılında 1.424.240 hindi kesimi yapılırken 12.744 ton hindi eti elde edilmiştir. 2022 yılında ise kesimi yapılan 5.593.282 hindiden 53.646 ton hindi eti elde edilmiştir. 1999 yılında kesimi yapılan hindilerden ortalama 8.95 kg et elde edilirken bu miktar dönemsel farklılıklar göstermesine rağmen 2022 yılına gelindiğinde hindi başına elde edilen verim miktarı artmış ve 9.59 kg ulaşmıştır (tablo 2).

Tablo 2. Yıllar bazında Kümes hayvanları kesilen hayvan sayısı ve et miktarı ton. (Kaynak TÜİK).

	Tavuk			**Hindi**		
Yıl	**Kesilen hayvan sayısı (Adet)**	**Et (Ton)**	**Kesilen tavuk başına kg et miktarı (Adet)**	**Kesilen hayvan sayısı (Adet)**	**Et (Ton)**	**Kesilen hindi başına kg et miktarı (Adet)**
1995	215.280.442	282.038	1,31	-	-	-
1997	310.256.550	471.415	1,52	-	-	-
1999	376.283.750	596.880	1,59	1.424.240	12.744	8,95
2001	370.909.696	614.745	1,66	1.707.401	15.125	8,86
2003	512.750.071	872.419	1,70	3.636.838	32.801	9,02
2005	538.900.235	936.697	1,74	4.417.319	42.709	9,67
2007	604.835.659	1.068.454	1,77	3.620.313	31.467	8,69
2009	717.401.256	1.293.315	1,80	2.981.847	30.242	10,14
2011	963.245.455	1.613.309	1,67	4.043.525	36.331	8,99
2013	1.060.673.395	1.758.363	1,66	4.574.443	39.627	8,66
2015	1.118.719.413	1.909.276	1,71	5.359.763	52.722	9,84
2017	1.228.444.095	2.136.734	1,74	5.218.613	52.363	10,03
2019	1.207.088.021	2.138.451	1,77	6.188.060	59.640	9,64
2021	1.243.408.593	2.245.770	1,81	5.170.017	51.301	9,92
2022	1.347.726.670	2.417.995	1,79	5.593.282	53.646	9,59

Tavuk başına elde edilen yumurta sayıları da yıllara göre oldukça farklılıklar arz etmektedir. 1991 yılında tavuk başına 1 yılda elde edilen yumurta sayısı 150.87 iken 2022 yılında bu rakam 180.40'a çıkmıştır (tablo 3). 2003 yılında tavuk başına elde edilen yumurta sayısı en yüksek seviyeye ulaşarak 209.72 adet sayısına ulaşmıştır. Yıllara göre tavuk başına elde edilen yumurta sayısının farklılık göstermesinin en büyük nedeni besleme maliyetlerinin artması ve tüketimin azalması gelmektedir.

Tablo 3. Yıllara göre elde edilen tavuk yumurtası sayısı. (Kaynak TÜİK).

Tavuk yumurtası sayısı			
Yıl	**Yumurta tavuğu (adet)**	**Tavuk yumurtası (Bin adet)**	**Tavuk başına yumurta sayısı (yıllık)**
1991	50.826.656	7.667.990	150,87
1993	58.179.047	10.006.269	171,99
1995	57.324.654	10.268.668	179,13
1997	61.401.783	12.089.341	196,89
1999	71.885.207	14.090.023	196,01
2001	55.675.750	10.575.046	189,94
2003	60.399.520	12.666.782	209,72
2005	60.275.674	12.052.455	199,96
2007	64.286.383	12.724.959	197,94
2009	66.500.461	13.832.726	208,01
2011	78.956.861	12.954.686	164,07
2013	88.720.709	16.496.751	185,94
2015	98.597.340	16.727.510	169,65
2017	121.556.027	19.281.196	158,62
2019	120.725.299	19.898.126	164,82
2021	121.000.775	19.297.591	159,48
2022	109.806.327	19.808.539	180,40

3. TARTIŞMA VE SONUÇ

Türkiye kanatlı hayvan varlığımızdaki bu dalgalanmalar bu hayvanlardan elde edilen et ve yumurta miktarlarını da etkilemiştir. Son yıllarda tavuk etine artan taleplerden kaynaklanan bu ürünlerde belirgin bir artışın olduğu görülmektedir. Hayvancılık sektöründe yeni teknolojilerinde kullanıldığı her türlü ıslah işlemlerinin bu hayvanlardan alınan verimi artırmaktadır. Daha önemlisi ise bu ıslah konusunun yetiştiricilerimiz tarafından benimsenmiş olmasıdır. Dünya iklimi son yıllarda çok büyük değişikler göstermektedir. Yerli ırklarımızın üstün yaşama kabiliyeti özelliklerinden yeterince ve iş işten geçmeden faydalanmamız gerekmektedir.

4. KAYNAKÇA

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SOME ENVIRONMENTAL FACTORS AFFECTING THE MEDULLATED AND NON-MEDULLATED FIBER DIAMETER CHARACTERISTICS IN CENTRAL ANATOLIAN MERINO SHEEP

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Abstract
The Merino sheep is a sheep breed raised worldwide with the aim of obtaining the most famous and valuable wool. It originated in Spain and is currently bred in many countries around the world. Merino sheep are raised in various climates and geographical regions worldwide for wool production. Countries such as Australia, Argentina, South Africa, New Zealand, and China are significant regions for Merino sheep farming. Wool qualities such as wool diameter, length, color, elasticity, strength, medullated, non-medullary rate, and greasy wool are critical in the textile industry. These qualities determine the quality and value of wool. In this study, the effects of age, body region on the Central Anatolian Merino's Medulla and Non-Medulla diameter (µ) were examined. The LSM of medulla fiber diameter for lamb, yearling, primiparous and multiparous were 24.20 µ, 25.55 µ, 25.31 µ, and 25.39 µ and non-medulla 25.20 µ, 24.81 µ, 24.69 µ, and 24.75 µ respectively. The effect of the body region on characteristics medulla fiber diameter (µ) for shoulder, rib and rump were 24.61 µ, 24.45 µ and 26.27 µ, non-medulla 24.02 µ, 25.49 µ, and 25.40 µ, respectively. Central Anatolian Merino, a sheep breed cultivated in Turkey, is particularly renowned for its wool quality. It is widely prevalent in the Central Anatolia region and is specifically bred for wool and meat production. The fleeces of Central Anatolian Merino sheep possess characteristics closely resembling fine, soft, and high-quality wool production. Therefore, considering the presence of Merino and crossbreed sheep in the country, it can contribute to reducing imports by supplying a portion of the wool needed by the textile industry
Keywords: Central Anatolian Merino, Medulla, Non-Medulla, Diameter

1. INTRODUCTION

The Merino sheep is a sheep breed raised worldwide with the aim of obtaining the most famous and valuable wool (Bean, 1913). It originated in Spain and is currently bred in many countries around the world. Merino sheep are raised in various climates and geographical regions worldwide for wool production. Countries such as Australia, Argentina, South Africa, New Zealand, and China are significant regions for Merino sheep farming (Anonymous, 2020). Just like in the rest of the world, Turkey has been using Merino sheep in crossbreeding efforts to increase wool and meat production since the early years of the republic (Polatoğlu, 2019).

Sheep breeding in Turkey is a traditional agricultural activity with a long history, and it is one of the countries where sheep breeding is widely practiced, with approximately 46 million sheep (91.1% domestic sheep breeds, 8.9% Merino crossbreeds) (TUIK, 2023). Karacabey Merino, Central Anatolian Merino, Malya, and Ramlıç sheep breeds were developed from Merino crossbreeds to boost fleece and meat production needed by the textile industry (Yalcin, 1986). These breeds, which are bred intensively in the Aegean region, Marmara region and Central Anatolia region, are preferred by breeders because they have adapted to poor pasture conditions and different geographical conditions. The Central Anatolian Merino breed is widely bred in the Central Anatolia region, especially in Ankara and Konya provinces.

Wool qualities such as diameter, length, color, elasticity, strength, medullated, non-medullary rate, and greasy wool are critical in the wool industry (Plowman et al., 2019). These qualities determine the quality and value of wool. Wool diameter is an important attribute since it determines the softness, fineness, and strength of the wool. While having a thin fiber diameter is a desired feature in the textile industry, whether the fiber has a medulla or non-medulla significantly affects the quality of the fiber. The use of medullated and non-medullarized fibers in the textile industry is determined by the product's purpose and requirements. In some cases, medullated fibers provide resilience and insulation, whereas non-medullarized fibers provide softness and comfort. However, a fine, high-quality wool fiber does not have a medulla layer. (Buğdaycı et al., 2023). These considerations are considered while determining the fiber to employ in the design and manufacture of textile products.

The medulla is a hollow structure in the fiber channel that varies based on heredity and environmental factors. This structure differs among cortical cells within the fiber (Ross and Speakman 1957). Fibers with medulla are used especially in the carpet industry, and fibers non-

medulla are preferred in textile production (Koyuncu et al., 1999). As a consequence, the present research sought to determine the effects of various environmental factors (age and body region) the fleece quality measurements (medulla and non-medulla diameter) of Central Anatolian Merino sheep.

2. MATERIALS AND METHODS

2.1. Animals And Phenotype

This study obtained samples from a farm engaged in breeding Central Anatolian Merinos CAM (85% German Meat Merino and 15% Akkaraman) breed sheep in the Polatlı district of Ankara province, with the necessary permissions. There were four groups of 30 animals apiece. Lambs (3-6 months), yearling sheep (1-1.5 years), primiparous (2-2.5 years), and secundiparous sheep (3-3.5 years and older) were the groupings. Wool samples were obtained from the shoulders, ribs, and rump of all animals. Each animal, or group of animals, had 100 g of wool taken from the body shoulders, ribs, and rump region. These samples were tagged and placed in plastic bags with clear identification of the age of each sample. The packed samples were kept in a suitable condition until the day of analysis. Descriptive statistics of wool Medulla and Non-Medulla Fleece Diameter traits are presented in Table 1.

To evaluate fiber diameter, the USTER OFDA 100 (also known as an optical fiber diameter analyzer) equipment was employed, which can measure 4,000-5,000 fibers at simultaneously. Clean fiber samples were cut at a certain rate and placed on a lamella in the apparatus's measuring unit in order to measure utilizing optical principles and deliver the resulting fiber medulla and non-medulla diameter measurements in microns. Before proceeding to advanced statistics, the data were cleansed for outliers, and samples greater than three standard deviations were deleted. The current study's statistical analyses were carried out using SPSS v21.0 for Windows. To evaluate the variance across groups for each wool attribute, the analysis of variance (ANOVA) test was used. DUNCAN multiple comparison tests were used to compare groups that had a statistical difference as a consequence of variance analysis. The least-square means (±SE) of the wool traits in Central Anatolian Merino are presented in Table 2.

Table 1. Descriptive statistics of wool Medulla and Non-Medulla Fleece Diameter traits.

Trait	Medulla Fleece Diameter (µ)	Non-Medulla Fleece Diameter (µ)
Number of observations	360	360
Mean	25.11	24.43
Standard error	0.13	0.12
Minimum	18.30	17.90
Maximum	33.20	32.20
Coefficient of Variation	10.04	9.40

2.2. Statistical Analyses

Outliers were removed from the data by removing observations with values greater than the mean three times the standard deviation. The Shapiro-Wilk test was used to determine the normality of the replies. Furthermore, the variance homogeneity was visually examined using a plot generated from the residual vs fitted value of the answers. This study first evaluated the impact of environmental parameters (age, body region) on the creation of the final linear mixed models. For linear model analysis, the SPSS 26" program was used. Generalized linear models were used to evaluate the impact of environmental factors prior to fitting the final models for the attributes. The mean least square differences of the components were analyzed using these mixed models, with herd effect included as a random factor in the model. Duncan's Test was then used to compare the differences between groups for the significant criteria. The following is a description of the final linear mixed model that was applied to the traits:

Model: $yij = \mu + ai + bj + eij$

Where yij are the observations of the dependent variables (i.e., Medulla, Non-Medulla); µ is the intercept; ai is the fixed effects of age (4 levels); bj is the fixed effects of body region (3 levels, where eij is the residual error of observations in the models.

3. RESULT AND DISCUSSION

In this study, the effects of age on the Central Anatolian Merino's Medulla and Non-Medulla diameter (µ) were examined. The least-square means (LSM) for the sheep are displayed in Table 2 by age. According to this study medulla diameter findings, lambs had the finest fleece, and yeraling sheep had the thickest fleece. Furthermore, non-medulla diameter findings,

primiparous had the finest fleece, and lambs had the thickest fleece (Table 2). The LSM of medulla fiber diameter for lamb, yearling, primiparous and multiparous were 24.20 µ, 25.55 µ, 25.31 µ, and 25.39 µ and non-medulla 25.20 µ, 24.81 µ, 24.69 µ, and 24.75 µ respectively. The medulla fiber diameter difference between groups was found statistically significant ($p < 0.001$). However, it was determined in the study that the difference between groups in non-medulla fibers was insignificant. In the results obtained in fibers with medulla, it was found in the study that lambs had the thinnest fiber diameter, but in those non-medulla, those in the yearling age group had the thinnest fibers.

The diameter of the medulla canal found in the center of wool fibers shows significant variations depending on the breed of animals and their care conditions (Tarakçıoğlu, 1983). When the structure of the fiber is examined, it is observed that as the animal fibers become thicker, the medulla canal also thickens, and as the fiber becomes finer, the medulla gradually disappears, becoming invisible under the microscope. Medullation affects the appearance of dyed fleece and its processing properties. Medullated fibers give a stiff rather than soft feel. Due to this characteristic, medullated fibers are not preferred in the textile industry. Medullated fibers, because of the empty fiber canal, their stiff appearance, and their ability to keep the fiber upright, are used in the carpet manufacturing industry. The preference of the textile industry is for medullar fibers, which can be easily dyed and have a soft structure.

Table 2. The least-square means (±SE) of the wool traits in Central Anatolian Merino

	Medulla (µ)			**Non-Medulla (µ)**		
Fixed Effects	**n**	**LSM ± SE**	**p-value**	**n**	**LSM ± SE**	**p-value**
Age			**			
Lamb	90	24.20±0.24[a]		90	25.20±1.10	
Yearling	90	25.55±0.24[b]		90	24.81±1.10	
Primiparous	90	25.31±0.24[b]		90	24.69±1.10	
Multiparous (2 ≥)	90	25.39±0.24[b]		90	24.75±1.10	
Body Region			***			
Shoulder	120	24.61±0.22[a]		120	24.02±0.96	
Rib	120	24.45±0.22[a]		120	25.49±0.96	
Rump	120	26.27±0.22[b]		120	25.40±0.96	
İntercept	360	26.54±0.30		360	25.18±1.35	

Notes: The mean values which have different superscripts are significantly different. ***P < 0.001. **P < 0.01. *P < 0.05. SE = standard error; n = number of observations.

Merino sheep have a fleece with a desirable diameter of 18 to 23, which is the fineness that the textile industry requires. (Lamb, 1997, Wood, 2003, Lyons, 2008, Holloway, 2017). Previously the studies conducted by Behrem et al., 2022 Atav et al., 2020, Sönmez, 1963, Harmancıoğlu, 1974 and Erdem, 1993 found the fiber diameter as 24.1 µ- 25.9 µ, 28.67 µ, 23.5–20.6 µ, 20.6–26.4 µ and 22.88 µ in the same breed respectively. In this study, the fineness of the obtained medullated fibers and in other previous studies, it has been observed that the quality of the fleece is age-dependent because the fleece quality characteristics are good until the age of 3-4, but deteriorate in later ages. However, in the case of non-medulla, when looking at the results obtained, it has been determined that the thickest fiber is in lambs, while It is thinner in other age groups. This situation indicates that age does not have any effect on the fineness characteristic in non-medulla fibers. The quality of the fiber structure is mostly influenced by the sheep's physical state. The growth of primary and secondary follicles in the skin plays a significant role in developing the features that determine fiber structure quality. As these follicles grow, they undergo metabolic changes that may affect the quality of the fleece. As a result of these changes, the quantity and quality qualities of the fleece vary. The quality of the fleece usually degrades over time as it ages (Behrem and Gul, 2022).

In this study, another environmental factor, the effect of the body region on the diameter (µ) characteristics of medullated and non-medullated fibers, has been investigated. The detailed Least-Square Means (LSM) results for the characteristics are presented in Table 2. The LSM of medulla fiber diameter for shoulder, rib and rump were 24.61 µ, 24.45 µ and 26.27 µ, non-medulla 24.02 µ, 25.49 µ, and 25.40 µ, respectively. Upon examining the obtained results, it was observed that in medullated fibers, the rib region has the finest fiber diameter, while the rump region has the thickest fiber diameter. Furthermore, it was determined that there is a significant difference in fiber diameter among different body regions in medullated fibers ($p < 0.001$). In non-medullated fibers, it is observed in the study that the shoulder region has the finest fiber diameter, there is little difference between the rib and rump regions, and they both have a thick fiber diameter. Additionally, it is noted that the differences among body region groups affecting non-medullated fibers are insignificant in the study. (Uzun Kara, 2008)found a fibre diameter of 23.86 µ in the shoulder area, 24.31µ in the rib area, and 24.75 µ in the rump area in Karacabey Merino; (Tuncer and Cengiz, 2018) found the fibre diameter as 25.16 µ in Anatolian merino and 30.99 µ in Akkaraman sheep; (Arık et al., 2003) reported the diameter

values of Anatolian merino as 23.19 µ in the shoulder, 23.07 µ in the ribs, and 23.46 µ in the rump region. When this study and others are examined, it is observed that there are differences in fiber fineness among body regions in a manner similar to this study. Similar results to the fiber fineness findings obtained in other Merino crossbreed races, except for the Akkaraman breed, were also obtained. The variations in fiber diameter among different body regions of sheep are typically associated with the variability in anatomical structure, which subsequently influences fiber growth. Each body region possesses a distinct anatomical structure, and these structures can exert an influence on the growth rate, quality, and diameter of fibers. Among different breeds, the development of primary and secondary follicles in fiber growth can exhibit variations (Champion and Robards 2000). It is generally acknowledged that in finer wool fibers, the development of secondary follicles is more pronounced. Furthermore, it is desirable for the fleece covering the body to exhibit uniformity not only in its fleece structure but also in its conformity to the desired characteristics throughout the entire body. For instance, the shoulder region of a sheep differs from the rib region due to variations in muscle groups, which can impact fiber growth. Additionally, differences among body regions can be attributed to genetic factors, nutrition, environmental conditions, and other factors (Peşmen and Yardımcı, 2012). Therefore, differences in fiber diameter generally arise from the distinct fiber quality and characteristics exhibited by different body regions of sheep. Such disparities can hold significance in industries such as the textile industry, as fiber quality and diameter can impact the quality of the final products.

4. CONCLUSION

Central Anatolian Merino, a sheep breed cultivated in Turkey, is particularly renowned for its wool quality. It is widely prevalent in the Central Anatolia region and is specifically bred for wool production. The fleeces of Central Anatolian Merino sheep possess characteristics closely resembling fine, soft, and high-quality wool production. Therefore, considering the presence of Merino and crossbreed sheep in the country, it can contribute to reducing imports by supplying a portion of the wool needed by the textile industry. The age of sheep is found to have a significant effect on fineness values in medullated fibers but is considered insignificant in non-medullated fibers. Breeding programs can potentially reduce the medullated fiber ratio. Furthermore, knowledge of the influence of age groups on fiber characteristics can facilitate producers in categorizing their sheep into age groups during shearing season, which can be

advantageous for pricing determination during the sales period. The influence of the body region of sheep is found to be significant on fineness values in medullated fibers but is considered insignificant in non-medullated fibers. Reduction in the medullated fiber ratio is achievable through breeding programs. Further research in this field can contribute to a better understanding and management of these traits, ultimately enhancing the overall quality of wool. Achieving uniformity among body regions is achieved by addressing the differences in fiber characteristics. This, in turn, eliminates potential inconsistencies in products to be sold as raw materials. Collaboration with organizations representing textile producers and industrialists is essential to coordinating sheep breeding objectives with the unique requirements of the textile sector. Breeders and textile producers may develop a cooperative partnership that encourages the production of high-quality wool and satisfies the demands of the increasing textile industry.

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LEGAL SUPPORT OF ECONOMIC METHODS OF ENVIRONMENTAL LAW AND ORDER MANAGEMENT IN THE REPUBLIC OF KAZAKHSTAN

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Abstract
A favorable environment is an objectively necessary condition for the life of every person, his health and the implementation of industrial, social, recreational and other useful activities. The preservation of a favorable level of the environment can be ensured in a variety of ways: the introduction of advanced production technologies, economic stimulation of environmental activities, financing of restoration of ecological natural systems, and many others. All of them together and individually can bring their own positive environmental result. The purpose of this article is to study the theoretical characteristics of the concept of environmental law and order as one of the conditions that ensure the sustainable development of society
Keywords: environmental law and order, environmental safety, environmental protection, favorable environment, human rights.

INTRODUCTION

The effectiveness of the implementation of environmental legislation depends not only on the improvement of legal regulations, but also on the level of environmental awareness of citizens and other legal entities, their awareness of their responsibility to society for the preservation of a favorable environment for future generations.

The management of an environmentally sound legal order can actually be carried out by economic and administrative methods. Each of them is important and necessary. According to paragraph 1 of Article 28 of the Environmental Code of the Republic of Kazakhstan dated 02.01.2021 No. 400-VI ZRK (Environmental Code,2021), the Government of the Republic of Kazakhstan develops the main directions of the state environmental policy and organizes their implementation. The authorized body in the field of environmental protection for the implementation of the unified state environmental policy of the Republic of Kazakhstan is the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan.

Peace, security, legal regulation of issues in the field of environmental management, human rights to a favorable environment are the main fundamental values that have become problematic for many countries of the world. As a result of the deepening contradictions between society and nature, environmental problems are becoming more and more dangerous. In addition, "the environmental problems that have arisen today are not only a consequence of the long-term neglect of environmental factors in the development of economic and other activities, the "stable idea of the inexhaustibility of nature" played a big role (Golichenkov A.K., 1991).

MATERIALS and METHODS

The methodological basis of the research was the teaching about the interaction of society and nature, about the dialectic of these relationships in development and contradictions, about the factors and negative consequences of anthropogenic impact on the environment, about the need to preserve its favorable state for present and future generations. The methodological basis of the research was the teaching about the interaction of society and nature, about the dialectic of these relationships in development and contradictions, about the factors and negative consequences of anthropogenic impact on the environment, about the need to preserve its favorable state for present and future generations.

FINDINGS and DISCUSSION

The fundamental document in the policy of environmental safety is the Constitution of the Republic of Kazakhstan dated August 30, 1995 (Constitution RK, 1995). The principles of the state environmental policy are the basis not only of environmental legislation, but also of all strategic and program documents in the field of environmental protection and rational use of natural resources. The main documents of environmental legislation – Ecological, Land, Water, Forest, Tax Codes, Codes of the Republic of Kazakhstan "On Subsoil and subsoil use" and "On administrative offenses", laws: "On protection, reproduction and use of wildlife", "On specially protected natural territories", "On mandatory environmental insurance", "On support of renewable energy sources" – posted in open access on the Internet resource http://ecogosfond.kz /. Kazakhstan has ratified more than 30 environmental conventions and protocols to them (Unified ecological Internet resource).

Economic methods should be understood as such a set of means of influence, which is based on the use of economic incentives that provide for the material interest and financial responsibility of managerial employees, collectives in the process of solving the tasks (Dukhno, N.A., 2000).

Specific economic ways of influencing the environmental law and order are quite clearly indicated in the Environmental Code of the Republic of Kazakhstan. The legislation of Kazakhstan in the field of the environment is systematized in the Environmental Code. Such as the implementation of a unified state environmental policy, environmental protection measures financed from budgetary funds, licensing of activities in the field of environmental protection, environmental regulation, environmental assessment. setting limits on the use of natural resources, emissions and discharges of pollutants into the environment and waste disposal; setting standards for fees and amounts of payments for the use of natural resources, emissions and discharges of pollutants into the environment, waste disposal and other types of harmful effects; providing enterprises, institutions and organizations, as well as citizens with tax, credit and other benefits when they introduce low-waste and resource-saving technologies and non-traditional types of energy, implementing other effective measures to protect the environment; compensation in accordance with the established procedure for damage caused to the environment and human health.

We do not aim to consider all these methods, but will focus only on the most problematic aspects of the implementation of these methods of economic impact on the environmental order. It is necessary to begin the presentation with such a forgotten economic category as planning. A plan is nothing more than a pre-planned system of activities that provides for the order, sequence and timing of work. He is an instrument of ordering, organized prudent activity. The range of its application is the widest. Legislative, managerial and other types of work are carried out on a planned basis (Dukhno, N. A., 2000).

But this type of activity is hardly correct to consider as an element of the economic mechanism of environmental protection. Having embarked on the transition to a market economy, the Republic of Kazakhstan has legislatively abandoned the planned management of the economy.

In fairness, it should be said that having abandoned the planned economy of the Soviet period, the state uses such a form of planning as strategic and program documents (Environmental Performance Reviews, 2019).

The development of national action plans for the implementation of signed international conventions, the system of environmental expertise, licensing and control and inspection work have become the basis not only for environmental legislation, but also for all strategic documents in the field of environmental policy and environmental protection, as well as the rational use of natural resources in the Republic of Kazakhstan. Defining in these documents is the political concept of interaction between society and nature, covering the basic conceptual provisions and principles of environmental protection, environmental safety, state and law. The main strategic document for the development of the Republic of Kazakhstan is the Strategy "Kazakhstan–2050": a new political course of an established state", which sets clear guidelines for building a sustainable and effective economic model based on the country's transition to a "green" path of development. Target indicators, norms and measures of the "green economy" are included in legislative acts and program documents and are guidelines for all levels of government and all sectors of civil society (Environmental Performance Reviews, 2019).

Decree of the President of the Republic of Kazakhstan dated May 30, 2013 No. 577 approved the Concept for the transition of the Republic of Kazakhstan to a "green economy". The Concept is implemented in three stages:

- 2013-2020 – the main priority of the state during this period is to optimize the use of resources and increase the efficiency of environmental protection activities, as well as the creation of a "green" infrastructure;

- 2020-2030 – on the basis of the formed "green" infrastructure, transformations in the national economy will begin, focused on the careful use of water, stimulating the development and widespread introduction of renewable energy technologies, as well as the construction of structures based on high energy efficiency standards;

- 2030-2050 – transition of the national economy to the principles of the so-called "third industrial revolution", focused on the use of natural resources, provided they are renewable and sustainable (National report of the Republic of Kazakhstan, 2021)

At the same time, the financing of environmental protection measures is an independent economic method of environmental management.

The source of financing for environmental protection activities and the formation of an environmentally friendly legal order are various types of fees for environmental management. The literature correctly emphasizes that they can have a purely fiscal purpose, but it is necessary that their collection pursues a dual purpose:

- accumulation of funds to finance environmental protection measures;

stimulation of rational use of natural resources and environmental protection activities of economic entities.

The procedure for charging fees for environmental pollution and environmental management is determined, in addition to legislative acts, by a number of subordinate regulations. In this regard, it is necessary to support the proposal of the authors, who consider it relevant to adopt a legislative act that would clearly regulate the procedure for establishing collection and expenditure of payments for environmental pollution.

In accordance with Chapter 4 and Chapter 5 of the Environmental Code of the Republic of Kazakhstan, the forms for providing information on budget revenues have been approved:

- from payment for emissions into the environment;

- from recovery of damage caused to the environment;

- from fines for violations of environmental legislation of the Republic of Kazakhstan;

- on budget expenditures for environmental protection measures (Ecological code of the Republic of Kazakhstan, 2021).

At the same time, the financing of environmental protection measures is an independent economic method of environmental management. The expenses of the State are a method of carrying out almost all of its functions. According to Section 2, Article 29 of the Environmental Code of the Republic of Kazakhstan, environmental protection measures are a set of technological, organizational, social and economic measures aimed at protecting the environment and improving its quality. Environmental protection measures are carried out at the expense of budgetary funds, as well as at the expense of natural resource users' own funds. Environmental protection measures are included in the action plan developed by the nature user to obtain environmental permits. In accordance with Chapter 12 of the Environmental Code of the Republic of Kazakhstan, state environmental control in the field of environmental protection, reproduction and use of natural resources is carried out by the authorized body in the field of environmental protection in order to ensure environmental safety, conservation of natural and energy resources and sustainable use of biological resources. The object of environmental control is, on the one hand, the environment (its components), on the other

– activities of enterprises, organizations, officials in terms of compliance with environmental rules and regulations. State environmental control is carried out in the following forms: - preventive control without visiting the subject (object);

- preventive control with a visit to the subject (object);

- checks (Ecological code of the Republic of Kazakhstan, 2021).

Preventive control without visiting the subject (object) is carried out by analyzing data obtained from the mass media and an automated system for monitoring emissions into the environment, documentation and reporting submitted to the authorized body in the field of environmental protection.

The results of the analysis may be the basis for preventive control and supervision with a visit to the subject (object) of control and supervision or an unscheduled inspection The grounds for preventive control with a visit to the subject (object) or an unscheduled inspection based on the results of data analysis from the automated monitoring system of emissions into the environment are determined by the rules approved by the authorized body in the field of environmental protection, which provide for the order of processing, transmission, storage and use of data from an automated system for monitoring emissions into the environment. The economic assessment of damage from environmental pollution is determined by direct or

indirect methods. According to the Environmental Code of the Republic of Kazakhstan, it is mandatory to conduct industrial environmental control (PEC) of the environment at all enterprises of the Republic. The PEC is carried out in order to obtain reliable information about the impact of the nature user on the environment and to assess the effectiveness of the environmental protection measures carried out by him and to forecast the consequences of this impact on the environment. The assessment of the ecological state of the environment is achieved by comparing the periodically obtained data of controlled parameters with normative indicators. The objects of control are atmospheric air, surface and groundwater, soil cover, the formation of production and consumption waste, the level of background radiation. As part of the implementation of industrial environmental control, operational monitoring, monitoring of emissions into the environment and monitoring of impacts are carried out. In addition to budget financing, environmental protection measures are also carried out at the expense of environmental funds. The creation and separation of state environmental funds is an important link in the system of measures of economic regulation and maintenance of favorable environmental law and order (Dukhno, N. A., 2000).

The Environmental Code establishes that payment for emissions into the environment is one of the key mechanisms of economic regulation of environmental protection and environmental management. The Environmental Code provides that the fee for emissions into the environment is established and charged in accordance with the procedure provided for by the Code "On Taxes and Other Mandatory Payments to the Budget" (Tax Code) of 2017. (Tax Code of the Republic of Kazakhstan) (Tax Code, 2017).

Emissions that do not exceed the limit standards are subject to a fee for environmental pollution, while two different types of payments are charged for excess emissions:

1) administrative fines;

2) monetary compensation for damage caused to the environment.

Emission standards are set in permits issued by environmental authorities at the national or regional level, depending on the size of the enterprise. A command-and-control approach is still applied to the largest ("significant") pollutants, which provides for punishment for non-compliance with the emission limit set in the environmental permit. The amount of the fee for permissible emissions is calculated on the basis of emission standards established for each enterprise.

THE FUTURE OF MARINE FUELS IN AZERBAIJAN: ALIGNING WITH IMO CLIMATE ACTIONS THROUGH THE DEPLOYMENT OF LNG, LPG, AND HYDROGEN

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Abstract
The International Maritime Organization (IMO) has set ambitious targets for reducing greenhouse gas (GHG) emissions from shipping, leading to the maritime industry's transition towards cleaner fuels. Azerbaijan, being a major producer and exporter of hydrocarbons, has the potential to play a significant role in decarbonising the maritime sector by using liquefied natural gas (LNG), liquefied petroleum gas (LPG), and hydrogen as marine fuels. This paper specifically examines the potential of LNG, LPG, and hydrogen as marine fuels in Azerbaijan. The paper assesses these fuels' technical, economic, and environmental benefits and the challenges that may arise during their deployment. After analysing the data, the paper concludes that LNG, LPG, and hydrogen are viable options to reduce GHG emissions in the maritime industry. Additionally, several policy measures are proposed to support the deployment of these fuels.
Keywords: International Maritime Organization, LPG, LNG

The International Maritime Organization (IMO) has been taking measures to reduce greenhouse gas emissions from shipping for the past decade since the adoption of the first set of international mandatory measures in July 2011. IMO has implemented a comprehensive capacity-building and technical assistance program to support the implementation of these measures and encourage innovation in reducing emissions. Additionally, IMO has undertaken several global projects such as the GEF-UNP-IMO GloMEEP Project, the European Union-funded global network of maritime technology cooperation centres (GMN project), the IMO-Norway GreenVoyage2050 project, and the IMO-Republic of Korea GHG SMART Project to address greenhouse gas emissions.

IMO has been working on regulatory measures aimed at mitigating greenhouse gas emissions from shipping. To this end, they have adopted short-term measures to reduce the carbon intensity of all ships by at least 40% by 2030 compared to the 2008 baseline. Additionally, the organisation has implemented mandatory energy efficiency regulations, which include the Energy Efficiency Design Index (EEDI) for new ships and the Ship Energy Efficiency Management Plan (SEEMP) for all ships.

IMO has established a mandatory Data Collection System (DCS) for ships to collect and report fuel oil consumption data. The system monitors and reduces greenhouse gas emissions.

The International Maritime Organization (IMO) has taken measures to reduce greenhouse gas (GHG) emissions from shipping. The Initial Strategy targets cutting GHG emissions by at least 50% by 2050.

IMO has also executed projects to assist developing countries in implementing energy efficiency measures. The GEF-UNDP-IMO GloMEEP Project and the European Union-funded Global Maritime Technology Cooperation Centre Network (GMN) project are among the initiatives supporting trials and training in developing countries.

To spread awareness and provide training on energy-efficient ship operation and alternative fuels for maritime shipping, IMO has launched e-learning courses and workshop packages (IMO,2021).

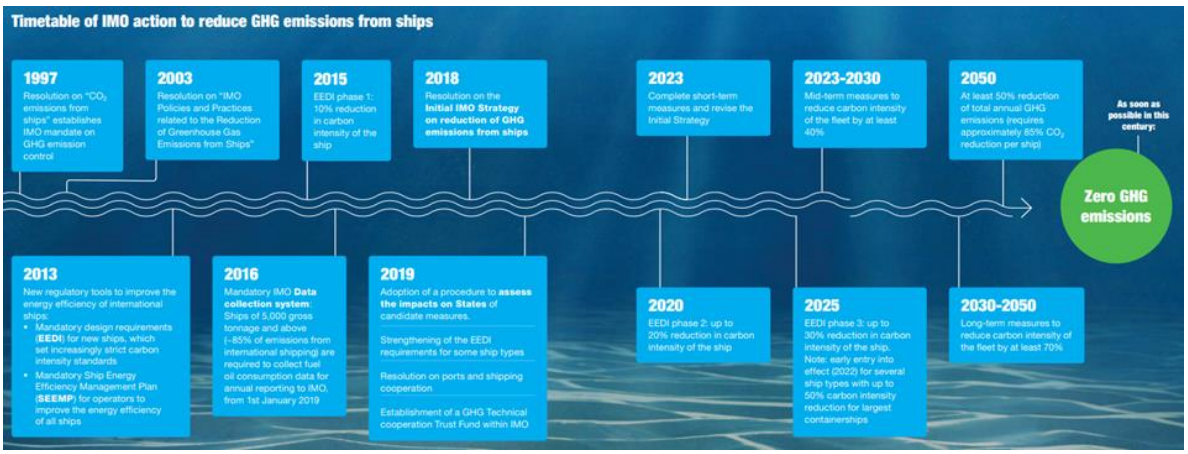


Figure 1. Timetable of IMO action to reduce GHG emissions from ships

Source: (IMO)

IMO has taken significant steps, including regulations, capacity building, and global projects, to reduce greenhouse gas emissions from shipping and support the fight against climate change.

Also under the CII scheme, ships must measure and record their actual carbon intensity during a year of operation to determine their attained annual operational CII. This value is then compared to the required annual operational CII to give a rating on a scale from A to E. If a ship is rated D or E for three consecutive years, it is required to submit a plan of corrective measures to achieve a rating of C or above. The Ship Energy Efficiency Management Plan (SEEMP) records the ship's performance in this regard.

Starting from 2023, the CII rating scheme will apply to all cargo, ropax, and cruise vessels of 5000 GT and above that trade internationally. The aim of this scheme is to encourage ships to transport cargo and passengers as efficiently as possible. The requirements for meeting these standards are expected to become more stringent in the future.

Energy Efficiency Design Index (EEDI) It aims to make ships more efficient. The EEDI has been implemented since January 2013.	One-time certification.	Applies to new ships.	Both the EEXI and the CII come into force in 2023 and apply to the following kinds of ships: ■ Bulk carriers ■ Gas carriers ■ Tankers ■ Container ships ■ General cargo ships ■ Refrigerated cargo carriers ■ Combination carriers ■ LNG carriers ■ Vehicle carriers ■ Ro-Ro cargo vessels ■ Ro-Ro Passenger vessels ■ Cruise ships
Energy Efficiency Existing Ship Index (EEXI) Addresses technical efficiency of existing ships by setting performance standards for ships of a given type, capacity and propulsion system. The main difference is the EEDI applies to new ships only, whereas the EEXI applies to existing ships.	One-time certification.	Applies to existing ships of 400 GT and above.	
Carbon Intensity Indicator (CII) Addresses operational efficiency of ships. Measures grams of CO_2 emitted per cargo-carrying capacity and nautical mile, giving each ship an annual rating between A (best) and E (worst). Ships rated D for three consecutive years, or E in a single year must submit a corrective plan as part of the Ship Energy Efficiency Management Plan.	Assesses emissions annually.	Applies to ships of 5000 GT and above.	

Source: BV, DNV and Lloyd's Register

Figure 2. Overview of EEDI, EEXI and CII

Source: (DNV,2023)

In modern times international shipping industry is currently dominated by fossil fuels. Also, the most fuels are heavy fuel oil (HFO), marine diesel oil (MDO) and liquefied natural gas (LNG) during 2012-2018 years. Maritime industries also have a role to climate change, as the percentage of global CO2 emissions from international shipping is 2.02%. All organisations also IMO want to decrease the effects of climate change and IMO in 2018, accept GHG strategy in the 2023 revision of the IMO initial GHG strategy goals is until by 2030 decrease GHG 20%, by 2040 decreasing 70% and until 2050 deceasing is 100% GHG emissions compared with 2008 levels (IMO, 2023).

Day by day, anthropogenic factors affect the increase because, in the world, the population quickly increases, leading to demand increasing. At the same time, pollution and negative effects also increase. In the global economy, its prominent role is the maritime industry. What is the anthropogenic factors or pollutant in the atmosphere? Three main groups are GHG(CO2, CH4, N2O), air pollution (NOX, SOX, PM and other) and ozone-depleting substances(CFC, HCFC).

It is a fact that reducing greenhouse gas (GHG) emissions without alternative fuels is impossible. Figure 1 demonstrates the percentage of GHG reduction methods available. In my

opinion, the GHG target cannot be achieved without using alternative fuels and energy sources that provide significant GHG emission savings compared to current fossil fuels.

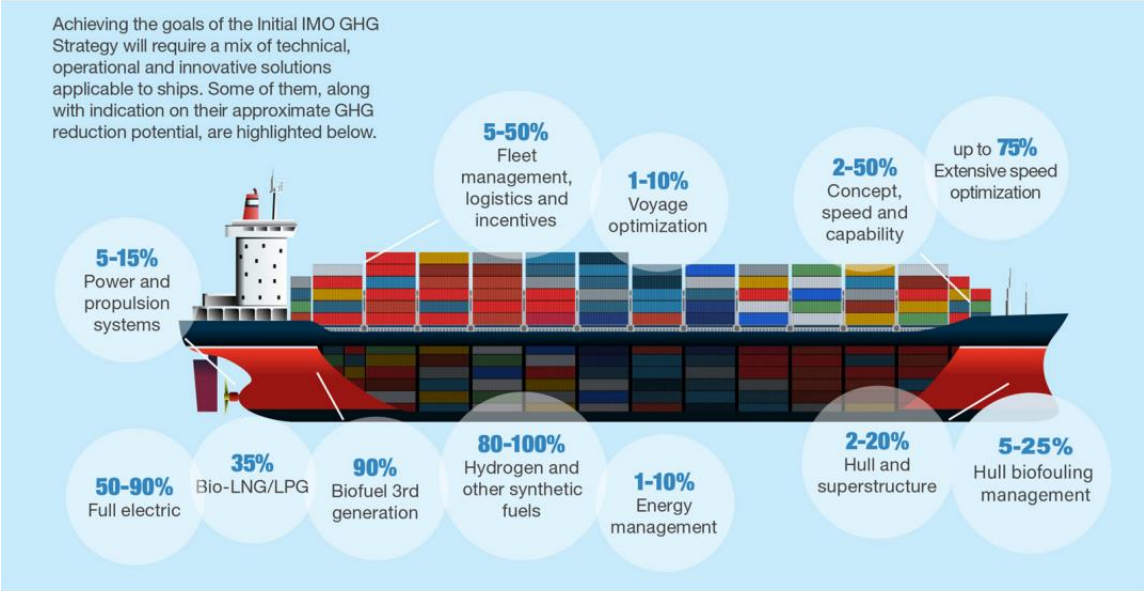


Figure 3. A wide variety of design operational and economic solutions

Source: IMO

There are a lot of types of alternative fuels here including LNG, LPG, Methanol, Biofuels, Batteries, Hydrogen, Ammonia, and others. Every fuels have advantage and disadvantages. This article will cover information about fuels and which kind of request need ports and ships for use this fuels and will analyse and compare these alternative fuels economical costs and currently which kind of alternative fuels is used in the world.

GHG goes through the atmosphere through production, distribution, transport, and operational emissions. Choosing an alternative fuel is the main factor.

LIQUEFIED NATURAL GAS (LNG)

The energy density of a substance at -162°C is measured at 53.6 MJ/kg or 22.2 MJ/dm3. It exists in a liquid state at this temperature and atmospheric pressure. When liquefied, it occupies 600 times less space than in its gaseous state. The volumetric density of LNG is lower compared to HFO, meaning that a larger volume of ship is required to accommodate storage tanks. In its liquid state, LNG is non-flammable, non-explosive and nontoxic. It has a flashpoint

of -188°C in its gaseous state and is commonly used in power generation. There are three types of LNG as Bio-LNG, E-LNG, and LNG. Type of LNG has own different energy source, production technology and processes.

It's worth noting that almost all liquefied natural gas (LNG) is currently produced from fossil natural gas, which is widely accessible. Although there are currently supply constraints for alternative feedstocks, it's expected that these constraints will lessen over time. The ability to produce environmentally-friendly LNG (E-LNG) is dependent on the availability of renewable power sources in the local area.

Liquefied Natural Gas (LNG) requires onshore facilities for storage, transportation and bunkering. The storage infrastructure is already well-established, with many ports having existing LNG storage facilities, especially in areas where natural gas markets are robust. In order to minimize heat loss and prevent the LNG from vaporizing, the storage tanks must be insulated. To prevent overpressurization of the tank, any vapor or Boil Off Gas (BOG) must be managed. LNG can be stored at atmospheric pressure in flat bottom tanks or pressurized in spherical or cylindrical tanks. The transportation of LNG is done globally via ships, trucks, pipelines, and rail. The process of loading and unloading LNG as a bulk product is widely familiar (IMO-Norway,2021).

Bunkering services are available in three ways: ship-to-ship, terminal-to-ship, and truck-to-ship. Currently, 96 ports provide LNG bunkering infrastructure, with an additional 55 ports in the process of developing facilities. The number of LNG bunker vessels is increasing, but their cost is higher than methanol and LPG storage due to the requirement of cryogenic temperatures for storage. The majority of ports with LNG bunkering infrastructure are in the Northern Hemisphere, and there is a need for more infrastructure in the Southern Hemisphere in the future.

Liquefied Natural Gas (LNG) requires onboard storage, handling, and propulsion facilities.

Double-walled pipes are necessary when dealing with low flash point fuel. In order to minimize the Boil Off Gas (BOG), LNG is stored in cryogenic insulated tanks made of suitable materials for use with a cryogenic liquid. It is important to note that larger tanks (2.3x) are required for equivalent energy content of HFO/MGO due to the lower volumetric energy density of LNG.

As LNG is widely handled as a bulk cargo, the risks associated with its handling are well-understood. The International Maritime Organization's (IMO) IGF code covers the handling of LNG as a fuel and requires additional crew training in accordance with established international standards and codes.

LNG combustion engines are already commercially available, including dual-fuel models, and retrofit Internal Combustion Engine (ICE) conversions are possible. Adaptations may include modifying the fuel injection system, and a purging system (such as N2 or other inert gas) is required to enable safe maintenance. Low and high-pressure 2-stroke ICE and low-pressure 4-stroke ICE engines are widely available. While LNG-based fuel cells are in an earlier development stage, they could provide higher efficiency than combustion engines if commercialized.

However, unburnt methane in the exhaust gas is a key issue, referred to as "methane slip," which can have an adverse effect on GHG emissions. This is particularly problematic in low-pressure engines, where lifecycle carbon equivalent emissions can sometimes exceed those of MGO or HFO.

Regulations, standards, and guidance are available, and guidelines are produced on a regular basis. In the world, there are many infrastructures and vessels for LNG, including the world's first sea-going large LNG bunker vessel, M.V. Green Zeebrugge, which entered operation based in Zeebrugge in 2017. This vessel has a capacity of 5,100 m^3 and is owned and operated by NYK. The Gate LNG import terminal in the port of Rotterdam has also provided the infrastructure to accommodate smaller vessels for LNG bunkering and feeder vessels to supply locations throughout Europe. Several LNG bunkering vessels now operate from here, including Shell's M.V. Cardissa and inland waterways barges.The Glutra was the first LNG-fueled ferry, built in 2000 at Langsten Yard, Norway, and is operating in the Norwegian Fjords. The Norwegian ferry company Fjord1 operates approximately 12 LNG fuelled ferries on the Norwegian Fjords.

LNG environmental impacts can be reduced by addressing methane emissions, utilizing renewable energy sources for production and transportation, and considering the nature of feedstock whether it comes from farming or waste.

Several barriers and risks are associated with using LNG as a fuel source. These include the uncertainty in future policy which may lead to low uptake of LNG technology, the high cost

of engine replacement or conversion, loss of space for cargo or passengers due to low volumetric energy density, and the availability of bunkering infrastructure. Additionally, methane slip is a concern, and using fossil LNG can lead to lock-in, preventing us from meeting long-term targets. While LNG burns more cleanly and emits up to 20% less GHG emissions than HFO/MGO fuels, this benefit can be offset by methane slip. Furthermore, relying solely on a 20% reduction is not a sustainable long-term solution, which means that we will have to look into non-fossil production pathways instead. It is important to note that LNG is only an interim fuel solution, and by using it, we are locking in engine and storage technology, as well as infrastructure (IMO-Norway,2021).

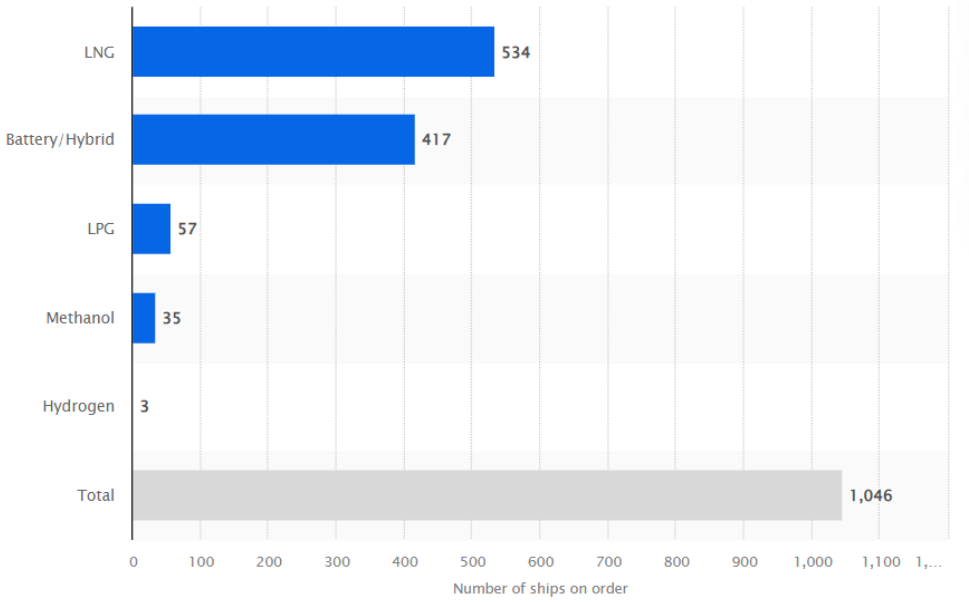


Figure 4. Number of ships using alternative marine fuels in global order book by fuel type in 2022

Source: (DNV, 2022)

LIQUEFIED PETROLEUM GAS (**LPG)**

LPG fuel has an energy density of 49.6 MJ/kg or 25.3 MJ/dm3, and its boiling point ranges from -42°C (pure propane) to -0.5°C (pure n-butane). The flashpoint is -104°C and has low water solubility with less than 200ppm at 20°C. It is commonly used as a fuel for both domestic and industrial purposes. Currently, most LPG is produced from crude oil and natural

gas, which are fossil feedstocks. The availability of waste oils is limited and unlikely to increase, while the use of vegetable oils competes with food and land demands. However, as the demand for biofuels increases, alternative feedstocks for bio-LPG may become more dominant.

LPG has onshore requirements that are quite easily met since many ports already have storage facilities for it. The existing infrastructure can be modified with only minor changes to the current fuel storage equipment. LPG does not affect stainless steel, ferrous metals or cast iron.

LPG is widely transported across the globe via ships, trucks, and rail, and there is widespread familiarity with loading and unloading it as a bulk product. The three types of ships that can transport LPG are refrigerated, semi-refrigerated, or pressurized.

Bunkering for LPG can be done directly at the load terminal, either by truck or via shipto-ship bunkering. However, LPG bunkering is relatively new and is not yet widely used as fuel in shipping. The use of LPG as fuel is regulated by the IGF code, which became effective in January 2017.

Here are the onboard requirements for using LPG as a fuel. Double-walled pipes are necessary due to its low flash point. Larger tanks, about 2-3 times larger, are required to store the same amount of energy as fossil fuels because of its lower volumetric energy density. If pressurized tanks are stored at atmospheric pressure, a reliquefaction system is required to handle boil-off gas. Due to its low viscosity, LPG is likely to leak.

LPG is already handled as a cargo product in compliance with IGC Code. The regulations that cover LPG as a fuel are covered by IGF Code. There are commercially available LPG combustion engines, including dual-fuel models. LPG-fueled engines have been in operation for many years ashore. Retrofit ICE conversions are also possible by modifying the fuel injection system. A purging system, using N2 or other inert gas, is required to ensure safe maintenance. Regulations, standards, and guidance are available to help ensure safe onboard use of LPG.

In the world, there are a lot of Projects about LPG. The LPG tanker market on a global scale has been valued at USD 182.02 million in 2021 and is expected to grow at a CAGR of 5.3% from 2022 to 2030. The market is likely to experience substantial growth due to the increase in shale gas production in the coming years. The shift of significant companies' focus

towards oil and gas production from shale rock, caused by the volatility of crude oil prices and advancements in hydraulic fracturing and horizontal drilling methods, is expected to enhance the market growth. The growing trade relationships between the U.S. and the APAC region, which are now producing shale gas, will likely outgrow the demand for liquified petroleum gas (LPG) tankers over the forecast period due to reduced transportation costs.

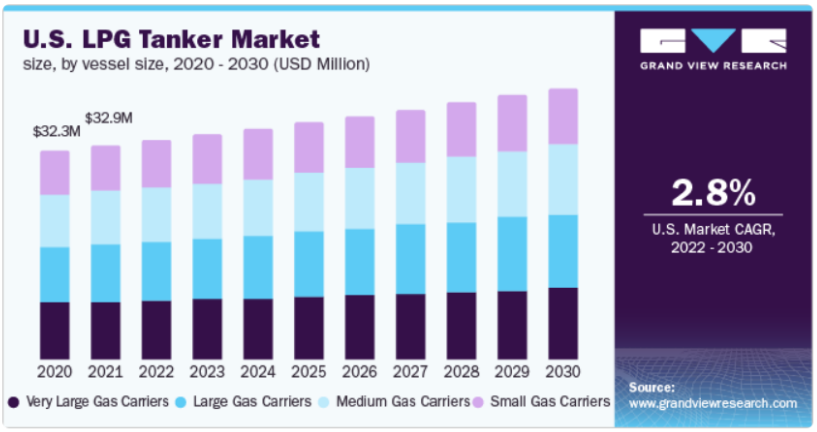


Figure 5. U.S. LPG Tanker market

Source: (LPG Tanker Market, 2020)

Environmental impacts caused by using LPG as an energy source for production and transportation are primarily determined by the nature of the feedstock and the reduction in well-to-wake GHG emissions. Which makes up 53 to 89 percent of Bio LPG, and has a lower environmental impact compared to fossil HFO. At the same time, it reduces SOx emissions by 90 percent, NOx emissions by 20 percent, and PM emissions by 90 percent (DNV GL, 2017).

Every alternative fuel has its own barriers and risks, including LPG. The low uptake of LPG technology is due to uncertainty in future policies, and the cost of engine replacement or conversion can be a deterrent. Additionally, the low volumetric energy density of LPG can lead to a loss of space for cargo or passengers. Low carbon production routes are dependent on the demand for other fuels and sectors, and other low-carbon routes are not economically favorable. Furthermore, some biomass sources may raise sustainability concerns. The use of fossil LPG can result in a lock-in that fails to meet targets.

Hydrogen (H2)

Hydrogen can be stored either as compressed gas (GH2) at up to 700 bar, or as a liquid (LH2) below -240°C, or chemically bound. It is already being used as a fuel for land-based transportation in fuel cell vehicles such as cars, buses, trucks, and trains. However, hydrogen is highly flammable and falls within an explosion range of 4-75 vol%.

The global demand for hydrogen in 2019 was 74 Mt. It is mainly used in refineries, ammonia, and methanol synthesis. Hydrogen production from natural gas is known as Grey (or blue) hydrogen. Low-carbon electricity and H2O produce green hydrogen. Residual biomass and municipal waste produce bio-hydrogen.

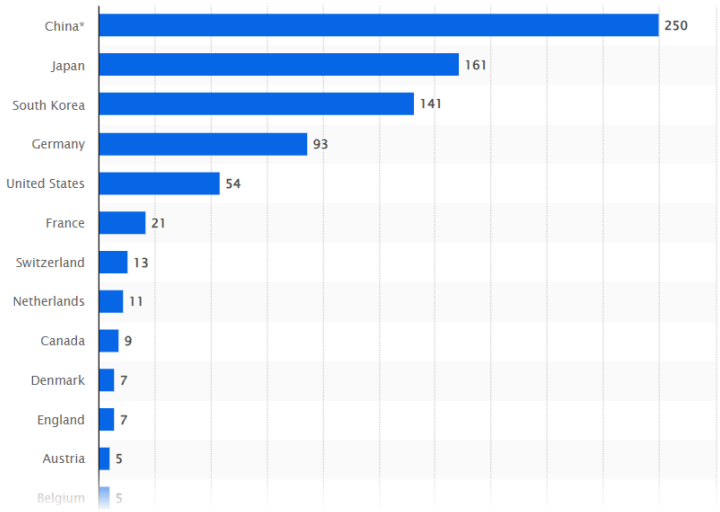


Figure 6. Number of hydrogen fueling stations for road vehicles worldwide as of 2022
Source: (US separtment of energy, 2022) Hydrogen tools

Currently, nearly all hydrogen (95%) is produced using fossil feedstocks such as natural gas and coal. Electrolysis of water has no feedstock limitation, but some regions have higher renewable energy potential and lower costs than others. The choice of low carbon production route is likely to be determined by the local availability of energy sources, such as natural gas plus CCS, renewable power, or sustainable biomass, as well as the economics of transporting hydrogen.

Storing hydrogen in a volume-efficient way is a challenge onshore. Only compressed gaseous hydrogen (GH2) or cryogenic liquid hydrogen (LH2) are currently available in their

elemental form. GH2 is stored in high-pressure tanks (<700 bar) but poses safety issues from the high pressures. LH2 is stored at -253◦C in cryogenic tanks, which requires a lot of energy and results in boil-off losses. Hydrogen can also be stored chemically in carrier molecules such as LOHC/NH3/PtX fuels.

If a network is available, pipelines are the best option for GH2 distribution. If the hydrogen needs to be transported by truck, the distance to be travelled determines whether GH2 (<300km) or LH2 is preferred. Ships have been designed to transport both LH2 (Kawasaki) and GH2 as a cargo.

There are currently no hydrogen bunkering or regulations due to the low level of use as fuel. The bunkering method will depend on the method of fuel storage (GH2 or LH2). GH2 is likely to be transferred to the ship by direct compression or via a pressure differential. LH2 will be bunkered using cryogenic pumps, drawing analogies with LNG. Bunkering can also occur via the direct exchange of container racks.

When it comes to using hydrogen as a marine fuel, there are certain requirements that need to be taken into consideration. Compression and liquefaction are both costly and energy-intensive methods. Liquefaction at extremely low temperatures of -253°C poses a problem due to boil-off losses. To prevent this, heavily insulated reservoirs with thick or double-walled vacuum-insulated containers are required. Alternatively, cold/cryo compression could be used, which is a hybrid method that involves temperatures ranging from 40K to 80K and pressure of 300 bar. The advantage of this method is that there is no boil-off loss. However, it requires tanks that are 4-13 times larger than those required for the same energy content of HFO. It's important to note that GH2 and LH2 tanks have fixed cylindrical shapes, so they cannot be packed into void spaces.

Safety is also a significant concern when storing high-pressure flammable gas on vessels since high-pressure tanks carry the risk of explosion. Currently, no regulatory requirements are available for hydrogen as a marine fuel. Therefore, crew members need to be trained on maintaining a hydrogen system on board a ship and handling fire safety.

Hydrogen can be burnt in a specialised internal combustion engine or gas turbine. Retrofit engine conversions are possible by modifying the fuel injection system. However, in ICE, H2 is blended with conventional fuels (diesel/LNG) to aid combustion. Hydrogen can also be used to generate electricity in fuel cells (PEMFC or SOFC), which can then drive electric

motors. Fuel cells have higher powertrain efficiencies than ICEs and produce no GHG or air pollutants. There are H2 ICE conversions available, but fuel cells are only at the demonstration level since they currently have only 1-2 MW power output.

The IGF Code covers the storage of liquefied gas on ships and does not include guidelines for storing hydrogen (H2) or using it as a fuel. Instead, ships must follow the SOLAS Regulation II-1/55 for alternative design approaches. However, the IGC and IGF Codes cover the storage of liquefied gas, and the C-tank rules generally cover liquid hydrogen storage (LH2).

ISO/TR 15916:2015 provides guidance for the safe use and storage of gaseous hydrogen (GH2) and liquid hydrogen (LH2). These guidelines outline basic safety concerns, hazards, risks, and the relevant properties of H2 for safety purposes.

There are no bunkering or port regulations for bunkering H2 fuel, and the bunkering of hydrogen-fuelled ships is subject to national regulations. ISO 20519 is a specification for the bunkering of gas-fuelled ships and is under preparation for final publication. Therefore, the evaluation of bunkering hydrogen-fueled ships needs to be done on a case-by-case basis.

ISO 14687 regulates the purity of hydrogen.

While there is no binding international regulatory framework for maritime fuel cell (FC) applications, Ships – Part 6 Chapter 2 Section 3 can be used to classify ships with FCs as FC(Power) or FC(Safety).

Regarding environmental impacts, the well-to-wake greenhouse gas (GHG) emissions for grey/blue H2 is a 22% reduction (blue) [1] and a 70% increase (grey). However, green H2 produces an 87% reduction in GHG emissions, and the production of bio H2 is highly dependent on the feedstock. (IMO-Norway,2021).

Barriers and Risks:

- High production costs for hydrogen, especially green but also blue, are a major challenge.
- The cost of replacing or converting engines to use hydrogen is also a concern.
- The low volumetric energy density of hydrogen leads to large tank volume requirements in fixed shape containers.
- There is currently no bunkering infrastructure, and the lack of regulations for bunkering and storage onboard and offboard is also a significant issue.
- The sustainability impacts of biomass and waste feedstocks used for hydrogen production can vary widely.

- The dominance of fossil fuels in hydrogen production is a major obstacle.
- Industrialization and scale-up of electrolyser and fuel cell components are also challenges.
- Safety is a significant concern due to hydrogen's high flammability range and low ignition temperature.
- The development of suitable transport and storage technology requires significant infrastructure investment (IMO-Norway,2021).

The Republic of Azerbaijan, located on the shores of the Caspian Sea, is one of the countries that plays a vital role in sea cargo transportation. Our country is constantly taking essential steps in the direction of increasing local and international transport in the field of maritime shipping, strengthening the existing fleets to strengthen the country's competitiveness and transit potential. In addition to the increase in transportation in the country, measures are being taken to achieve sustainable development goals and reduce greenhouse gases emitted into the atmosphere. Azerbaijan is constantly studying the world's experience in the fight against global warming and trying to apply innovations in shipping to ships.

The Azerbaijani government has taken several steps to promote the reduction of climate change. These steps include:

- To achieve the Sustainable Development Goals, the National Coordinating Council for Sustainable Development of Azerbaijan was established by Decree No. 1066 of the President of the Republic of Azerbaijan dated October 6, 2016.
- Document "Framework document on sustainable development cooperation between the United Nations and Azerbaijan 2021-2025".
- According to subsection 5.2 of the document "Azerbaijan 2030: National Priorities for Socio-economic Development" approved by the Decree of the President of the Republic of Azerbaijan dated February 2, 2021, No. 2469, the use of alternative and renewable energy sources will increase significantly in advanced countries in the strategic period. To meet the needs of current and future generations, the application of environmentally friendly "green" technologies should be expanded. Based on the scientific and technical potential, the impact on climate change should be reduced by increasing the share of alternative and renewable energy sources in primary consumption in all areas of the economy. International cooperation in sustainable development and global warming is carried out in our republic.

- The adoption of laws, conceptions on the protection atmosphere and renewable energy

The Azerbaijani government is committed to reducing greenhouse gas (GHG) emissions from the maritime sector. The government is also committed to developing a sustainable maritime industry. Using alternative fuels can help reduce the environmental impact of shipping and support the development of a green maritime industry in Azerbaijan. The Azerbaijani government is working with some stakeholders to promote the green, sustainable maritime sector. These stakeholders include:

- Shipping companies
- Port authorities
- Fuel suppliers
- Equipment manufacturers
- Financial institutions

A big part of the vessels belong to the "Azerbaijan Caspian Sea Shipping" (ASCO), which has the largest fleet in the country. ASCO focuses on minimising the environmental impact on the marine environment and atmosphere of sludge, used oil, fuel, other liquid and solid wastes generated during the operation of ships. All necessary preventive measures are taken to prevent damage to the environment and atmosphere during operations. The requirements of the ISO international management standard are implemented to ensure efficiency in energy use. In accordance with the requirements of the MARPOL Convention, fuel is sampled and regulated by means of special equipment installed for the determination of sulfur oxides (SOx) on ships that make and will make international voyages. ASCO's activities resulted in a reduction in the volume of direct and indirect emissions, and a reduction in total emissions of greenhouse carbon dioxide (CO2) and acute air pollutant SO2. As a result of efforts to reduce the impact on the environment, ASCO has seen a downward trend in the volume of direct emissions from its operations. Savings were achieved in drinking water and fuel consumption in transportation.

ASCO implements various measures to improve energy efficiency and reduce energy consumption in its fleet of ships and shore facilities. The company uses different types of fuels and takes regular measures to explore the use of alternative and renewable means. The company pays special attention to fleet renewal, gradually decommissioning older and more fuel-consuming vessels and replacing them with ships equipped with more modern technology and

consuming less fuel. ASCO also continuously monitors and takes measures to reduce greenhouse gas and other air emissions from its vessels and shore-based facilities.

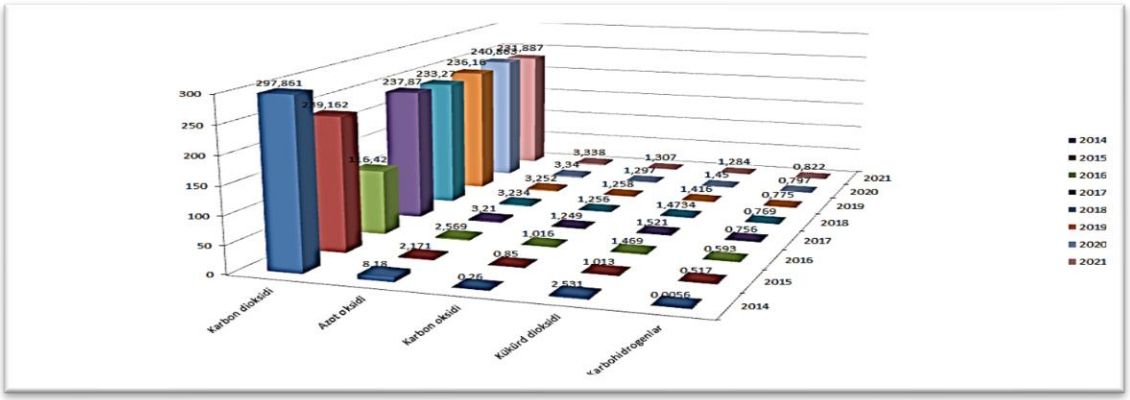


Figure 7. Volume of harmful emissions released into the atmosphere as a result of fleet activities

Source: (ASCO,2022)

ASCO, the largest shipping company in the country, is taking measures to control and reduce greenhouse gases. These measures include using low-sulphur, high-quality fuel and fuel filters, maintaining ship engines, and using the coastal electricity grid to power ships approaching bridges if there is appropriate infrastructure in ports.

Many ports are operating in the country. Baku International Sea Trade Port, located 70 km south of Baku, the largest commercial port in the Caspian basin, is an example for assessing the current situation.

The main objective of the port is to apply environmentally friendly methods in the operation of the port to minimise negative environmental impacts in the region, carefully balancing environmental, social and economic factors, policies and practices that promote sustainability.

Different parties are directly responsible for greenhouse gas emissions. These include ship owners, shipping companies and outsourcing companies. They, therefore cannot directly influence some emissions that occur in the port. This includes emissions from ships not entering the port or inland land transportation. It is currently working to reduce direct and indirect port emissions (from shipping, transportation and outsourcing companies). These efforts aim to respond positively to shipowners' efforts to use environmentally friendly technologies and clean fuels. In its field of activity, it identifies emissions from cars, loading and unloading of

containers, technical repair and installation of machinery equipment in the port, and indirect emissions due to electricity consumption as sources of atmospheric emissions.

The aim of the port's environmental policy is to reduce greenhouse gas emissions and prevent environmental impacts from shipping and inland transportation as well as port activities. Direct and indirect carbon dioxide (CO2) emissions at the port are assessed and monitored.

2018-ci il üzrə illik emissiyalar (İllik CO_2 miqdarı ton)				
Mənbənin təsviri	2015	2016	2017	2018
Dizel istehlakı	336.3	189.5	72.063	106.76
Qazolin istehlakı	95.57	62.93	104.89	177.15
Elektrik enerjisi istehlakı	909.9	1056.1	1268.7	3009.6

Table 1. Annual emissions for 2018 (Annual amount of CO2 tons)

Source: (Port Of Baku,2018)

In addition, by providing shore power to ships in the port, air pollution and emissions can be avoided, reducing carbon dioxide emissions. The necessary equipment for this has been installed on all bridges purchased and incentive programs for ship owners are being negotiated to encourage the use of shore power transmission.

There are two main strategies to reduce greenhouse gas emissions and air pollution from port operations: improving energy efficiency and promoting the use of renewable energy in the port.

A key component of the project is a feasibility study to investigate the technical, economic and environmental feasibility of integrating renewable energy (wind, solar, geothermal energy) into the Port's operations.

On the environmental side, we are taking all possible measures to continuously reduce energy consumption by increasing the efficient use of energy in the port through various mechanisms. In addition, cargo lifting operations at the port are carried out by means of 6 new German-made gantry cranes installed in 2018. Thanks to these taps, energy savings of up to 30% are achieved, no fuel is consumed and a positive impact on air quality is achieved.

In order to protect the port ecosystem, reduce gases emitted into the atmosphere and increase energy efficiency, the lighting of the facilities in the port area was gradually switched to light-

emitting diode technology depending on the high energy consuming servers. Systematic measures are being taken to implement virtualization technology, which allows to significant reduction in energy consumption, to replace printers in rooms with central printing devices with scanners, digital distribution and secure archiving, to allow employees to move around the port area, to reduce port controlled emissions by replacing old engines with newer, cleaner engines, to ensure that the entire port fleet and all buses run on compressed natural gas or other alternative fuels.

In 2020, the amount of greenhouse gases emitted to the atmosphere as a result of port activity is given below.

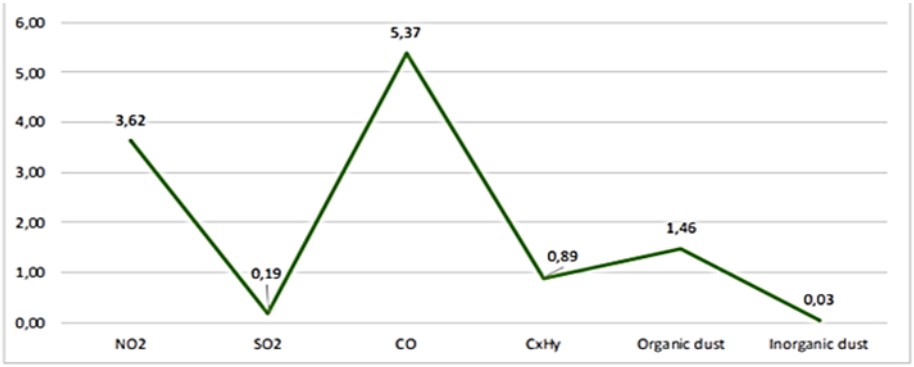


Figure 8. Amount of GHGs in 2020 (in tons)

Source: (Port Of Baku, 2020)

Conclusion

I have analyzed all events related to reducing GHG emissions and as a result, in the article demonstrates that every alternative fuel has its own advantages and disadvantages. In modern times, the situation in ports and shipping has been analyzed and demonstrated, and it has been concluded that zero emissions without alternative fuels is impossible. IMO and Azerbaijan are also working towards achieving green shipping and have taken many steps to achieve their GHG goals. At present, it is impossible for all shipping to use alternative fuels, but every year, new ships will built with hybrid engines. For example, the first step is to accept green maritime strategy and policy, then to design eco-friendly ships and ports, followed by pilot projects that use alternative fuels and other events. Currently, in the article we saw three types of alternative fuels, and after comparing them, I have concluded that LNG is the most viable option for ports and ships as it has economic, social and environmental benefits, and there is a lot of experience

with this alternative fuel's vessels and infrastructure in international ports. Hydrogen alternative fuels are better than LNG, but at present, they require a lot of research and have many risks compared to LNG ships. In the future, ships may use hydrogen alternative fuels.

LNG 7-10 USD[1]	LPG ~10 USD[1]	Grey/Blue Hidrogen 11-26 USD 13-27 USD
Bio-LNG 8.5-28.5 USD[2]	Bio-LPG ~11 USD[3]	Green Hidrogen 16-33 USD
E-LNG 23-110 USD[2]		Bio Hidrogen 20-54 USD

Table 2. Current Fuel cost of LNG (per GJ fuel)

Source: (IMO-Norway,2021)

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FARKLI BİTKİ SIKLIĞININ KIŞLIK ARA ÜRÜN OLARAK YETİŞTİRİLEN GAP PEMBESİ YEM BEZELYE (*PİSUM ARVENSE* L.) ÇEŞİDİNDE BAZI VERİM DEĞERLERİNE ETKİSİNİN BELİRLENMESİ

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Özet
Bu araştırmada; Şanlıurfa ekolojik koşullarında kışlık ara ürün olarak farklı sıklıkta yetiştirilen Gap Pembesi yem bezelyesi (*Pisum arvense* L.) çeşidinin bazı verim özelliklerinin bitki boyu (cm), çiçeklenme gün süresi (gün), olgunlaşma gün süresi (gün), bitkide bakla sayısı (adet/bitki), yeşil ve kuru ot verimleri (kg/da) incelenmiştir. Deneme 2021-2022 yetiştirme sezonunda Harran Üniversitesi Osmanbey kampüsünde yer alan Ziraat Fakültesi Tarla Bitkileri Bölümü arazisinde, tesadüf blokları deneme desenine göre, 5 bitki sıklığında (10-15-20-25-30) cm ve 4 tekerrürlü olarak yürütülmüştür. Araştırmada, bitki boyu 29.16-32.81 cm, yeşil ot verimi 161.79-224.31 kg/da, kuru ot verimi 34.88-49.30 kg/da, bitkide bakla sayısı 6.03-8.86 (adet/bakla), çiçeklenme gün süresi 87.50-90.25 (gün), olgunlaşma gün süresi 121.25-123-75 (gün) arasında değişim göstermiştir. Araştırma sonunda yapılan analiz sonuçlarına göre, kışlık ara ürün olarak yetiştirilen Gap Pembesi yem bezelye çeşidindeki en yüksek verim değerleri 30x15 cm bitki sıklığı uygulamasında gözlemlenmiştir.
Anahtar Kelimeler: Yem bezelyesi, yeşil ot, çiçeklenme ve olgunlaşma süresi, kuru madde oranı

DETERMINATION OF THE EFFECT OF DIFFERENT PLANT DENSITY ON SOME YIELD VALUES IN GAP PEMBESI FODDER PEA (*Pisum arvense* L.) VARIETY GROWN AS WINTER INTERCROP

Abstract
In this study; Some yield characteristics of Gap Pink forage pea (*Pisum arvense* L.), which is grown as a winter intermediate in Şanlıurfa ecological conditions at different frequencies, is plant height (cm), flowering day time (day), maturation day time (day), number of pods per plant (piece/unit). plant), green and dry grass yields (kg/da) were investigated. The experiment was carried out in the field of Field Crops Department of the Faculty of Agriculture, located in Harran University Osmanbey campus, in the 2021-2022 growing season, according to the randomized blocks trial design, at a density of 5 (10-15-20-25-30) cm and with 4 replications. In the study, plant height was 29.16-32.81 cm, green grass yield was 161.79-224.31 kg da^{-1}, hay yield was 34.88-49.30 kg da^{-1}, number of pods per plant was 6.03-8.86 (pieces/pod), flowering day duration was 87.50-90.25 (days), maturation day duration varied between 121.25-123-75 (days). According to the results of the analysis made at the end of the research, the highest yield values in the Gap Pink forage pea variety grown as a winter intermediate product were observed in the application of 30x15 cm plant density.
Keywords: Forage peas, green grass, flowering and ripening time, dry matter content

1. GİRİŞ

Ülkemizdeki hayvansal ürün talebi sürekli artmaktadır. Ancak yem bitkileri üretiminin yetersizliği, hayvancılık işletmelerinin girdi maliyetlerini yükseltmekte ve bu da et ve süt ürünlerinin fiyatlarını artırmaktadır. İşte bu sorunun üstesinden gelmek ve insanların protein ihtiyacını karşılamak için ülkemizin coğrafi çeşitliliği sayesinde birçok farklı yem bitkisi türü yetiştirilebilir. hayvan otlatma alanlarında rotasyon, sulama, gübreleme gibi uygulamalarla bu alanların sürdürülebilirliği sağlanabilir. Yem bitkilerinin verimliliğini artırmak için modern tarım teknikleri kullanılarak daha verimli ürün elde edilmesi, maliyetleri düşürebilir. Bezelye (*Pisum sativum* L.), hayvanların ihtiyaç duyduğu proteinin karşılanmasında önemli bir kaynak olan, dünyadaki en değerli baklagillerden biridir. Bu bitki, tarihsel olarak Güney-Batı Asya'ya özgüdür ve tarımın erken dönemlerinde yetiştirilmeye başlanmıştır. Bezelye, hem insanlar için hem de hayvanlar için yüksek besin değerine sahip olmasıyla bilinir (Ghafoor ve Arshad, 2008).

Yem bezelyesi (*Pisum sativum*), otu, sapı ve taneleri için üretimi yapılan tek yıllık bir baklagil yem bitkisidir. Bu bitki, çiftlik hayvanlarının beslenmesinde önemli bir rol oynamakta olup, otunun besleme değeri yüksektir ve tanelerinde yüksek oranda protein bulunur.

Yem bezelyesi otu, çiftlik hayvanları için değerli bir yem kaynağıdır. Yüksek besin değeri ve lezzeti sayesinde hayvanlar tarafından istekle tüketilir. Ayrıca tanelerinin yüksek protein içeriği, hayvanların büyüme, et veya süt üretimi için gerekli protein ihtiyacını karşılamada etkilidir. Taneleri kırıldıktan sonra kaba yemlerle karıştırılabilir, böylece hayvanların beslenmesi zenginleştirilebilir. Ayrıca yem bezelyesi, tahıl karışımları içinde kullanılarak dengeli bir yem sunabilir. Yem bezelyesi, çiftlik hayvanlarının sağlıklı beslenmesini sağlayan değerli bir yem bitkisidir ve bu özellikleriyle çiftçilerin hayvanlarının ihtiyaçlarını karşılamasına katkıda bulunabileceğini Açıkgöz (2001) bildirmektedir.

Ülkemizin elverişli ekolojik koşullarına rağmen yetersiz bezelye üretiminin temel nedenleri arasında çeşit geliştirme eksikliği, yetersiz üretim alanları ve pazarlama sorunları yer almaktadır. Bu sorunları aşarak bezelye üretimini artırmanın ve bu ürünün münavebe kullanılmasını teşvik etmenin yolu

farklı ekolojik koşullarına uygun çeşitlerin geliştirilerek ve yetiştirme tekniklerinin iyileştirilerek bezelyeden yüksek verimi elde edilmesi hedeflenmelidir. Bu çalışma; Şanlıurfa İli ekolojik koşullarında ot üretimi amacıyla bu bölgeye adapte olmuş sertifikalı Gap Pembesi yem bezelye çeşidinin farklı sıklıkta verim ve besleme değerindeki değişimi incelemek ve

otunun ülkemizde yapılan hayvancılık faaliyetlerinde alternatif bir kaliteli kaba yem kaynağı olarak kullanılabilirliğini belirlemek amacıyla ele alınmıştır.

MATERYAL ve YÖNTEM

Araştırmada materyal olarak Diyarbakır ilinde bulunan GAP Uluslararası Tarımsal Araştırma ve Eğitim Merkezi Müdürlüğü tarafından 2015 yılında Diyarbakır ilinde ıslah edilen Gap Pembesi yem bezelyesi (*Pisum arvense* L.) sertifikalı çeşidi kullanılmıştır.

1.1 Araştırma alanına ait toprak ve iklim özellikleri

Deneme yerinin toprak bünyesi killi-tınlı olup, toplam tuz %071, pH 7.78, kireç %29.2, organik madde %0.28 dekara 1.30 kg yarayışlı fosfor (P_2O_5) ve 30.3 kg potasyum (K_2O) olarak belirlenmiştir. Harran Üniversitesi Ziraat Fakültesi deneme alanı toprağı; killi-tınlı bünyeli, pH hafif alkali ve çok fazla kireçli bir yapısı vardır. Potasyum bakımından yeterli, azot ve fosfor bakımında fakir, organik maddece yetersizdir (Şahin, 2021). Şanlıurfa ilinde yer alan araştırma alanının Kasım 2021 ve Nisan 2022 arası ve uzun yıllar ortalamasına ait bazı iklim değerleri Çizelge 1'de verilmiştir.

Çizelge 1. Şanlıurfa ili bazı iklim verilerinin araştırma yılı ve uzun yıllar ortalama değerleri *

Yıllar	**Kasım**	**Aralık**	**Ocak**	**Şubat**	**Mart**	**Nisan**
Şanlıurfa			**Ortalama sıcaklık (°C)**			
2021-22	19.4	11.6	6.8	11.7	19.7	21.0
Uzun yıllar**	13.1	7.6	5.6	7.1	10.9	16.2
Ortalama nispi nem (%)						
2021-22	53.5	45.2	35.8	36.3	45.4	31.1
Uzun yıllar**	59.9	69.9	70.3	66.9	60.4	56.2
Toplam yağış miktarı (kg/m²)						
2021-22	0.0	0.0	0.1	0.0	0.1	0.0
Uzun yıllar**	44.7	80.2	87.4	68.3	62.8	49.5

* Mgm, (2021-2022) ** Mgm, (1929-2021)

Çizelge 1'de belirtildiği gibi araştırmanın yapıldığı dönemde, en düşük ve en yüksek ortalama sıcaklık değerleri sırasıyla 6.8°C ile Ocak Ay'ında ve 21.0°C ile Nisan Ay'ında görülmüş olup, uzun yıllar ortalamalarına ait en düşük ve en yüksek ortalama sıcaklık değerleri

ise sırasıyla 5.6°C ile Ocak Ay'ında ve 16.2°C ile Nisan Ay'ında gözlemlenmiştir. Araştırma dönemindeki yağış miktarlarına bakıldığında, ekim zamanından bitkilerdeki çiçek ve bakla oluşumu dönemine kadar (Nisan Ay'ı dahil) yağış ölçülmemiş olup, kış ve ilkbahar mevsimleri kurak geçmiştir. Bu da bitkilerin yeterli miktarda yağış alamadıklarını göstermektedir. Araştırma; tesadüf blokları deneme desenine göre 5 bitki sıklığında (10-15-20- 25- 30) cm olup 4 tekerrürlü olarak oluşturulmuştur. Toplam parsel sayısı 20 (5 bitki sıklığı x 4 tekerrür) olup her bir parsel 4 sıradan teşekkül etmiştir. Parsel alanları; (10cm sıra üzerinde 5x0.10x4=2.0 m^2), (15 cm sıra üzerinde 5x0.15x4=3.0 m^2), (20 cm sıra üzerinde 5x0.20x4=4.0 m^2), (25 cm sıra üzerinde 5x0.25x4=5.0 m^2) ve (30 cm sıra üzerinde 5x0.30x4=6.0 m^2) olarak belirlenmiştir.

Her bir parsel aralarında 50 cm, tekerrürler arasında ise 1.5 metre mesafe bırakılmış, ekimde dekara 15 kg hesabıyla tohumluk kullanılmıştır (Bozkurt, 2018). Sıra aralığı 30 cm olarak ayarlanmıştır. Kasım Ay'ının ikinci haftası elle ekimi yapılmıştır. Denemede standart olarak toprak analizleri dikkate alınarak 3.5 kg/da azot, 10 kg/da P_2O_5 tamamlanacak şekilde (18:46 DAP) gübre uygulanmıştır (Sayar, 2007). Bitkilerin ilk çıkış dönemlerinde el ile, 30 cm yüksekliğe ulaştığında ise çapa ile yabancı ot mücadelesi yapılmıştır. Bitkiler kurak koşullarda sulama yapılmaksızın yetiştirilmiştir. Deneme parselinin tamamı bakla bağlamaya başladığı döneminde ot verimi ile ilgili gözlemleri almak için elle biçilmiştir (Sayar, 2007). Toplam deneme alanı ise 24.5m x 8m = 196 m^2 olarak planlanmıştır.

Araştırmada; Bitki boyu (cm): Her parselin orta 2 sırasından tesadüfî olarak alınan 10 bitkide bakla bağlama başlangıcı döneminde toprak yüzeyi ile bitkinin en uç noktası arasındaki uzunluk ölçülerek bitki boyu ortalamaları (cm) olarak belirlenmiştir (Sümerli ve Ark., 2002).

Çiçeklenme gün süresi (gün): Ekim zamanı ile bitkilerin %50 çiçeklenme zamanı arasındaki geçen gün sayısı olarak hesaplanmıştır.

Olgunlaşma gün süresi (gün): Çeşitlerin ekim zamanı ile tohum hasat olgunluğuna kadar geçen gün sayısı olgunlaşma süresi olarak hesaplanmıştır.

Bitkide bakla sayısı (adet/bitki): Her bir parselden tesadüfi olarak alınan 10'ar bitkinin baklaları sayılıp ortalamaları alınarak bitkide bakla sayısı saptanmıştır.

Yeşil ot verimi (kg/da): Her parselde, kenar tesirleri atıldıktan sonra geriye kalan kısım 8-10 cm yükseklikten biçilerek tartılmış ve parsel verimleri belirlenip, hasat alanı dikkate alınarak, dekara yeşil ot verimleri hesap edilmiştir.

Kuru ot verimi (kg/da): Hasat edilen bitkilerden en fazla 0.5 kg'lık örnekler 78°C'ye ayarlanmış etüvde 24 saat süreyle kurutulduktan sonra tartılıp ve belirlenen kuru ağırlıklarda gerekli dönüşümler yapılarak dekara kuru ot verimi hesaplanmıştır.

Araştırmadan elde edilen verilerin varyans analizi, uygun paket programı yardımıyla tesadüf blokları deneme deseni düzenine göre yapılmış ve çoklu karşılaştırma testi ile ise F testi sonuçlarına göre gruplar arasındaki farklılıklar Lsd (%5) tespit edilmiştir (Yurtseven, 2011).

2. BULGULAR ve TARTIŞMA

Bitki boyu (cm)

Farklı bitki sıklıklarında Gap Pembesi yem bezelyesinde tespit edilen bitki boyu ortalamaları Çizelge 3'de verilmiştir. Çizelge 3. incelendiğinde farklı ekim sıklıklarına ait bitki boyu değerleri 29.16-32.81 cm arasında değişim göstermiştir. en yüksek bitki boyu 32.81 cm ile 30x10 bitki sıklığından elde edilirken, en düşük bitki boyu değeri ise 29.16 cm ile 30x30 bitki sıklığındaki parsellerde ölçülmüştür. Çeşidin bitki boyu ortalaması 30.95 cm olarak tespit edilmiştir. Yapılan LSD testi sonuçlarına göre üç farklı grubun oluştuğu görülmektedir. Deneme sezonunda uzun yıllar ortalaması altında yağış düşmesinin, bitkilerde su stresini tetiklediğinden bitkilerdaha kısa boylu olmuşlardır. Su stresi büyümeyi kısıtlayıp generatif devreye geçişi teşvik etmiş, böylece bitki boyları kısa kalmıştır (Özel ve ark. 2016). Denemenin yürütüldüğü kış yetiştirme döneminde, özellikle kış aylarının çok soğuk ve kurak geçmesi, oluşan soğuk ve kurak zararı olduğu düşünülmektedir (Çizelge 1.).

Bu çalışmada elde edilen bitki boyuna ait değerler, Açıkgöz ve ark. (2001) Bursa'da 30-189 cm, Guy (2002), ABD'da 60-75 cm, Sümerli ve ark. (2002), Diyarbakır'da 43–70 cm, Sayar ve ark. (2009), Diyarbakır ekolojik koşullarında39.22- 79.33 cm, Seydoşoğlu (2013), Güneydoğu ekolojik koşullarında 67.6-87.9 cm, Kavut ve ark. (2016), İzmir'de 155.89-144.56 cm, Mart ve ark. (2017), Çukurova'da 47.2-93.8 cm, Ömeroğlu (2016), Isparta'da 74.40-92.60 cm, Çınar (2017), Çanakkale'de 125.17-127.84 cm, Kılınç (2017), Giresun ilinde 50-145 cm, Halil (2020), Bursa'da bitki boyu 5-190 cm ve Özeroğlu (2021), Aydın'da 85.7-103.2 cm olarak bulmuşlardır. Dar sıraya ekimde ışık rekabeti, bitkilerde boylanmayı teşvik etmiştir. Bitki boyuna ait elde edilen bulguların diğer araştırmacıların elde ettikleri bulgulardan farklılık arz etmesi, söz konusu araştırmaların yürütüldüğü çevre koşulları, sulama ve gübreleme gibi kültürel uygulamalardan kaynaklanmış olabilir.

Çizelge 3. Farklı sıklıktaki Gap Pembesi yem bezelyesinin bazı verim özelliklerine ait ortalamalar ve oluşan gruplar*

Bitki sıklıkları (cm)	Bitki boyu (cm)	Çiçeklenme gün süresi (gün)	Olgunlaşma gün süresi (gün)	Bitkide bakla sayısı (adet/bitki)	Yeşil ot verimi (kg/da)	Kuru ot verimi (kg/da)[1]
30x10 cm	32.81 a	90.25 a	123.75	6.03 c	224.31 a	49.30 a
30x15 cm	30.92 b	89.50 ab	123.75	6.50 c	195.38 b	37.96 b
30x20 cm	30.81 b	87.75 bc	121.25	7.68 b	196.70 b	39.57 b
30x25 cm	31.06 b	87.50 c	121.25	8.18 b	199.15 b	34.88 b
30x30 cm	29.16 c	87.75 bc	122.25	8.86 a	161.79 c	39.35 b
Ortalama	30.95	88.55	122.25	7.45	195.46	40.21
Lsd (%5)	1.63	1.95	ö.d.	0.65	18.08	5.89

*) Aynı sütunda benzer harf grubu ile belirtilen ortalamalar, Lsd (%5) değerine göre farklı değildir.

[1)] Kuru ot verimine ait değerler, Cengiz ve ark. (2022)'ye ait makaleden alınmıştır.

Çiçeklenme gün süresi (gün)

Çiçeklenmeye kadar geçen süre bakımından; incelenen çeşidin farklı sıklıkları arasında istatistikî olarak %5 seviyesinde önemli farklılıklar bulunmuştur. Yem bezelyesi farklı sıklıklardaki çiçeklenme süresi ortalama değerleri ve oluşan gruplar Çizelge 3'de verilmiştir. Çizelge 3'de görüldüğü gibi, çiçeklenme süresi 87.50 gün ile 90.25 gün arasında değişim göstermiştir. En uzun çiçeklenmeye kadar geçen süre 90.25 gün ile 30x10 cm bitki sıklığında, en kısa çiçeklenmeye kadar geçen süre 87.50 gün ile 30x25 bitki sıklığında gözlenmiştir. Çiçeklenme süresi; bitkilerin erken veya geç olgunlaşmalarının bir göstergesidir. Daha önce yapılan çalışmalarda farklı sıklıktaki GP yem bezelyesinin çiçeklenme gün süresi ile ilgili farklı değerler elde edilmiştir. Sümerli ve ark., (2002),Diyarbakır'da 126.00-132.44 gün, Çeçen ve ark. (2005), Antalya ekolojik koşullarında 122 gün, Sayar ve ark. (2009), Diyarbakır'da 156-169 gün, Gündüz (2013) Erzurum'da 59-77 gün, Seydoşoğlu (2013), Diyarbakır'da 157.8-175.5 gün, Mart ve ark. (2017), Çukurova'da 51-39.3 gün, Varol (2016), Sivas'ta 271.0-295.0 gün, ve Kılınç (2017), Giresun'da 65-145 gün olarak tespit etmişlerdir. Bunun nedeni,Çizelge 1'de belirtilen sıcaklık ve yağış değerlerinden anlaşılacağı üzere çalışmamızın yürütüldüğü kış yetiştirme döneminde, özellikle kış aylarının çok soğukve kurak geçmesi sebebiyle oluşan soğuk ve kurak zararı yanında ilkbahar aylarının daha yağışlı ve serin geçmesinden, araştırmamızın ekim tarihinin daha erken olmasından kaynaklanmış olabilir.

Olgunlaşma gün süresi (gün)

Çizelge 3. incelendiğinde Gap yem bezelyesinin farklı sıklıktaki en uzun olgunlaşma gün sayısı değerinin önemsiz olmasına rağmen rakamsal olarak en uzun olgunlaşma gün sayısı 123.75 gün ile 30x10-30x15 bitki sıklıklarında gözlenmiştir. Bütün sıklıklarda olgunlaşma gün sayısı ortalaması 122.55 olarak tespit edilmiştir.

Bu araştırmada elde edilen olgunlaşma gün süresine ilişkin değerlerim, Sümerli ve ark. (2002), Diyarbakır koşullarında 166.33–170.11 gün, Sayar (2007), Diyarbakır'da 195.66-209.00 gün, Sayar ve Anlarsal (2008), Diyarbakır'da 201 gün, Varol (2016), Sivas'ta 282.6-316.6 gün ve Çınar (2017), Çanakkale'de 211-218 gün, sayısından daha düşüktür. Bunun nedeni Çizelge 1'de sıcaklık ve yağış bakıldığında denemenin yürütüldüğü kış yetiştirme sezonunda uzun yıllar ortalamasına göre kışın daha soğuk geçmesiyle oluşan soğuk zararı yanında, ilkbahar aylarının daha az yağışlı geçmesinden kaynaklanmış olabilir. Zira kuraklığın; bitkilerde su kaybını artırarak erken olgunlaşmayı teşvik edebileceğini Özel ve ark. (2016) bildirmektedirler.

Bitkide bakla sayısı (adet/bitki)

Farklı sıklıkta yem bezelyesinin tespit edilen bitkide bakla sayısı ortalamaları Çizelge 3'de verilmiştir. Çizelge 3. incelendiğinde farklı sıklıklardaki Gap yem bezelyesi çeşidinin, bitkide bakla sayısı 6.03 adet ile 8.86 adet arasında değişmekte olup, en yüksek değer 30x30 cm, en düşüğü 30x10 cm ile 30x15 cm'deki sıklıklardan elde edilmiştir. Bunun sebebi; bitki sıklığın yüksek olduğu parsellerde bitkinin daha az besine ulaşabilip daha az bakla oluşumuna sebebiyet verdiğini söyleyebiliriz, Farklı sıklıktaki bitkide bakla sayısı ortalaması ise 7.45 adet olarak tespit edilmiştir.

Bu çalışmada elde edilen sonuç; Kılınç (2017), Giresun'da 7-35 adet/bitki, Gündüz (2013), Erzurum'da 2.67-39.50 adet/bitki, Yörük (2015), Sivas'ta 1.3-12.3 adet/bitki, Timurağaoğlu ve Altınok (2004), Ankara'da 5-13 adet/bitki, Sayar (2007),Diyarbakır'da 5.63-9.00 adet/bitki, Tamkoç (2007), Konya'da 6.8-9.4 adet/bitki, Sayarve ark. (2009), Diyarbakır'da 6.49-10.0 adet/bitki ve Ömeroğlu (2016), Isparta'da 7.50-8.80 adet/bitki, Varol (2016), Sivas'ta 2.6-13.7 adet/bitki, Bozkurt (2018), Bingöl'de 10.33-28.33 adet/bitki, olarak bildirdikleri değerlerden farklılık arz etmektedir. Bitkide bakla sayısına ilişkin elde edilen sonuçların araştırmacıların elde ettikleri değerlerden farklı olmasının nedeni, söz konusu araştırmaların

yürütüldüğü farklı alan ekolojilerinin, kışlık ekim ve farklı ekim normunun bitkide bakla sayısındaki farklılıklara sebebiyet vermiş olabileceği düşünülmektedir.

Yeşil ot verimi (kg/da)

Farklı sıklıklardaki Gap Pembesi yem bezelyesinin yeşil ot verimi karakter ortalamaları ve oluşan gruplar Çizelge 3.'de verilmiştir. Çizelge 3. incelendiğinde farklı bitki sıklıklarının ait ortalama yeşil ot verimi değerleri 161.79 kg/da ile 224.31 kg/da arasında değişim göstermiştir. En yüksek yeşil ot verimi30x10 cm sıklıktaki parsellerden, en düşük değeri ise 30x30 cm'deki parsellerden tespit edildiği görülmektedir. Bunun sebebi olarak; sıklığın yüksek olduğu parsellerdebitkinin diğer bitkilerle rekabet edebilmek amacıyla kısa sürede boylanmasından, yanitür içi rekabetten dolayı yeşil ot veriminin artabileceğini (Okant , 1992;Tansı veUçar,1996; Karadağ ve Büyükburç, 2003;Bilgen ve Özyiğit, 2005) bildirmektedirler. Ayrıca, denemedeki yeşil ot veriminin oldukça düşük olası bitki gelişim döneminin kısalması ve vejetasyon döneminin çok kurak geçmesi çok düşük ot veriminin elde edilmesine sebep olmuştur (Çizelge 1.). Değişik ekolojilerde farklı genotiplerle yapılan çalışmalarda yeşil ot veriminin Timurağaoğlu ve Altınok (2004), Ankara koşullarında 1.525-2.022 kg/da, Çeçen ve ark. (2005), Antalya'da 1219 kg/da, Çil ve ark., (2007), Şanlıurfa'da 2178 kg/da, Sayar(2007), Diyarbakır'da 884.58-1648.06 kg/da, Sayar ve ark. (2009),Diyarbakır ekolojikkoşullarında 1156-1658 kg/da, Seydoşoğlu (2013), Diyarbakır'da 1143.1-2417.6 kg/da, Kavut ve Ark. (2016), İzmir'de 4360-3398 kg/da, Ömeroğlu (2016), Isparta'da 907.00-1109.00 kg/da, Karaköse (2018), Bingöl'de 853.6-2442.0 kg/da, Erkovan ve ark. (2020), Eskişehir'de 1679.16- 1812.74kg/da, Tankuş (2020), Şanlıurfa koşullarında 2462.78 kg/da ve Özeroğlu (2021), Aydın'da 1449.2-3452.8 kg/da olarak bildirdikleri değerlerden farklılık arz etmektedir.

Yeşil ot verimine ait elde edilen sonuçların diğer araştırmacıların tespit ettikleri değerlerden farklı olmasının sebebi, araştırmaların yürütüldüğü alanın ekolojik koşulları, özellikle ortalama sıcaklık ve toplam yağış miktarındaki farklılık ve farklı ekim zamanından kaynaklandığını söyleyebiliriz.

2.1 Kuru Ot Verimi (kg/da)

Farklı sıklıklardaki Gap Pembesi yem bezelyesinin kuru ot verimine ait karakter ortalamaları ve oluşan gruplara ait veriler Çizelge 3.'de belirtilmiştir. Çizelge 3. incelendiğinde, farklı sıklıktaki Gap yem bezelyesinde iki farklı grubun oluştuğu, kuru ot verimi en yüksek

dekara 39.30 kg ile 30x10 bitki sıklığında, en düşüğü ise dekara 34.88- 39.57 kg degerleriyle 30x15, 30x20, 30x25 ve 30x30 cm'den elde edilmiştir. Bitki sıklığının yoğun olduğu 30x10 cm uygulamasından elde edilmesi, tür içi rekabetle açıklanabilir (Galal ve ark. 1974;Tansı. 1987;Okant, 1992). Bütün farklı sıklıklardaki kuru ot veriminin ortalama değeri ise dekara 40.21 kg olarak tespit edilmiştir. Denemede, 2021 yılı vejetasyon döneminde yeterli nemin olmayıp çok kurak geçmesi, tüm uygulamalarda kuru ot veriminin oldukça düşük çıkmasına sebep olmuştur (Çizelge 3.). Dekara kuru ot verimi ile ilgili diğer araştırmacıların değerlerine bakıldığında; Tekeli ve Ateş (2003), Tekirdağ ekolojik koşullarında 731,9 kg, Timurağaoğlu ve ark. (2004), Ankara'da 404-542 kg, Çeçen ve ark. (2005), Antalya'da 317 kg, Çil ve ark. (2007), Şanlıurfa'da 457 kg, Sayar ve ark. (2009), Diyarbakır'da 279-410 kg, Yörük (2015), Sivas'ta 198,2-466,3 kg, Ömeroğlu (2016), Isparta'da 221-281 kg, Çınar (2017), Çanakkale'de 430,65 kg, Karaköse (2018), Bingöl'de 264.0-580.8 kg, Temel ve Yazıcı (2021), Ağrı-Eleşkirt koşullarında 204.4–398.2 kg olarak tespit edilmiş olup, bildirdikleri değerlerden farklılık arz etmektedir.

Araştırma sonuçlarının diğer araştırmacıların bulgularıyla benzerlik göstermemesinin sebebi; belirtilen sıcaklık ve yağış değerlerinden görülebileceği gibi çalışmanın yürütüldüğü 2021 kış yetiştirme sezonu esnasında, düşük yağış ve düşük sıcaklıkların uzun yıllar ortalamasına göre daha soğuk geçmesi, diğer araştırıcıların sulu arazi koşullarında denemelerini yürütmüş olma ihtimali ile kuru ot verimlerinin daha yüksek çıkmasına sebebiyet verdiği düşünülmektedir (Çizelge 1.).

3. SONUÇ

Bu çalışmada; Şanlıurfa İli ekolojik koşullarında kışlık ürün olarak farklı sıklıkta yetiştirilen Gap Pembesi yem bezelye (*Pisum arvense* L.) çeşidinin benzer ekolojik koşullar için yüksek yeşil ve kuru ot verim özellikleri birlikte değerlendirildiğinde 30x15 cm bitki sıklığı tavsiye edilmektedir.

AÇIKLAMA

Bu tezde kullanılan veriler, ilk yazarın yüksek lisans tezi olup, HÜBAP tarafından desteklenen 21250 nolu projeden alınmıştır. Ayrıca, makale yazarları aralarında herhangi bir çıkar çatışması olmadığını beyan ederler.

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DETERMINATION OF CO_2 EMISSION FROM SOILS WITH SEWAGE SLUDGE APPLICATION UNDER DIFFERENT IRRIGATION REGIMES THROUGH CARBON STOCK CHANGES

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Abstract
The application of sewage sludge to agricultural lands is becoming increasingly common worldwide. While sludge enriches the soil with organic matter, it can lead to increased greenhouse gas emissions when carbon stocks are not managed effectively. Soil CO_2 emissions result from microbial respiration, where soil microorganisms break down organic matter. Changes in soil moisture affect microbial activity, thereby influencing soil CO_2 emissions. In this study, silage maize cultivation was conducted under three different irrigation regimes (irrigations corresponding to the values of 25 mm, 50 mm, and 75 mm calculated by sum of difference evapotranspiration and effective precipitation) and four different sewage sludge doses (D0: control, D1: 30t/ha, D1: 60t/ha, D1: 90t/ha). Potential CO_2 emissions from changes in soil carbon stocks were calculated per unit area and per unit yield, taking into account season start and end values. As the wetting-drying cycles in surface soil extended, CO_2 emissions decreased, leading to a reduction in seasonal potential CO_2 emissions per unit area. However, the seasonal potential CO_2 emissions per unit yield increased. In conclusion, frequent irrigation is found recommendable as it leads to a reduction in the total emission quantity due to the reduced land area for same yield, resulting in lower emissions per unit yield.
Keywords: Irrigation regime, CO_2 emissions, Sustainable agriculture, Sewage sludge

1. INTRODUCTION

The application of sewage sludge to agricultural lands is becoming increasingly common worldwide due to its high organic matter content, especially its nitrogen (N) content, which provides significant benefits to the soil. The addition of sewage sludge enriches the soil with organic matter, leading to substantial improvements in soil productivity. Organic matter decomposition in the soil supports the formation of soil aggregates, increasing soil porosity. Improved soil structure facilitates root growth, enhances water uptake by plants, and ultimately increases crop yield. However, when soil carbon stocks are not effectively managed, it can lead to a significant increase in greenhouse gas emissions, primarily carbon dioxide (CO_2), among other gases (Yerli et al., 2023). Agricultural activities contribute to a quarter of greenhouse gas emissions, with the rest originating from fossil fuels (Pathak and Wassmann, 2007; Tubiello et al., 2015; Vurarak and Bilgili, 2015). CO_2 emissions in soil are an indicator of soil fertility and occur as a result of carbon oxidation in soil with the aid of oxygen (Yerli et al., 2019, Tufenkci et al., 2021, Yerli and Sahin, 2021). CO_2 is considered the most significant greenhouse gas and accounts for approximately 82% of all emissions (Thangarajan et al., 2012).

Soil CO_2 emissions result from microbial respiration, where soil microorganisms break down organic matter. Soil moisture deficiency reduces microbial activity and, consequently, decreases soil CO_2 emissions. In conditions of water scarcity, inadequate soil moisture negatively affects microbial activity, making it more challenging for microorganisms to access nutrients and carry out metabolic activities, ultimately leading to reduced soil CO_2 emissions. Several researchers have reported that increased soil moisture content stimulates microbial activity in the soil, resulting in elevated CO_2 emissions (Jabro et al. 2008; Zornoza et al., 2016; Sinaie et al., 2019; Zhong et al., 2021; Yerli et al., 2022; Yerli et al., 2023). Therefore, adopting a deficit irrigation approach that limits soil moisture can be used as a practice to reduce CO_2 emissions. The majority of agricultural CO_2 emissions originate from soil (Yerli et al., 2023).

Soil moisture and temperature can enhance microbial activities, leading to faster organic matter mineralization and increased CO_2 emissions. Higher CO_2 emissions generally occur under conditions of higher temperature and humidity. These conditions promote plant growth, accelerate development, and positively influence crop yield. Several researchers have noted that soil CO_2 emissions are regulated by various factors, including soil and air temperature, soil moisture, soil aeration, and plant residues (Sun et al., 2011, Rowlings et al., 2012, Evans and

Burke, 2013, Mancinelli et al., 2015; Yerli et al., 2022). While some of the plant residues are released as CO_2 into the atmosphere, a significant portion is preserved in the soil as organic matter (Ntonta et al., 2022). Haddaway et al. (2017) reported that soil physical, chemical, and biological properties influence CO_2 emissions.

Urbanization, industrialization, and population growth have led to an increase in waste production. This has made environmental concerns, waste management, and sustainable resource management essential. Failure to manage waste effectively can result in environmental pollution, soil and water contamination, air pollution, reduced biological diversity, and ecosystem disruption. Therefore, measures must be taken to reduce waste generation, promote recycling, ensure proper waste disposal, and minimize environmental impacts. The application of sewage sludge to agricultural lands is considered an important disposal option (Altun and Sahin, 2022). Other methods, such as controlled landfilling, incineration, and discharge into the sea or on land, are insufficient in terms of sustainability (Singh and Agrawal, 2008). The agricultural application of sewage sludge is regarded as the most the easiest option (Mondal et al., 2015). Additionally, it has been reported that using sewage sludge for agricultural purposes is the most economically viable approach (Ghazy et al., 2009). Numerous researchers have highlighted the positive contributions of sewage sludge disposal for agricultural soil improvement (Abdallh and Sahin, 2020; Ors et al., 2015). Sewage sludge contains essential plant nutrients such as high organic matter, nitrogen, phosphorus, and potassium, which can also meet the requirements of chemical fertilizers (Badaou and Sahin, 2021; Sahin et al., 2020). Silage maize is a high-yielding forage crop that serves as an important source of energy and nutrients for animals. It is commonly used in animal feeding due to its high dry matter content, high yield, and suitability for silage without the need for additives (Keskin et al., 2017). However, water scarcity can lead to significant yield losses in maize (Ors et al., 2015; Peichl, 2018; Çakmakçı, 2018; Yerli, 2022).

The primary objective of this study is to investigate the effect of different sewage sludge application doses and various irrigation regimes (wetting-drying processes) on CO_2 emissions from soil. The study also aims to determine seasonal potential CO_2 emissions per unit area and per unit yield.

2. MATERIAL and METHOD

2.1. Materials and Methods Study Area and Experimental Design

This study was conducted on experimental field area at the Ataturk University Plant Production Application and Research Center in Erzurum Province, Turkey. The experimental field is located at a latitude of 39.933° North and a longitude of 41.236° East, with an elevation of 1780 meters above sea level. The experiment was carried out in a completely randomized design with three repetitionsmin a total of 36 plots, where the main plots were the doses, considering three different irrigation treatments and four different sewage sludge doses.

2.2. Irrigation System, Irrigation Timing and Quantity

Irrigation water was apllied the surface drip irrigation method placed one lateral for each plant row. Irrigations until the plants have 4-6 leaves, all plots were equally irrigated to bring the soil moisture content at a 30 cm depth to field capacity when total ETc - Peff values was reached 40% of the available water at a 30 cm soil depth. During different irrigation regimes period, After the plants reached the 4-6 leaf stage (40-50 cm height), when the total (ETc - Peff) values reached 40% of the available water at 90 cm soil depth, irrigations were carried out and continued until harvest wity this way. The Total (ETc - Peff) values for the three irrigation regimes as S1, S2, and S3 were considered 25 mm, 50 mm, and 75 mm, respectively. Crop evapotranspiration (ETc) values were calculated using the ETc = ETo x kc equation. The plant coefficient (kc) values were obtained from the "Plant Water Consumption Guide for Irrigated Plants in Turkey" published by the Ministry of Agriculture and Forestry's General Directorate of Agricultural Research and Policies (TAGEM) and the State Hydraulic Works in 2017 (TAGEM, 2017). Reference evapotranspiration (ETo) values were calculated using the Penman-Monteith equation (FAO) with climate data obtained from the Erzurum Airport Meteorology Station, located approximately 5 km from the experimental area. Precipitation was directly measured using a rain gauge installed in the experimental field.

2.3. Incorporation of Sewage Sludge into the Soil, Planting, and Other Cultural Practices

Stabilized sewage sludge doses, D0: 0 t/ha, D1: 30 t/ha, D2: 60 t/ha, and D3: 90 t/ha were applied. On September 20, 2020, stabilized sewage sludge was brought to the field. At this time, the trial field was first plowed to a depth of approximately 25 cm with a moldboard plow and

then leveled using a disc harrow (disc plow). The determined doses were evenly spread on the surface of the created plots. In the spring of 2021, the soil was reworked to a depth of 15 cm with a rotary tiller before planting.

In the study, the DKC6777 (FAO700) maize variety, which is well adapted to the region and has high yields of dry and green forage, was sown using a pneumatic planter in plots arranged in 5 rows with a row spacing of 70 cm and a within-row spacing of 15 cm on May 7, 2021.

No chemical fertilizers were applied to the plots where sewage sludge was used. In the control plots, the deficiency of nitrogen and phosphorus fertilizers was determined based on productivity analysis results in the 0-30 cm soil layer, and all of the phosphorus and half of the nitrogen were applied immediately after planting. The remaining half of the nitrogen was manually applied during the ear-filling stage when the plants reached 40-50 cm (4-6 leaf) growth stage. Weed control included the first hoeing when the plants reached 15-20 cm in height, and the second hoeing was conducted in the throat-filling stage when the plants reached 40-50 cm (4-6 leaf) in height.

2.4. Determination of Organic Matter Content and Bulk Density

To determine the changes in organic matter content and bulk density values during the growing season, soil samples were collected from all plots at the beginning of the planting period and at the end of each month, as well as during the harvest (9 September). These samples were taken to represent the 0-30 cm layer. Organic matter content was determined using the Smith-Weldon method (Nelson and Sommers, 1982). Bulk density values the oven dry weights of undisturbed soil samples taken with a cylinder of approximately 100 cm3 volume were determined by weighing them after drying in an oven at 105 °C for 24 hours and then dividing by the total volume (Blake and Hartge, 1986).

Approximately 58% of the soil organic matter's mass is composed of carbon. Therefore, in this study, the soil organic carbon percentage was estimated from the soil organic matter percentage using a conversion factor of 0.58 (FAO, 2017).

SOC = 0.58 x SOM

Where:

SOC: Soil organic carbon content (%)

SOM: Soil organic matter content (%)

Carbon stock change calculations were performed on a monthly basis during the trial period, taking into account the 0-30 cm depth. The guidelines recommended by The Intergovernmental Panel on Climate Change (Change, 2006) were followed to estimate SOC stocks, with soil samples collected from the 0-30 cm depth layer.

The soil organic carbon stock (SOCstock) was estimated for each unit area (ha) by considering the soil mass in the designated volume (γt x D x 10000) and applying the following equation (Melenya et al., 2015; FAO, 2017; Anonim, 2018; Budak and Günal, 2018).

SOCstock = (SOC/100) x (γt x D x 10000)

Where:

SOCstock: Soil organic carbon stock (t/ha)

SOC: Soil organic carbon content (%)

γt: Bulk density (t/m³)

D: Soil layer depth (0.30 m)

2.5. Estimation of CO_2 Emissions from Soil Organic Carbon Stock Changes

In estimating the monthly and seasonal CO_2 emissions from changes in carbon stock, the following equation was used (Change, 2006):

$$\Delta CO_2 emission = \Delta SOC \; x \; (\frac{44 \; unit \; CO_2}{12 \; unit \; C})$$

$$\Delta SOC = \frac{SOC_e - SOC_i}{T}$$

Where:

ΔCO_2 emission: Monthly and seasonal CO_2 emission (g/m²/h)

ΔSOC: Monthly and seasonal change in carbon stocks

SOCe: Soil organic carbon stock at the end of the period

SOCi: Soil organic carbon stock at the beginning of the period

T: Default time period

The calculation of seasonal CO_2 emissions considered the vegetation period, and the data collected from CO_2 emission calculataions. These seasonal values were used to determine CO_2 emissions per unit area and per silage yield.

3. RESULTS and DISCUSSION

Considering the monthly potential CO_2 emission values in different irrigation regimes in the growing period of silage maize (Figure 1), it is observed that the higher emissions occurred in June and july in all three irrigation regimes, followed by August. It could be indicated that, during these months, changes in soil moisture due to irrigation, as well as air temperature and consequently soil temperature, accelerated the mineralization of organic matter, resulting in increased emissions.

Frequent irrigation in S1 treatment leaded to higher CO_2 emissions by prolonging the time the soil remains moist. When examining the monthly potential CO_2 emission values according to doses (Figure 2), it is determined that the higher emissions throughout the growing period were occurred in the sewage sludge treatments. The most significant increases were observed in the D3 dose. Yerli et al. (2023) reported that an increased organic matter content in soil treated with sewage sludge led to higher CO_2 emissions. In general, researchers have indicated that soil CO_2 emissions are influenced by factors such as soil and air temperature, soil moisture content, and soil aeration status (Sun et al., 2011, Rowlings et al., 2012, Evans and Burke, 2013, Mancinelli et al., 2015; Yerli et al., 2022).

The effects of different irrigation regimes and different sewage sludge doses on seasonal potential CO_2 emissions per unit area and per unit yield in the maize crop cultivation were found to be significant ($p<0.01$) (Figures 3 - 6). As the surface soil drying period decreases, the seasonal potential CO_2 emissions per unit area increase. Sinaie et al. (2019) indicated that as soil moisture decreases, microbial activities also slow down, leading to reduced CO_2 emissions. Many other studies have reported that as the soil surface dries, CO_2 emissions decrease (Li et al., 2010; Şenyiğit and Akbolat, 2010; Mancinelli et al., 2015; Zornoza et al., 2016; Zhong et al., 2021; Yerli et al., 2022, Yerli et al., 2023). However, it has been observed that as the soil surface drying period increases, the seasonal potential CO_2 emissions per unit yield also increase. Here, the effect of decreasing yielding in increasing irrigation regime can be mentioned.

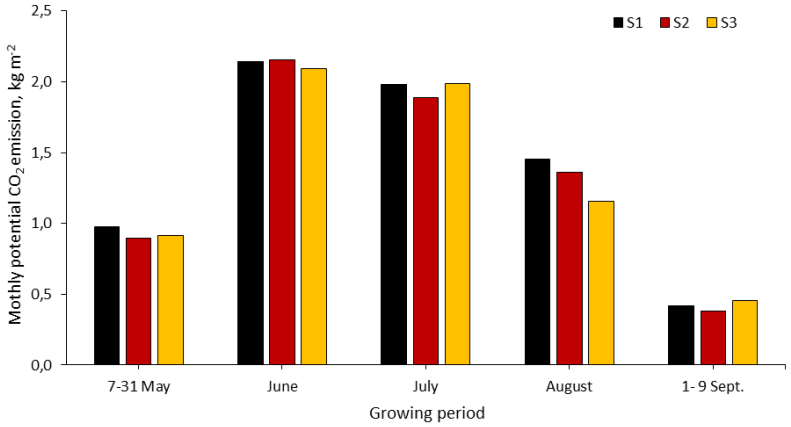


Figure 1. The changes monthly potential CO_2 emission in different irrigation regimes in the growing period

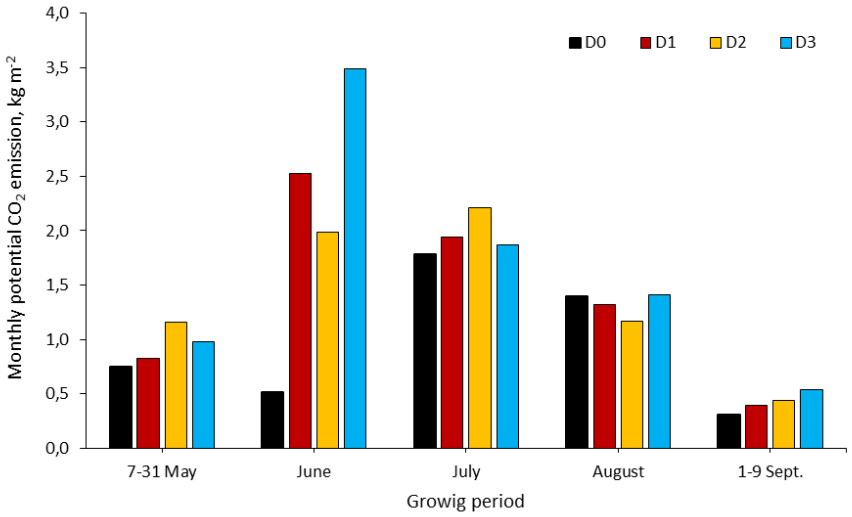


Figure 2. The changes monthly potential CO_2 emission in different different sewage sludge doses in the growing period

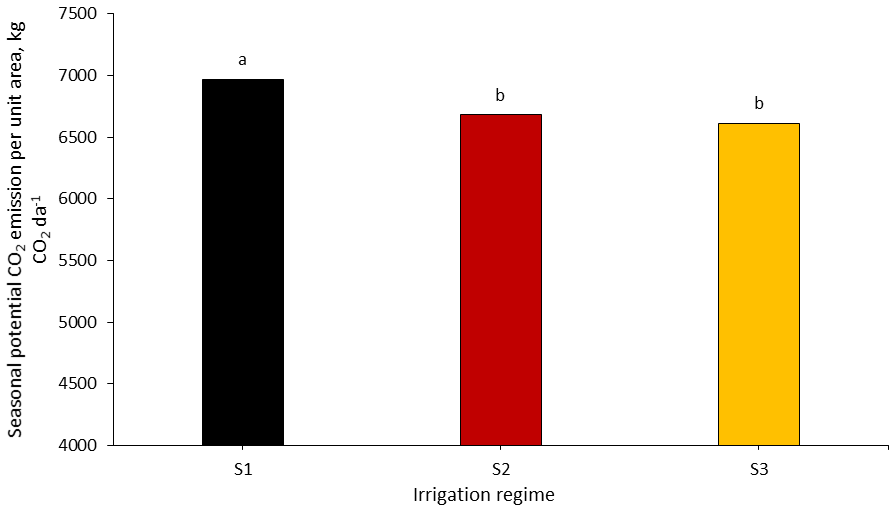


Figure 3. The changes seasonal potential CO_2 emission per unit area in different sewage sludge doses

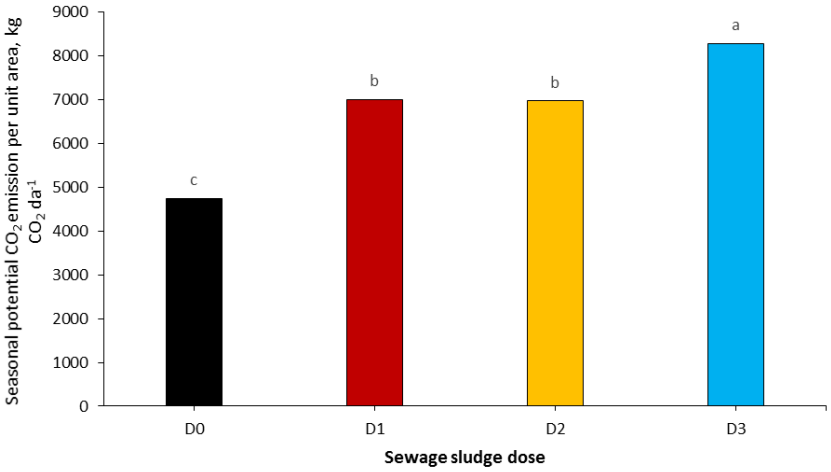


Figure 4. The changes seasonal potential CO_2 emission per unit area in different sewage sludge doses

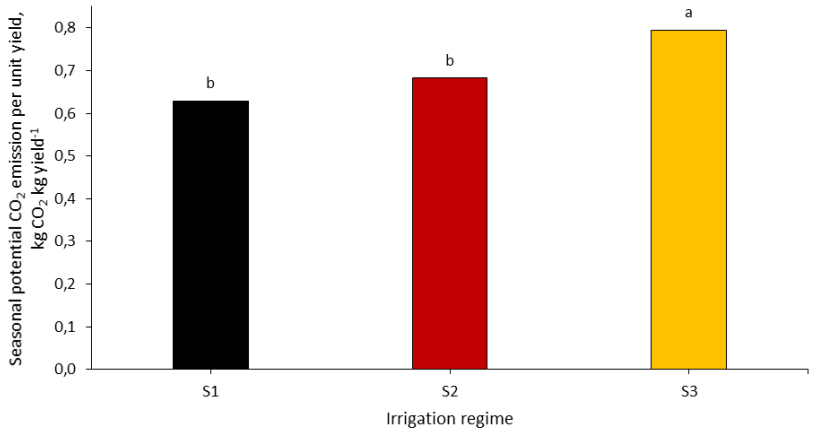


Figure 5. The changes seasonal potential CO_2 emission per unit yield in different irrigation regimes

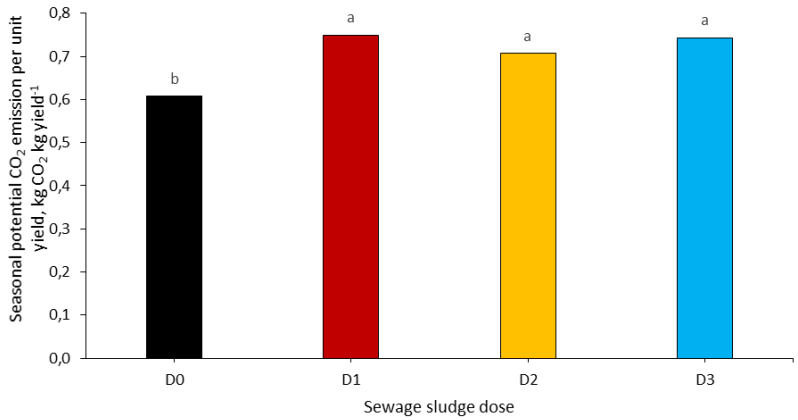


Figure 6. The changes seasonal potential CO_2 emission per unit yield in different sewage sludge doses

4. CONCLUSION

The results indicate that as the wetting-drying cycles decrease, CO_2 emissions increase in the surface soil where sewage sludge is applied. Similarly, an increase in soil organic matter content has led to increased CO_2 emissions. When considering the potential CO_2 emissions per unit yield, they have increased despite a decrease in soil moisture content, while on a per-unit area basis, they have decreased. In terms of emissions per unit yield, it was evaluated that the same yield could be obtained in a smaller area, and more frequent irrigation would be more effective for this purpose.

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Statement of Conflict of Interest

The authors declare that they are no conflict of interest.

Authors' Contributions

Authors designed, analyzed and arranged the research, worked together on the preparation of figures. The authors contributed to the writing of the article and took part in the process of publication of the article and read and approved it.

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THE CHALLENGES OF IMPLEMENTİNG AN E-GOVERNMENT ALBANIA SYSTEM THE CASE OF THE PUBLICATION OF SENSITIVE DATA FOR ALBANIAN CITIZENS

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Abstract
New information technologies have enabled the transformation of traditional administrative processes into services that can be performed much faster. Information security has become a matter of vital importance for almost all organizations, due to the current trends of rapid developments and the ease with which information can be carried or transferred. Organizations are forced to adapt to the development trend and find ways to better manage information security aspects. Some mechanisms or areas that are of special importance in this aspect are policies, procedures, and standards. Through the use of these mechanisms, organizations learn to create a secure environment for their operations as well as the preservation of their assets, which in this case are information. The aim and purpose of this paper are to research the aspects of information security in public sector institutions in Albania. Attention has also been paid to the challenges and opportunities that these institutions have for the prevention and treatment of possible cases of information security violations. Another aspect is the adaptation of these organizations to standards, good practices, and the drafting of policies or other important documents in the field of information security. Of particular interest is the perception of IT employees regarding security issues and the implementation or non-implementation of certain mechanisms in the organizations where they work.
Keywords: Security, Information Systems, Management, Technology

1. INTRODUCTION

Information systems as an important field of social life, which has become part of society very early, including its implications in the academic, business, and institutional aspects. Individuals are focused on different information from morning to night mentioning, curiosities about technology, entertainment, different sciences, etc., getting it from sources like newspapers, magazines, television, and others. However, businesses, organizations, and academic units use information to make decisions or solve problems. The information system is described as a set of all the tools and methods that managers use to support work and decision-making in enterprises. The security aspects of information systems in the public sector are important because these are often part of critical infrastructures or deal with personal or sensitive data. Although the size of the public sector varies between countries, it usually includes the central government, which consists of several separate ministries, and also different levels of local government, which consist of a large number of institutions. small (such as regional institutions, Municipalities, Administrative Units, etc.), distributed throughout the country. In most countries the public sector performs very important functions for their economic, and social life and development, it also puts into operation the legislation, rules, and framework for all economic and social activities. The public sector also includes the police, emergency services, legislative and judicial authorities, and numerous independent supervisory authorities, all of which are of critical importance to all economic and social activity in the country. In addition, in various countries, there are public organizations (public enterprises) that provide goods and services, which are considered essential for strategic reasons and therefore fall under the umbrella of the state. This category can be very broad and can include hospitals, research institutes, educational institutions, state lotteries, energy, telecommunications, transport organizations, etc. The case of the publication of sensitive data for Albanian citizens is a serious issue that needs to be addressed. It is important to understand the root cause of the problem in order to prevent similar incidents from happening in the future. The government and relevant authorities should take necessary measures to ensure the privacy and security of citizens' personal information, which includes implementing strict protocols and guidelines for handling sensitive data. It is also crucial to educate the public on the importance of protecting their personal information and how they can safeguard their data from potential threats.

2. LITERATURE REVIEW

The public sector is generally characterized by the lack of economic markets for their final products [Bozeman & Bretschneider 1986)]. Then there is the support that this sector has from the government for financial resources. This support produces another limitation, political influence. Different forms of accountability may be necessary that are not typically practiced by private sector firms [(Rainey & Steinbauer, 1999]).

It should also be noted that information systems planning, development, operation, and management in public sector organizations take place in a very specific context that presents particular challenges. Public sector organizations are often burdened with inflexible procurement, employment, reward, and pay procedures and operate within an institutional framework that is not easily changed. These factors contribute to several issues and difficulties related to information system security in the public sector. Public institutions are required to keep accurate records to maintain internal controls and protect corporate assets against unauthorized use. In addition to the more traditional list of assets such as plant, land, equipment, cash, and people, the list of corporate assets also includes information that is used to support the business or organization. The company's physical assets are protected because lost or damaged assets hurt the company's chances of success. In the same way, by protecting the company's information assets we increase the chance of success. Taking care of asset security improves value by providing a better competitive position in the industry and improved customer service (Peltier, 2004).

The growing need to maintain national security eventually led to more complex and technologically sophisticated computer security safeguards [(Whitman & Mattord, 2011)]. There have always been various omissions in terms of safety, especially when dealing with new products that have not been used before. Thus according to [Nayak & Rao (2014)8888]

The value that information provides is great and must be used with great care by enterprises and organizations to do business and develop in the market. Information systems are of great importance in enterprises and organizations because they can lead to the change of strategy that may occur due to major changes in the market, including market conditions, and especially rapid technological developments. Companies do this to follow the competition or to create a competitive advantage in the market (Laudon, 2014). Threats to Information According to Whitman & Mattord (2011) a threat is a category of objects, persons, or other entities that pose

a risk to an asset. Threats are always present and can be intentional or unintentional. Internal threats and external threats are the two main groups of network security threats. Insider threats are threats from someone inside the organization who has appropriate access to the network and network resources, who has a good understanding of the network infrastructure, and who understands security applications and security holes. External threats are threats from people outside the organization. They do not have authorized access to network resources. They act by attempting and gaining unauthorized access to the network and network resources to damage the resources or for profit (Nayak & Rao, 2014). Advanced Persistent Threat and Cyber Attacks The different types of threats are evolving rapidly, with the rise of highly organized and funded groups capable of executing persistent attacks. to achieve long-term goals, including cyber-espionage and cyber-terrorism. The rise of organized crime online is entirely logical. Given that money and information are now exchanged over the Internet, organized crime has followed suit, focusing on the theft of valuable assets such as intellectual property (Harkins, 2016).

3. METHODOLOGY

1. The method followed in the data is through a case study related to the case of the release of data in Albania for Albanian citizens. These released data affected everyone's life as well as a fundamental violation of human rights.

2. Referring to the situation created in the connection where everyone's data is in everyone's hands, it is the duty of all institutions and the government to take immediate steps to deal with the problem and immediate recovery. It is obvious that now the data have come out and they are still today after so long in everyone's hands and this is an event that has no measure for the negative impact created today and in the future where these data exist in the hands of ordinary citizens. Regarding the importance of protecting the data, a questionnaire was built with a sample of n=80 and it is distributed electronically to qualified experts who operate in the largest organizations that operate in Albania, whether private or public. To help with the findings made in this chaotic data release situation, semi-structured or open questions have been formulated in the form of opinions from the best IT and cyber security experts.

4. INFORMATION SYSTEMS E - ALBANIA

A case of success so far in the category of information systems in Albania we would mention the unique multifunctional government portal e-Albania. al which is administered and developed by the National Agency of Information Society, serves as a gateway through which

any interested person can receive electronic services provided by public institutions in Albania via the Internet.

The e-Albania government portal is connected to the Government Interaction Platform, which is the basic architecture on which interaction with the electronic systems of public institutions is enabled. To become the main channel for receiving public administration online services

What does e-Albania offer?

• E- Albania is a one-stop office for public administration online services

• Is an online channel for providing public services 24 hours a day, 7 days a week

• Offers electronic services of levels 3 and 4 (according to UNPAN 2014) through the latest technology standards, possibility to make online payments for these services through debit and credit cards

• Offers electronic services of levels 1 and 2 (according to UNPAN 2014), where anyone interested can receive detailed information about services for the public, (licenses, permits, authorizations, documents equipped with a digital stamp, certificates, or other services similar), the necessary documentation, the procedure that must be followed, the operating hours and the location of the administration offices, contacts, as well as the address of the official website of the institution that offers the relevant service, where it can be oriented for further details

• Is in full compliance with government policies in the field of ICT and the Cross-Sectoral Strategy "Albania's Digital Agenda 2015-2020"

• Provides communication opportunities for any ambiguity, question, or problem regarding registration, the services offered on the portal, through the portal forum, e-mail, comments, and messages on social networks

• Has improved the provision of services, reducing the time of receiving the service, avoiding bureaucracies, as well as reducing corruption

• Provides information and electronic services that are created and maintained by various public and private institutions. The availability and accuracy of the service is the responsibility of the responsible institution, which provides its electronic service through the portal

• To be the main channel for receiving online public administration services for citizens, businesses, and public administration employees themselves, to offer users a platform where they can be an active part of improving public services and drafting government policies

• To expand the user experience through the continuous addition of electronic services with more than 100 other electronic services within the year 2017, to increase the information on the existence of public administration services to all Albanian citizens

• Ensures 24/7/365 availability with over 99% portal functionality

• Is connected to the Government Platform of Interaction (Government Gateway), in which 48 systems are connected which exchange data in real-time

• The interaction system is a multifunctional central system, an Enterprise Service Bus solution with a service-oriented architecture

• Payments for electronic services are made securely through the Government Electronic Payments Platform, which is connected to banking and non-banking institutions

• Offers the integration of a variety of security technologies to protect user data. The registration process is carried out through the government portal and the data filled in by users during the registration process are verified electronically with the data of the National Register of Civil Status for individuals and the National Commercial Register for businesses (CKB).

• The authentication and identification process is based on the "Single-Sign-On" strategy, to create a unique identity for each user, using NID for citizens and NUIS for businesses

• Is compatible with the latest versions of Internet browsers such as Internet Explorer, Google Chrome, Mozilla Firefox, Safari, etc.

• Accessible in mobile web, iOS, and Android mobile app versions

• It is offered 100% in the Albanian language; E-Albania is a secure system and is not related to any leakage of information. Precisely for the registries to interact safely, the governmental interaction platform was built, which makes it possible to have no exports, but the systems to communicate with each other in real-time and automatically, without people from behind. The 17 million transactions of this platform that are made every month, in addition to reducing all the generating documents that the citizens and businesses need, are carried out securely, leaving clear logs. The platform is maintained by Microsoft, which enables full security

5. CASE STUDY. THE CASE OF THE PUBLICATION OF SENSITIVE DATA FOR ALBANIAN CITIZENS

In April 2021, a few days before the general elections in the country, a database with the private information of around 910,000 voters in Tirana was leaked to the media.

It was claimed that the database belonged to the ruling Socialist Party and was taken from state institutions and used for electoral purposes. The database, which BIRN has seen, contained some 910,000 entries including names, addresses, birth dates, personal ID cards, employment information, and other data. The Socialist Party denied wrongdoing, insisting that the information was gathered in door-in-door surveys. After some months another database containing the personal data of hundreds of thousands of Albanian citizens which has been circulated on social media.

It is alleged that the data contains the monthly salaries, job positions, employer names, and ID numbers of some 630,000 citizens, from both the public and private sectors. It is suspected that the list was leaked from the tax service or the Social Insurance Institute.

A government spokesman said that the Ministry of Finance was following up with concern about the release of data on the salaries of Albanian citizens, and described the document as “illegal”.

In Albania, several databases with the personal data of hundreds of thousands of Albanian citizens, such as salaries, ID card numbers, and vehicle license plates, the number mobiles are circulating on WhatsApp and social networks. ´The information that came from the General Directorate of Taxes told that suspected to be the source of the leakage of the payrolls, he found that this institution did not have the appropriate standards for the protection of personal data. Experts and journalists say that the prosecutor's office, which has launched an investigation into the criminal offense of "Misuse of personal data and Abuse of duty", has sufficient evidence to investigate other criminal offenses such as money laundering. corruption and fiscal evasion. After circulating on the WhatsApp social network, the three databases, two with the payrolls of 630,000 thousand Albanian citizens, and one with car license plates. Legal and national security experts emphasized that the disclosure of salaries and other personal data such as identity card numbers constitutes the biggest scandal of all time in the field of personal data in Albania. "This is not a random leak of information since, as you saw, the first list came out, a more reduced list, the prime minister came out to give explanations, and another detailed list came out.

This process leads to collapse, and this requires an urgent undertaking. Below we are giving a table of this database that is circulating and today even their number has been added. We are referring to the findings of some indicators obtained in the processing of this database.

	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Muhamec	Haxhiu	Muhamec		3:00 AM	Durrës		70,000.00	Administrator	I punësuar me kohë të plotë ose të pjesshme c			
2	Emri	Mbiemri	EMRI I PL	NIPT	Subjekti	DRT		Paga Bruto	Profesioni	Kategoria			
3	Anonymo	Anonymo	Anonymo	J92113001	SHERBIMI INI	Tiranë		58,074,817.00	Papercaktuar	Papercaktuar			
4	Ben	Blushi	Ben Blush	K1200700	TOP CHANNE	DTM		24,756,130.00	Drejtor i përgjith	I punësuar me kohë të plotë ose të pjesshme c			
5	Anonymo	Anonymo	Anonymo	K5171305	DREJTORIA SI	Tiranë		9,285,761.00	Papercaktuar	Papercaktuar			
6	Sadik	Ismailaj	Sadik Ism	L6240503	FINMAN	Tiranë		8,510,061.00	Sipërmarrës	I punësuar me kohë të plotë ose të pjesshme c			
7	Idajet	Ismailaj	Idajet Ism	L6240503	FINMAN	Tiranë		8,510,061.00	Sipërmarrës	I punësuar me kohë të plotë ose të pjesshme c			
8	Michael	Smith	Michael S	L2180700	Shell Upstrea	DTM		6,555,621.00	Kontabilist	I punësuar me kohë të plotë ose të pjesshme c			
9	Anonymo	Anonymo	Anonymo	K5290522	SHERBIMI INI	Elbasan		6,528,303.00	Papercaktuar	Papercaktuar			
10	Anonymo	Anonymo	Anonymo	K5782954	SHERB.INFOR	Lezhë		6,449,679.00	Papercaktuar	Papercaktuar			
11	Mentor	Petrela	Mentor P	K6182100	AMERICAN H	DTM		6,360,949.00	Kirurg në neurok	I punësuar në dy subjekte (i dypunësuar) kur sh			
12	Anonymo	Anonymo	Anonymo	K9403059	SH.I.SH. DREJ	Fier		5,811,335.00	Papercaktuar	Papercaktuar			
13	Anonymo	Anonymo	Anonymo	K6231001	KORPUSI I PA	Tiranë		5,614,483.00	Papercaktuar	Papercaktuar			
14	Eduard	Curraj	Eduard Cu	K6220204	DELTA PHARI	DTM		5,577,915.00	Drejtor ekzekutiv	I punësuar me kohë të plotë ose të pjesshme c			
15	Ilia	Jorgji	Ilia Jorgji	K0312460	ELKA-SA	DTM		5,569,282.00	Drejtor i përgjith	I punësuar me kohë të plotë ose të pjesshme c			
16	Anthonie	Frens	Anthonie	L2180700	Shell Upstrea	DTM		4,732,187.00	Administrator	I punësuar me kohë të plotë ose të pjesshme c			
17	Peter	Francis	Peter Fra	L5181600	BRUNEL ENEI	DTM		4,503,007.00	Manaxher projek	I punësuar për herë të parë apo rishtazi te subj			
18	Bozhidar	Todorov	Bozhidar T	K7201480	Banka e Parë	DTM		4,474,258.00	Drejtor i përgjith	I punësuar me kohë të plotë ose të pjesshme c			
19	CHRISTIAI	CANACAR	CHRISTIAI	J6191100	RAIFFEISEN B	DTM		4,368,654.00	Drejtor i përgjith	I punësuar me kohë të plotë ose të pjesshme c			
20	Zeljko	Mirnic	Zeljko Mi	J6190106	COCA-COLA E	DTM		4,225,600.00	Drejtor në shërbi	I punësuar me kohë të plotë ose të pjesshme c			
21	Denis	Kelleher	Denis Kell	L2180700	Shell Upstrea	DTM		4,078,912.00	Inxhinier shpimi	I punësuar me kohë të plotë ose të pjesshme c			
22	Anonymo	Anonymo	Anonymo	K4312864	DREJTORIA R	Gjirokastër		4,055,900.00	Papercaktuar	Papercaktuar			
23	Kristina	Naumi	Kristina N	K9162402	Tranzit	Tiranë		4,051,400.00	Administrator	I punësuar me kohë të plotë ose të pjesshme c			
24	Petrit	Maho	Petrit Mal	J7142402	I N T E R M E I	DTM		3,978,227.00	Administrator	I punësuar me kohë të plotë ose të pjesshme c			
25	SILVIO	PEDRAZZI	SILVIO PE	J8181700	INTESA SANP	DTM		3,916,195.00	Drejtor shërbime	I punësuar me kohë të plotë ose të pjesshme c			

Table 1 Table of the salary list of citizens in Albania that are public in social media and wp.

There are 630,000 citizens, from both the public and private sectors. The fields that are complete In the field begin with the ID, name, surname, name, and surname (it is written in red), the NIPT of the entity where the salary is received, the name of the entity where you work, the location as well as the gross salary received (it is written in red) to continue with the column of the job position he holds as well as the full-time or part-time status.

This circulating database is a reference and we can see it in drawing some conclusions

- First, we calculate the average salary in Albania by referring to the data published through Excel with the AVERAGE formula by setting the first and last salary cells, in our case it would be =AVERAGE (H3:H523349), and through this function of Excel, we calculate the average salary in Albania, which in fact according to the declared data turns out to be 52,403 ALL.
- In the same way, we can calculate the maximum and minimum salary through the functions MAX, and MIN, functions which reveal to us that the maximum salary is 58,074,817 while the minimum is 1,200 ALL.
- For further statistical analysis, we can also use the percentage, which signifies a statistical measure that shows the value below which a certain percentage of observations in a group of observations falls, for example, this function shows us the value of the salary that has less than 75 % of citizens =PERCENTILE (H3:H523349,0.75), the value of this function is 60,870 ALL, so 25% of them have salaries higher than this value.

- Variance and Standard Deviation are the two important measurements in statistics. Variance is a measure of how data points differ from the mean, while standard deviation is a measure of the distribution of statistical data.
- Furthermore, it is convenient to measure how much salaries vary relative to the mean. For this purpose, we calculate the standard deviation and variance with the auxiliary function STDEV and VAR.P.
- We first calculate the standard deviation through the formula =STDEV.S(H3:H523349) this function from which the value 113.384 comes out, so this is the number of salaries that differ from the average. Continuing further with the variance function from which =VAR.P(H3:H523349) we calculate the spread of the data around its mean value.

Referring to its use, all citizens must protect themselves and be careful. Many problems with institutions, to social problems in the entire population. Problems and challenges for the management of this system and the challenges that arise to standardized nowadays where we are officially candidates for part of the integration in Europe. As a country that wants to become part of Europe, we must also respond to the standards of the institutions that deal with this information and sensitive data for Albanian citizens. ***Questions that arise are some as below***

1. Why is the release of a payroll from almost a year ago happening now?
2. What purpose is hidden behind this act, which was also followed by the publication of a database with car license plates of Albanian citizens?
3. Is it a concern that should be considered for national security?
4. Are there other sensitive data that can be released later according to a structured plan?
5. If there will be other data, is an organization facing a certain goal, which aims to either shift attention from an important investigation or other essential problem or to create a destabilizing situation in Albania
6. Are persons protected in Albania?
7. Should the publication of personal data be considered, the responsibility for the violation of the legislation? There may be other questions as derivatives of those raised above, but we are limiting ourselves here.

Conclusions of case study

Dealing with the situation seriously is not done with justifications of improving the work with control groups or with other findings, because if the accessory is not stopped, then all the data will be released to the public. Therefore, the system must be ensured,

The Commissioner for the Right to Information and Protection of Personal Data considers the publication of the salaries and ID card numbers of hundreds of thousands of citizens a serious event and says that an administrative investigation has been launched. The necessity of improving security management systems, the need to increase the budget for the protection of personal data, as well as the preparation of experts in this field, should be considered immediately.

Such a gap and publication in the published database that is in everyone's hands promotes numerous social problems that harm businesses that are the promoters of the economy.

The publication of personal data in Albania highlights the weaknesses of the institutions.

Many citizens, with the publication of data, risk being targeted by criminal groups. And to be used by them Many citizens referring to their high salaries can hide affairs and corrupt acts., for the effect of what we usually call 10, 15, or 20 percent of tenders. There is a possibility that in these companies. with such high salary levels, employers should agree with employees of the type "I will set the salary at 3 million. Of these 3 million, you take one, you will return the rest". And then this money is used for bribes. It finds certain companies which on the one hand come out with a negative balance, and on the other hand, have high salaries.

For the Albanian level of wages, some salaries surprised, and here there are full indications have investigations for certain companies for the criminal offense of money laundering.

So are other companies that can be investigated for concealment of income and tax evasion.

The Commissioner for the Right to Information and Protection of Personal Data as well as experts say that administrative and criminal sanctions for extracting personal data are negligible concerning the damages, and add that they should be strengthened.

Great achievement digitization of services, must be accompanied by strong security measures.

The release of citizens' data from the government information system in Albania

6. ANALYSIS OF A SURVEY FOR THE SENIOR LEVEL OF IT EMPLOYEES (SELECTED WITH MOSTLY OPEN QUESTIONS)

Referring to a simple survey conducted mainly with high-level TI specialists, we came up with some findings. A survey of 80 representative people in large private and government businesses has the following:

1. Regarding the information security strategy, the majority of IT employees (52.4%) answered negatively, i.e. that the organization they work for does not have a documented security strategy. However, many of these organizations have other documents, security policies, or general policies for the use of IT equipment and services.

2. Referring further to the findings of the survey, it can be seen that a large number of organizations do not have any documented information security strategy, as the main document related to this field. However, many of these organizations have other documents, security policies, or general policies for the use of IT equipment and services. So we understand what are the main areas addressed through the existing documents that issues and requests related to passwords are addressed in 95.2% of cases. Whereas other issues such as the use of the Internet and e-mail are addressed in 90.5% of cases. Issues that are still not sufficiently addressed are data classification and information storage/destruction (after a certain time). A large increase in the use of mobile devices has also been noted, therefore not regulating this field can be problematic for these organizations since based on the answers we understand that about 61.9% have addressed mobile devices through official documents. From this, we notice that even mobile devices still do not have adequate handling of these documents.

- It can be seen that the majority of employees appreciate that there is adequate security in the buildings and locations of their organizations. But there are also a small number who do not appreciate this very important aspect of security.

- It is known that one of the primary aspects of security is denying physical access to certain devices to persons who are not authorized to work with them. Also, another aspect is the issue of cables which must be placed in safe ways to avoid the possibility of intentional or accidental damage. Employees have assessed that the placement and protection of equipment and cables is adequate but generally not at a satisfactory level. This can be justified considering the different nature of the organizations. We have organizations that operate in modern facilities and locations that have been built in recent years, or in facilities that have undergone

renovations and adjustments in terms of networks and infrastructure. While a part of the organizations also operates in private facilities which do not meet the conditions they should in terms of security issues. The rest of the organizations operate in public facilities but possess outdated infrastructure or have deficiencies in this regard. Another aspect is the control of access to the computer network. Here the respondents gave mostly positive answers, implying that there are adequate controls that prevent unauthorized persons from accessing the organization's computer network. While network access can be controlled by various methods including physical ones, this can be more problematic when it comes to Wireless networks. It is known that the use of Wireless networks is a particular challenge for many organizations when we consider the easier possibility of accessing them compared to wired networks.

- A significant number of respondents stated that the organization they work for specifies safety obligations for its employees. Some of them (28.6%) have no information about this, and 19% answered negatively. This is a very important issue since employees are the ones who have access to various information and not clearly defining their duties and obligations regarding information security can result in security incidents.
- As for contracts with external parties, it is a different picture. Where a large majority of organizations specify security requirements to external parties. However, even here there is room for improvement, knowing that external parties do not always have good intentions when they enter the organization's premises. This is especially true for many organizations that have multiple services that are outsourced.
- It is known that organizations differ from the smallest to the largest, in this respect, the responsible personnel who deal with security issues also differ. The largest number of respondents have emphasized that the main persons responsible for security are the Network Administrator or the System Administrator. While a smaller number have emphasized that this field is covered by an IT Specialist or, in the best cases, an Information Security Specialist. In this respect, the situation is not ideal because it is known that the staff who perform other important functions find it difficult to fully dedicate themselves to security issues. Only a certain number of larger organizations have the possibility of delegating this responsibility to a dedicated person or department.
- The most frequently used ways to increase awareness regarding information security seem to be the general ones that also include verbal forms. While a smaller number distribute relevant

news from time to time. Several people have stated that they try to achieve this by complying with different standards and policies. Here too we note that the organization of training for certain groups is not one of the priorities of these organizations. Another aspect addressed is the evaluation of the efficiency of information security management. The majority of respondents (57.1%) answered that an assessment regarding efficiency is made by the IT staff/department. A smaller part (19%) stated that such evaluation is done by the internal audit. While 33.3% have emphasized that no such assessment is made at all regarding the efficiency of information security management.

- One of the key aspects that is also described by many different standards that have been mentioned above is the management of incidents. Knowing this, the question was asked whether the organization has written procedures for the management of security incidents, which was answered positively by less than half of the respondents. This is a major concern knowing that the lack of written procedures leaves the door open for such incidents and creates major obstacles in restoring service when they do occur.

- The Continuity Plan of the business or organization is certainly difficult to imagine without a Disaster Recovery plan or strategy. About 47.6% of respondents answered positively to this question. This can also be explained by the nature of some smaller organizations which may have carried this responsibility to a larger supervisory organization. However, regarding the way organizations evaluate such a plan, most have answered that this is done through a partial simulation of the restoration of certain backups. Another part stated that such an evaluation is not performed at all and that this can be very problematic if a previous backup needs to be returned and it does not work because it has not been tested in advance. While no response has been received to the option of simulating emergencies, i.e. organizations do not practice this method.

- The application and implementation of internationally accepted standards are still not present in public organizations. Based on the responses received, it appears that most organizations do not use any specific standard. Several answers have emphasized the use of any other standard, other than those listed (which are part of the set of the most popular standards). In the second part of Figure 12 is the question related to the implementation and use of ISMS, the Information Security Management System. Even in this area, most organizations have not implemented ISMS. However, the largest number of respondents stated that the possibility of implementing

ISMS has been considered and will probably be considered again. A smaller part stated that the use of ISMS was never thought of and considered as an option. While some of the respondents stated that ISMS is used in certain organizations.

8. CONCLUSION

Through the conducted research, we can reach some conclusions regarding information security and its management in public sector organizations. The results show that despite many areas where there is an adequate handling of security issues, there are also areas that require improvement.

The conclusions and recommendations in this case are more general than specific to certain organizations. One of the main aspects is the design and development of policies and procedures. Greater investment in this direction would affect the clear establishment of responsibilities for all activities related to information security. Written procedures would not leave much room for ambiguity regarding the handling of incidents or other areas of security. Here I believe that better coordination is needed with management and relevant legal officials so that they have as clear as possible the importance of policies and procedures in IT because there are cases when these officials are not so familiar with procedural issues in IT. This is when it is known that a certain part of the management in these organizations is political and not always interested in the smooth running of certain processes.

Another area for improvement is to better address the issue of information classification. Utilizing a more coherent classification, the management of information would be facilitated, especially where sensitive information is concerned. The organization of pieces of training for users is another aspect that has room for improvement. This is because information security issues are often not taken seriously by users. In this direction, organizations can perhaps use the existing infrastructure of training institutes in the public sector.

The assessment or evaluation of current practices in IT in general but also in information security needs significant improvement. This is because, based on the answers, we have understood that often such evaluations are made by the employees themselves, or in other cases they are not made at all.

In the above-mentioned field of assessment of practices and processes implemented in IT, the audit of IT processes would play an important role. This field is still in its initial phase in our country, always referring to the public sector. Audits carried out so far by external auditors are

mainly focused on regularity and financial issues. With the development of IT audit (part of this would also be the issue of information security) an opportunity would be created to influence the practices implemented in IT. Through recommendations and alignment with standards or good practices, better security management would be ensured. This would also be of great help to IT staff in various organizations as they would be more up-to-date with these practices. Another issue more specific to the public sector is the procurement of IT equipment and services. This often affects the creation of certain situations where an organization can be left without a certain service or device (affecting security) for a certain time, therefore very precise planning of these activities is required to avoid reaching the point where endangers safety.

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DETERMINATION OF CO_2 EMISSION FROM SOIL WITH FARM MANURE APPLICATION UNDER DIFFERENT IRRIGATION REGIMES THROUGH CARBON STOCK CHANGES

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Abstract
The use of organic fertilizers in agriculture can lead to beneficial effects on soil structure and increased fertility, while posing a risk to the environment with carbon emissions. Therefore, this study focuses on the impact of organic farm manure on CO_2 emission from soil in silage maize cultivation, a significant forage crop for dairy cows in both global and Turkish agriculture. The research explores the effects of different irrigation regimes in a semi-arid region with high-altitude conditions, where organic fertilization (farm manure) and drip irrigation are employed, in comparison to mineral fertilization. The study investigates monthly and seasonal variations in carbon stocks and associated CO_2 emissions, with a focus on the role of soil moisture, organic matter content, and irrigation strategies. The findings reveal that soil carbon emissions are influenced by factors such as soil moisture and temperature, with higher emissions observed during periods of increased soil moisture and temperature. Frequent irrigation, while beneficial for crop yield, can lead to higher CO_2 emissions due to its potential to reduce soil carbon stocks. In conclusion, this study provides valuable findings into the interplay between farm manure, irrigation regimes applied with different irrigation intervals, and CO_2 emissions, emphasizing the importance of sustainable agricultural practices with carbon management in agricultural ecosystems.
Keywords: Farm manure, CO_2 emission, Irrigation regimes

INTRODUCTION

The intensive use of mineral (chemical) fertilizers can lead to harmful effects for high production targets. This situation can cause damage to soil structure and increase soil acidity. Research indicates that excessive use of mineral fertilizers can result in soil dispersion (Yıldız, 2018). Therefore, the utilization of materials containing organic matter to fulfill plant nutrient requirements has become more widespread. High-content organic fertilizer sources include compost, farm manure, stabilized sewage sludge, green manure, and others. Particularly in agricultural enterprises focused on animal husbandry, these organic materials are preferred to mitigate negative impacts on soil structure and reduce the cost of commercial fertilizers. Materials like farm manure provide essential plant nutrients such as N, P, K, Ca, Mg, Cu, and Zn, while also enhancing the physical, chemical, and biological properties of the soil. This improvement extends to areas such as water retention capacity, aeration, structural stability, microbial activity, and productivity (Nazlı et al., 2014; Arslan, 2016). Organic fertilizers also stimulate soil microorganisms, facilitating the availability of plant nutrients (Fandika et al., 2007).

Silage maize is a significant animal feed crop both globally and in Turkey. According to the 2020 data, in Turkey, the silage maize cultivation area, total production quantity, and average silage yield were 526,261.3 hectares, 27,186,949 tons, and 51.7 tons/ha, respectively (TUİK, 2021). Maize cultivation, being a C4 plant, involves the use of substantial amounts of water and nutrients, resulting in high yields per unit area in relation to the consumed water and nutrients. Nitrogen, especially, is the primary nutrient source for plant growth and high yields in silage maize. However, if this requirement is met with organic ways, it can lead to negative effects such pollution in the atmosphere caused by greenhouse gas emissions.

The mineralization of soil organic matter increases the emission of CO_2, which is recognized as a greenhouse gas. Carbon in the soil interacts with oxygen and transforms into the form of CO_2. The emission quantity of CO_2 is closely related to factors such as soil moisture, organic matter content, soil temperature, and aeration rate (Vurarak and Bilgili, 2015; Deniz, 2019). Carbon and nitrogen mineralization in soil are substantially influenced by wetting-drying cycles and related processes (Morugán-Coronado et al., 2011; Shi and Marschner, 2014). Arid or semi-arid regions, in particular, experience increased microbial activity upon remoistening dried soil (Lamparter et al., 2009). The CO_2 resulting from the microbial decomposition of

organic matter contributes to 99% of the total emissions, thus reducing the organic carbon pool in the soil (Hossain et al., 2017). The loss of carbon in soil negatively impacts soil structure, productivity, and fertility. Therefore, carbon preservation in soil is a fundamental requirement, serving as both a source of plant nutrients and a potential sink for atmospheric CO_2. A significant reduction in CO_2 emission typically signifies increased soil carbon storage known as "carbon sequestration" in agriculture. Hence, managing soil moisture, particularly through irrigation strategies, can play a pivotal role in enhancing carbon storage and reducing greenhouse gas emissions. Frequent irrigation in low-water regimes reduces tension (matric + osmotic) in the soil, facilitating easier water uptake by plants, leading to positive contributions to yield and quality. However, sustained high moisture levels pose risks for CO_2 emissions due to their potential to cause a reduction in surface soil carbon stocks.

In this context, comprehensive information is needed regarding the management of irrigation regimes under farm manure application conditions to reduce CO_2 emissions. The objective of this study is to compare CO_2 emissions from change of soil carbon stocks achieved through the management of irrigation regimes in a semi-arid region at high altitude, where organic (farm manure) fertilization and drip irrigation are practiced, with mineral fertilization.

MATERIAL and METHOD

In 2021, between 7 May and 9 September, a field study was conducted in the Erzurum region, which has a semi-arid climate. The study focused on the growth of DKC6777 variety of silage maize, known for its high green grass yield. The maize was grown in 18 plots with 5 plant rows and a spacing of 70 cm in each plot. Surface drip method with a dripline placed in each plant row was used for irrigation.

The experiment considered two fertilization methods: farm manure and mineral fertilizer, as well as three different irrigation regimes. The farm manure was spread evenly by hand on the plot surface and mixed into the top 15 cm of soil. The goal was to increase the organic matter content of the soil to a good/high level (around 4%). The mineral fertilizer was applied at recommended doses for silage maize in the region, considering the nitrogen and phosphorus levels in the top 20 cm of soil before planting. Half of the required nitrogen was applied at planting, while the other half was applied when the plants reached 4-6 leaves.

The irrigation regimes were categorized as low (S1), medium (S2), and high (S3) based on the difference between real-time evapotranspiration and effective precipitation. Irrigation was

performed when sum of these differences reached 20%, 40%, and 60% of the available water content in the effective rooting depth for each respective regime.

To estimate evapotranspiration (ETc), the study used the FAO56_Penman-Monteith equation, which multiplied the reference evapotranspiration (ETo) by crop coefficients (kc). ETo values were calculated using the CROPWAT (Ver. 8.0) program, which utilized real-time daily climate data from the Erzurum Airport Meteorology Station. The kc values, specific to different plant development stages, were obtained from the plant water consumption guideline for irrigated plants in Turkey (TAGEM, 2017). Precipitation was measured using a pluviometer located in the experimental field.

During the initial period (until the plants reach the stage of 4-6 leaves), all plots were irrigated equally to bring the moisture content in the top 30 cm of soil to field capacity, considering a 0.30 wetting rate. In the subsequent period, when the plants reached 4-6 leaves, irrigations were carried out to bring the moisture content in the top 90 cm of soil to field capacity, with a wetting rate of 0.65 for each irrigation regime. Soil moisture was determined using the gravimetric method.

To monitor changes in the organic matter content and bulk density values throughout the growing season, soil samples were collected from all plots at the commencement of the planting period, at the end of each month, and during the harvest from 0-30 cm soil layer. Organic matter content was determined using the Smith-Weldon method (Nelson and Sommers, 1982). Bulk density values were calculated by weighing and then dividing the weight by the total volume (Blake and Hartge, 1986).

Roughly 58% of the weight of soil organic matter is comprised of carbon. Hence, in this research, the percentage of soil organic carbon was calculated based on the soil organic matter percentage using a conversion factor of 0.58 (FAO, 2017).

SOC = 0.58 x SOM

Where:

SOC: Soil Organic Carbon Content (%)

SOM: Soil Organic Matter Content (%)

The soil organic carbon stock in soil mass was calculated per unit area (ha) by considering the soil layer 30 cm (FAO, 2017; Budak and Günal, 2018)

Using the monthly and seasonal changes in carbon stocks, the potential CO_2 emissions have been estimated using the following equations (Change, 2006).

$$\Delta CO_2 emission = \Delta SOC \; x \; (\frac{44 \; unit \; CO_2}{12 \; unit \; C})$$

$$\Delta SOC = \frac{SOC_e - SOC_i}{T}$$

Where:

ΔCO2 emission: Monthly and seasonal CO_2 emission (g/m²/h)

ΔSOC: Monthly and seasonal change in carbon stocks

SOCe: Soil organic carbon stock at the end of the period

SOCi: Soil organic carbon stock at the beginning of the period

T: Default time period

Potential CO_2 emissions estimated were analyzed using SPSS software, and comparison test was applied for significant means.

RESULTS and DISCUSSION

When examining the monthly potential CO_2 emission values based on irrigation regimes (Figure 1), it was observed that the higher emissions occurred in June and July for all three irrigation regimes, followed by August. During these periods, fluctuations in soil moisture due to irrigation practices, coupled with ambient air temperature and consequently soil temperature variations, appeared to accelerate organic matter mineralization, leading to increased CO_2 emissions. Particularly, in the S1 treatment where irrigation was applied more frequently, the soil remained consistently moist, resulting in higher CO_2 emissions (Figure 3).

As for the analysis of monthly potential CO_2 emission values farm manure and mineral fertilizer applications (Figure 2), it was determined that the peak emissions occurred in June for farm manure and followed by July and August. This finding supports the idea that higher organic matter content in the soil leads to increased CO_2 emissions, as previously reported by Yerli et al. (2023).

In general, CO_2 emissions in the soil are influenced by factors such as soil and air temperature, soil moisture content, and soil aeration. Previous research has also emphasized the importance of these factors in affecting CO_2 emissions (Sun et al., 2011; Rowlings et al., 2012; Evans and Burke, 2013; Mancinelli et al., 2015; Yerli et al., 2022).

The impact of different irrigation regimes and fertilizer types on the seasonal potential CO_2 emissions per unit area and unit yield in different fertilizer types and irrigation levels was found to be significant ($p<0.01$) (Figures 3-6). As the dry period of surface soil decreases, the seasonal potential CO_2 emissions per unit area increase. Sinaie et al. (2019) observed that as soil moisture decreases, microorganism activities slow down, resulting in decreased CO_2 emissions. Several other studies have reported a decrease in CO_2 emissions as surface soil moisture decreases (Şenyiğit and Akbolat 2010; Mancinelli et al., 2015; Zornoza et al. 2016; Zhong et al. 2021; Yerli et al., 2022, Yerli et al., 2023). However, it has been observed that as the surface soil drying period increases, the seasonal potential CO_2 emissions per unit yield also increase.

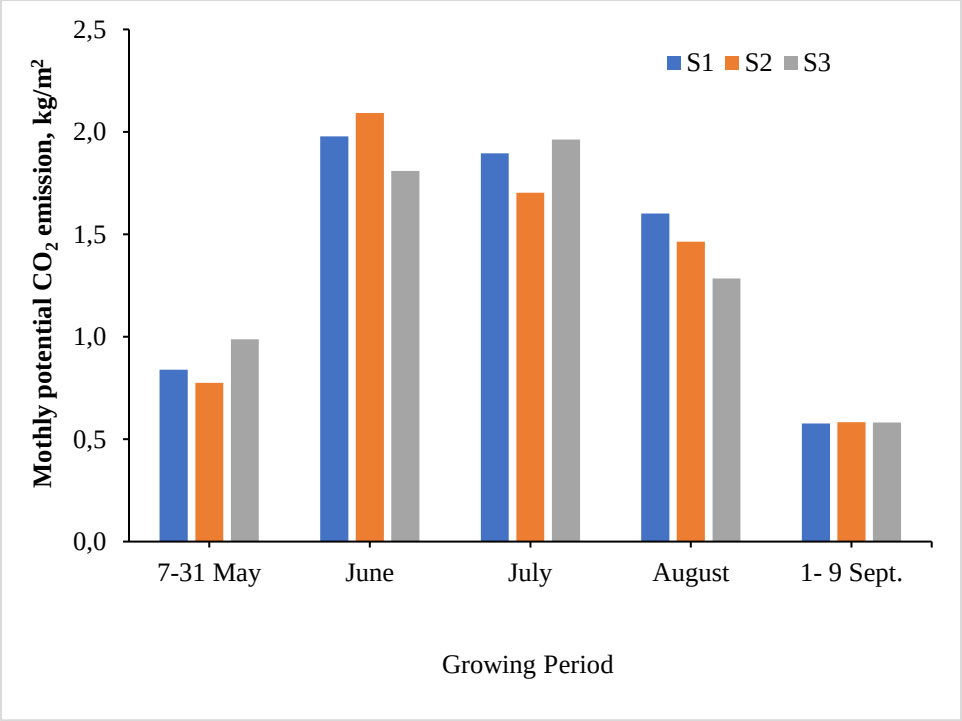


Figure 1. The monthly changes in potential CO_2 emissions with irrigation applications in the growing period

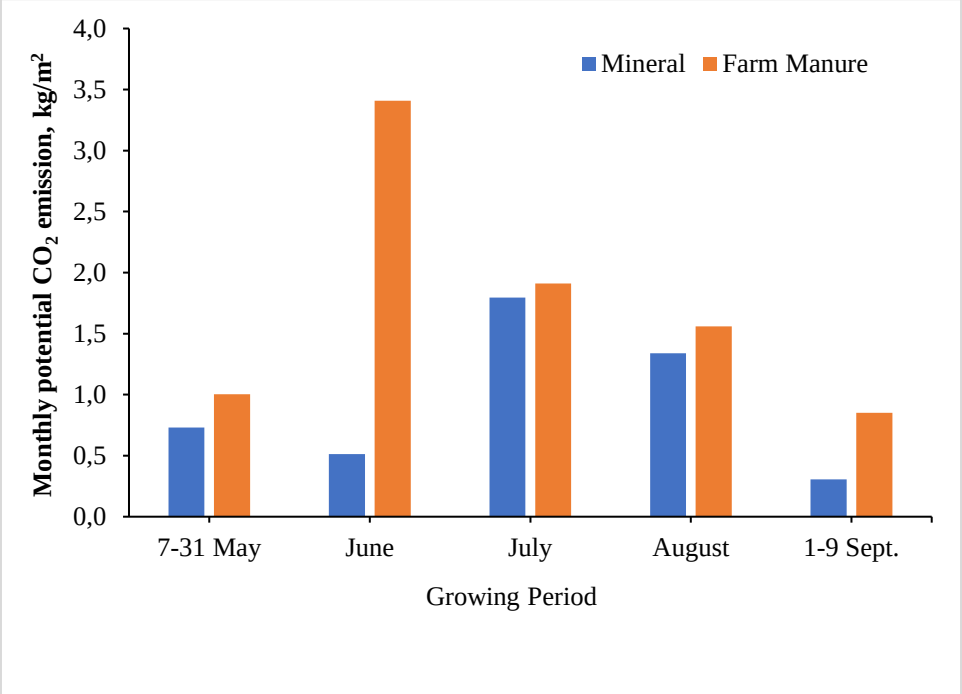


Figure 2. Changes in monthly potential CO_2 emissions with farm manure and mineral fertilizer applications in the growing period

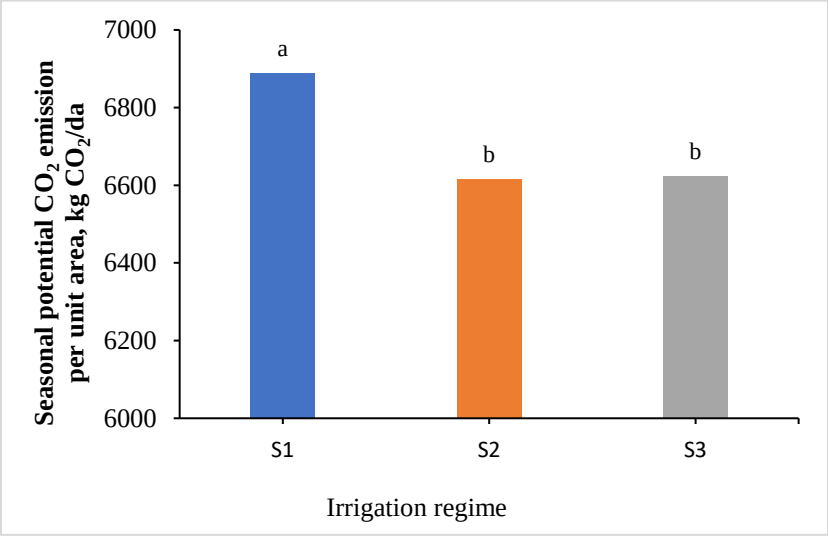


Figure 3. The changes in seasonal potential CO_2 emissions per unit area with irrigation applications

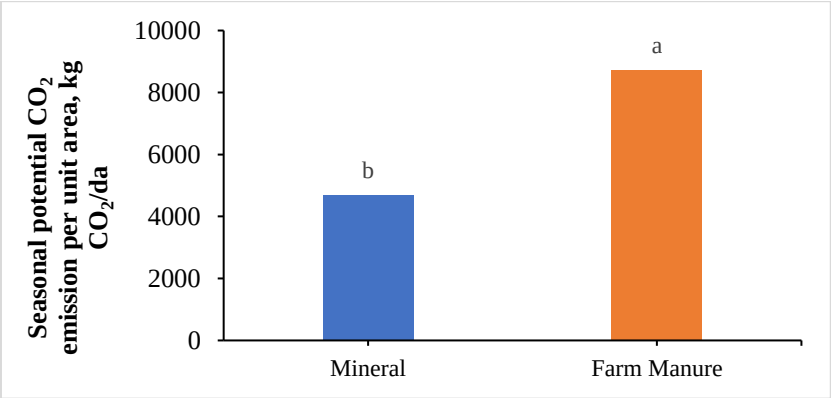


Figure 4. The changes in seasonal potential CO_2 emissions per unit area with fertilizer types

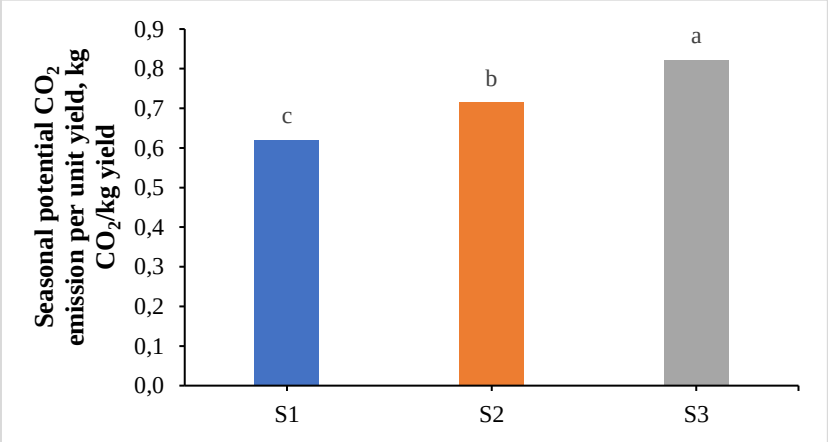


Figure 5. The changes in seasonal potential CO_2 emissions per unit yield with irrigation applications

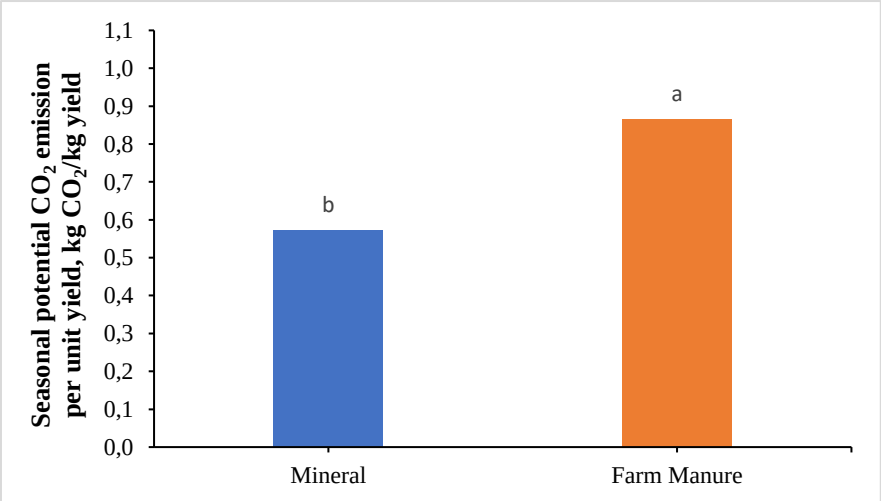


Figure 6. The changes in seasonal potential CO_2 emissions per unit yield with fertilizer types

CONCLUSION

The incorporation of farm manure into the surface soil increased CO_2 emissions. Considering seasonal potential CO_2 emissions per unit yield in the S3 treatment, CO_2 emission was increased despite a decrease in soil moisture content in surface soil. However, when calculated per unit area, these emissions have decreased. This indicated that to be more available results in terms of decrease CO_2 emissions per unit yield.

In summary, these findings highlight the complex interplay of irrigation practices, soil moisture, organic matter content, and environmental factors in influencing seasonal CO_2 emissions from the soil. Understanding these dynamics is crucial for sustainable agricultural practices and managing carbon cycling in agricultural ecosystems.

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Statement of Conflict of Interest

The authors declare that they are no conflict of interest.

Authors' Contributions

Authors designed, analyzed and arranged the research, worked together on the preparation of figures. The authors contributed to the writing of the article and took part in the process of publication of the article and read and approved it.

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FEASIBILITY STUDY ANALYSIS OF PURING FABRIC IN PAKISPUTIH VILLAGE KEDUNGWUNI SUBDISTRICT

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Abstract
This study aims to find out whether the puring cloth business is feasible or not and about the market and production aspects of the business. In this study, the researcher used a qualitative type of research with interview methods conducted on the croton cloth entrepreneurs by observing the conditions of the croton cloth business starting from the production and marketing of the croton cloth, as well as interviewing consumers who came to find out more information about the business. The results showed that the analysis of the feasibility study of the croton cloth business can be said to be feasible. This can be seen from the production aspect where the location, production process, and production technology can be said to be feasible and market aspects when viewed from competitors, product, price, place and promotion. it can also be said that it is feasible to run and where the business has experienced an increase in income from the start of opening a business until now.
Keywords: Business Feasibility Study, Production Aspect, Marketing Aspect

1. INTRODUCTION

A business feasibility study is a study used to check whether a project or business can be successfully implemented or not. Projects under investigation can be direct or involve construction(Aneli et al., 2016). Currently, the business world is experiencing very rapid progress(Rofa et al., 2021). Anyone who intends to engage in business activities can take advantage of the opportunity to improve their life. Even in this day and age, people can achieve success through their business if they are able to spot opportunities. Indonesia's economy is highly unstable, which has contributed to skyrocketing poverty rates of the laid off and educated unemployed who have never found a job. In this case, the government is asked to take smart steps and quick and effective solutions to overcome the large number of educated unemployed and reduce poverty. To reduce poverty and unemployment in Indonesia, young, small and medium enterprises or MSMEs are currently needed(Study et al., 2022).

Marketing is a set of business practices designed to design, decide on costs, promote and select products that will satisfy customer needs and achieve the goals of target markets and partners. (Sunyoto, 2014: 32). According to Jumingan (2011), the production aspect is an aspect that looks at business aspects, such as how warehouses, machinery and equipment are arranged and rooms for business expansion.

Pakisputih is a village that can be said to be a warehouse for the jeans manufacturing industry where in every hamlet there are several jeans manufacturers, so this business opportunity is suitable, especially in Pakisputih Village. The croton cloth business in Pakisputih Village itself is one of the businesses in the village so that this business is the main center if there is anything related to croton cloth used for lining jeans pockets. This business is called Tuman's Puring, which is located in his own house in Pakisputih Village, Dukuh plutungan Rt 001 Rw 002. This business has been established for 6 years, this business was founded by a businessman named Mr. Tusmono, he has a Puring Cloth business where the puring cloth is already cut and then sold which is used to make jenas bags.

Based on the explanation above, the puring cloth business needs business analysis because this analysis activity is important and must be carried out in running a business. The importance of doing business analysis is to find out whether the business is profitable or not and to find out whether the business being run is feasible or not to be cultivated and developed,

therefore the author is interested in raising the title "Analysis of the Feasibility Study of the Puring Cloth Business in Pakisputih Village"Kedungwuni District.

2. RESEARCH METHODS

This research was conducted in Pakisputih Village, Dukuh Plutungan, Kedungwuni District, Pekalongan Regency. The type of research conducted is qualitative research with the interview method which aims to obtain data that is as accurate as possible in accordance with its authenticity. The data source used in this study is based on primary data obtained from interviews with business owners and consumers.

3. RESULTS and DISCUSSION

3.1. Research Result

Overview of Puring Cloth

The Puring Cloth business is a business that has been managed since 2017 until now, located in Pakisputih Village, Dukuh Plutungan, Kedungwuni District, Pekalongan Regency. Puring cloth is a fabric that is usually sewn on the outside of jackets, shirts, pants, or other clothing to coat the inside or to be used as clothing. as a lining for jeans pockets. As for the use or function of puring cloth asfollowing :

1. Repairing Stitches
2. Minimizes discomfort caused by hard materials
3. Pocket lining

Based on the explanation above, this Croton fabric business is used to line jeans bags. In this business, there are 2 types of croton fabrics, namely Asahi type croton fabrics and TR type croton fabrics.

The results of research conducted on the puring cloth business in terms of the marketing aspect use the WOMM (Word of Mouth Marketing) technique where the promotion is carried out directly interacting with consumers with the aim that the person can immediately recognize the business being run and with interaction the greater the opportunities the name of the business will spread. The capital expended in this kai puring business is quite productive. Viewed from the production aspect, this business uses production tools that are easily available and affordable. Even though there are many business competitors engaged in this field, this

puring cloth business still makes its business in great demand by consumershow to maintain the quality of the puring cloth.

3.2. DISCUSSION

1. Production Aspect
   a. Business Location

The location of this business is located in Pakisputih Village, Dukuh Plutungan, Kedungwuni District, Pekalongan Regency. The production location for this business is very strategic because the location of the production site is not separate from the home of the business owner and many people produce jeans in the surrounding area, thereby opening up great opportunities for puring cloth business. Apart from being close to consumers, it is also close to suppliers of raw materials and other convection equipment. So, based on the location of this business, it is feasible to operate because of the strategic location and easy access by consumers.

   b. Production Technology

The technology used in this business is a small cloth cutting machine with the Octa brand.

   c. Production process

The production process of this business is carried out every day, because the production process takes a long time, so it must have stock in advance so that consumers who buy do not wait long. Puring cloth is in the form of meter sheets which are then cut according to the size the consumer wants, one bunch of puring cloth contains 100 pieces of cloth.

2. Market Aspect
   a. Marketing Area

The puring cloth industry belongs to or belongs to the type of regional market because the marketing process is through an area where sellers and buyers of this puring cloth are still in the same area as the products produced or it can also be said that the regional market is where supply and demand are still in one area.

   b. Market Competition Analysis

Competitors in business are really an obstacle, this is because the production of croton cloth business in Pakisputih Village, Dukuh Plutungan, has many competitors. The marketing strategy carried out by the owner of this business is as follows:

- Product

The strategy used in the puring cloth business is to maintain the quality of the goods so that consumers are not disappointed. Thorough in cutting the material to match the size of consumer demand.

- Price

The price determined by the owner of this business is for puring asahi cloth with a standard size of 1 bunch of 100 pieces for Rp. 725,- . As for the standard size TR croton cloth, 1 bunch of 100 pieces costs Rp. 800,-. The owner's price determination has taken into account the financing of raw materials and anticipated profits when determining the selling price. You could say this company can sell at low prices and affordable by everyone. So, this puring cloth can be said to be worth running based on price.

Marketing of puring fabric production is carried out directly from the production house, the ownerwill send goods if there are consumers who buy the puring cloth. Within a week the production of croton fabrics is capable of selling approximately 60 bundles or 6,000 pieces of puring cloth, both Asahi and TR.

- Place

The location of this business is located in Pakisputih Village, Dukuh Plutungan, Kedungwuni District, Pekalongan Regency. The production location for this business is very strategic because the location of the production site is not separate from the home of the business owner and many people produce jeans in the surrounding area, thereby opening up great opportunities for puring cloth business. So, based on the location of this business, it is feasible to operate because of the strategic location and easy access by consumers.

- Promotion

At first, no one knew about this puring cloth business and it took a long time to sell the cloth. Over time, the business owner intended to further develop his business. In terms of business promotion, it uses the WOMM (Word of Mouth Marketing) technique where the promotion is carried out directly by interacting with consumers with the aim that that person can immediately recognize the business being run and with interaction the greater the opportunitiesthe name of the business will spread. As said by the source, for customer or consumer income, he has to visit every jeans production place and then promote his business,

but as the business grows, there are some consumers who already recognize this business and no longer need to carry out this promotion.

4. CONCLUSION

The puring cloth business in terms of the marketing aspect uses the WOMM (Word of Mouth Marketing) technique where the promotion is carried out directly interacting with consumers with the aim that the person can immediately recognize the business being run and with interaction the greater the chance that the business name will spread . If viewed from the production aspect, this business uses production equipment that is easily available and affordable.

Analysis of the feasibility study of the puring cloth business can be said to be feasible, this can be seen from the production and marketing aspects, as well as where the business has experienced an increase in income from the start of opening the business to the present.

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SÜRDÜRÜLEBİLİR TARIMDA YENİLİKÇİ BİR YAKLAŞIM OLARAK NANOMATERYALLERİN SEBZE TOHUM UYGULAMALARINDA KULLANIMI

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Özet
Nanoteknoloji uygulamaları gelişen teknoloji ile birçok alanda yaygın olarak kullanılmaya başlamıştır. Son zamanlarda ise artan çevre kirliliği, iklim değişikliği gibi yetiştiricilik için stres faktörü olarak görülen uygulamalar ile daha etkin bir şekilde mücadele etme arayışı ile nanoteknoloji tarımsal üretimdeki çalışmalarda da yer bulmaya başlamıştır. Nanoteknolojinin ilk tarımsal üretimde kullanımı Amerika ulusal planlama atölyesi tarafından nanomateryallerin tarımda özellikle pestisit kalıntıları ile mücadele ve gıda ambalajlama endüstrisi için kalıntıların hızlı tespitinde kullanılabilecek bir materyal olduğunu önermesi ile gerçekleşmiştir. Daha sonraki çalışmalarda ise bunu pestisit formülasyonlarının geliştirilmesi, pestisit kalıntı analizlerinin araştırılması, gübre ve bitki düzenleyicilerindeki kullanımları takip etmiştir. Uluslararası Temel ve Uygulamalı Kimya Birliği (IUPAC) gelecek yıllarda insanların etkileneceği 10 kimyasal teknolojiyi yayınladığı listede nanopestisitler çevre ve insan sağlığına verebileceği zarar potansiyelinin düşük olması nedeni ile ilk sırayı almıştır. Penetrasyonu arttırması, kapsama alanının genişliği ve aktif bileşenlerin kullanım oranını arttırması gibi özellikleri yönü ile tarımsal üretimde nanoteknolojik materyaller ile hazırlanan tüm kimyasal ilaçlar ve gübrelerin verimini arttırmak, çevre kirliliğini azaltmak ve tarımsal üretimde sürdürülebilirliğin artması, gıda güvenliğinin iyileştirilmesine katkı sağlamak gibi pozitif yönleri ile tarımsal üretimde büyük bir paya sahip olacağı öngörülmektedir. Nanomateryallerin bitkisel üretimde yaprak, kök ve tohumdan uygulandığında farklı etkilerinin olduğu yapılan çalışmalar ile ortaya koyulmuştur. Bu farklı etkilerin temelinde nanomateryallerin parçacık boyutu, parçacıkların ağırlıkları ve özel yüzey gerilimine sahip oldukları için daha fazla parçacık bulunmasından kaynaklandığı ifade edilmektedir. Bu derleme ile tarımsal üretimde güncel bir yaklaşım olarak kullanılan nanoteknoloji uygulamalarını tarımsal üretimde ve özellikle sebze yetiştiriciliği alanında ne derece etkili olduğu, son çalışmaların hangi tarımsal uygulamalarda yoğunlaştığı hakkında önceki çalışmalar ışığında bir değerlendirme yapılmıştır.
Anahtar Kelimeler: Nanoteknoloji, Nanogübre, Nanopestisit, Nanopriming.

THE USE OF NANOMATERIALS IN VEGETABLE SEED TREATMENTS AS AN INNOVATIVE APPROACH IN SUSTAINABLE AGRICULTURE

Abstract
Nanotechnology applications have begun to be widely used in many areas with developing technology. Recently, nanotechnology has begun to find a place in agricultural production studies in the search for a more effective fight against practices that are seen as stress factors for cultivation, such as increasing environmental pollution and climate change. The first use of nanotechnology in agricultural production was made by the American National Planning Workshop, which suggested that nanomaterials were a material that could be used in agriculture, especially in the fight against pesticide residues and in the rapid detection of residues for the food packaging industry. In later studies, this was followed by the development of pesticide formulations, investigation of pesticide residue analysis, and their use in fertilizers and plant regulators. In the list published by the International Union of Pure and Applied Chemistry (IUPAC) of 10 chemical technologies that will affect people in the coming years, nanopesticides took the first place due to their low potential for harm to the environment and human health. It has positive aspects such as increasing the penetration, width of the coverage area and increasing the usage rate of active ingredients, increasing the efficiency of all chemical pesticides and fertilizers prepared with nanotechnological materials in agricultural production, reducing environmental pollution, increasing sustainability in agricultural production and contributing to the improvement of food safety. It is anticipated that it will have a large share. Studies have shown that nanomaterials have different effects when applied to leaves, roots and seeds in plant production. It is stated that the basis of these different effects is due to the particle size of nanomaterials, the weight of the particles and the presence of more particles because they have a special surface tension. With this review, an evaluation has been made in the light of previous studies about how effective nanotechnology applications, which are used as a current approach in agricultural production, are in agricultural production, especially in the field of vegetable cultivation, and on which agricultural applications recent studies have concentrated.
Keywords: Nanotechnology, Nanofertilizer, Nanopesticide, Nanopriming.

GİRİŞ

Artarak devam eden nüfus yoğunluğu, tarımsal üretim alanlarının kirleticilere maruz kalması, düşen verim, iklim değişikliği ve artan tüketim ihtiyacı günümüzün ve önümüzdeki yüzyılın tarımsal üretim sürecinin en büyük problemlerinin başında geleceği düşünülmektedir. Üretim sürecindeki bu problemler ile başa çıkmak ancak yeni gelişmeler ve teknolojinin tarımsal üretim alanına entegrasyonu ile mümkün kılınacaktır. Teknolojinin bu çağında son zamanların en yeni tekniklerinden biri olarak görülen nanoteknoloji, bilim ve teknoloji dünyasında ilgiyle çalışmaların devam ettiği bir alan olarak görülmektedir. Teknolojinin yeni bir getirisi olan nanoteknoloji uygulamaları; metrik sistemin ötesinde milyarda bir birim olarak nitelendirilen ve genellikle boyutları 1-500 nanometre aralığında atom ve molekül seviyesinin üzerinde çalışılan ve geliştirilen yapılar olarak görülmektedir. Bu yöntemler ile elde edilen materyallerin ise daha kaliteli, daha uzun ömürlü, daha ucuz, daha hafif ve daha küçük boyutlarda yapılar olduğu tespit edilmiştir (Ateş, 2015; Şahin ve ark., 2021).

Nanomateryallerin tarımsal üretim alanında kullanımı ise pek çok alana yayılmış durumdadır. Zirai kimyasal girdilerin minimize edilmesi için; nanogübreler (Chen ve ark., 2020) ve nanopestisitler, verim ve kalitenin artışı için; nanopriming (Özmen ve ark., 2022a, b), nanoferomonlar (Seo ve ark., 2016) ve nanogübreler (An ve ark., 2022), hastalık ve zararlılar ile mücadele için; nanopestisit (Zheng ve ark., 2020) ve nanoherbisitlerin kullanımı üzerindeki çalışmalar artarak devam etmektedir.

Nanopartiküllerin son zamanlarda bu denli önem kazanmasının nedeni azalan yüzey alanı ve düşük parçacık boyutu ile uygulanan yüzeyin uygulama materyalini kolayca absorbe etmesini sağlaması, düşük dozlarda kullanımı ile maliyeti azaltılması, çevresel kirleticilerden uzak olması, nanapartiküllerin bitkilerde alınması, taşınması ve birikmesini kolaylaştırması ve kimyasal kullanımını sınırlandırması gibi yönleri ile araştırıcıların dikkatini çeken bir uygulama alanı olarak görülmektedir. Ayrıca uygulamalar esnasında uygulanan ajanın içeriği, üretimin nasıl gerçekleştirildiği (yeşil sentez veya kimyasallar ile üretim gibi), boyutu ve uygulama dozunun etkinlik derecesini değiştirdiği, yüksek dozların bazı çalışmalarda baskılayıcı bir özellik gösterdiği gözlemlenmiştir (Wlodarczyk ve Smolinska, 2022; Sanchez-Perez ve ark., 2023).

Bu derleme ile tarımsal üretimde nanoteknolojinin yeri, sürdürülebilir tarım için öneminin belirlenmesi ve sebze tohumu uygulamalarında güncel bir yaklaşım olarak görülen

nanopriming uygulamalarında kullanılan nanomateryallerin tanımlanması, etki mekanizması ve eksik yönlerinin tespit edilmesi hedeflenmiştir.

SEBZE TOHUMLARINDA PRİMİNG UYGULAMARI

Çimlenme oranı ve çimlenme zamanı tohumların kalitesi ve canlılığı hakkında önemli belirteçlerdendir. Tohumların bu özellikleri birçok iç (tohum özellikleri) ve dış (sıcaklık, nem vb.) faktörlerden etkilenmektedir (Bewley ve Black 1994). Tohumlarda çimlenme ve çıkış oranını arttırmak, çimlenme ve çıkış zamanını kısaltmak, homojen ve bir örnek çıkış sağlamak, bazı tohumlarda bulunan dormansiyi kırmak ve fide kalitesini arttırmak amacıyla tohumlarda birçok farklı ekim öncesi işlem uygulanmaktadır. Bu uygulamalardan en çok tercih edileni ise priming uygulamalarıdır. Tohum çimlenmesi için gerekli olan enzimatik aktivasyonun sağlanması ve depo maddelerin parçalanarak en etkin şekilde kullanılması priming uygulamaları ile desteklenmektedir (Demir ve ark., 1994).

Priming uygulamasının ardında ön çimlenme aşamasında tohumda metabolik işlevlerin ilerlemesine olanak tanınırken, kökçük çıkışının istenmediği kontrollü bir su alımı süreci temeline dayanmaktadır (Heydecker ve ark., 1977). Su alımı ile başlayan bu süreçte farklı nem seviyelerinde farklı fizyolojik aktiviteler meydana gelmektedir. Priming sonrası tohumlar direkt ekime alınabildiği gibi, depolama süresi kısa tohumlar için kurutulup depoya alınabilmektedir. Depolama sonrası tohumlarda yavaş ve düzensiz çimlenmeler görülürken priming sonrası yapılan depolamalarda maksimum depo ömrüne ulaşılırken aynı zaman tohum çimlenmesini arttırdığı ve daha homojen bir çıkış sağladığı bilinmektedir. Birçok farklı türde, farklı priming uygulamasının yapılması ve sonuçlarının değerlendirilmesi ile ilgili çok sayıda çalışma olduğu bilinmektedir. Tarımda sürdürülebilirliğin sağlanması için ise organik priming ve nanopriming uygulamaları son zamanların öne çıkan ekim öncesi tohum uygulamalarının başında gelmektedir.

Sebze tohumlarında priming uygulamaları ile ekim öncesi tohumlarda karşılaşılan pek çok probleme çözüm arayışına girilmiştir. Bu kapsamda bazı çalışmalarda halopriming uygulaması KNO_3 ve PEG kullanılarak gerçekleştirilirken (Mavi ve ark., 2010), hormon priming uygulamalarıda GA_3 (Mavi ve ark., 2006) yaygın olarak kullanılmaktadır. Organik priming uygulamalarında ise alelopatik etkiye sahip bitkisel ekstraktlar tercih edilebilmektedir (Mavi, 2013). Nanopriming uygulamalarında ise kimyasal ve yeşil sentez ile elde edilen katkılı veya

katkısız pek çok nanopriming ajanı üzerinde çalışmalar yürütülmektedir (Özmen ve ark., 2022a, b).

NANOTEKNOLOJİ ve SÜRDÜRÜLEBİLİR TARIM

Tarımsal üretim insanlığın hayatta kalması için gerekli besin maddelerinin üretimi için gereklidir. Sürdürülebilir tarım faaliyetleri ise çevreyi korurken verimliliği sürdürmek için makul bir çözüm yöntemi olarak günümüzde tarımsal üretimde etkin bir yöntem haline gelmiştir. Verimliliği ve topluma yararlılığı süresiz olarak koruyan bir sistem olarak görülmektedir. Nanoteknoloji uygulamaları ise sürdürülebilir tarımın temel yapısına uyacak şekilde, özellikle çevreye duyarlı, kaynak açısından verimli teknolojilerin üretilmesine katkıda bulunarak akıllıca kullanılabilecek olan yeni bir yaklaşım olarak karşımıza çıkmaktadır. Nanoteknolojinin sürdürülebilir tarım sistemlerinde uygulama alanı, kimyasalların hedeflenen dağıtımını, atık yönetimini, toprağın hidrofilikliğini arttırmayı, nano boyutta besin alımıyla verimliliğin arttırılmasını ve daha birçok yeni yönlü uygulamayı içermektedir. Tarımsal üretimde gıda güvenilirliği bakımından, bu tarz yenilikçi yaklaşımlar sadece üretimde verimliliğin artmasını değil üretim sisteminin yönetilebilirliği sayesinde tüm üretim sisteminin bütünsel olarak sürdürülebilir kılınmasını sağlamaktadır.

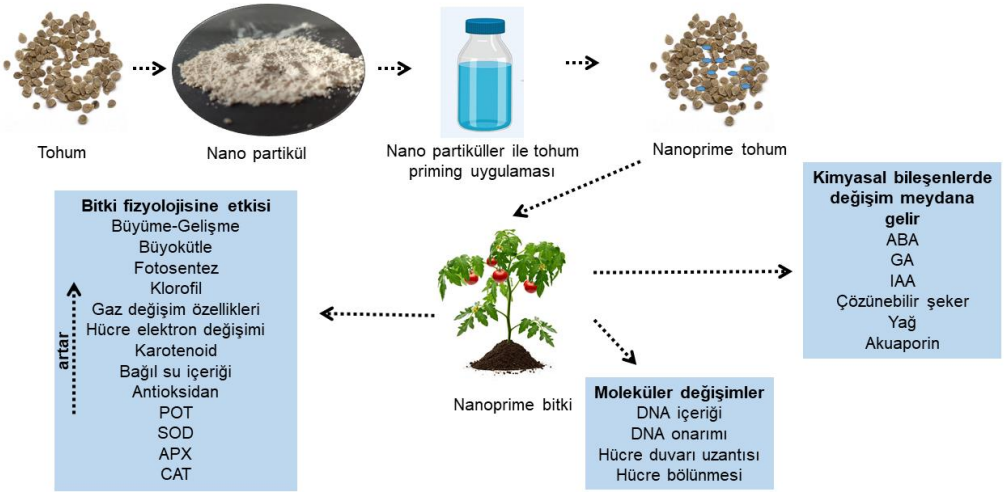
Nanoteknoloji uygulamalarının tarımsal üretimde kullanılması toprak ve su kalitesinin iyileştirilmesi, ürünlere uygulanan gübre ve pestisit miktarının azaltılması, artan iklim değişikliklerine karşı bitkide direnç oluşturması gibi pozitif yönleri ile çevre dostu ve devamlılığı sağlanabilir bir uygulama olmasının yanı sıra sürdürülebilir tarım uygulamaları için bir çözüm olarak görülmektedir. Nanoteknoloji sayesinde üretilen gübreler kimyasal gübrelerin neden olduğu çevresel etkenlerden ari olduğu yapılan çalışmalar ile ortaya konmuştur. Ayrıca kimyasal gübrelerin kullanımının bitki tarafından tek bir seferde alınamadığı için zamanla su kütlelerine ve yeraltı sularına sızması gibi çeşitli dezavantajları mevcuttur. Bitki tarafından hızla alınamadığı için gübreleme işlemi tekrarlamalı bir şekilde yapılmakta ve bu uygulamalar da toprak verimliliğini, fizikokimyasal özelliklerini olumsuz yönde etkilemektedir. Yapılan çalışmalar sonucunda uygulanan azotlu gübrelerin yarısının tarım alanlarından suya ve havaya karıştığı belirlenmiştir. Nanogübreler, boyutları küçük ve etki ettiği yüzey alanın ise daha büyük olması, bu durumun da besin maddelerinin yavaş ve sürekli salınımına yol açması sebebiyle uygulama miktarını azaltmaktadır. İklim değişikliği açısından ise nanogübreler bitki beslenmesini ve stres toleransını iyileştirdiği ve bu nedenle sürdürülebilirliği teşvik etme

açısından değerli olduğu görülmektedir. Nanogübreler ile yapılan uygulamalar bitkiler tarafından verimli bir şekilde kullanılmakta ve toprakta, havada veya yer altı suyunda çok az kalıntı bırakmaktadır (Arora ve ark., 2022).

Tarımsal üretimde bir diğer kullanım alanı olarak görülen nanopestisit uygulamaları ise genel olarak iki grupta sınıflandırılmaktadır. İlk grup zararlıları öldürme potansiyeline sahip nanomateryallerden oluşmaktadır. Bu grupta yapılan uygulamalarda kullanılan yapılar inorganik yapıdadır ve pestisit etkisine sahip olduğu görülmektedir. Bu uygulamaların nanosilika, nanotitanyum dioksit, nanoçinko, nanogümüş, nanobakır, nanoalüminyum gibi uygulamalardan oluştuğu görülmektedir (Kah ve Hofmann, 2014). Silika veya alüminyumdan üretilen nanomateryallere kıyasla gümüş ve bakırdan üretilen nanomateryallerin antimikrobiyal özellikleri sayesinde etkinliklerinin daha yüksek olduğu yapılan çalışmalarla belirlenmiştir (Debnath ve ark., 2011; Kim ve ark., 2012; Mondal ve Mani, 2012) .

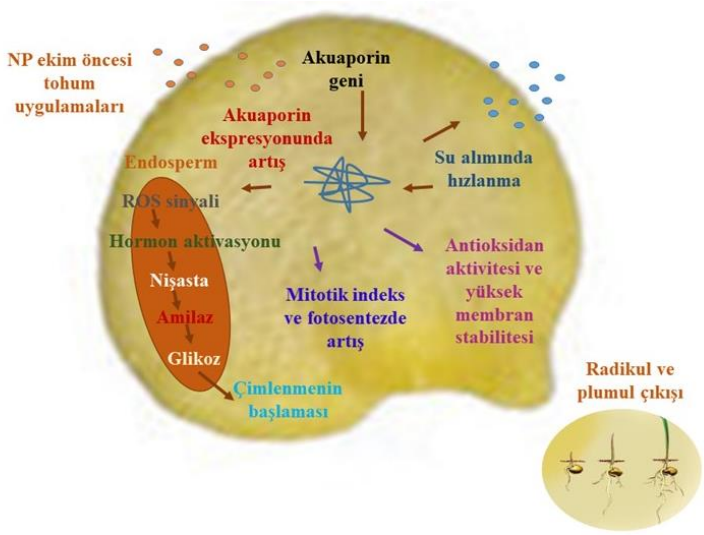
TOHUM UYGULAMALARINA YENİ BİR YAKLAŞIM: NANOPRİMİNG

Tohum çimlenmesi ve fide gelişimi bitkisel üretimde en önemli basamaklardır. Tohum ekiminin ardından hızlı ve bir örnek çimlenme fide gelişimi ve verim üzerinde etkili faktörlerdendir. Tohumlara yapılan priming uygulamaları ile stres faktörlerinin çimlenme ve erken fide döneminde oluşturduğu etkiler azalmaktadır. Tohumların biyokimyasal aktivitelerinde bir artış meydana gelmektedir (Şekil 1).



Şekil 1. Nanopriming uygulaması ve uygulama sonrası tohum ve bitkide meydana gelen değişimlerin şematize olarak gösterimi (Orijinal, 2023)

Priming uygulamalarına yeni bir yaklaşım olan nanopriming uygulamalarında gümüş, çinko, altın gibi içerikler ile elde edilen nanopartiküller kullanılmaktadır. Nanopartiküller priming uygulamasında kullanıldığında tohumda bulunan nişastayı parçalayarak şeker içeriğini arttırmaktadır. Tohumlarda bulunan ve çimlenme mekanizmasını teşvik ederek su alımını hızlandıran aquaporin genini düzenler ve reaktif oksijen türlerinin (ROS) üretimini azaltarak stres tolerans düzeyini arttırmaktadır. Tüm bu özellikleri ile fide büyümesini teşvik ederek fide kalitesini arttırmaya yardımcı olmaktadır. Ayrıca tohumların su imbibasyonunu arttırarak tohumlarda bulunan antioksidan enzimlerin aktivasyonunu sağlamaktadırlar (Mahakham ve ark., 2017)(Şekil 1, 2). Birçok farklı sebze türünde farklı doz ve boyutta elde edilen katkılı veya katkısız nanomateryallerin tohum çimlenmesi, biyokimyasal aktivitesi ve fide gelişimine pozitif etkilerinin olduğu yapılan çalışmalar ile açık bir şekilde saptanmıştır (Çizelge 1). Nano TiO_2'nin maydonoz tohumlarına uygulanması sonucu çimlenme oranı, kök ve gövde uzunluğu, klorofil a, b ve toplam klorofil içeriğindeki artış Dehkourdi ve Mosavi (2013) tarafından bildirilmiştir. Bir başka çalışmada ise nano SiO_2 uygulamalarının domates tohumlarının tohum çimlenme oranını arttırdığı, çimlenme süresini kısalttığı, fide canlılık indeksi değerini arttırdığı ifade edilmiştir (Siddiqui ve ark., 2014). Uygulamaların tohum canlılığı ve fide kalitesinde meydana getirdiği değişimlerin incelendiği çalışmaların yanı sıra özellikle stres uygulamalarında gösterdikleri etkinin belirlenmesi için yapılan çalışmalarda yaşanılan iklim değişikliği ve toprak-hava kirliliği gibi birçok dezavantajlı duruma karşı yeni bir mücadele olarak düşünülmektedir. Uygulamaların domateste kuraklık stresi üzerine etkinliği Akhoundnejad ve ark. (2021) tarafından belirlenirken, Semida ve ark. (2021) uygulamaların patlıcanda kuraklık stresinde pozitif sonuçlar verdiğini bildirmişlerdir. Değer ve Çevik (2021) ise yetiştirme ortamında artan tuzluluğa karşı nano TiO_2 uygulamalarının stres koşullarında fide gelişimini desteklediğini ifade etmişlerdir. Çimlenme ve gelişim aşamasında bitkiler karşılaştıkları stresi tolere ettiğinde büyüme döneminde gelişimine devam edebilmektedir. Stres koşullarında priming uygulamaları, uygulanmamış tohumlara kıyasla tohum çimlenmesini ve büyümesini teşvik ettiği gözlemlenmiştir. Nanopriming uygulamaları esnasında akuaporin genin ekspresyanunda bir artış meydana gelmektedir. Bu durumda su alım aktivitesi hızlanırken tohumların çimlenebilmesi için ROS miktarını azaltırken hormonların aktivasyonunu teşvik ettiği ve nişastanın parçalanmasının daha hızlı gerçekleştiği bilinmektedir (Şekil 2).



Şekil 2. Nanopriming uygulaması ve uygulama sonrası su alımı ile beraber tohumda meydana gelen reaksiyonların şematize olarak gösterimi (Orijinal, 2023).

Çizelge 1. Farklı sebze türlerinde yapılan nanopriming uygulamaları ve uygulama sonrası etkileri

Uygulama materyali	**Nanomateryal boyutu**	**Uygulama dozu**	**Uygulama yapılan sebze türü**	**Uygulama yöntemi**	**Etki mekanizması**	**Kaynak**
Nanoplant ultra (Ticari)	6.5-105 nm	5 mL g^{-1} tohum	Bezelye (*Pisum sativum* L.)	Nanopriming	Çimlenme oranında artış, kök ve sürgün büyümesini teşvik, kök ve sürgün yaş ve kuru ağırlığında artış, yüksek vigor index değeri	Tamindzic ve ark., (2023)
Demir Oksit	13.5 nm	25, 50, 75 ve 100 ppm	Bezelye (*Pisum sativum* L.)	Nanopriming	Kuraklık stresine tolerans, kök büyümesinde artış, SOD ve CAT enzimlerinde artış, oksidatif zararlanmaya direnç	Mazhar ve ark., (2023)
Selenyum kitosan	60-200 nm	0, 10 ve 20 mg L^{-1}	Kudret narı (*Momordica charantia* L.)	Nanopriming	Tuz stresine tolerans, büyümede artış, antioksidan enzim aktivitesinde artış, fotosentez parametrelerinde artış	Sheikhalipour ve ark., (2023)
Magnezyum katkılı demir	-	0, 2, 5, 10 ve 20 mg L^{-1}	Habanero tip biber (*Capsicum chinense*)	Nanopriming	Çimlenme hızında artış, kök bölgesinde mineral madde artışı, fotosentez hızı ve besin alımında artış	Coria-Tellez ve ark., (2023)
Kalsiyum fosfat katkılı çinko oksit	97-202 nm	0.002, 0.004 ve 0.01 g L^{-1}	Kavun (*Cucumis melo*)	Nanopriming	Çıkış oranında artış, çıkış süresinde azalma, fide kalitesinde artış	Özmen ve ark., (2022b)
TNE ve AgNP	100-200 nm	1:5 g mL^{-1}	Karpuz (*Citrullus lanatus*)	Nanopriming	Su ve besin alımındaki artışa bağlı olarak klorofil içeriğinde artış, toplam fenol ve radikal süpürme aktivitesinde artış	Acharya ve ark., (2020)
Gümüş ve Altın	100-1000 nm	-	Soğan (*Allium cepa* L.)	Nanopriming	Kök ve sürgün uzunluğunda artış, verimde artış, toplam fenol içeriğinde artış	Acharya ve ark. (2017)

YAYGIN OLARAK KULLANILAN NANOPRİMİNG AJANLARI VE ETKİ MEKANİZMALARI

Nanopriming uygulamalarında daha önce etkinliği kanıtlanan ve yapılan çalışmalarda gümüş, altın, bakır ve çinko gibi kimyasal elementler katkılı veya katkısız şekilde nano boyutta üretimleri gerçekleştirilerek çalışmalarda kullanılmaya başlamıştır (Çizelge 1). Çalışmalarda yoğun olarak kullanılan ve etkinlikleri belirlenen nanopriming ajanları ise aşağıda sınıflandırılmıştır.

Gümüş nanomateryaller: Antimikrobiyal özelliği ile öne çıkan gümüş birçok avantaja sahiptir. Bakterilere karşı direncinin neredeyse hiç olmaması, geniş etki alanına sahip bir antibiyotik olarak görülmesi ve iz miktarlarda kullanıldığında toksik etkilere neden olmaması gibi yönleri ile tercih edilmektedir (Rai ve ark., 2009).

Altın nanomateryaller: Altının nanomateryal olarak kullanımı 16. yüzyıla kadar dayanmaktadır. Nanomateryal üretiminde sıklıkla tercih edilmesinin nedeni ise en kararlı yapıya sahip metal olarak kabul edilmesidir. Birçok çalışmada bitki gelişimi üzerindeki etkinliği farklı nanoboyutlarda test edilmiş ve pozitif sonuçlar alınmıştır (Judy ve ark., 2012).

Bakır nanomateryaller: Bakır fotosentez ve bitki gelişimi için gerekli temel elementlerden biri olarak ifade edilmektedir. Protein ve hidrokarbon yapılarının denatürasyonu yanı sıra fotosentezde de rol oynar. Özellikle askorbik asit ve polifenol oksidaz enzimlerinin oksitlenmesinde kullanılmaktadır. Bitkinin gelişmesi esnasında metabolitik fonksiyonların yürütülmesi ve bitki büyümesinde gereklidir. Yararlı etkilerinin yanı sıra yüksek doz uygulamalarının toksik etki yarattığı da görülmektedir. Daha önceki çalışmalarda düşük dozlarda uygulanan nano yapılı bakır uygulamaları bitki gelişimi ve büyümesini, tohum çimlenmesi ve çimlenme mekanizmasının teşvik edilerek çimlenme süresini kısalttığı bildirilmiştir (Passam ve ark., 2007; Lee ve ark., 2008; Singh ve ark., 2017).

Çinko nanomateryaller: ZnO, Fe, Zn, TiO_2 ve Ag gibi metal bazlı nanomateryallerin son zamanlarda tarımsal üretimde kullanımında bir artış vardır. Özellikle stres koşulları altında ZnO nanomateryallerin bitki gelişimini teşvik ettiği belirlenmiştir (Song ve ark., 2006). Çinko bitkilerin gelişimi ve büyümesi için istenilen mikro besinlerden biridir. Gelişim sürecinde fotosentetik reaksiyonların gerçekleşmesinde önemli bir rol oynamaktadır. Ayrıca hücre bölünmesini kontrol ederek bazı biyolojik süreçleri desteklemektedir. ZnO nanomateryallerin

bitkisel üretimde kullanılması enzim aktivitesini önemli ölçüde iyileştirerek stres faktörlerine dayanım konusunda önemli bir etken olarak görülmektedir (Ahmad ve ark., 2020).

Demir nanomateryaller: Demir protein içeriği yüksek olan bitkilerin yetiştiriciliğinde gerekli olan elementlerdendir. Demir enzim aktivasyonu ve RNA sentezinde yardımcı olmanın yanı sıra fotosentetik reaksiyonların gerçekleşmesinde önemli rol oynamaktadır. Bu olumlu etkilerin yanı sıra bitki gelişimi ve tohum çimlenme mekanizmasının aktivasyonunda etkilidir (Bayat ve ark., 2021).

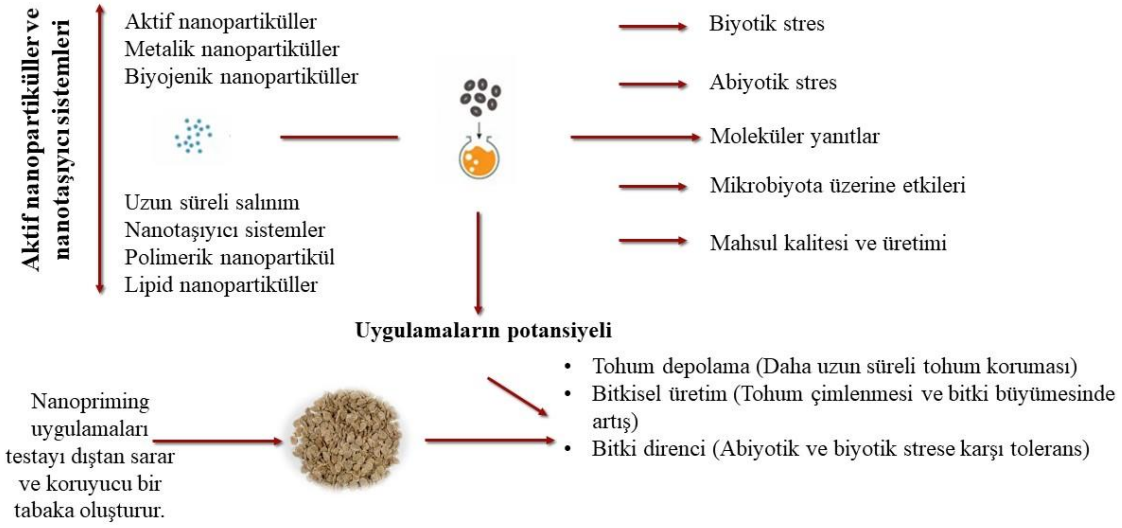
Magnezyumoksit nanomateryaller: Nanomateryal olarak kullanılan Magnezyumoksit (MgO), yüksek iyonik karakteri, kristal yapısı ve farklı yüzey yapısı nedeni ile tercih edilmektedir (Singh ve ark., 2020).

Silikon dioksit nanomateryaller: Absorbsiyon sonrasında hücre duvarında bakteri, mantar ve nematod gelişimini engelleyen, bitki su kaybını azaltan, hastalık direncini arttıran, yüksek sıcaklık ve nem gibi stres faktörlerinde bitki büyümesini iyileştirici etkisi olmaktadır. Yapılan araştırmalar sonucunda silikon eksikliği olan topraklara silikon içerikli gübre uygulamasının yapılması bitki büyümesini, hastalığa direnci, soğuk ve ağır metallere karşı direnci arttırdığı gözlemlenmiştir. Silikon gübreleme ile aynı zamanda potasyum emilimi teşvik edilmekte sodyum emilimi kısıtlanmakta, nitrojen ve kükürt birikimi desteklenmekte ve bitki beslenmesi iyileştirilmektedir (Guo, 2000; Wang, 2002; Liu, 2003).

Titanyum dioksit (TiO_2) nanomateryaller: Nano boyutta TiO_2 ışık ile tepkimeye girerek süperoksit iyon radikali ve hidroksit üretebilmektedir. Organik maddelerin daha hızlı parçalanması ve aktif kullanımı yanı sıra antimikrobiyal etkinliğini bu aktif oksijenler sayesinde kazanmaktadır. Nano boyutlu TiO_2 kullanımı ile artan direnç sayesinde stres faktörlerine dayanım kazanılırken, bitki büyüme ve gelişimi desteklenmektedir. Ayrıca çimlenmeyi teşvik etmesi, son ürün verimini arttırması ve bitkisel özelliklerin iyileştirilmesi ve kalite artışı gibi nedenler ile kullanımı da son yıllarda artmıştır (Yang, 2007).

Yukarıda sınıflandırılan nanopriming uygulamalarında yaygın olarak kullanılan elementler ve anlatılan etkilerinin yanı sıra nanomateryallerin bitkisel üretimde yaprak, kök ve tohumdan uygulandığında farklı etkilerinin olduğu yapılan çalışmalar ile ortaya koyulmuştur. Bu farklı etkilerin temelinde nanomateryallerin parçacık boyutu, parçacıkların ağırlıkları ve özel yüzey gerilimine sahip oldukları için daha fazla parçacık bulunmasından kaynaklandığı belirlenmiştir. Dolayısıyla bu özellikleri ile nanomateryaller bitkinin uygulamalarda materyal ile daha fazla

etkileşimde bulunmasına neden olmaktadır. Daha küçük yapı ve artan etkileşim ile kullanılan materyalle bağlı olarak besin maddelerinin tohum kabuğundan emiliminde de bir artış meydana gelmektedir (Şekil 3). Nanomateryallerin tohum uygulamalarında kullanılması özellikle reaktif oksijen türlerinin (ROS) birikimini arttırması ve ROS sinyalleri ile giberellik asit sentezinin aktivasyonu ile çimlenme mekanizmasının uyarılmasında etkili olduğu görülmüştür (Guha ve ark., 2018). Böylelikle ROS hücre duvarlarında bulunan hidrolik bağları kırarak absisik asit ve giberellik asit hormonlarını düzenleyerek tohumlarda dormansisinin kırılmasını ve çimlenme mekanizmasını teşvik etmektedir (Bailly, 2019).



Şekil 3. Nanopriming uygulamaları sonrasında uygulama materyali ve uygulama potansiyelinin etki mekanizmasının şematize edilmesi (Orijinal, 2023).

SONUÇ

Konu ile ilgili kaynaklar bir bütün olarak incelendiğinde nanomateryallerin bitkisel üretimde kullanılması güncel bir yaklaşım olmasının yanı sıra sürdürülebilirliği, kolay elde edilebilir olması, uygulamalarda düşük dozlarda kullanılması açısından ekonomik olması, kimyasal girdilere kıyasla çevre kirliliğine neden olan tüm kirlilik unsularından ari olması gibi birçok avantajlı yönü ile tercih edilmektedir. Ancak çalışmalarda farklı doz uygulamalarının sonucunda doz kontrolünün önemi ortaya konulmuştur. Düşük boyutlu yapıları nedeni ile bitkisel materyal tarafından tohum kabuğundan kolay geçmesi ile su alım hızını arttırması ve çimlenme mekanizmasının teşvik edilmesi, çimlenme oranı ve çıkış oranını arttırması, fide

kalitesini iyileştirmesi ve strese maruz kalan bitkilerin tolerans düzeyini arttırması gibi yönleri ile priming uygulamalarında yenilikçi bir yaklaşım olarak tercih edilmelerini sağlamaktadır. Ayrıca nanopriming uygulamalarında kullanımı esnasında yüksek dozların teşvik edici değil engelleyici yönünü yapılan çalışmalar ortaya koymuştur. Çalışmalarda kullanılan tüm nanomateryaller için etkin dozların belirlendiği bir çalışmanın yapılmasının önemi bu noktada ortaya çıkmaktadır. Dünyada yaşanan iklim değişiklikleri, toprakta artan tuzluluk, ağır metal birikimi, yüksek ve düşük sıcaklık stresi gibi faktörler göz önüne alındığında ise optimum koşullarda gerçekleştirilen çalışmalara kıyasla stres koşullarında nanomateryallerin ve nanopriming uygulamalarının etki mekanizmasının belirlenmesine yönelik araştırmaların artması, etki mekanizmasının tam olarak anlaşılabilmesi için biyokimyasal ölçümlerin detaylı olarak yapıldığı çalışmalara önem verilmesi gerektiği görülmektedir. Nanomateryallerin farklı nanopriming ajanları kullanılarak uygulamalarının farklı türlerde, farklı stres koşullarına (sıcaklık stresi, tuzluluk vb.) etkisinin ve tohumların depolanabilirliği üzerine etkinliğinin belirlenebilmesi için yeni çalışmaların yapılması gerekmektedir. Stres faktörleri ve düşük canlılık gibi parametreler düşünüldüğünde nanomateryallerin uygulanabilirliğinin arttığı ve bu gibi çalışmalarda daha iyi sonuç verdiği düşünüldüğünde özellikle özel sektör firmaları tarafından uygulanabilirliğinin yüksek olduğu düşünülmektedir. Önümüzdeki çalışmalarda farklı nanomateryallerin priming uygulamalarında kullanımının tarım sektöründeki tohum uygulamalarında kullanım alanlarının giderek artacağı ve yetiştiricilik uygulamalarında yeni bir bakış açısı kazandıracağı ön görülmektedir.

TEŞEKKÜR

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ECONOMIC THOUGHT OF CLASSICAL MUSLIM SCIENTISTS (ZAID BIN ALI, ABU HANIFAH, ABU YUSUF, ABU UBAID)

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Abstract
This research aims to analyze the economic ideas of classical Muslim scientists, some of which may still be used today. History is a science that frees itself to be interpreted by anyone who researches it. Through historical writing, one researcher and another can differ in interpreting various historical moments that have occurred. So it is not uncommon for us to come across various historical articles that do not seem to completely display the historical facts that occurred in the field. One thing we need to pay attention to is the advancement of Islamic civilization through the mastery of knowledge which today seems to be obscured. The results of this research show that the ideas of classical scientists are still used today, although some have changed with the times, such as Zaid Bin Ali's thoughts, selling on credit at a higher price than cash, Zayd bin Ali allows the sale of things. the. It's just that Zayd bin Ali does not allow the price for deferred payments to be higher than cash payments, such as additional payments when postponing loan repayment. According to Abu Hanifah's thoughts, there are several things, namely salam contracts, honey zakat and hawalah contracts. Just like the thoughts of Abu Yusuf and Abu Ubaid, they are still used today in different versions according to the times. Even though classical economic thought during the time of the Prophets and Khulafaurrasyidin has developed with the times, it is still based on the basic principles of Islam using the Al-Quran, Hadith, Ijma or Qiyas.
Keywords: economics, history, classical scientists, development.

1. INTRODUCTION

After Rasulluah SAW died, Islamic economics has been practiced for more than 1000 years and then developed in various models that differ from time to time in each country or society. Islamic economics, which was developed by Muslim scholars and scholars known as classical Islamic economics figures, has from time to time experienced its triumphs and setbacks. Several prominent Muslim intellectual figures who have contributed to developing Islamic economics are such as Zaid Bin Ali, Abu Yusuf, Abu Hanifah, Abu Ubaid.

Zayd Bin Ali Zayd bin Ali was the initiator of selling on credit at a higher price than the cash price. Zayd bin Ali allowed the sale of this. It's just that Zayd bin Ali does not allow the price of deferred payments to be higher than cash payments, such as additional payments in postponing loan repayment, because additional deferrals are usury.

Imam Abu Hanifah was born in Kufa in 80H during the time of Caliph Abdul Malik bin Marwan. He was born with the name Nu'man bin Thabit bin Marzuban, of Persian descent. Abu Hanifah originally came from Kabul, the current capital of Afghanistan, but his grandfather Marzuban converted to Islam during the time of the caliph Umar ibn Khattab which finally made him move to Kuffah and settle there. Abu Hanifah has a very intelligent and wise personality, and Imam Abu Hanifah loves the Al-Qur'an so much that he often reads the Al-Qur'an and studies its contents followed by studying hadith and fiqh.

Abu Yusuf (113-182 H/731-798 AD) was a fukaha who was actually born during the Ummayyah era, but began working with recognized quality during the Abassiyah era. The full name of Abu Yusuf is Imam Abu Yusuf Ya'qub bin Ibrahim bin Habib al-anshari al-jalbi al-Kufi al-Baghdadi. He was called alanshari because his mother was a descendant of one of the companions of the Prophet Muhammad, Sa'ad Al-Anshari. He was born in the city of Kufa. In his childhood, Imam Abu Yusuf had a strong interest in science, especially in the science of hadith. Abu Yusuf gained various knowledge from many great scholars, such as Abu Muhammad Atho bin as-Saib Al-Kufi. His education started by studying hadith from several figures. He is also an expert in the field of fiqh, he studied from a teacher named Muhammad Ibnu Abdur Rohman bin Abi Laila who is better known as Ibn Abi Laila. For seventeen years

Abu Yusuf never stopped studying with Abu Hanifa, he was also known as one of the one of Abu Hanifa's leading disciples. The books that Abu Yusuf has written include :

a. the book al-Atsar

b. Ibni Abi Hanifa wa Laila's book of ikhtilaf

c. Buku ar-Radd ala al-Siyar Auza`i d. Buku al-Kharaj.

Abu Ubaid al-Qasim bin Salam bin Malang bin Zaid al-Harawi al-Azhabi alBaghdadi, is none other than the long name of a Muslim intellectual figure known by his short name Abu Ubaid. He comes from Byzantine descent, because his father was from the Maula group who were of Azad ethnicity. He was born in 157 AH in a city located in the northwest of Afghanistan, precisely in the city of Khurasan, an area called Hara. After fully absorbing knowledge in their homeland at the age of 20, the two Abus began their educational journey in cities such as Basyrah dome and Baghdad.

2. RESEARCH METHOD

About the classical economic thinking of Muslim scientists in relation to existing data sources, data collection methods, and data analysis. This research method was carried out based on literature study with various journal and book references as well as several updated articles. Library research is research carried out by collecting data and theoretical foundations by studying books, scientific works, results of previous research, related journals, related articles and sources related to research in accordance with the research being studied.

3. RESULTS DISCUSSION

3.1 Research results

From the explanation above, it can be concluded from the paper 'Economic Thought of Classical Muslim Scientists Zaid Bin Ali, Abu Hanifah, Abu Yusuf, Abu Ubaid', namely that the first Economic Thought of Zayd Bin Ali was the initiator of selling on credit at a higher price than the cash price. Abu Hanifah's thoughts agree with other scholars regarding the six conditions for greetings. The first condition is that the price of the goods must be known, the second is that Abu Yusuf was the first person to introduce the concept of taxation in his work entitled Al-Kharaj. This book was written to serve as a guide in regulating the baitul mal system and sources

of state income such as al-kharaj, al-'ushr, and al-jizyah. Likewise with how to distribute these assets and how to avoid manipulation. And finally, Abu Ubaid's thoughts are contained in the Book of Al Amwal, which is a masterpiece about economics created by Abu 'Ubaid which emphasizes several issues regarding taxation, law, as well as administrative law and international law. The Al-Amwal Book comprehensively discusses the Islamic public financial system, especially in the field of government administration. This book also contains the history of Islamic economics durin the first two centuries of the Hijriyah, and is a summary of the original Islamic traditions of the Prophet, his companions and followers regarding economic issues. Abu 'Ubaid, in the Book of Al-Amwal, quotes many economic views and treatments from previous imams and scholars.

3.2 Discussion

Zayd Bin Ali's Economic Thought Zayd bin Ali was the initiator of selling on credit at a higher price than the cash price. Zayd bin Ali allowed the sale of this. It's just that Zayd bin Ali does not allow the price for deferred payments to be higher than cash payments, such as additional payments in postponing loan repayment, because additional deferrals are usury. In principle, transactions of goods or services are halal if they are based on mutual consent and are permitted, as Allah SWT says in Surah AnNisa' Verse 29: "O you who believe, do not consume each other's wealth in a false way, except by means of trade between you, and do not kill yourselves, surely Allah is Most Merciful towards you.

During his time, Zayd bin Ali had begun to develop the process of buying and selling goods using a credit system or deferred payment transactions. At that time the higher price is determined by the seller, if the buyer postpones payment in installments then it is compensation to the seller, because the seller makes payments easier for the buyer. This transaction is valid and justified as long as the transaction is based on the principle of mutual consent between the two parties.

Imam Abu Hanifah is known as a madzhab leader in matters of fiqh. So there were no specific policies or ideas regarding economics offered by Abu Hanifah, but he expressed many opinions in the muamalat contracts from a fiqh perspective. Some of Abu Hanifah's economic thoughts are as follows:

Abu Hanifah's thoughts which will be discussed first are regarding greetings. Abu Hanifah agrees with other scholars regarding the six conditions for greetings. The first condition is that

the price of the goods must be known, whether in money or other valuables. Second, you must know the exact price. Third, handing over the price as trader's capital must be done at the contract ceremony. Fourth, the merchandise must be in the hands of the trader. Fifth, the value of merchandise can be estimated from its size, length, weight and characteristics. Sixth, determining the time of delivery of goods. Apart from these six conditions, there are several other conditions which are debated by all scholars, but Abu Hanifah requires these things. With the aim of protecting economic actors from losses from greeting contracts, Abu Hanifah requires these conditions.

Imam Abu Hanifah's economic thought which will be discussed next is zakat on honey. Abu Hanifah and his students said that zakat must also be paid from honey, as long as the beehive is not located on kharaj land. Likewise, their principle is that kharaj and 'ushr cannot coincide. Zakat on honey is also required for honey produced in barren land. Abu Hanifah's basis for requiring zakat on honey is a hadith narrated by Ibn Majjah. From Amr bin Syu'aib from his father, from his grandfather, from Abdullah bin Amr, from the Prophet SAW that he had collected one tenth of zakat from honey.

Abu Hanifah has the idea that zakat must be issued to anyone who has honey with a miqdar equal to the miqdar of zakat on agricultural products, namely one tenth.

a. Hawalah contract

The basis of this contract is hadith and ijma' which have been agreed upon by scholars including Abu Hanifah. Hadith narrated by muttafaqun alaih. From Abu Hurairah RA said: Rasulullah SAW said: delaying payment of a debt for a rich person is an injustice and if it is transferred from you to a rich person, then he must accept the handover. 87 Rukun hawalah according to Abu Hanifah is the consent of the muhil: "I transfer debt to so and so." As well as qabul from muhal and muhal alaih with the words: "I accept, I am pleased with it or so on. 88 The reason why Abu Hanifah requires the blessing of muhal and muhal alaih is because hawalah is a muamalah with muhal alaih by transferring obligations to him.

Abu Yusuf was the first person to introduce the concept of taxation in his work entitled Al-Kharaj. This book was written to serve as a guide in regulating the baitul mal system and sources of state income such as al-kharaj, al-'ushr, and al-jizyah. Likewise with how to distribute these assets and how to avoid manipulation, injustice, and how to realize these assets can be used for the common good. In the book AlKharaj, there is a discussion of public economics, which

focuses on taxation and the role of the state in development. Abu Yusuf highly upholds the values of justice, fairness and conformity to the ability to pay taxes, as well as the importance of accountability in managing state finances. In this case, the state has an important role in providing the public facilities needed by the people.

The book Al-Kharaj is dominated by Abu Yusuf's thoughts on economics. This book is based on a selection of the majority of issues discussed in the book, namely taxes, jizyah, and is inspired by explanations of several issues that explain government administration. Apart from that, kharaj is defined as property issued by the land owner to be given to the state. In Abu Yusuf's time, there was a growing assumption that if there were few goods available then the price would be expensive and if there was a lot available then the price would be cheap. But he rejected society's assumptions. According to him, not always a small supply of goods (supply) causes prices to be expensive, likewise a large supply of goods causes prices to be cheap. Because in reality prices do not depend on demand (supply) alone but also depend on the power of supply (demand). Therefore, an increase or decrease in prices is not always related to an increase or decrease in demand for goods.

In Abu Yusuf's time, there was a growing assumption that if there were few goods available then the price would be expensive and if there was a lot available then the price would be cheap. But he rejected society's assumptions. According to him, not always a small supply of goods (supply) causes prices to be expensive, likewise a large supply of goods causes prices to be cheap. Because in reality prices do not depend on demand (supply) alone but also depend on the power of supply (demand). Therefore, an increase or decrease in prices is not always related to an increase or decrease in demand for goods.

4. CONCLUSIONS

The conclusion from the explanation above is that Islamic economics emphasizes economic concepts that are in accordance with the rules of Allah SWT in the Koran and also refers to the hadith of the Prophet, such as those in the thoughts of classical Muslim scientists in the time of Rsulluah.

5. ACKNOELEDGMENTS

Based on the conclusions above, it is hoped that it can be understood well, and it is hoped that in the future someone will continue research on classical Muslim economic thought in depth.

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Özet
Son yıllarda araştırmalar, adaptasyon yeteneği yüksek alternatif türlerin tanımlanmasına ve bu ürünlerin insan gıdası veya hayvan yemi olarak potansiyel kullanımının araştırılmasına odaklanmıştır. Ayrıca, 2019'dan bu yana yaşanan küresel krizler, gıda güvenliği ve tarımsal üretimin insanlığın sonsuza dek karşı karşıya kalacağı en önemli konulardan ikisi olduğunu göstermiştir. Bu bağlamda, endüstriyel üretimde kullanılabilecek alternatif bitkilerin detaylı bir şekilde araştırılması büyük önem taşımaktadır. Bu tanıma tam olarak uyan yer elması (*Helianthus tuberosus*), yüksek besin değeri ve yüksek adaptasyon kabiliyeti ile öne çıkan bir üründür. Yunanca'da helios (güneş) ve anthos (çiçek) sözcüklerinden oluşturulan Helianthus kelimesi, *Compositae* (*Asteraceae*) familyasına ait bir cinse verilen isimdir. Yeryüzünde 1000' e yakın cins ve 20.000 kadar tür ile temsil edilen *Compositae* familyası, çiçekli bitkilerin en zengin familyalarındandır. *Compositae* familyasına ait 133 kadar cins ve 1156'dan fazla tür yetişmektedir. Bu familyadan olan *Helianthus* cinsi, bir kısmı çok yıllık, bir kısmı tek yıllık olmak üzere 50'nin üzerinde tür içermektedir. Yer elmasının (*Helianthus tuberosus*) birçok önemli hastalığa karşı olumlu koruyucu veya tedavi edici etkisi birçok bilimsel çalışmaya konu olmuştur. İnülin bakımından zengin yer elmasının toprak altı kısımları (yumruları) gıda, kimya ve ilaç endüstrilerinde önemli bir hammadde olarak hizmet vermektedir. Ayrıca çevrenin iyileştirilmesinde büyük bir değere sahiptir ve potansiyel bir yenilenebilir enerji kaynağıdır. Yer elması (*Helianthus tuberosus* L.) Kuzey Amerika'nın orta ve kuzey bölgelerinde doğal olarak yetişir. Bu bitki 1600'lü yılların başında Fransız kâşif Champlain tarafından Fransa'ya götürülmüş ve aynı yüzyılın ortalarından itibaren insan gıdası ve hayvan yemi olarak kullanılmaya başlanmıştır. Türkiye'de 1800'lü yıllarda İstanbul ve çevresinde üretimine başlandığı ve zamanla diğer bölgelere yayıldığı bilinmektedir. Sahip olduğu büyük potansiyele rağmen, yer elması üretimi Türkiye'de henüz hak ettiği ilgiyi görmemiştir. Bu çalışmada, son yıllarda artış gösteren yer elması üretimi ve ticaretine ilişkin güncel veriler bir araya getirilerek analiz edilmiştir.
Anahtar Kelimeler: Alternatif ürün, Gıda, İnulin, Helianthus tuberosus, Yer Elması.

AN OUTLOOK OF THE WORLD JERUSALEM ARTICHOKE MARKET

Abstract
In recent years, research has been focused on defining adaptable, alternative species and investigating the potential use of these crops as human food or animal feed. Also, the global conflicts since 2019 have shown that food security and agricultural production are two of the most crucial issues that humanity will face forever. In this regard, it is of great significance to investigate in detail alternative plants to be used in industrial production. Jerusalem artichoke (*Helianthus tuberosus*), which perfectly fits this description, is a crop that stands out with its high nutritional value and high adaptation ability. The word Helianthus, formed from the Greek words helios (sun) and anthos (flower), is the name given to a genus belonging to the *Compositae* (*Asteraceae*) family. The Compositae family, which is represented by nearly 1000 genera and about 20.000 species on earth, is one of the richest families of flowering plants. There are about 133 genera and more than 1156 species belonging to the Compositae family. The genus *Helianthus*, which belongs to this family, contains more than 50 species, some of which are perennial and some of which are annual. Positive protective or therapeutic effect against several important diseases of Jerusalem artichoke (*Helianthus tuberosus*) has been the subject of many scientific studies. The underground parts (tubers) of the inulin-rich Jerusalem artichoke serve as an essential raw material in the food, chemical and pharmaceutical industries. It also has a great value in the improvement of the ecological environment and is a source of potential renewable energy. Jerusalem artichoke (*Helianthus tuberosus* L.) is native to the central and northern areas of North America. This crop was introduced to France by the French discoverer Champlain in the beginning of the 1600s and has been used as human food and animal feed since the middle of the same century. In Türkiye, it is reported to have begun to be cultivated in and neighboring Istanbul in the 1800s and expanded to other areas in the following years. Despite its great potential, Jerusalem artichoke production has not yet received the attention it deserves in Türkiye. In this study, current data on Jerusalem artichoke production and trade, which have been on the rise in recent years, are brought together and analyzed.
Keywords: Alternative crop, Food, Inulin, *Helianthus tuberosus*, Jerusalem artichoke

1. INTRODUCTION

Variety breeding studies and seed policies, which have increased rapidly with the help of developing techniques, have contributed to the introduction of many new varieties in our country in recent years. In addition to the positive contributions of new varieties, especially to the production amount, they also have very important negatives such as causing erosion of local village varieties by abandoning their use. Because primitive varieties and local village varieties are unique resources to be used in future research and their potentials in some issues have not yet been elucidated (Akgün et al., 1998). To effectively manage a plant genetic resource, characterization of the plant material constituting that resource by appropriate methods is a priority among the studies that should be carried out. Obtaining the expected benefit from the genetic resource and its long-term maintenance reveals its value for a country (Kresovich and McFerson, 1992). Several plants that were disregarded because of their low fresh consumption have begun to resurface in popularity as a result of the advancement of alternate assessment techniques and growing awareness of their impact on human health. Jerusalem artichoke (*Helianthus tuberosus* L.), a member of the sunflower family that grows naturally in home gardens across much of our nation and is not yet seriously traded, is becoming the focus of international scientific research because of its high bioactive component content and remarkable tolerance for harsh environmental conditions. The term Helianthus refers to a genus of the Compositae (Asteraceae) family. The name is derived from the Greek words "helios" (sun) and "anthos" (flower). The Compositae family is one of the richest families of flowering plants on Earth, with around 20,000 species and almost 1,000 genera. The Compositae family has a large number of desirable decorative plants that are planted in landscapes or for floriculture purposes. More than fifty species make up the genus Helianthus; some are yearly, and some are perennial (Seiler and Brothers, 1999). Jerusalem artichoke (*Helianthus tuberosus* L.) occurs naturally in the middle and northern areas of North America. This crop was transported to France by the French discoverer Champlain in the beginning of the 1600s and has been used as human food and animal feed since the same century (Cosgrove et al., 2005). In Turkiye, it is recognized that it started to be cultivated in and near Istanbul in the 1800s and then spread to neighboring areas gradually (Vural et al., 2000).

Numerous efforts have been conducted to identify the biochemical properties of Jerusalem artichoke and to search for alternative industrial utilization fields. The major cause of this

attention to Jerusalem artichoke is that it is quite tolerant to adverse stress situations, in contrast to many other industrial crops. It has been reported that 70-80% of photosynthetic sugars are stored in the stem and the remaining 20-30% in the yam tubers before flowering. Only after flowering, reserves accumulate in the stems; therefore, the stem is a temporary storage organ and these reserves are then transferred to the tubers (D'Egidioa et al., 1998; Hanci and Tuncer, 2019).

2. CULTIVATION of JERUSALEM ARTICHOKE

The Jerusalem artichoke plant has remarkable resistance to extreme temperatures. Fructan metabolism has been connected to this ability to tolerate and adapt to harsh stressors (D'Egidioa et al., 1998). It makes logical that Jerusalem artichokes can withstand low temperatures, dryness, and thin soil. Furthermore, it is disease- and pest-resistant. When it comes to fertilizer requirements, it offers a number of advantages over conventional crops (Swanton, 1986). In dry and infertile soils, Jerusalem artichokes are particularly well-suited, and their tuber productivity per unit area is higher than that of potatoes in these conditions (Ma et al., 2011; Liu et al., 2012). The principal method of propagating Jerusalem artichokes is by tubers. Because of this, it would be more accurate to refer to the plant material utilized as tubers rather than seeds for creating a new Jerusalem artichoke plantation. The first place that new plants sprout on tubers are the buds. It is not a good idea to transplant large tubers with plenty of buds since this may cause competition amongst new shoots later on. Instead, large tubers should be planted in segments or tiny tubers with a few growth buds should be used as starting material. New tubers can form up to 50–60 cm distant from a planted tuber, depending on the physical properties of the soil and growth procedures (Hanci, 2023).

The number of tubers that need to be planted per 1000 square meters varies according on the conditions of growing. The primary rule is that rows should not be closer than 40–50 centimeters apart. A range of 80-90 cm can be used for interrow spacing. However, in order to have access to the field for other growing techniques, it is best to schedule the distance between rows at 150–160 cm every 2-3 rows. In this instance, 1000 m2 should have 1600–1700 tubers implanted. Assuming an average tuber size of 50–60 g, a decare requires around 75–100 kg of tubers. It is more accurate to estimate the quantity of tubers rather than their weight. Planting tubers happens at different times. Both autumn planting (October–November) and spring

planting (March–April) can provide a comparable amount and quality of output in Turkey's Central Anatolia region, which has extremely harsh winters. Planting depth should be at least 15 cm when growing in a windy area (Hanci, 2023).

One of the best plants for using soil nutrients is the Jerusalem artichoke. However, this does not mean that there is no need to apply fertilizer. Nitrogen is often given to Jerusalem artichokes in the form of urea (46%, N). If planting in the spring, urea has to be worked into the soil together with the planting; if planting in the fall, urea needs to be worked into the soil early in the growing season. It has been shown that the variances between clones and the kind of plant nutrients in the soil have an impact on how much fertilizer should be applied. Applications of 8–10 kg/da of urea have been shown to improve yield and quality standards. In the fertilization scheme, 7-8 kg/da of triple super phosphate (P2O5) can be utilized as phosphorus. Particularly beneficial to tuber output and quality is potassium. A study indicated that an application of 11.5 kg/da of potassium salt (60% K) was sufficient. Consequently, it is likely to be around 5–7 kg of pure N–P–K that should be administered each decare (Bogucka and Jankowski, 2010; Anwar et al., 2011; Amarowicz et al., 2020).

One vegetable with relatively strong drought tolerance is Jerusalem artichoke. Nevertheless, tuber and above-ground yields are impacted if soil moisture is less than 30% of field capacity at the onset of tuber development. The major cause of Jerusalem artichoke's drought tolerance is its high water use efficiency and aggressive rate of growth.

Jerusalem artichokes can be irrigated using a variety of methods, depending on the soil type, field slope, equipment accessibility, and personal preference. The furrow irrigation method is the most economical choice. The lengthy (2–3 m) stems of Jerusalem artichokes make sprinkler watering techniques exceedingly challenging to employ. In Kayseri, Türkiye, drip irrigation methods can also be employed to achieve effective yield. However, as soon as the plants are seeded, the system should be installed and put into use (Hanci, 2023).

When the stalks are completely dry is the best time to pick tubers. This day falls around the end of October or early November for Turkey specifically. Dense vegetative areas should be removed prior as they will make harvesting more difficult. Harvesting can also be done gradually in small-scale farming because the sale will happen gradually. However, one should keep in mind that when winter weather is harsh, harvesting will get harder. In small regions, harvesting is done by hand. Modified potato harvesting equipment is the favored choice in

larger fields. The fact that Jerusalem artichoke tubers can vary in size more than potato tubers is the main issue making machine harvesting more difficult (Hanci, 2023).

3. JERUSALEM ARTICHOKE MARKET

Jerusalem artichoke has great economic potential for human and animal nutrition due to its high biological and chemical properties. In global production, Jerusalem artichoke is grown on 2.5 million hectares. This value is recorded as 700 thousand hectares in the USA, 500 thousand hectares in France and 130 thousand hectares in Austria. It has an average tuber yield of 50-60 tons per hectare (Shazoo et al., 2013; Shariati et al., 2021).

Jerusalem artichoke is utilized for various reasons such as animal feed, human food and as a raw material for bioenergy and bioproduct manufacturing (Li et al., 2013). Furthermore, the plant can be grown under diverse environmental conditions (Rebora, 2008). It contains high levels of fructo-oligosaccharides and inulin (16-20% of fresh weight) (Van Loo et al., 1999; Hanci et al., 2020).

Jerusalem artichoke possesses a variety of therapeutic benefits. It is employed in the creation of very potent medications that regulate metabolism in cases of diabetes, obesity, atherosclerosis, kidney, liver, cardiovascular system, and gastrointestinal disorders. As the "supplier" of fructose for the human body, Jerusalem artichoke is a great tool for preventing diabetes since eating fructose rather than sucrose lowers the risk of developing this dangerous condition (Shariati et al., 2021). It is advised to take Jerusalem artichoke for cardiovascular conditions include anemia, hypertension, arrhythmias, and circulation issues. It has digestive and diuretic qualities as well as strengthening effects on the neurological system during periods of extreme stress. For those who have heartburn, Jerusalem artichoke is an essential food that helps alleviate high-acid gastritis. Additionally, it can be used to treat duodenal and stomach ulcers before they develop (Leonid et al., 1999; Radovanovic et al., 2015).

Milk products are prepared using Jerusalem artichoke tubers on a large scale. As a result, the authors have created a technique for making yogurt without fat by mixing in Jerusalem artichoke powder. The use of Jerusalem artichoke powder makes it possible to add important nutrients to yogurt. Based on the data analysis, Jerusalem artichoke powder is a loose, light beige mass with a pleasant flavor (Fedorovich et al., 2013).

According to Ermosh et al. (2020), the addition of 10-15% Jerusalem artichoke powder to the instructions composition of wheat and rye-wheat bread activates the process of fermentation of the dough, produces ideal acidity, which forms a better developed porosity, raises the volume of the final product, decreases down the staling process, and enhances the bread's nutritional and preventive qualities. By adding Jerusalem artichoke powder (JAP), the pastry goods' fiber content is increased, which improves their nutritional value.

Özer (2019) examined on how Jerusalem artichoke powder affected the way fermented sausage's quality qualities changed. The researcher reported that adding 25% of Jerusalem artichoke powder to the process of making low-fat fermented sausages resulted in favorable nutritional outcomes, including reduced caloric content and beef fat as well as rich dietary fiber and longer sausage shelf life.

Alabina et al. (2018) produced a variety of beverages using mashed Jerusalem artichoke (15–20%), such as mashed carrot, pumpkin, and apple, in addition to reconstituted juices of peach, passion fruit, and pineapple. Two goals guided the writers as they developed the drink assortment: first, to develop a line of low-calorie vegetable drinks using Jerusalem artichoke puree (for the target consumer); second, to develop a tasty, harmonious product in which the distinct flavor of Jerusalem artichoke "masked" by brighter notes of fruit additives, like pineapple, passion fruit, etc.

Table 1. Top Ten Countries in the Worldwide Jerusalem Artichoke Market

Rank	**Country**	**Export Value (2022) (%)**	**Export Value (2022) USD**	**Yearly Growth in Export Value 2021-2022 (%)**	**Yearly Growth in Export Value 2019-2022 (%)**
1	China	57.32	65,110,000	11.54	35.20
2	Mexico	16.31	18,530,000	247.31	4.81
3	Netherlands	6.36	7,220,000	-10.64	64.48
4	Spain	4.05	4,600,000	-14.90	27.00
5	USA	3.75	4,250,000	28.39	156.50
6	France	3.28	3,730,000	8.99	-4.75
7	Mynmar	2.67	3,030,000	-33.05	
8	Belgium	0.97	1,100,000	-8.12	9.45
9	Germany	0.73	823,940	3.92	14.97
10	India	0.53	603,430	-75.63	32.88

Table 1 lists the countries that dominate the global Jerusalem artichoke market. China is at the top of the list in terms of export value. Mexico ranks second with a 247% increase between 2021-2022. Although there have been some decreases in value in the last year, when the export values of the last three years are analyzed, it is seen that all countries except France have experienced significant increases in the value of Jerusalem artichoke exports.

Table 2. Top ten exporter in Jerusalem artichoke market of the last eight years (Million USD)

Ranks	**Country**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**Total**	**Mean**
1	China	48.9	52.7	50.9	50.5	48.2	55.7	58.4	65.1	430.4	53.8
2	Mexico	9.5	9.8	11.6	13.7	17.7	13.4	5.3	18.5	99.5	12.4
3	Netherlands	1.4	2.2	3.2	3.7	4.4	4.9	8.1	7.2	35.1	4.4
4	Spain	5.7	5.3	4.1	4.3	3.6	4.7	5.4	4.6	37.7	4.7
5	United States	1.2	0.981	0.968	1.8	1.7	2.7	3.3	4.3	16.9	2.1
6	France	2.7	2.8	2.9	3.2	3.9	3.2	3.4	3.7	25.8	3.2
7	Myanmar	0.08	0.281	-	0.142	-	0.13	4.5	3	8.1	1.4
8	Belgium	0.944	1.1	1.7	1.4	1	1.2	1.2	1.1	9.6	1.2
9	Germany	0.389	0.508	0.705	0.586	0.716	0.792	0.792	0.823	5.3	0.7
10	India	0.633	0.961	0.711	0.358	0.454	1.1	2.5	0.603	7.3	0.9
	World	124.7	118.2	115.6	125.9	147.7	210.6	261.1	113.6		

Table 2 presents the values of the world's ten largest exporters of Jerusalem artichoke for the last eight years. Considering the average export values, it can be seen that China has a significant lead over the other countries. Although there have been fluctuations from time to time, China has managed to earn over 53 million dollars annually during this period. Mexico, on the other hand, steadily increased its exports in the 2015-2019 period, but experienced a very serious decline, especially in 2021. This decline returned to an upward trend in 2022.

Table 3. Flow directions in the global Jerusalem artichoke trade (USD)

Ranks	**Country**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
1	China to United States	11.8M	10.0M	7.8M	9.4M	7.5M	8.5M	6.6M	11.7M
2	China to Singapore	8.8M	8.9M	8.3M	8.2M	9.1M	8.8M	9.8M	8.3M
3	Honduras to United States	3.9M	974.6K	-	-	-	-	-	4.4M
4	China to Canada	4.6M	5.0M	4.9M	4.9M	4.9M	4.2M	4.0M	4.3M
5	China to Japan	4.6M	4.5M	3.6M	3.8M	4.3M	2.8M	3.4M	4.2M
6	China to United Kingdom	1.0M	957.8K	1.2M	1.4M	1.2M	1.2M	2.8M	4.2M
7	Honduras to United Kingdom	-	-	-	-	35.2K	18.7K	216.5K	4.1M
8	China to South Korea	2.6M	2.1M	2.6M	2.6M	3.1M	2.9M	4.0M	4.0M
9	Belgium to Spain	14.2K	6.8K	815.0	8.1K	3.0K	9.3K	2.5M	3.9M
10	India to United Kingdom	875.2K	417.9K	347.3K	770.5K	1.5M	1.8M	2.5M	3.4M
	Total	160.9M	167.0M	108.8M	117.6M	121.3M	118.5M	138.6M	113.7M

When the sales traffic between countries in the Jerusalem artichoke trade is analyzed, it is seen that China exports large amounts to the USA, Singapore, Canada, Japan, the United Kingdom and South Korea. Of these countries, the trade in Jerusalem artichoke with the US, Singapore, Canada and Japan did not show a significant fluctuation in the 2015-2022 period. However, there is an increasing trend in exports from China to the United Kingdom and South Korea. The other country that draws attention in this table is Honduras. This country earned significant revenues from its exports to the United Kingdom and the United States, especially in 2002.

Table 4. Top ten importer in Jerusalem artichoke market of the last eight years (Million USD)

Ranks		**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
1	United States	65.6	74.9	11.2	12.6	12.4	18.7	14.4	22.1
2	United Kingdom	12.2	12.9	11.5	13.6	16.2	11.1	13.9	20.3
3	Spain	3.7	6.0	5.3	6.3	5.9	6.4	9.3	10.5
4	Singapore	9.3	9.4	8.8	8.8	9.7	9.4	10.7	9.3
5	Canada	6.7	7.0	7.0	7.5	7.4	7.7	7.9	8.6
6	Netherlands	1.8	2.9	3.3	3.3	3.4	3.5	5.7	6.4
7	Belgium	8.2	2.0	5.5	5.8	5.6	5.0	4.9	5.4
8	Germany	2.8	2.7	3.9	3.8	7.1	7.6	7.6	5.2
9	Japan	4.8	4.8	3.7	4.1	4.3	2.9	3.7	4.3
10	South Korea	2.6	2.5	2.9	3.0	3.4	3.1	4.1	4.0
	World	160.9	167.0	108.8	117.6	121.3	118.5	138.6	113.7

The top ten countries with the highest number of Jerusalem artichoke purchases are shown in Table 4. The list shows that in 2022, the United States, the United Kingdom, Spain and Singapore will account for more than half of global imports.

4. CONCLUSION

In this study, while sharing some technical characteristics of Jerusalem artichoke cultivation, its economic potential and current situation are also presented. All these data show that Jerusalem artichoke is a vegetable that will increase its popularity. People's understanding of the importance of healthy nutrition and the fact that food supply security is a current issue will further increase the interest in this product. The fact that governments are looking for alternative crops for farmers is another aspect that increases the potential of this crop.

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SİVRİCE (ELAZIĞ) EKOLOJİSİNE AİT BAZI YEREL ÜZÜM ÇEŞİTLERİNİN TANE KALİTE ÖZELLİKLERİ

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Özet
Türkiye, bağcılık için yerkürenin en elverişli iklim kuşağı üzerinde bulunmasının yanı sıra, kültür asması (*Vitis vinifera* L.) ve bağcılığın anavatanı olması nedeniyle zengin bir gen potansiyeline sahiptir. Asmanın heterozigotik yapısı zaman içerisinde geniş bir çeşit ve tip zenginliği ortaya çıkarmıştır. Türkiye'de üzüm çeşitliliğinin fazla olduğu bölgelerde, yöreye ait daha az tanınan ve bilinen yerel üzüm çeşitlerinin özelliklerinin ortaya konulması önemlidir. Zira, yerel üzüm çeşitleri son derece rekabetçi olan dünya üzüm ve şarap piyasasındaki niş ürün adaylarıdır. Bu çalışma Sivrice (Elazığ) ekolojisinde aynı koşullarda yetiştirilen yedi yerel üzüm çeşidinin tane kalite özelliklerinin belirlenmesi amacıyla yapılmıştır. Olgunluk aşamasında hasat edilen salkımlarda salkım ağırlığı, genişliği ve uzunluğu; tane ağırlığı, eni ve boyu; şıra randımanı, suda çözünür kuru madde (SÇKM), pH ve titre edilebilir asitlik özellikleri incelenmiştir. Çalışma sonucunda salkım uzunluğu 13.83 cm (Köse)-20.00 cm (Çavuş Üzümü), salkım genişliği 5.47 cm (Çavuş Üzümü)-8.00 (Keçimemesi), salkım ağırlığı 180.18 g (Keçimemesi)-584.17 g (Boğazkere), tane eni 14.86 (Keçimemesi)-19.41 mm (Köse), tane boyu 17.09 mm (Çavuş Üzümü)- 20.65 mm (Keşmir), tane ağırlığı 2.77 g (Keçimemesi)- 4.94 g (Keşmir), şıra randımanı %73.71 (Top Üzümü)-%89.54 (Keşmir), SÇKM %15.90 (Keşmir)-%25.26 (Köse), pH 3.3 (Öküzgözü)-4.0 (Top Üzümü), titre edilebilir asitlik %0.26 (Öküzgözü) %0.62 (Boğazkere) aralığında belirlenmiştir. Ayrıca üzüm çeşitlerinin glikoz ve fruktoz içerikleri yüksek performanslı sıvı kromatografisi-refraktif indeks dedektör (HPLC-RID) sisteminde belirlenmiştir. Çeşitlerin glikoz içerikleri 6.02 g/100 g-10.97 g/100 g, fruktoz içerikleri ise 6.11 g/100 g-10.44 g/100 g aralığında tespit edilmiştir. En düşük glikoz ve fruktoz içeriği Keşmir çeşidine ait iken en yüksek miktar Köse üzüm çeşidinde belirlenmiştir. Genel olarak çalışmada kullanılan çeşit farklılığına bağlı olarak tane fiziksel ve kimyasal özelliklerin farklılık gösterdiği gözlenmiştir.
Anahtar Kelimeler: *Vitis vinifera* L., gen kaynakları, kalite ve kantite, benzerlik

BERRY QUALITY CHARACTERISTICS OF SOME NATIVE GRAPE VARIETIES OF SİVRİCE (ELAZIĞ) ECOLOGY

Abstract
Türkiye has a rich gene potential due to its location on the most favorable climate region of the globe for viticulture as well as being the homeland of cultivated grapevine (*Vitis vinifera* L.) and viticulture. The heterozygosis of the grapevine has resulted in a very wide variety and type richness over time. In regions of Türkiye where grape diversity is high, it is important to reveal the characteristics of local grape varieties that are less known and recognized. Because local grape varieties are niche product candidates in the highly competitive world grape and wine market. This study was carried out to determine the berry quality characteristics of seven local grape varieties grown under the same conditions in Sivrice (Elazığ) ecology. In clusters harvested at maturity, cluster weight, width and length, must yield, berry weight, width and length; pH and titratable acidity characteristics were analyzed. As a result of the study, cluster length is 13.83 cm (Köse)-20.00 cm (Çavuş üzümü), cluster width is 5.47 cm (Çavuş üzümü)-8.00 (Keçimemesi), cluster weight is 180.18 g (Keçimemesi)-584.17 g (Boğazkere), berry width is 14.86 (Keçimemesi)-19.41 mm (Köse), berry size 17.09 mm (Çavuş üzümü)- 20.65 mm (Keşmir), berry weight 2.77 g (Keçimemesi)-4.94 g (Keşmir), must yield 73.71% (Top üzümü)-89.54% (Keşmir), total soluble solids (TSS) 15.90% (Keşmir)-25.26% (Köse), pH 3.3 (Öküzgözü)-4.0 (Top üzümü), titratable acidity was determined in the range of 0.26% (Öküzgözü)-0.62% (Boğazkere). Additionally, glucose and fructose contents of grape varieties were determined in the high-performance liquid chromatography-refractive index detector (HPLC-RID) system. Glucose contents of the varieties were determined in the range of 6.02 g/100 g-10.97 g/100 g, and fructose contents were determined in the range of 6.11 g/100 g-0.44 g/100 g. While the lowest glucose and fructose content belonged to the ‘Keşmir’ variety, the highest amount was determined in the ‘Köse’ variety. In general, it was observed that the physical and chemical properties of the berries varied depending on the variety used in the study.
Keywords: *Vitis vinifera* L., genetic resources, quality and quantity, similarity

1. Giriş

Üzüm (*Vitis vinifera* L.)'de kalite, çok sayıda faktörün birlikte etkisi sonucu ortaya çıkan bir özellik olup birçok araştırmanın temelini oluşturmaktadır. Üzüm kalitesi ve buna bağlı olarak tanenin kimyasal içeriği; çeşit, yıl, iklim, rakım, anaç, yer ve yöney ile uygulanan kültürel işlemler gibi birçok faktörün etkisiyle şekillenmektedir (Korkutal ve ark., 2012; Keskin, 2017; Costa ve ark., 2020; Yağcı ve Bozkurt, 2020; Uyak ve ark., 2021). Üzüm çeşitlerinin fiziksel ve kimyasal özelliklerinin belirlenmesi çeşidin nasıl değerlendirilebileceği (sofralık, kurutmalık, şaraplık ve şıralık) açısından önemlidir. Türkiye, dünyanın bağcılık bakımından en uygun iklim kuşağı üzerinde yer almasının yanı sıra; asmanın anavatanı olan bölgeler arasında olması, eski ve köklü bir bağcılık geçmişine sahip olması ve asmanın kültüre ilk alındığı merkez olması nedeniyle zengin bir gen kaynağına sahiptir. Ne yazık ki ülkemizde bağcılık ve şarapçılık sektörünün geliştirilmesinde, sahip olunan bu genetik zenginlikten yeterince yararlanılmamaktadır. Teruar kavramı ile birlikte son yıllarda yerli çeşitlere olan ilgi güçlü bir şekilde yeniden canlanmıştır. Bu çalışmada Sivrice (Elazığ) ekolojisinde yetiştirilen yerel yedi üzüm çeşidinin tane fiziksel ve kimyasal kalite özelliklerinin belirlenmesi amaçlanmıştır.

2. Materyal ve Yöntem

Materyal

Çalışmanın materyalini Elazığ ili Sivrice ekolojisinde yetiştirilen Boğazkere, Öküzgözü, Top üzüm, Keşmir, Çavuş üzümü, Köse ve Keçimemesi çeşitleri oluşturmaktadır (Şekil 1).



Şekil 1. Çalışmada kullanılan üzüm çeşitleri (üst soldan sağa Boğazkere, Öküzgözü, Top üzüm, Keşmir, alt soldan sağa Çavuş üzümü, Köse, Keçimemesi)

Yöntem

Üzüm çeşitlerine ait salkımlar, fiziksel olgun görünüm aşamasında, refraktometre değeri belirlenerek (çeşide göre 15-25 °Briks) hasat edilmiştir. Salkım, tane ve çekirdeklerde fiziksel ve kimyasal kalite özellikleri ölçülmüştür.

Salkım ağırlığı (g): Salkım ağırlığı, Mettler Toledo WL-2000-G marka/model dijital terazi ile belirlenmiş ve sonuçlar g olarak ifade edilmiştir.

Salkım genişliği ve uzunluğu (cm): Salkım genişliği ve salkım uzunluğu cetvel ile ölçülerek belirlenmiştir.

Tane eni ve boyu (mm): Elektronik kumpas yardımıyla mm cinsinden ölçülmüştür.

Tane ağırlığı (g): Salkımların üstünden, ortasından ve altından olacak şekilde 3 tekerrür ve her tekerrürde 20 tane olacak şekilde örnekler alınmış ve bu örnekler, MettlerToledoWL-2000-G marka/model dijital terazide tartılmış ve sonuçlar g olarak kaydedilmiştir.

Çekirdek sayısı (adet) ve ağırlığı (g): Rasgele alınan tanelerden, 3 tekerrür ve her tekerrürde 20 tane olacak şekilde çekirdekler çıkartılmış ve çekirdek sayısı (adet) ile çekirdek (g) ağırlığı belirlenmiştir.

Şıra randımanı (%): Alınan 100 g yaş üzüm örnekleri önce parçalayıcıdan geçirilmiş, daha sonra presle sıkılarak çıkan şıra miktarı (%) ölçülmüştür.

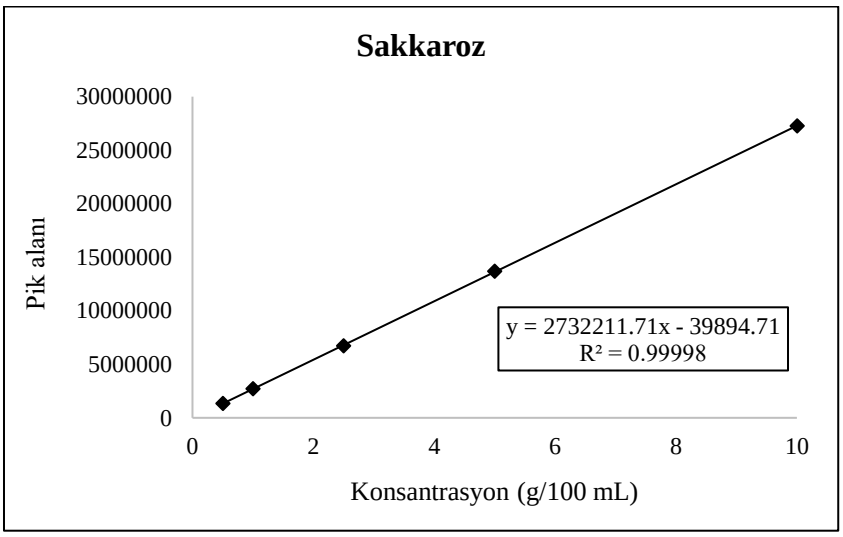
Suda Çözünür Kuru Madde (%, SÇKM): Üzüm taneleri ayıklandıktan sonra, meyve sıkacağı yardımıyla elde edilen meyve suyunda, SÇKM değerleri el refraktometresi (Pocket Refractometer PAL-1, Atago) yardımıyla ölçülmüş ve sonuçlar yüzde (%) olarak ifade edilmiştir (Cemeroğlu, 2010).

pH: Örneklerden elde edilen meyve suyunda, cam elektrotlu dijital pH metre ile pH değerleri ölçülmüştür. Ölçüm yapılmadan önce pH metre, pH'sı 4 ve 7 olan standart tampon çözeltilerle kalibre edilmiştir (pH metre, Thermo Scientific Orion 2 Star).

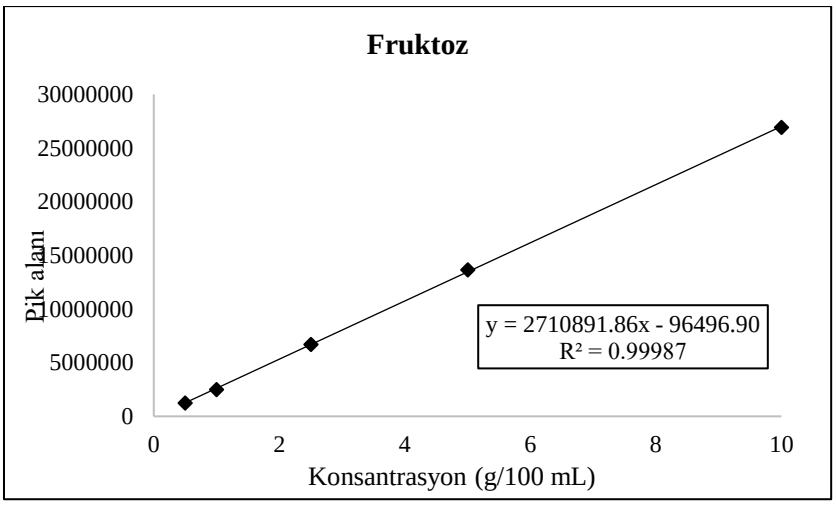
Titre edilebilir asitlik (%): Her uygulamaya ait meyve örneklerinden elde edilen meyve suyundan 10 mL alınarak, saf su ile 100 mL'ye tamamlanmış ve pH metrede 8.1 değeri okunana

kadar 0.1 N NaOH çözeltisi ile titre edilmiştir. Sonuçlar yüzde (%) tartarik asit cinsinden hesaplanmıştır (Cemeroğlu, 2010).

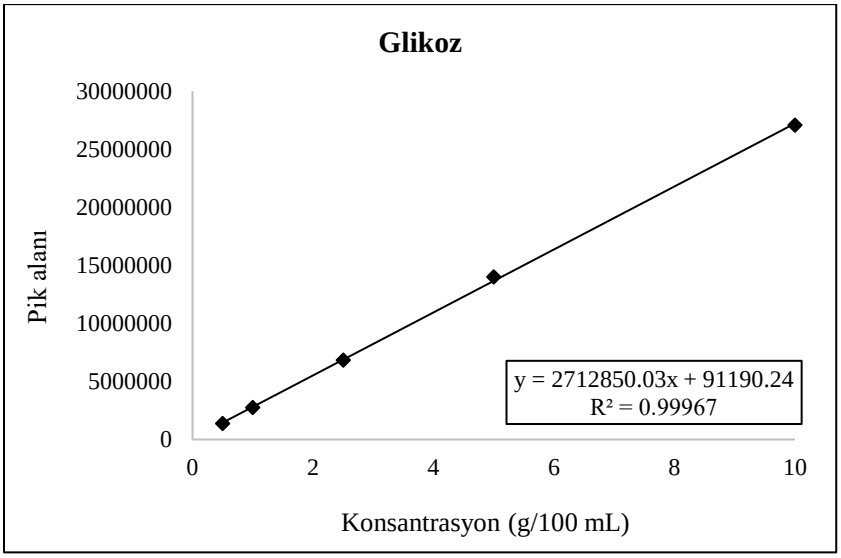
Bireysel şeker analizi: Homojen şekilde öğütülen tanelerden yaklaşık 1'er g örnekler alınarak tartılmıştır. Üzerine 10 mL saf su eklenmiş ve vorteks karıştırıcı ile iyice karıştırılmıştır. Elde edilen süpernatant kısım 0.45 µm PVDF filtre yardımıyla süzülmüş ve HPLC'de (Shimadzu marka, RID dedektörü, 7.8x300 mm, Carbosep CHO 87C karbonhidrat kolonu) analiz edilmiştir. Mobil faz olarak ultra saf su kullanılmıştır (Talcott ve ark., 1999; Llano ve ark., 2017). Farklı konsantrasyonlarda hazırlanan sakkaroz, glikoz ve fruktoz bileşenlerine ait kalibrasyon eğrileri Şekil 2, 3 ve 4'te verilmiştir.



Şekil 2. Sakkaroz standardına ait kalibrasyon grafiği



Şekil 3. Fruktoz standardına ait kalibrasyon grafiği



Şekil 4. Glikoz standardına ait kalibrasyon grafiği

İstatistik analiz: Çalışmada ele alınan özellikler için tanımlayıcı istatistikler; ortalama, standart sapma, minimum ve maksimum değerler olarak ifade edilmiştir. Bu özellikler bakımından çeşitleri karşılaştırmada Tek yönlü varyans analizi yapılmıştır. Varyans analizini takiben farklı çeşitleri belirlemede, Duncan çoklu karşılaştırma testi kullanılmıştır. Ele alınan özellikler bakımından çeşitler arasındaki benzerlik düzeyini belirlemek üzere, Kümeleme analizi yapılmıştır. Kümeleme analizinde, bağlantı yöntemi olarak Tekli bağlantı, uzaklık ölçüsü olarak Öklit uzaklığı kullanılmıştır. Hesaplamalarda istatistik önemlilik (anlamlılık) düzeyi %5

olarak alınmış ve hesaplamalar için SPSS (ver:21) ve MINITAB (ver:14) istatistik paket programları kullanılmıştır

3. Bulgular ve Tartışma

Salkım özellikleri bakımından çeşitlere göre tanımlayıcı istatistikler ve karşılaştırma sonuçları Çizelge 1'de sunulmuştur. Çeşitlerin salkım ağırlıklarının 180.18 g (Keçimemesi) ile 584.16 g (Boğazkere) arasında değişim gösterdiği tespit edilmiştir. Salkım eni bakımından en yüksek değer 20.00 mm iken (Çavuş üzümü), en düşük değer 13.83 mm (Köse) olarak belirlenmiştir. Ancak salkım eni bakımından çeşitler arasındaki fark istatistik olarak önemli bulunmamıştır. En yüksek salkım boyu Keçimemesi çeşidinden elde edilmekle birlikte, salkım boyları arasındaki fark da istatistik olarak önemli bulunmamıştır. (Çizelge 1).

Çizelge 1. Salkım özellikleri bakımından çeşitlere göre tanımlayıcı istatistikler ve karşılaştırma sonuçları

Özellikler	**Çeşitler**	**Ortalama**	**St. Sap.**	**Min.**	**Mak.**	***p***
Salkım Ağırlığı (g)	Öküzgözü	435.58 b	59.01	347.17	547.52	0.001
	Keçimemesi	180.18 d	2.78	175.35	185.01	
	Çavuş üzümü	431.59 b	51.85	342.52	522.13	
	Top üzümü	275.13 cd	2.89	270.12	280.14	
	Köse	278.32 cd	23.02	238.45	318.20	
	Boğazkere	584.165a	26.57	538.13	630.20	
	Keşmir	339.78 bc	13.59	316.25	363.31	
Salkım Eni (mm)	Öküzgözü	18.00	0.577	17.00	19.00	0.097
	Keçimemesi	15.00	1.527	13.00	18.00	
	Çavuş üzümü	20.00	0.577	19.00	21.00	
	Top üzümü	15.33	1.763	12.00	18.00	
	Köse	13.83	1.964	10.00	16.50	
	Boğazkere	17.01	1.154	15.00	19.00	
	Keşmir	15.66	1.452	13.00	18.00	
Salkım Boyu (cm)	Öküzgözü	7.00	0.577	6.00	8.00	0.418
	Keçimemesi	8.00	1.527	6.00	11.00	
	Çavuş üzümü	5.46	0.088	5.30	5.60	
	Top üzümü	6.00	0.577	5.00	7.00	
	Köse	6.67	0.338	6.00	7.03	
	Boğazkere	7.83	0.600	7.00	9.00	
	Keşmir	7.33	1.452	5.00	10.00	

a. b. c. …. : Her özellik için farklı harfi alan çeşitler arası fark önemlidir (p<0.05).
Fark önemli bulunmayan özellikler için harflendirme yapılmamıştır.

Tane ve çekirdek özellikleri bakımından çeşitlere göre tanımlayıcı istatistikler ve karşılaştırma sonuçları Çizelge 2'de sunulmuştur. Tane ağırlığı, tane eni ve tane boyu bakımından çeşitler

arasında istatistik olarak önemli fark bulunmuştur (p<0.05). Tane ağırlığı ile ilgili yapılan değerlendirmelerde en düşük tane ağırlığı değeri Keçimemesi çeşidinden (2.770 g), en yüksek tane ağırlığı değeri ise Keşmir (4.935 g) çeşidinden elde edilmiştir. Bölgeler arasındaki iklimsel değişkenlerin üzüm tane fiziksel özellikleri ile kompozisyonu üzerindeki potansiyel etkisinin araştırıldığı birçok çalışma mevcuttur. Özellikle yıllık yağışın düşük olduğu daha sıcak bölgelerde tane ağırlıklarının düşük olduğu bildirilmiştir (Costa ve ark., 2020). Tane eni bakımından Köse çeşidi (19.411 g) yüksek bulunurken, en düşük değer Keçimemesi (14. 856 g) çeşidinde belirlenmiştir. Tane boyunda ise en yüksek değer Keşmir (20.654 mm) çeşidine aittir. Artan üzüm üretim kapasitesi ile yeni bir sektör olarak üzüm çekirdeği yağı üretimi son yıllarda giderek artmaktadır. Üzümlerden elde edilen yağların sahip oldukları yağ miktarı ile kimyasal kompozisyonu ve biyoaktif bileşimi, üzümün cinsine ve ekolojik koşullara bağlı olarak değişmektedir (Sevindik ve Selli, 2016). Çalışmada üzüm çeşitlerinin içerdiği çekirdek sayısı ve ortalama ağırlık değerleri belirlenmiştir. Elde edilen sonuçlara göre çeşitler arasında sayı ve ağırlık değerleri bakımından istatistik olarak önemli fark bulunmuştur (p<0.05). Çekirdek ağırlıkları alınan örnekler için 20 tane çekirdeğin ortalama değeri hesaplanarak verilmiştir. Çekirdek ağırlıkları bakımından en yüksek değer (1.49 g) Köse çeşidine aitken, en düşük değer (0.61 g) Çavuş çeşidine aittir (Çizelge 2).

Çizelge 2. Tane ve çekirdek özellikleri bakımından çeşitlere göre tanımlayıcı istatistikler ve karşılaştırma sonuçları

Özellikler	**Çeşitler**	**Ortalama**	**St. Sap.**	**Min.**	**Mak.**	***p***
Tane Eni (mm)	Öküzgözü	16.20 c	0.264	13.92	18.00	0.001
	Keçimemesi	14.85 d	0.178	13.46	16.98	
	Çavuş üzümü	15.55 cd	0.247	12.95	17.35	
	Top üzümü	17.38 b	0.345	14.74	20.04	
	Köse	19.41 a	0.226	17.36	21.74	
	Boğazkere	15.92 c	0.198	13.75	17.18	
	Keşmir	18.96 a	0.273	15.97	20.96	
Tane Boyu (mm)	Öküzgözü	19.45 b	0.616	14.73	27.80	0.001
	Keçimemesi	18.74 bc	0.215	16.68	20.61	
	Çavuş üzümü	17.09 d	0.304	14.87	19.56	
	Top üzümü	19.79 ab	0.405	16.84	23.12	
	Köse	19.32 b	0.163	18.13	21.02	
	Boğazkere	17.85 cd	0.297	14.41	19.70	
	Keşmir	20.65 a	0.280	18.04	22.36	
Tane Ağırlığı (g)	Öküzgözü	3.65 c	0.214	1.82	5.65	0.001
	Keçimemesi	2.77 e	0.069	2.06	3.70	
	Çavuş üzümü	2.94 de	0.119	1.81	3.88	
	Top üzümü	4.13 b	0.222	2.46	5.75	
	Köse	4.68 a	0.160	3.54	6.42	
	Boğazkere	3.32 cd	0.114	2.06	4.09	
	Keşmir	4.93 a	0.197	2.88	6.34	
Çekirdek Ağırlığı (g)	Öküzgözü	1.20 b	0.096	1.10	1.40	0.001
	Keçimemesi	0.86 c	0.031	0.81	0.92	
	Çavuş üzümü	0.61 d	0.034	0.55	0.67	
	Top üzümü	0.96 c	0.020	0.93	1.00	
	Köse	1.49 a	0.025	1.45	1.54	
	Boğazkere	0.92 c	0.017	0.89	0.95	
	Keşmir	0.98 c	0.011	0.96	1.00	
Çekirdek Sayısı (adet)	Öküzgözü	28.66 e	0.881	27.00	30.00	0.001
	Keçimemesi	51.50 c	0.866	50.00	53.00	
	Çavuş üzümü	46.50 d	0.866	45.00	48.00	
	Top üzümü	54.00 b	0.577	53.00	55.00	
	Köse	22.00 f	0.577	21.00	23.00	
	Boğazkere	46.00 d	0.577	45.00	47.00	
	Keşmir	58.50 a	0.288	58.00	59.00	

a. b. c. …. : Her özellik için farklı harfi alan çeşitler arası fark önemlidir (p<0.05).
Fark önemli bulunmayan özellikler için harflendirme yapılmamıştır.

Kimyasal özellikler bakımından çeşitlere göre tanımlayıcı istatistikler ve karşılaştırma sonuçları Çizelge 3'te verilmiştir. Özellikle şıralık/şaraplık çeşitlerin değerlendirilmesinde önemli bir kriter olan şıra randımanı bakımından çeşitler arasındaki fark istatistik olarak önemli olmamakla birlikte en yüksek şıra randımanı Keşmir ve Keçimemesi (sırasıyla %89.09 ve %88.57) çeşitlerinde belirlenmiştir.

Çizelge 3. Kimyasal özellikler bakımından çeşitlere göre tanımlayıcı istatistikler ve karşılaştırma sonuçları

Özellikler	**Çeşitler**	**Ortalama**	**St. Sap.**	**Min.**	**Mak.**	***p***
Şıra Randımanı (%)	Öküzgözü	86.41 b	0.977	84.63	88.00	0.001
	Keçimemesi	88.57 a	0.245	88.15	89.00	
	Çavuş üzümü	83.65 c	0.285	83.16	84.15	
	Top üzümü	74.35 d	0.372	73.71	75.00	
	Köse	82.90 c	0.173	82.60	83.20	
	Boğazkere	85.60 b	0.228	85.21	86.00	
	Keşmir	89.09 a	0.256	88.65	89.54	
SÇKM (%)	Öküzgözü	18.40 c	0.230	18.00	18.80	0.001
	Keçimemesi	16.90 d	0.057	16.80	17.00	
	Çavuş üzümü	20.08 b	0.049	20.00	20.17	
	Top üzümü	20.40 b	0.230	20.00	20.80	
	Köse	25.13 a	0.075	25.00	25.26	
	Boğazkere	18.70 c	0.115	18.50	18.90	
	Keşmir	15.95 e	0.028	15.90	16.00	
Titre Edilebilir Asitlik (%)	Öküzgözü	0.26 f	0.002	0.26	0.27	0.001
	Keçimemesi	0.30 e	0.003	0.30	0.31	
	Çavuş üzümü	0.34 d	0.004	0.34	0.35	
	Top üzümü	0.40 c	0.010	0.39	0.43	
	Köse	0.46 b	0.009	0.45	0.48	
	Boğazkere	0.60 a	0.005	0.60	0.62	
	Keşmir	0.60 a	0.004	0.60	0.62	
pH	Öküzgözü	3.25 f	0.028	3.20	3.30	0.001
	Keçimemesi	3.70 cd	0.057	3.60	3.80	
	Çavuş üzümü	3.88 ab	0.008	3.87	3.90	
	Top üzümü	3.95 a	0.028	3.90	4.00	
	Köse	3.80 bc	0.057	3.70	3.90	
	Boğazkere	3.57 de	0.043	3.50	3.65	
	Keşmir	3.50 e	0.057	3.40	3.60	
Glikoz (g/100 g)	Öküzgözü	7.75 d	0.071	7.63	7.88	0.001
	Keçimemesi	9.18 b	0.047	9.10	9.27	
	Çavuş üzümü	7.82 d	0.127	7.60	8.04	
	Top üzümü	7.35 e	0.161	7.07	7.63	
	Köse	10.97 a	0.029	10.92	11.02	
	Boğazkere	8.35 c	0.055	8.26	8.45	
	Keşmir	6.02 f	0.074	5.89	6.15	
Fruktoz (g/100 g)	Öküzgözü	7.55 d	0.038	7.48	7.62	0.001
	Keçimemesi	9.24 b	0.002	9.24	9.25	
	Çavuş üzümü	8.12 c	0.120	7.92	8.34	
	Top üzümü	7.64 d	0.148	7.39	7.90	
	Köse	10.40 a	0.085	10.29	10.59	
	Boğazkere	8.01 c	0.029	7.97	8.07	
	Keşmir	6.11 e	0.062	6.01	6.22	

a. b. c. …. : Her özellik için farklı harfi alan çeşitler arası fark önemlidir (p<0.05).
Fark önemli bulunmayan özellikler için harflendirme yapılmamıştır.

SÇKM, pH, toplam asitlik ve şeker konsantrasyonu üzümde teknolojik olgunluğu oluşturan temel kalite kriterleridir. Üzüm çeşitlerinin pH değeri 3.3 (Öküzgözü)-4.0 (Top üzümü) aralığında değişmektedir. Çeşitler arasındaki fark istatistik olarak önemli bulunmuştur ($p<0.05$). pH değeri iklim, rakım ve çeşit etkisi ile değişmekle birlikte üzümlerin şaraba işlenmesinde önemli bir özelliktir. Bazı çeşitlerin şıralarında bulunan daha yüksek titre edilebilir asitlik ve daha düşük pH, şarapların kırmızı rengini korumasına yardımcı olmaktadır (Rienth ve ark., 2021). Doğan ve ark. (2018), Öküzgözü çeşidinin de yer aldığı üzüm çeşitleriyle Malatya'da yürüttükleri çalışmada SÇKM, pH ve toplam asitlik değerlerini sırasıyla %21.10, 3.26 ve %0.65 olarak tespit etmişlerdir. Diyarbakır ili Dicle ilçesinde yürütülen diğer bir çalışmada ise Öküzgözü çeşidi için sırasıyla %18.93, 3.30 ve %0.47 değerleri belirlenmiştir. Aynı çalışmada Boğazkere çeşidi için ise SÇKM, pH ve asitlik değerleri sırasıyla %17.84, 3.23 ve %0.43 olarak saptanmıştır (Özdemir ve Sessiz, 2018).

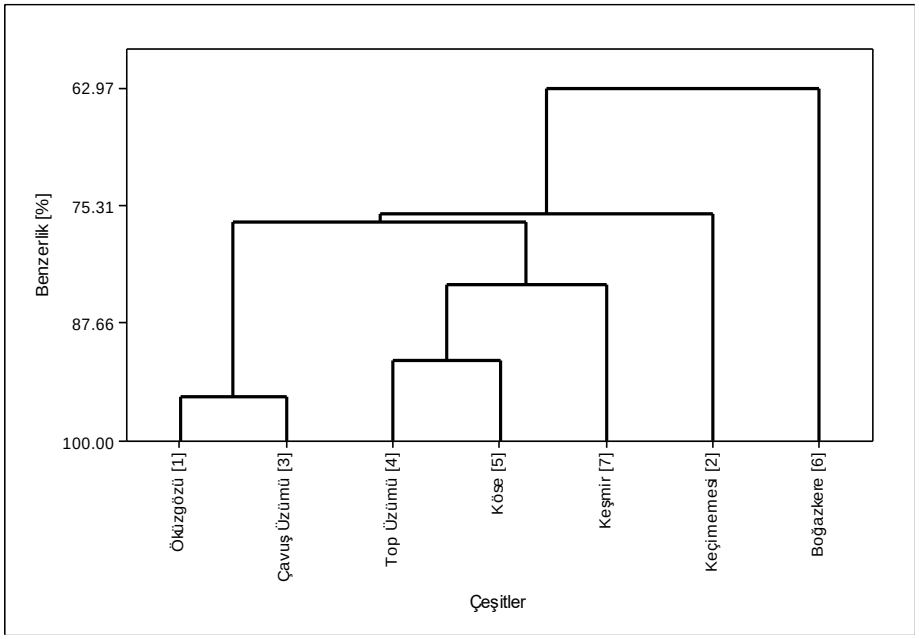
Glikoz ve fruktoz miktarı bakımından üzüm çeşitleri arasında istatistik olarak önemli farklılıkların olduğu tespit edilirken ($p<0.05$), sakkaroz çeşitlerde tespit edilmemiştir. Tanede bulunan şekerin yaklaşık %99'unu glikoz ve fruktoz oluşturmaktadır. Bu oranlar olgunluk dönemleri ile ilişkili olarak değişmektedir. Tanede büyümenin başlangıcında glikoz daha yüksek konsantrasyonda iken tam olgunlukta glikoz ve fruktoz konsantrasyonları eşitlenmektedir. Geç olgunlukta ise fruktoz daha yüksek konsantrasyondadır (Dharmadhikari, 1994; Korkutal ve ark., 2012). Çeşitlerin glikoz miktarı 7.35 (Top üzüm)-10.97 g/100 g (Köse), fruktoz miktarı ise 7.55 (Öküzgözü)-10.44 g/100 g (Köse) aralığında tespit edilmiştir (Çizelge 3).

Kümeleme analizi özet sonuçları Çizelge 4'te ve buna ilişkin dendogram ise Şekil 5'te verilmiştir. Çizelge 4 ve Şekil 5'ten anlaşılacağı üzere; en yüksek benzerlik yaklaşık %95.3 ile Öküzgözü ve Çavuş üzümü çeşitleri arasında gözlenirken, bunu yaklaşık %91.58 ile Köse ve Top üzümü arasındaki benzerlik oranı izlemiştir. Daha sonra bu kümeye, Keşmir çeşidinin katılması ile benzerlik düzeyi %83.50'ye düşmüştür. Boğazkere dışındaki diğer çeşitler arasındaki benzerlik oranı, yaklaşık %76.19 olurken, bu altı çeşidin oluşturduğu kümeye Boğazkere çeşidinin katılması ile benzerlik oranı %62.97'ye gerilemiştir. Böylece çeşitlerin benzerlik oranı, yaklaşık %95 ile %63 arasında değişim göstermiştir. Diğer bir ifadeyle, bu

çeşitler arasında yaklaşık %63 benzerlik gözlenirken, %37 oranında fenotipik varyasyon olduğu söylenebilir.

Çizelge 4. Kümeleme analizi özet sonuçları

Adım	Küme Sayısı	Benzerlik Düzeyi (%)	Birleşen Çeşitler		Yeni Küme	Kümedeki Çeşit Sayısı
1	6	95.3148	1	3	1	2
2	5	91.5772	4	5	4	2
3	4	83.4955	4	7	4	3
4	3	76.9444	1	4	1	5
5	2	76.1893	1	2	1	6
6	1	62.9723	1	6	1	7



Şekil 5. Çeşitler arası benzerlik için dendogram

4. Sonuç

Bu çalışmada, Elazığ ili Sivrice ekolojisinde yetişen Öküzgözü ve Boğazkere gibi bilinen çeşitlerin yanı sıra; daha az tanınan Top üzüm, Keşmir, Çavuş üzümü, Köse ve Keçimemesi gibi yerel üzüm çeşitlerinin tane fiziksel ve kimyasal kalite özellikleri belirlenmeye çalışılmıştır. Çalışma sonuçlarının, yerel çeşitlerin tanınırlığını artırmaya katkı sağlamak ve rekabetçi bir ürün yelpazesi oluşturmayı mümkün kılmak bakımından önemli olduğu

düşünülmektedir. Bununla birlikte, tane fiziksel ve kimyasal kalite özellikleri bakımından, Elazığ ilinin zengin asma gen potansiyeli varlığının, gelecek çalışmalarda ayrıntılı olarak incelenmesi önerilmektedir.

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BATTALGAZİ (MALATYA) EKOLOJİSİNDE YETİŞTİRİLEN BAZI ÜZÜM ÇEŞİTLERİNİN OLGUNLUK AŞAMASINDA TOPLAM FENOLİK BİLEŞİK İÇERİĞİ VE ANTİOKSİDAN AKTİVİTESİ

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Özet
Üzüm, tüm dünyada yaygın olarak tüketilen ve çok sayıda çeşide sahip ekonomik bir meyve olup, doğal fenolik bileşik ve antioksidan kaynağıdır. Üzümlerden elde edilen çeşitli fenolik bileşik ve antioksidanların beslenme ve sağlık üzerindeki etkilerine ait araştırmalar günümüzde de dinamik bir çalışma alanıdır. Üzüm tanesinin bileşiminde bulunan antioksidan bileşiklerin kompozisyonu, başta çeşit faktörü olmak üzere; iklim, toprak, ekoloji ve olgunluk gibi faktörlere göre şekillenmektedir. Bu nedenle, üzüm çeşitlerinin, bulundukları koşullar içerisinde sahip oldukları fenolik profilin belirlenmesi gerek çeşitlerin karşılaştırılması gerekse de tür içi kapasite değişiminin ortaya konması bakımından önemlidir. Bu çalışmada, 728 m rakıma sahip Malatya Kaysı Araştırma Enstitüsü Müdürlüğü Battalgazi Yerleşkesi Koleksiyon Bağı'nda 110 R anacı üzerinde yetiştirilen sekiz yaşlı 10 adet üzüm çeşidinin 2021 yılı vejetasyon döneminde toplam fenolik bileşik içeriği ve antioksidan aktivitesi belirlenmiştir. Çalışmanın materyalini oluşturan Ağın Beyazı, Barış, Hatun Parmağı, Italia, Kureyş ve Tahannebi beyaz-sarı, Banazkara, Horoz Karası, Köhnü ve Öküzgözü ise kırmızı-siyah tane rengine sahip çeşitlerdir. Olgunluk aşamasında Suda Çözünür Kuru Madde (SÇKM) değerleri refraktometre ile belirlenerek, üzüm çeşitlerine göre 14-21 °Briks aralığında hasat gerçekleştirilmiştir. Tanelerde toplam fenolik bileşik içeriği Folin Ciocalteu yöntemi ile gallik asit eşdeğeri (GAE), antioksidan aktivite ise Difenil-1-pikrihidrazil Radikal Söndürücü Kapasitesi (DPPH) yöntemine göre troloks eşdeğeri (TE) olarak spektrofotometre ile analiz edilmiştir. Her iki özellik bakımından da çeşitler arası fark istatistik olarak önemli bulunmuştur ($p<0.001$). Çeşitlerin toplam fenolik bileşik içeriği 447.160 mg GAE/100g (Banazkara)-123.977 mg GAE/100g (Hatun Parmağı), antioksidan aktivite değerleri ise 254.577 mg TE/g (Banazkara)-113.977 mg TE/g (Hatun Parmağı) aralığında değişim göstermiştir. Çalışma sonucunda toplam fenolik bileşik içeriği ve antioksidan aktivite bakımından Banazkara, Horoz Karası ve Tahannebi çeşitlerinin yüksek potansiyele sahip oldukları belirlenmiştir.
Anahtar Kelimeler: *Vitis vinifera* L., gen kaynakları, Malatya, olgunluk, fenolik bileşikler

TOTAL PHENOLIC COMPOUND CONTENT AND ANTIOXIDANT ACTIVITY OF SOME GRAPE VARIETIES GROWN IN BATTALGAZİ (MALATYA) ECOLOGY AT MATURITY

Abstract
Grape is an economical fruit that is widely consumed all over the world and has many varieties, and is a source of natural phenolic compounds and antioxidants. Research on the effects of various phenolic compounds and antioxidants obtained from grapes on nutrition and health is still a dynamic field of study today. The composition of antioxidant compounds found in grape berries depends on the variety factor; it is shaped according to factors such as climate, soil, ecology and maturity. For this reason, determining the phenolic profile of grape varieties under their conditions is important in terms of both comparing the varieties and revealing the variation in capacity within the species. In this study, the total phenolic compound content and antioxidant activity of 10 eight-year-old grape varieties grown on 110 R rootstocks in the Malatya Kaysı Research Institute Directorate Battalgazi Campus Collection Vineyard at an altitude of 728 m were determined during the 2021 vegetation period. 'Ağın Beyazı', 'Barış', 'Hatun Parmağı', 'Italia', 'Kureyş' and 'Tahannebi' white-yellow, which constitute the material of the study, are varieties with white-yellow berry color, while 'Banazkara', 'Horoz Karası', 'Köhnü' and 'Öküzgözü' are varieties with red-black berry color. At the maturity stage, total soluble solids (TSS) values are determined by a refractometer. Depending on grape varieties, harvesting was carried out within the 14-21 °Brix. Total phenolic compound content in the berries was analyzed as gallic acid equivalent (GAE) by the Folin Ciocalteu method, and antioxidant activity was analyzed as trolox equivalent (TE) by the Diphenyl-1-picrihydrazyl radical quenching capacity (DPPH) method, by spectrophotometer. The difference between varieties in terms of both characteristics was found statistically significant ($p<0.001$). Total phenolic compound content of the varieties varied between 447.160 mg GAE/100g (Banazkara)-123.977 mg GAE/100g (Hatun Parmağı), and antioxidant activity values varied between 254.577 mg TE/g (Banazkara)-113.977 mg TE/g (Hatun Parmağı). As a result of the study, it was determined that 'Banazkara', 'Horoz Karası' and 'Tahannebi' varieties had high potential in terms of total phenolic compound content and antioxidant activity.
Keywords: *Vitis vinifera* L., genetic resources, Malatya, maturity, phenolic compounds.

1. GİRİŞ

Fenolik bileşikler, bitki sekonder metabolitleri olup, bitkinin savunma mekanizmasında görev alarak çevresel streslere karşı tolerans mekanizmasında görev yapan organik bileşiklerdir (Shahab vd.2023). Bitki mekanizmasındaki görevlerinin yanı sıra tıbbi etkilerinin anlaşılması ve geliştirilmesi önemli olmuştur (Kunter ve Keskin 2019).

Birçok çalışma, sebze ve meyve tüketen bireylerin kanser, kardiyovasküler hastalık ve hipertansiyon gibi kronik hastalıklara yakalanma riskinin daha düşük olmasını, fitokimyasallar olarak bilinen yüksek biyoaktif bileşikler, yani karotenoidler, fenolik bileşikler, vitaminler ve meyve-sebzelerdeki içsel metabolitler ile ilişkilendirmiştir (Giusti ve Jing 2007; Howard ve Hager 2007; Wang 2007). Bu nedenlerle fenolik bileşikler araştırmacılar ve gıda üreticileri için gün geçtikçe daha cazip hale gelmektedir (Manach vd. 2004).

Üzüm ve üzüm ürünleri antioksidanlar, fenolikler, mineraller, organik asitler ve vitaminler bakımından zengin olup çeşitli sağlık yararları nedeniyle tercih edilmektedir. Üzümün kalitesi ve besin bileşimi, çevresel faktörlere (toprak, iklim ve sezon), kültürel uygulamalara (gübreleme, sulama, yabancı ot ile hastalık ve zararlı kontrolü), bazı dışsal kimyasal uygulamalara (kaolin, hormonlar ve sakkaroz gibi), bağcılık tekniğine (çeşit, omca yaşı, terbiye şekli, kış budaması, ürün yükü), taç yönetimine (terbiye sistemi ve budama, salkım seyreltme, bilezik alma, yaprak alma) ve uygulamaların kombinasyonlarına bağlı olarak değişim göstermektedir (Fidelibus vd., 2018, Lo'ay ve El-Boray, 2018; Askari-Khorasgani ve Pessarakli, 2019; Izcara vd., 2021). Fenolik bileşikler üzümlerin ticari kullanımına yönelik kalite faktörleri olarak da önemlidir.

Malatya, asma genetik kaynaklarının değerlendirilmesinde geleneksel yaklaşımlarıyla çeşitliliğe sahip önemli bir ildir. İlde bir yandan filokseranın yoğun zararı, diğer yandan yoğun şekilde hissedilen kırsal alandan göç olayı, bağcılığın gerilemesine neden olsa da Merkez, Pötürge, Yazıhan, Kuluncak, Yeşilyurt, Doğanyol, Kale, Hekimhan, Akçadağ, Doğanşehir, Battalgazi, Darende, Arguvan ve Arapkir ilçelerinde bağcılık faaliyetleri devam etmektedir. Malatya'da hem sofralık hem şıralık-şaraplık, hem de çekirdekli kurutmalık üzüm çeşitleri başarı ile yetiştirilebilmektedir. Yaklaşık 36.348 dekarlık bir alanda toplam 19.304 ton üzüm üretimi (TÜİK, 2021) gerçekleşmiş olup üzüm üretimi daha çok çekirdekli sofralık çeşitlerle yapılmaktadır. Yetiştirilen mevcut çeşitler, daha çok orta mevsim ve geçci çeşitlerdir.

Bu çalışmada, Malatya Kayısı Araştırma Enstitüsü'nün Battalgazi ilçesinde bulunan koleksiyon bağında yetiştirilen 10 farklı üzüm çeşidinin toplam fenolik bileşik ve antioksidan kapasitesi belirlenmiştir.

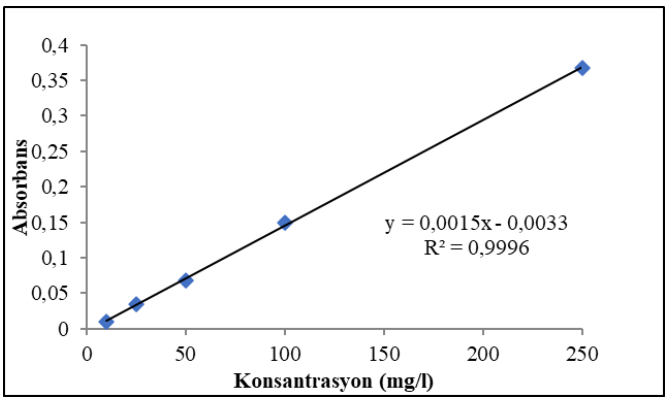
2. MATERYAL VE YÖNTEM

Materyal

Çalışma, 2021 yılı vejetasyon döneminde Malatya Kaysı Araştırma Enstitüsü Müdürlüğü Battalgazi Yerleşkesi (38°27'30.73"K enlemi ile 38°21'18.60"D boylamı ve 728 m rakım) Koleksiyon Bağı'nda yürütülmüştür. Üzerinde çalışılan üzüm çeşitleri 110 R anacı üzerinde yetiştirilen sekiz yaşlı Ağın Beyazı, Banazkara, Barış, Italia, Hatun Parmağı, Horoz Karası, Köhnü, Kureyş, Öküzgözü ve Tahannebi'dir. . Çeşitlerden Ağın Beyazı, Barış, Hatun Parmağı, Italia, Kureyş ve Tahannebi beyaz renkli Banazkara, Horoz Karası, Köhnü ve Öküzgözü çeşitleri ise renklidir. Koleksiyon bağı, 3.5x2 m dikim sıklığında tesis edilmiş ve omcalar 80 cm yüksekliğinde gövde üzerinde çift T telli terbiye sisteminde çift kollu kordon şeklinde terbiye edilmiştir. Tüm üzüm çeşitlerine aynı bakım ve mücadele işlemleri uygulanmıştır. Bağda sulama damla sulama sistemi ile gerçekleştirilmiştir. Hastalık ve zararlı durumuna göre düzenli olarak ilaç uygulanmasına rağmen külleme, gri küf, kuş ve arı zararı önlenememiştir. Bu talihsiz durum verim ve kalite özelliklerini olumsuz etkilemiştir. Üzüm çeşitleri fiziksel olgun görünüm aşamasında refraktometre değeri belirlenerek (çeşide göre 14-21 °Briks) hasat edilmiştir.

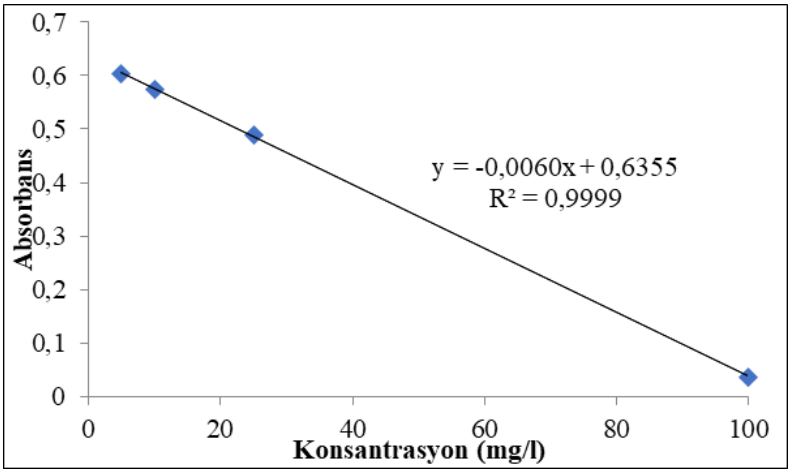
Yöntem

Ekstraksiyon için yaklaşık 1g homojenize edilmiş taze üzüm örnekleri falcon tüpler içerisine tartılmıştır. Metanol: su: hidroklorik asit (70:29.9:0.1, h/h/h) çözgen karışımında ekstrakte edilmiştir. Süpernatant kısımlar 0.45 µm Polivinilidendiflorür (PVDF) filtre yardımıyla süzülmüştür. Elde edilen ekstraktlar analiz edilinceye kadar +4 ºC'de muhafaza edilmiştir. Üzüm örneklerinin toplam fenolik bileşik içeriğinin belirlenmesi için 100 µl örnek, 2300 µl saf su ve 150 µl Folin reaktifi eklenerek iyice karıştırılmıştır. Karışım, 3 dakika bekletilmiş ve ardından 450 µl Na_2CO_3 eklenerek homojen bir şekilde karışması sağlanmıştır. Örneklerin absorbans değerleri 2 saatin sonunda 765 nm'de köre karşı ölçülmüştür. Örneklerin toplam fenolik bileşik miktarı gallik asit eşdeğeri (mg GAE/kg taze ağırlık) olarak belirlenmiştir (Şekil 2.1).



Şekil 2.1. Gallik asit standardına ait kalibrasyon grafiği

Üzüm çeşitlerinin antioksidan kapasitesi Difenil-1-pikrihidrazil Radikal Söndürücü Kapasitesi (DPPH) yöntemiyle belirlenmiştir. Örnek ekstraktlarının antioksidan kapasitesi için hazırlanan DPPH (2,2-difenil-1-pikrilhidrazil) çözeltisinin absorbans değeri 517 nm'de 0.700±0.03 olacak şekilde metanol ile seyreltilerek ayarlanmıştır. Ardından tüplerde 50 µl örnek, 250 µl ekstrasiyon çözgeni ve üzerine 3700 µl DPPH konularak iyice karıştırılmıştır. Elde edilen karışımlar 30 dakika bekletilmiştir. Sürenin sonunda absorbans değerleri 517 nm'de ölçülmüştür. Elde edilen sonuçlar troloks eşdeğeri (mg TE/g taze ağırlık) olarak verilmiştir (Şekil 2.2). Üzerinde durulan özellikler bakımından çeşitlere göre tanımlayıcı istatistikler; ortalama, standart hata minimum ve maksimum değer olarak verilmiştir. Bu özellikler bakımından çeşitler arası fark olup olmadığını belirlemek amacıyla Tek yönlü Varyans analizi (One way ANOVA) yapılmıştır. Varyans analizi sonrası farklı çeşitleri belirlemek üzere Duncan çoklu karşılaştırma testi kullanılmıştır. Hesaplamalarda istatistik önemlilik (anlamlılık) düzeyi %5 olarak alınmış ve hesaplamalar için SPSS (ver: 21) istatistik paket programı kullanılmıştır.



Şekil 2.2. DPPH Troloks standardına ait kalibrasyon grafiği

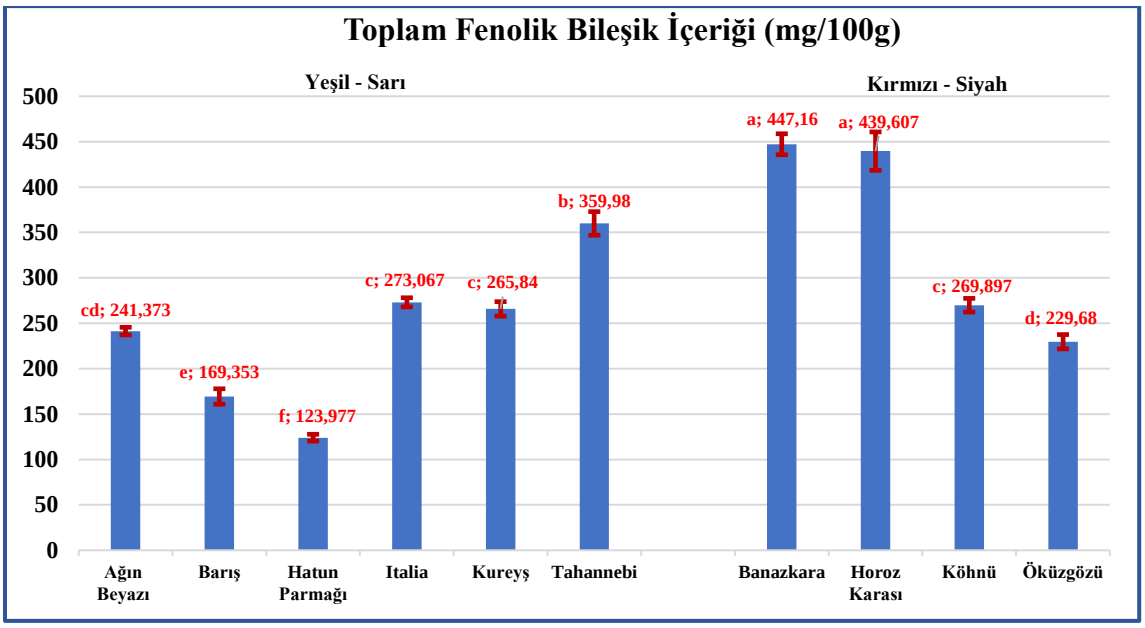
3. BULGULAR

Toplam fenolik bileşik bakımından çeşitlere göre tanımlayıcı istatistikler ve karşılaştırma sonuçları Çizelge 3.1 ve Şekil 3.1' de verilmiştir.

Çizelge 3.1. Toplam fenolik bileşik bakımından çeşitlere göre tanımlayıcı istatistikler ve karşılaştırma sonuçları

	Çeşitler	Ort.	St. Hata	Min.	Mak.	p
Toplam Fenolik Bileşik İçeriği (mg/100g)	Banazkara	447.160 a	11.565	426.96	467.02	0.001
	Kureyş	265.840 c	7.981	253.07	280.52	
	Köhnü	269.897 c	7.543	255.30	280.50	
	Tahannebi	359.980 b	13.002	340.63	384.70	
	Öküzgözü	229.680 d	7.900	215.00	242.08	
	Ağın Beyazı	241.373 cd	4.197	235.28	249.42	
	Barış	169.353 e	8.510	155.03	184.48	
	Hatun Parmağı	123.977 f	3.789	116.46	128.57	
	Italia	273.067 c	5.075	263.39	280.56	
	Horoz Karası	439.607 a	21.152	397.86	466.41	
	Genel	281.993	18.833	116.46	467.02	

a, b, c, .,. ↓: Farklı küçük harfi alan ortalamalar arası fark istatistik olarak önemlidir.



Şekil 3.1. Toplam fenolik bileşik içeriği bakımından üzüm çeşitlerinin karşılaştırılması

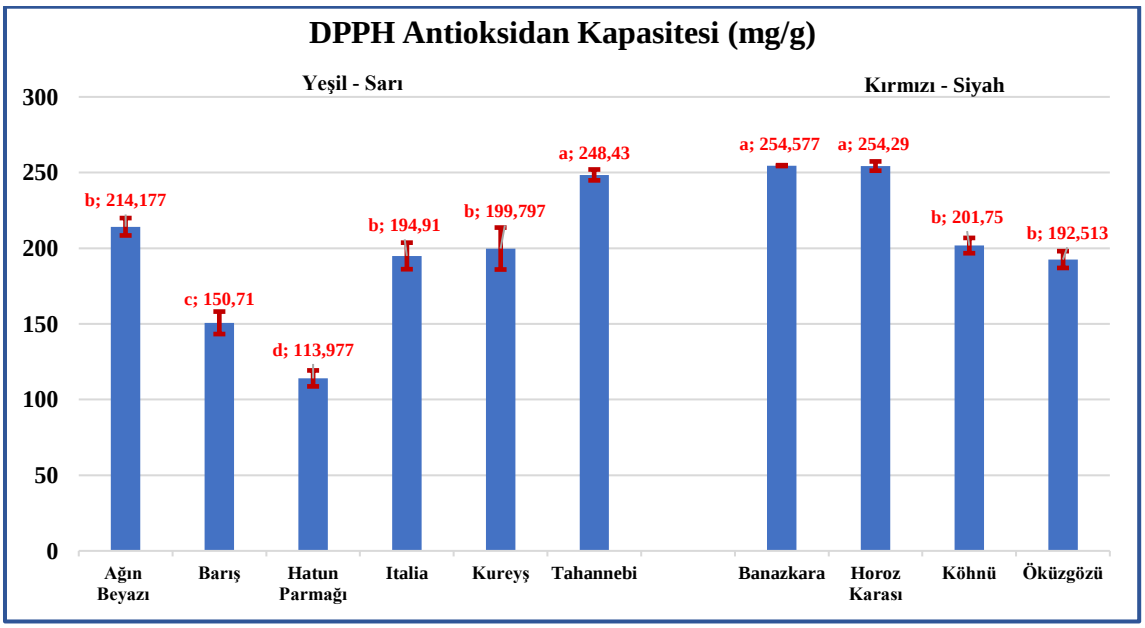
Toplam fenolik bileşik içeriği bakımından çeşitler arası fark istatistik olarak önemli bulunmuştur ($p<0.001$). En yüksek içerikten en düşük içeriğe doğru çeşitler Banazkara (447.160 mg/100g) > Horoz Karası (439.607 mg/100g) > Tahannebi (359.980 mg/100g) > Italia (273.067 mg/100g) Kureyş (265.840 mg/100g) > Köhnü (269.897 mg/100g) > Ağın Beyazı (241.373 mg/100g) > Öküzgözü (229.680 mg/100g) > Barış (169.353 mg/100g) > Hatun Parmağı (123.977 mg/100g) şeklinde sıralanmıştır. Üzümde fenolik bileşik içeriği başta çeşit özelliği olmak üzere, iklim, teruar ve olgunluk düzeyi gibi dört önemli faktör tarafından etkilenmektedir (Boonterm, 2010). Beyaz üzüm çeşitlerinde antosiyanin sentezlenmediğinden genellikle toplam fenolik bileşik miktarı kırmızı üzümlere göre daha düşüktür (Ivanova vd., 2011). Ancak çalışmada Tahannebi, Kureyş ve Ağın Beyazı gibi beyaz çeşitlerin toplam fenolik bileşik içeriği Öküzgözü ve Köhnü gibi renkli çeşitlere göre daha yüksek bulunmuştur. Çeşitlerin toplam fenolik bileşik ekstraksiyonunda bütün tane kullanılmış olup söz konusu çeşitlerin yüksek toplam fenolik bileşik içeriğinin çekirdeklerinden kaynaklı olduğu düşünülmektedir. Çünkü üzümde fenolik bileşikler en fazla çekirdeklerde (%60-70), daha sonra kabukta (%28-35) ve en az tane etinde (sadece yaklaşık %10) bulunmaktadır (Shi vd., 2003).

Toplam antioksidan kapasitesi (DPPH)bakımından çeşitlere göre tanımlayıcı istatistikler ve karşılaştırma sonuçları Çizelge 3.2 ve Şekil 3.2’ de verilmiştir.

Çizelge 3.2. Antioksidan kapasite bakımından çeşitlere göre tanımlayıcı istatistikler ve karşılaştırma sonuçları

	Çeşitler	Ort.	St. Hata	Min.	Mak.	p
DPPH Toplam Antioksidan Kapasitesi (mg/g)	Banazkara	254.577 a	0.286	254.07	255.06	0.001
	Kureyş	199.797 b	13.856	172.16	215.40	
	Köhnü	201.750 b	5.062	196.42	211.87	
	Tahannebi	248.430 a	3.596	242.20	254.66	
	Öküzgözü	192.513 b	5.560	186.68	203.63	
	Ağın Beyazı	214.177 b	5.743	208.20	225.66	
	Barış	150.710 c	7.437	141.24	165.38	
	Hatun Parmağı	113.977 d	5.279	107.87	124.49	
	Italia	194.910 b	8.770	177.71	206.49	
	Horoz Karası	254.290 a	3.054	249.00	259.58	
	Genel	202.513	8.147	107.87	259.58	

a, b, c, .,. ↓: Farklı küçük harfi alan ortalamalar arası fark istatistik olarak önemlidir.



Şekil 3.1. Antioksidan kapasite bakımından üzüm çeşitlerinin karşılaştırılması

Antioksidan kapasitesi bakımından çeşitler arası fark istatistik olarak önemli bulunmuştur ($p<0.001$). En yüksek değerden en düşük değere doğru çeşitler Banazkara (254.577 mg/g) > Horoz Karası (254.290 mg/g) > Tahannebi (248.430 mg/g) > Ağın Beyazı (214.177 mg/g) >

Köhnü (201.750 mg/g) > Kureyş (199.797 mg/g) > Italia (194.910 mg/g) > Öküzgözü (192.513 mg/g) > Barış (150.710 mg/g) > Hatun Parmağı (113.977 mg/g) şeklinde sıralanmıştır. Duran (2014), Banazkara, Köhnü, Kureyş ve Tahannebi üzüm çeşitlerinin DPPH yöntemi ile kabuk ve çekirdeğinde antioksidan kapasitelerini sırasıyla 34.04-510.64 mg/g (Tahannebi), 11.09-529.60 mg/g (Kureyş), 25.36-538.29 mg/g (Banazkara) ve 38.21-536.10 mg/g (Köhnü) olarak belirlemiştir.

4. SONUÇ

Üzüm, insan sağlığı üzerinde etkileri olan çok güçlü bir polifenolik bileşik kaynağıdır. Ülkemizin 1400'den fazla asma genetik kaynağına sahip olduğu düşünüldüğünde çeşitler özelinde bu değerli bileşiklerin belirlenmesi önemlidir. Bu çalışmada, Malatya Kayısı Araştırma Enstitüsü'nün Battalgazi ilçesinde bulunan koleksiyon bağında yetiştirilen 10 farklı üzüm çeşidinin toplam fenolik bileşik ve antioksidan kapasitesi belirlenmiştir. Çalışma sonucunda toplam fenolik bileşik içeriği ve antioksidan aktivite bakımından Banazkara, Horoz Karası ve Tahannebi çeşitlerinin yüksek potansiyele sahip oldukları belirlenmiştir.

Teşekkür: Bu çalışma Van YYÜ Bilimsel Araştırma Projeleri Koordinasyon Birimi tarafından FYL-2021-9699 No'lu proje ile desteklenmiştir.

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TARIMSAL FAALİYETLERİN KIRSAL KALKINMADAKİ ROLÜNÜN SÜRDÜRÜLEBİLİR KALKINMA HEDEFLERİ PERSPEKTİFİNDEN İNCELENMESİ

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Özet
Tüm dünyada bölgesel gelişme politikaları kapsamında odaklanılan önemli bir politika alanı olan kırsal kalkınma, kırsal kalkınma politikaları aracılığıyla refahın ülke geneline daha dengeli yayılması ve tüm bölgelerin ulusal kalkınmaya azami düzeyde katkı sağlanmasına aracılık etmektedir. Türkiye'de de bölgesel gelişme vizyonuna ulaşılmasında barındırdığı potansiyel bakımından önemle ele alınması gereken bir konu olarak gündemde yer almaktadır. Tüm dünyada olduğu gibi, Türkiye'de de kırsal alanlardaki ekonomik faaliyetlerin odağında tarımsal faaliyetler yer almaktadır. Türkiye'nin kalkınmasına paralel olarak tarım sektörünün GSYH içindeki payı düşüş eğiliminde olmakla birlikte, gelişmiş ülkeler ortalamasının halen üzerindedir. İstihdam açısından değerlendirildiğinde ise, Türkiye'deki toplam istihdamın yaklaşık beşte birini oluşturan tarımsal istihdamın neredeyse tamamı kırsal alanlardadır. Kırsaldaki toplam istihdam içerisinde, tarım istihdamının payının yüzde 60'ın üzerinde olduğu tahmin edilmektedir. Diğer taraftan kırsal alanlardaki ekonomik faaliyetler, istihdam verilerine de yansıdığı üzere sadece tarımla sınırlı değildir. Kırsal sanayi, kırsal hizmetler, enerji ve madencilik gibi diğer iktisadi faaliyet kollarında da kırsal alanda önemli hareketlilik söz konudur. Bu çerçevede kırsaldaki ekonomik faaliyetleri sadece tarımdan ibaret olmadığı gibi, kırsal alanları da sadece köy olarak düşünmemek gerekmektedir. Çağdaş kır-kent yaklaşımları, kırı ve kenti kesin çizgilerle ayırmak yerine; mekânı süreklilik arz eden bir çerçevede karşılıklı bağımlılıklar üzerinden ele alarak kırsal ve kentsel entegrasyona odaklanmaktadır. Dolayısıyla, kırsal ekonomi köy altı yerleşim yerlerinden başlayarak belde, ilçe, küçük-orta büyüklükteki il merkezi ve metropollere uzanan bir ekonomik zincirin parçasıdır. Türkiye'de yaygın kabul gören kırsal alan tanımı, kırsalı nüfusu 20 binden düşük yerleşim yerleri olarak sınıflandırmaktadır. Bu itibarla ülke nüfusumuzun yaklaşık yüzde 25'i kırsalda yaşamaktadır. Bununla birlikte, kırsal alanların ulusal kalkınmaya katkısı ülke sathında homojen dağılmamaktadır. Bazı bölgelerin katkısı azami düzeyde bulunmaktayken, bazı bölgelerde kırsal alanlarda henüz değerlendirilememiş atıl kapasite bulunduğu görülmekte olup, bu bölgelerin refahının ülke ortalamasına yaklaştırılması ihtiyacı söz konusudur. Ulusal Kırsal Kalkınma Stratejisi (2021-2023)'le uyum gözetilerek, ülkemizin bölgesel gelişme perspektifinde kırsal ekonominin geliştirilmesine yönelik faaliyetlerin ana unsurları Sürdürülebilir Kalkınma Hedefleri arasında yer alan Hedef 8- İnsana Yakışır İş ve Ekonomik Büyüme, Hedef 11- Sürdürülebilir Şehir ve Yaşam Alanları, Hedef 2- Açlığa Son hedefleri ve alt hedeflerinin içerdiği amaçlar ve politikalar aracılığıyla incelenecektir.
Anahtar Kelimeler: Tarımsal Faaliyetler, Kırsal Kalkınma, Sürdürülebilir Kalkınma Amaçları

EXAMINING THE ROLE OF AGRICULTURAL ACTIVITIES IN RURAL DEVELOPMENT FROM THE PERSPECTIVE OF SUSTAINABLE DEVELOPMENT GOALS

Abstract
Rural development, which is an important policy area focused on within the scope of regional development policies all over the world, is instrumental in spreading welfare more evenly across the country through rural development policies and ensuring that all regions contribute to national development at the maximum level. In Turkey, it is also on the agenda as an issue that needs to be addressed with importance in terms of its potential in achieving the regional development vision. As in the rest of the world, agricultural activities are at the center of economic activities in rural areas in Turkey. Although the share of the agricultural sector in GDP has been declining in parallel with Turkey's development, it is still above the average of developed countries. In terms of employment, almost all agricultural employment, which accounts for about one-fifth of total employment in Turkey, is in rural areas. The share of agricultural employment in total rural employment is estimated to be over 60 percent. On the other hand, economic activities in rural areas are not limited to agriculture, as reflected in employment data. Other branches of economic activity such as rural industry, rural services, energy and mining also have significant mobility in rural areas. In this framework, rural economic activities are not only limited to agriculture, and rural areas should not be considered only as villages. Contemporary rural-urban approaches focus on rural and urban integration by considering the space through interdependencies in a continuous framework, rather than separating rural and urban areas. Therefore, the rural economy is part of an economic chain starting from sub-village settlements and extending to towns, districts, small-medium sized provincial centers and metropolises. The widely accepted definition of rural areas in Turkey classifies rural areas as settlements with a population of less than 20 thousand. In this respect, approximately 25 percent of the country's population lives in rural areas. However, the contribution of rural areas to national development is not homogeneously distributed across the country. While the contribution of some regions is maximized, in some regions there is untapped idle capacity in rural areas, and there is a need to bring the welfare of these regions closer to the national average. In line with the National Rural Development Strategy (2021-2023), the main elements of the activities for the development of the rural economy in the regional development perspective of our country will be examined through the goals and policies included in Goal 8 - Decent Work and Economic Growth, Goal 11 - Sustainable Cities and Living Spaces, Goal 2 - No Hunger among the Sustainable Development Goals and their sub-goals.
Keywords: Agricultural Activities, Rural Development, Sustainable Development Goals

1. GİRİŞ

Bir bölgenin sürdürülebilir kalkınması, kentleşmiş bölgeler için bir tedarik ve kaynak kaynağı olarak kırsal kesimlerinin sürdürülebilirliğini gerektirir. Mevcut iklim değişiklikleri, biyoçeşitlilik kaybı, sınırlı kaynaklar, nüfus azalması, ekonomik koşulların bozulması ve hatta yoksulluk kırsal nüfusun sürdürülebilir kalkınmasını sınırlayabilir. Bu çalışma, kırsal alanların sürdürülebilir kalkınmasının seçilen Sürdürülebilir Kalkınma Göstergeleri ışığında değerlendirilmesine ilişkin bir çalışma sunmaktadır. Değerlendirme, sürdürülebilirliğin çevresel, sosyal ve ekonomik ayaklarını kapsamaktadır. Bununla birlikte, sanitasyon dahil temel hizmetlere sınırlı erişim, doğal çevre üzerindeki insan baskısı, temiz ve yenilenebilir enerjiye sınırlı erişim, nüfusun azalması, yaşlanma, olumsuz ekonomik koşullar ve tarımın nispeten düşük verimliliği dahil olmak üzere kırsal sürdürülebilirlik için bazı ciddi sınırların varlığı söz konusudur.

Bugün kullanılan şekliyle sürdürülebilir kalkınma kavramı 1987 yılında Dünya Çevre ve Kalkınma Komisyonu (WCED) tarafından Ortak Geleceğimiz adlı raporda ortaya atılmıştır (UN, 1987). Ayrıca 1997 yılında Polonya Cumhuriyeti Anayasası'nın 5. Maddesine eklenmiştir. Söz konusu rapora göre sürdürülebilir kalkınma, bir yandan şimdiki neslin kalkınma arzularını tatmin ederken diğer yandan gelecek nesillerin de aynı arzuları tatmin etme olasılığını korumayı amaçlayan bir süreç olarak tanımlanmıştır (Altınay vd., 2022). Aynı zamanda, sürdürülebilir kalkınmanın küresel ölçekte ekonomik, sosyal ve çevresel alanlardaki faaliyetlerin eşzamanlı olarak bütünleştirilmesi ve uyumlaştırılması gereken bir süreç olduğu güçlü bir şekilde vurgulanmıştır. Sürdürülebilir kalkınmanın, doğaya ve nesiller arası adalet kuralına saygı çerçevesinde gerçekleştirilen karmaşık ve kompleks stratejileri, sürdürülebilirliğin yukarıda bahsedilen tüm çemberlerini entegre etmelidir. 2001'de oluşturulan ve 2006'da değiştirilen Avrupa Birliği Sürdürülebilir Kalkınma Stratejisi kapsamında, doğal çevrenin korunması, adalet ve sosyal uyum, ekonomik refah ve AB taahhütlerinin uluslararası düzeyde uygulanmasını içeren dört ana eylem hedefi tanımlanmıştır. Stratejinin temel zorlukları iklim değişikliği ve temiz enerji, sürdürülebilir ulaşım, tüketim ve üretim, doğal kaynakların korunması ve yönetimi, kamu sağlığı, sosyal bütünleşme, demografi ve göç, küresel yoksulluk ve sürdürülebilir kalkınma alanındaki zorluklardır (Harris vd., 2001).

Bir nüfusun sürdürülebilir kalkınması, daha geniş ölçekte ele alındığında, yalnızca doğal kaynakları tüketmeden şehirlerin inşa edilmesi ve sürdürülmesi anlamına gelen kentsel

sürdürülebilirlikle sınırlı kalmamalı, aynı zamanda gıda, lif ve enerji dahil olmak üzere insan ve doğal kaynakların tedarik kaynağı olan kırsal bölgelerin sürdürülebilirliğini de kapsamalıdır. Küresel çevre krizine yol açan iklim değişiklikleri, kentleşme, yoksulluk ve biyoçeşitlilik kaybı, kırsal alanlardaki topluluklar için risk oluşturmakta ve kırsal alanların sürdürülebilir kalkınmasını birçok bölgede önemli bir konu haline getirmektedir. Kırsal kalkınma, tarım sistemlerinin doğal çevreye yakınlığı ile de yakından ilgilidir ve önemli bir ekilebilir toprak alanı ve su ile sulama gerektirir. Yeraltı sularının, nehirlerden, akarsulardan ve göllerden alınan suyun yaklaşık %70'inin tarımsal üretim için kullanıldığı varsayılmaktadır (Loris vd., 2008). AB'nin "Kırsal Alanlarda Daha İyi Bir Yaşam" başlıklı Cork 2.0 bildirgesinde kırsal kalkınmanın desteklenmesine olanak tanıyan ve diğerlerinin yanı sıra kırsal refahın teşvik edilmesi, kırsal canlılık ve canlılığa yatırım yapılması, kırsal çevrenin korunması, kırsal kaynakların yönetilmesi, bilgi ve yeniliğin desteklenmesi, kırsal yönetişimin geliştirilmesi ve performans ve hesap verebilirliğin iyileştirilmesi gibi çeşitli politikalar belirtilmiştir. Ancak, kırsal alanların sürdürülebilir kalkınması karmaşık bir görevdir ve farklı bölgelerde birçok ciddi sınır ve engelle karşılaşmaktadır (Ivanovic vd., 2009). Avrupa Birliği'nin Ortak Tarım Politikası (CAP) için stratejik planlarında da rapor edilen Avrupa Birliği'ne üye ülkelerin çoğunda tanımlanan en önemli sorunlar yaşlanma, nüfus azalması, yoksulluk, sosyal dışlanma, temel altyapı eksikliği (su ve kanalizasyon hizmetleri dahil), işsizlik, kaliteli iş fırsatlarının eksikliği ve kırsal ve kentsel alanlar arasındaki sosyo-ekonomik uçurumdur. Ancak, bu sorunlar dünyanın çeşitli bölgelerindeki gelişmekte olan ülkelerin birçok farklı bölgesi için tipiktir (Kestemont vd., 2011).

Bu çalışma, kırsal alanların sürdürülebilirlik göstergeleri ışığında sürdürülebilir kalkınma değerlendirmesine ilişkin özgün bir çalışmayı sunmaktadır. Sunulan çalışma, çevresel, sosyal ve ekonomik sürdürülebilirliğin çeşitli yönlerini yansıtan seçilmiş Sürdürülebilir Kalkınma Göstergeleri (SKG) setine dayanmaktadır.

2. KIRSAL BÖLGELER KAVRAMI

Literatürde kırsal alan, kırsal bölge ve kırsal kalkınma terimlerinin bazı tanımları sunulmaktadır. Geleneksel olarak kırsal, tarımla ilgilidir; bu vizyon, son yıllarda ortaya çıkan dinamikler, süreçler ve faaliyetler nedeniyle geçerliliğini yitirmiştir. Günümüzde, kırsal alanları tanımlamak zordur çünkü kentsel ve kırsal alanlar arasındaki sınırlar giderek daha karmaşık

hale gelmekte ve bulanıklaşabilmektedir. Benzer şekilde, Avrupa Komisyonu da kırsal alan kavramının çok çeşitli ekonomik ve sosyal dokulardan oluşan bir bütünü ifade ettiğini ifade etmektedir (Ledoux vd., 2005). Ayrıca, kırsal alanın ne olduğunu tanımlayan yere bağlı olarak, belirli kriterlerin uygulandığı kabul edilmektedir. Örneğin, Türkiye, Almanya, İspanya, Fransa, İrlanda ve İtalya gibi ülkelerde bir mekanı kırsal olarak tanımlayan temel kriter nüfus iken Birleşik Krallık, Danimarka, Belçika, Lüksemburg ve Hollanda'da ise bölgesel gelişmişlik kriteri dikkate alınmaktadır. Ayrıca, Ekonomik İşbirliği ve Kalkınma Örgütü (OECD) ve Avrupa Komisyonu İstatistik Ofisi (EUROESTAT), km2 başına düşen kişi sayısı 150 ve 100 sınırını tanımlayan nüfus yoğunluğu kriterlerini uygulamaktadır. Kırsal-kentsel alan arasında giderek artan bir ilişki ve kırsal alanda geliştirilen ekonomik faaliyet türlerindeki değişiklikler geleneksel iş olan tarımsal faaliyetlerden ikincil üretim ve hizmet faaliyetlerine doğru bir kayma olduğu için alan/bölge tanımının zaman içinde değiştiği ve çok boyutlu bir kavram haline geldiği tespit edilmiştir (Harris vd., 2001).

3. KIRSAL KALKINMA KAVRAMI

Kırsal kalkınma kavramı, ekonomik ve sosyal kalkınmadaki yeni koşullar aileler ve kırsal faaliyetler üzerinde değişiklikler yarattıkça zaman içinde değişmiştir. Bununla birlikte, kavramın amacı aynı kalmıştır; bu da kırsal nüfusun refahını artırmaktır. Ayrıca, kırsal kalkınmayı "bölgesel bir politika ve katılımcı kuruluşlar tarafından bölgesel temelli tedbirlerin entegre bir şekilde uygulanması yoluyla kırsal dünyanın ekonomik, sosyal ve çevresel potansiyeline dayalı olarak dengeli ve kendi kendini sürdürebilir bir şekilde yeniden canlandırılması süreci" olarak tanımlamaktadır; bölge ve kırsal kalkınma birbiriyle yakından ilişkili iki kavramsal unsurdur. Benzer şekilde, bu bölgelerde şu anda mevcut olan dinamiklere katkıda bulunan yeni kırsal kalkınma paradigmasının bol miktarda literatürünü tanımlamaktadır. Ancak, kırsal kalkınma kavramının muğlak ve zayıf tanımlanmış olduğunu kabul etmektedir. Yukarıdakilere dayanarak yazarlar, kırsal kalkınmanın kırsal alanlardaki yaşam ve çalışma koşullarının iyileştirilmesinden oluştuğunu, bu sayede bölgelerin sosyal, kültürel ve çevresel değerlerine saygı duyulduğunu, yani kırsal kalkınmanın nüfusun ve bölgenin yaşam kalitesine olumlu katkıda bulunduğunu anlamaktadır (Palme ve Tillman, 2008; Harris, 2001).

Benzer şekilde, modernleşme paradigması olan dışsal ve sektörel yaklaşımın, hem ekonomik hem de sosyal ve çevresel hedefleri dikkate alan yerel karakterli, endojen ve entegre yeni bir

yaklaşıma geçmesinden bu yana yaklaşımda önemli bir değişikliğe işaret eden kırsal kalkınmaya yönelik yeni yaklaşımlara da katkılar tespit edilmiştir (Prescot, 2001). Dolayısıyla Avrupa bölgesel politikası, geleneksel yukarıdan aşağıya (top-down) yaklaşımların yerine yeni aşağıdan yukarıya (bottom-up) yaklaşımları getirerek kırsal kalkınmadaki bu önemli değişikliklere öncülük etmektedir (Ivanovic vd., 2009).

4. KIRSAL - KENTSEL BAĞLANTILARIN SÜRDÜRÜLEBİLİR KALKINMA PERSPEKTİFİNDEN ELE ALINMASI

Kır-kent ilişkileri, merkezler ve çeperler arasındaki mekânsal farklılıklar arttığı için bölgelerin sürdürülebilir kalkınmasında çok önemli bir faktördür. Bu nedenle, 28 ülkeden sadece üçünün mekânsal eşitsizliklerde bir azalma kaydettiğini, diğer ülkelerde ise bu farklılıklarda bir artış olduğunu ölçmektedir. Başka bir deyişle, bu mekânsal eşitsizlikler, bölgesel kalkınma çalışmalarının kırsal ve kentsel bölgeler arasındaki karşılıklı bağımlılığı analiz etmesini gerektirmektedir. Bu doğrultuda, insan, mal/hizmet, bilgi ve finans akışının temel olarak tanımlandığı kırsal ve kentsel alanlar arasındaki bağlantıları ilişkilendirmektedir. Yani, insan akışı kırsal ve kentsel alanlar arasındaki insan hareketliliği ile ilgilidir. Orta ve uzun vadede istihdam fırsatlarının ve pazarların eksikliğini yansıtan kaynak eşitsizliği nedeniyle esas olarak kırsal alanları etkiler. Ayrıca, mal ve hizmet işlemlerinin akışı kırsal ve kentsel bölgeler arasındaki en önemli bağlantılardan biridir, kentsel alanlar doğal kaynaklara (gıda, işgücü ve diğerleri), kırsal alanlar ise kentsel alanlardaki hizmetlere (sağlık, eğitim vb.) bağlıdır (Tsai, 2010). Benzer şekilde, bilgi akışı insanların ihtiyaçlarını, piyasaların durumunu, yenilikleri ve bölgeler arasında tarımsal üretim, yaşam tarzları ve diğer yönlerin seviyesini yükseltmek için yeni teknolojileri karşılar (Kestemont vd., 2011). Son olarak, fon akışı üç türle ilişkilidir; birincisi resmi - kurumsal (krediler), ikincisi gayri resmi (kredi verenler) ve üçüncüsü de kırsal alanların kalkınmasına katkıda bulunan kentsel hükümet ve kurumların yatırımlarıdır (Ledoux vd., 2005).

5. DEĞERLENDİRME

Çevresel, sosyal ve ekonomik kalkınma göstergesine dayalı olarak kırsal alanların çevresel, sosyal ve ekonomik kalkınması, incelenen sürdürülebilirlik göstergeleri konusunda olumlu değişiklikler sağlanabildiğinde ulaşılabilir olacaktır. Birçok durumda, kırsal nüfusun gelişiminin sürdürülebilmesi için, özellikle tarımın verimliliğinin artırılması ve geliştirilmesi, yoksulluk ve sosyal dışlanma riskinin sınırlandırılması ve kırsal nüfus demografisinin

iyileştirilmesi için devlet müdahalesi gerekmektedir. Arıtılmış yağmur suyu sunarak musluk suyu talebinde önemli bir azalma sağlayan yerel evsel yağmur suyu toplama tesislerine de mali destek sağlanmalıdır. Bireysel şebeke dışı yenilenebilir enerji kaynaklarının geliştirilmesi ve ısınma için temiz enerji sağlanması, fosillerin yakılmasıyla doğal çevreye uygulanan antropopresif baskının önemli ölçüde azaltılması için de devlet desteği gereklidir. Tarım turizmi de dahil olmak üzere kırsal nüfus tarafından tarım dışı ekonomik faaliyetlerin geliştirilmesi de devlet tarafından teşvik edilmeli ve desteklenmelidir.

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THE EFFECTIVENESS OF HERBICIDES OXYFLUORFEN AND PENDIMETHALIN IN CONTROLLING REDROOT PIGWEED (*Amaranthus retroflexus* L.) and LAMB'S QUARTERS (*Chenopodium album* L.)

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Özet
Önemli yağ bitkilerinden biri olan Ayçiçeği (*Helianthus annuus* L.) yetiştiriciliğinde yabancı ot kontrolü, verim ve kaliteyi optimize eden yönetim sistemindeki en kritik unsurlardan birisidir. Yabancı ot kontrolü açısından Ayçiçeği ekim dönemi nedeniyle dar ve geniş yapraklı yabancı otlardan oluşan spesifik yabancı ot florasıyla karakterize edilmektedir. Ayçiçeği üretiminde önemli verim ve kalite kayıplarına neden yabancı otların kontrolü amacıyla Pendimethalin ve Oxyfluorfen aktif maddeli herbisitlerin etkinliği elek ev koşullarında saksı denemeleri şeklinde yürütülmüştür. Çalışmada herbisitler ekim öncesi ve çıkış öncesi uygulamaları ile Tesadüf Parselleri Deneme Deseni'ne göre 4 tekerrürlü olarak yürütülmüştür. Denemede ayçiçeği ve yabancı ot tohumları ayrı ayrı saksılara ekilerek herbisit uygulamalarının etkinliği ele alınmıştır. Ekim öncesi dekara 20 litre su hesabıyla 500 ml/da dozunda Pendimethalin etkili maddeli herbisit uygulanmış ve toprağın 5-8 cm derinliğine homojen olarak karışımı sağlanmıştır. Ayçiçeği ve yabancı ot tohumları (her saksıda 0.10 gram olacak şekilde yaklaşık 250 adet) ekimi gerçekleştirilmiştir. Oxyfluorfen etkili maddeli herbisit, ayçiçeği ve yabancı ot tohumlarının ekiminden sonra 100 ml/da dozunda çıkış öncesi uygulaması yapılmıştır. Herbisit uygulamalarını takiben haftalık gözlemler gerçekleştirilerek yaklaşık 4 hafta sonunda yabancı otlar sayılarak tüm saksıdaki yabancı otların yaş ağırlıkları kaydedilerek 48 saat 65˚C'de etüvde bırakılarak kuru ağırlıkları elde edilmiştir. Elde edilen sonuçlara göre her iki aktif söz konusu türlerin kontrolünde etkili bulunmuştur. Ayçiçeği için herbisit seçenekleri genişlemiştir, ancak verim potansiyelini korumak ve başarılı yabancı ot yönetimi stratejilerini sürdürmek için entegre bir yaklaşıma gereksinim duyulmaktadır.
Anahtar Kelimeler: Ayçiçeği, *Amaranthus retroflexus* L., *Chenopodium album* L., Oxyfluorfen, Pendimethalin

OXYFLUORFEN VE PENDIMETHALIN ETKİLİ MADDELİ HERBİSİTLERİN KIRMIZI KÖKLÜ TİLKİ KUYRUĞU (*Amaranthus retroflexus* L.) ve SİRKEN (*Chenopodium album* L.) KONTROLÜNDEKİ ETKİNLİĞİ

Abstract
In the cultivation of Sunflower (*Helianthus annuus* L.), one of the important oil crops, weed control is one of the most critical elements in the management system that optimizes yield and quality. In terms of weed control, sunflower is characterized by a specific weed flora consisting of grass and broad-leaved weeds due to the planting period. The effectiveness of herbicides containing Pendimethalin and Oxyfluorfen was conducted in potted experiments under screen house conditions to control weeds that cause significant yield and quality losses in sunflower production. In the study, herbicides were applied pre-sowing and pre-emergence according to the Randomized Complete Block Design with 4 replications. The effectiveness of herbicide applications was evaluated by planting sunflower and weed seeds separately in pots. Pre-sowing, Pendimethalin was applied at a dose of 500 ml/da, using 20 liters of water per decare, and a homogeneous mixture was ensured into the soil to a depth of 5-8 cm. Sunflower and weed seeds (approximately 250 pieces, 0.10 grams in each pot) were planted. Oxyfluorfen was applied pre-emergence at a dose of 100 ml/da after the sowing of sunflower and weed seeds. Following the herbicide applications, weekly observations were made, the weeds were counted at the end of approximately 4 weeks, the fresh weights of all the weeds in the pot were recorded, and their dry weights were obtained by leaving them in the oven at 65˚C for 48 hours. According to the results, both actives were found to be effective in controlling the species in question. Herbicide options for sunflowers have expanded, but an integrated approach is needed to maintain successful weed management strategies to maintain yield potential.
Keywords: Sunflower, *Amaranthus retroflexus* L., *Chenopodium album* L., Oxyfluorfen, Pendimethalin

1. INTRODUCTION

As the world's population grows, so does the problem of nutrition. Proteins, carbohydrates, and fats are essential nutrients for human health. Oils can be sourced from animal or plant products. Plant-based sources significantly contribute to the world's oil production. Palm oil, rapeseed, soy, peanut, and sunflower are the primary sources used in vegetable oil production worldwide, according to the USDA (2019). The plant is adaptable to diverse agro-climatic conditions and soil types, with simple crop management, photo-insensitivity, and a high seed multiplication ratio (1:50). Commercially available varieties/hybrids contain approximately 36 to 42% oil, 15g of total fat, 1g of saturated fat, 6g of protein, 6g of carbohydrates, and 3g of fiber in the seed (Hakke, et al., 2022). Vegetable oils in particular are of great importance for human nutrition. Sunflower, which has the largest share of vegetable oil production in our country with 50% and is the leading oil crop, can be grown in many regions, including Thrace, the Aegean and the Black Sea regions. Around 45-50% of the seeds of the sunflower plant are utilised in the oil and margarine industries. Moreover, sunflower meal, popular as a snack, is also employed as animal feed. Vegetable oils are strategic products used extensively in the food, energy and chemical sectors (Taşkaya Top and Uçum 2012). The sunflower cultivated in the second product exhibits high grain and oil yields, along with an elevated linoleic acid content.

This highlights the importance of sunflower agriculture from a new perspective. In the 2020/21 marketing year, sunflowers were grown mostly in Russia, Ukraine, EU, Argentina and China, while 72.9% of world sunflower production was realized in Russia, Ukraine and the EU. In the 2020/2021 season, the area under sunflowers in Turkey decreased by 3.2% compared to the previous season and reached 728 thousand hectares.

The area under sunflower in Turkey in 2020 is about 650 thousand hectares. Tekirdağ (142 thousand ha), Edirne (90 thousand ha), Adana (60 thousand ha), Kırklareli (77 thousand ha) and Konya (66 thousand ha) account for 67% of the oil sunflower area. The sunflower production in Turkey for 2020/2021 declined by 1.6% in comparison to the previous season, yielding 2 million tons, whereof 1.9 million metric tons comprises of oil. For oil sunflower production, Tekirdağ (353 thousand tons), Konya (278 thousand tons), Adana thousand tons),

Adana (195 thousand tons), Edirne (240 thousand tons) and Kırklareli (226 thousand tons) (Anonim, 2023a; Anonim, 2023b).

In terms of edibility, sunflower oil is widely used in Turkey where there is also a high consumption of sunflower seeds due to their oil content, which ranges between 22-50%. The per capita consumption and population growth in Turkey indicate an increasing demand for vegetable oil. Nonetheless, producing sufficient levels of fat remains a challenge. While the sunflower plantation area in Uşak province was reported as 25,200 hectares last year, it has been recorded as 34,220 hectares this season.

As animal-sourced fats, which play a vital role in human nutrition, are costly and inadequate, a considerable proportion of the necessary fat intake (92.1%) has been obtained from vegetable oils in recent times (Bihter et al., 2017).

Sunflower are anticipated to have a critical place in the oilseed economy of the country due to their adaptable properties. One of the major factors responsible for the low seed yield of sunflower is proper weed management, which limits the seed production of sunflower.

Weeds compete with sunflowers, resulting in poor growth and lowered yield. The extent of yield losses due to weed competition is determined by the weed density, species, and climatic conditions. The losses caused by the weed are greater than those from any other category of agricultural pests (Kalaisudarson et al., 2020; Selvakumar, 2021). The productivity of sunflowers is frequently decreased by a range of biotic and abiotic factors. Of these factors, weed competition is a major biotic constraint to achieving higher sunflower productivity, due to wider spacing and the application of higher doses of fertilisers. Uncontrolled weed growth can cause a reduction in sunflower seed yield of up to 55% (Wanjari et al., 2001). During the initial 4-week period after germination in sunflower, weed competition plays a crucial role in determining damage. The yield of sunflower is reduced by 58% due to weed competition (Daugovish et al., 2003). The initial four weeks after emergence are the most critical for assessing weed damage in sunflowers, making early weed control crucial. The degree of weed infestation in sunflowers varies by location and has a direct impact on the strength of the

competitive interactions among crops and weeds, leading to increased yield reductions (Vrataric, 2004). The sowing period of this crop, which is typically between mid-March and mid-April, results in a diverse and complex weed population consisting of both grass and broadleaved weeds (Fried et al., 2006). for this effective weed control measures must be implemented. This weed flora has traditionally been controlled using pre-post emergence herbicides. There is a considerable variety of herbicides available for managing weeds in sunflowers, but most of them are meant for pre-emergence applications. This is because the majority of herbicides have been developed primarily for the control of weeds in more economically important crops (Gressel 2002). If pre-emergence herbicides were not applied or their efficacy was insufficient, the application of post-emergence herbicides becomes necessary. Nevertheless, the usage of post-emergence herbicides presents sensitivity issues when it comes to sunflowers, thus making weed control challenging (Andr et al., 2009). Weed competition leads to a reduction in sunflower biomass and yield loss, which can reach up to 81%. This reduction varies depending on weed density, duration of competition, weed spectrum and other factors (Carranza et al., 1995). Many authors review the efficacy of a wide range of herbicides and herbicide combinations to control problem weeds in conventional sunflower production (Kirchenko and Saratov, 2012; Delchev and Georgiev, 2015) In common with most crops, sunflower is susceptible to weed interference, particularly in the first 3-4 weeks after planting (Thompson et al., 2009). Maximum seed yields are reported when sunflower is kept free from weeds for 4 to 6 weeks following planting (Johnson, 1971). *Amaranthus viridis, A. retroflexus, Sinapis arvensis, Chenopodium album, Solanum nignum, Portulaca oleracea, Lactuca serriola, Cirsium arvense* and *Convolvulus arvensis, Setaria viridis, Echinochloa crus-galli* are the most frequently recorded species in sunflower agriculture (Arslan and Kara, 1997; Zengin, 1999; Karabacak and Uygur, 2017; Asav and Serim, 2019). This experiment was designed to evaluate the efficacy and selectivity of the herbicides oxyflourfen and pendimethalin for *Amaranthus retroflexus*, *Chenopodium album* control in sunflower.

2. MATERIAL AND METHODS

2.1.Material

In this study, *Amaranthus retroflexus* and *Chenopodium album* were used as model weeds and herbicides with active ingredients of Pendimethalin and Oxyfluorfen for the control of weeds causing significant yield and quality losses in sunflower production. Redroot is common in

warm climates and localised in cold climates. The plant can easily adapt to different climates. Under unfavorable conditions, the plant height remains short. Generally found in crops rich in plant nutrients, sometimes in dry soils. Widespread in subtropical regions. Common lambs, a broad-leaved plant, is one of the most common summer annuals. Common lambs is generally considered to be edible. However, under certain conditions, the plant's production of oxalates can increase to levels toxic to livestock if large amounts of leaves are consumed in a short period. Common lambs are also susceptible to many viruses that affect a range of crops and ornamentals. Apparent Oxyfluorfen herbicide is a selective herbicide for the control of certain annual grasses and broadleaf weeds. It is applied to sunflowers in the first week after sowing before weeds emerge. It offers the advantage of application before sowing or before emergence in sunflowers. The effective results are obtained by mixing it into the soil before sowing. Within 4 days after the application, it should be mixed into the soil at a depth of 5 - 8 cm with a disc, rototiller, or harrow. If 10 mm of rainfall falls during this period, mixing with the soil is not compulsory.

2.2.Methods

The research was conducted as pot studies at the Uşak University Faculty of Agriculture Research and Application area under screen house conditions. The study aimed to evaluate the effectiveness of oxyflourfen and pendimethalin, in controlling *Amaranthus retroflexus* and *Chenopodium album*, the most common species in sunflower production areas.

Weeds used in the experiments were obtained by sowing seeds in pots and preparing them for application. The seeds collected from weeds in the same region were used for the pot experiments. The pots used in the experiments were filled with a peat, soil and perlite mixture in a ratio of 1:1:1.

Herbicides were applied pre-sowing and pre-emergence according to the Randomized Complete Block Design with 4 replications. The effectiveness of herbicide applications was evaluated by planting sunflower and weed seeds separately in pots. Pre-sowing, Pendimethalin was applied at a dose of 500 ml/da, using 20 liters of water per decare, and a homogeneous mixture was ensured into the soil to a depth of 5-8 cm. Sunflower and weed seeds

(approximately 250 pieces, 0.10 grams in each pot) were planted. Oxyfluorfen was applied pre-emergence at a dose of 100 ml/da after the sowing of sunflower and weed seeds. Following the herbicide applications, weekly observations were made, the weeds were counted at the end of approximately 4 weeks, the fresh weights of all the weeds in the pot were recorded, and their dry weights were obtained by leaving them in the oven at 65˚C for 48 hours.



Figure 1. Soil preparation and herbicide application for the experiment

3. RESULTS AND DISCUSSION

The results showed that both active ingredients were effective in controlling the species in concern. The effects of both actives on the number of emergence, and fresh and dry weights of the weed species were found to be statistically similar. Herbicides were different from the control in all parameters evaluated (Table 3.1.). However, the study had to be stopped after 4 weeks due to animal damage to the pots (rabbits dug up the plants in the pots and disturbed the soil). As it is not possible to follow the situation in the later stages of weed and sunflower growth, data are presented for the first 4 weeks. In this context, the employment of chemical weed management is increasing in significance. Selvakumar, (2021) the application of herbicides can ensure that the crop remains entirely free of weeds from its initial stages of growth. Kudsk, (2002) Complex combinations of pre and post-emergence herbicides, along with herbicide mixtures, are commonly used in many countries to maximise the efficacy of weed control and minimise application costs. Besides that Pannacci et al., (2007) mentioned

applying oxyfluorfen alone in pre-emergence at 240 g ai/ha, which had not been used in previous experiments, was equally as effective as the best pre-emergence treatments and resulted in complete weed control.

Table 3.1. Average number of weed emergence recorded per week (pieces/pots).

Herbicides	*Amaranthus retroflexus* L.					
	1st week	2nd week	3rd week	4th week	Fresh weight (g)	Dry weight (g)
Control	7	47	88	122	27,04	5,32
Oxyfluorfen	1	7	10	11	3,80	1,094
Pendimethalin	0	11	15	15	3,01	0,986
	Chenopodium album L.					
	1st week	2nd week	3rd week	4th week	Fresh weight (g)	Dry weight (g)
Control	5	35	64	101	30,01	5,84
Oxyfluorfen	0	2	14	16	3,48	1,34
Pendimethalin	2	5	10	17	3,35	1,04

Pre-emergence application of pendimethalin followed by post-emergence application of propaquizafop at 15-20 DAS, it was found that effective weed management was achieved while maintaining grain yield comparable to a weed-free condition (Hakke et al., 2022). In another study, it was found that, oxyfluorfen provided excellent weed control (81-100%) of grasses throughout all seasons, regardless of supplementary weeding, and gave good to excellent control of broad-leaved weeds in early seasons. However, towards the end of the growing season, oxyfluorfen exhibited satisfactory to excellent control of broad-leaved weeds (Osman et al., 2014). Jursik et al. (2011) investigated numerous herbicide combinations and determined that oxyfluorfen was the most effective herbicide, while the most effective combination was fluorochloridone + acetochlor. Horvath and Osztrogonac (1991) state that the herbicide Goal (oxyfluorfen) inhibits the development of secondary haustoria of Orobanche cumana Wall. in sunflowers and severely restricts the development of weeds. The impact is more significant in vegetation treatment than in soil application of the herbicide. The vegetative treatment with Goal leads to higher phytotoxicity in the sunflower plants.

4. CONCLUSION

Chemical control has emerged as the most effective approach to weed management. The pre-sowing application of pendimethalin and pre-emergence oxyfluorfen has demonstrated successful and economical weed control in sunflower. The experiment was conducted under controlled conditions in pots, and potential variations in efficacy should be observed under field conditions. Evaluating the effectiveness of tank mixtures and integrated weed management programmes is also crucial. For future research in the region of Uşak, effective weed control for sunflowers should be evaluated through combinations of herbicides and tank mixtures with adjuvants, fertilisers, and growth regulators. It is important to assess their efficacy.

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EFFECTS OF RECOMMENDED COCOYAM PRODUCTION TECHNOLOGIES ON OUTPUT OF FARMERS IN ENUGU STATE, NIGERIA

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Abstract
The study assessed the effects of adoption of recommended cocoyam production technologies on the output of farmers in Enugu State, Nigeria. Five-stage sampling procedure was used to select 245 cocoyam farmers. Structured questionnaire was used to collect primary data which was analyzed using descriptive statistics and multiple regression analysis. The results obtained revealed that mean age of the farmers was 56 years and majority (84.1%) of them had formal education. More so, only 20.4% of the farmers had access to credit facilities while 48.6% had contact with extension agents. Most of the farmers adopted all the recommended cocoyam technologies such as fertilizer application (NPK 15:15:15) after planting (99.6%), timely planting between May–June (99.2%), planting method using internodes at 1-2cm thickness (98.8%) and harvesting by digging around cocoyam plant at about 30cm (98.8%).. Regression estimate for the effects of adoption of recommended cocoyam technologies on output of farmers revealed that almost all the technologies had positive and significant effects at varying levels of probability with the output, except fertilizer which was negative but significant ($P< 0.01$) probability level. Thus, it was concluded that the recommended cocoyam technologies had significant effects on the output of the farmers. The study recommends that more sensitization campaign should be carryout by the research institutions in order to scale-up the adoption of recommended cocoyam technologies in the region and beyond.
Keywords: Adoption, recommended technologies, cocoyam production, farmers

INTRODUCTION

Agriculture still remains substantially a family business in Nigeria. Inadequate use of modern agricultural technologies in addition to low resource status of the farmers have made Nigeria's agriculture to remain unimproved (Adeniji, 2002; Ajayi *et al.*, 2017). However, the challenges of inadequate food production and shortages in raw materials supply has led to development of improved technologies to enhance food production and living standard of farmers. In spite of the various food crop production programmes embarked upon by Federal Government of Nigeria (FGN), there has been concern about the capability of Nigeria's agriculture to meet the food requirement of her fast-growing population (International Institute for Tropical Agriculture (IITA), 2013; Muhammed *et al.*, 2019).

In recent years, emphasis have been placed on production of root and tuber crops like cocoyam, which has the potentials of alleviating poverty by improving the income earning capacity and food security of farmers in Nigeria (Ephraim *et al.,* 2021). According to Olaniyan *et al*. (2013), tuber crops are among the most important staple food crops in manny tropical African countries and constitute one of the largest source of calories in the case of Nigeria. The average production figure in Nigeria is 5.4 metric tonnes which accounts for about 37% of total world's output of cocoyam (Food and Agriculture Organization (FAO), 2014). Chukwu *et al*. (2012) posited that cocoyam is nutritionally superior to yam in terms of its digestibility, crude protein contents and some important minerals like phosphorus, Calcium and Magnesium.

However, there has been decline in the yields of cocoyam which could be attributed to the use of low-impact technologies available to the farmers, inadequate improved planting materials, weed problems and poor soil conditions which resulted into reduced cocoyam productivity (National Agricultural Extension and Research Liaison Services (NAERLS), 2011; Nwakor *et al*., 2015). The National Root Crops Research Institute (NRCRI), Umudike as a research agency saddled with the responsibility of providing research-based information on improved or recommended cocoyam production technologies for adoption has developed and extended frontier through various extension teaching methods to educate farmers (NRCRI, 2013).

Therefore, it becomes imperative to examine the extent to which the recommended cocoyam technologies have been adopted and its effects on farmers' output. It was against the backdrop of aforementioned this study was conceived and the following research objectives were put forward to describe the socio-economic background of cocoyam farmers; examine the adoption

level of recommended cocoyam production technologies and determine the effects of recommended cocoyam technologies adoption on output of the farmers in the study area.

METHODOLOGY

Study Area

The study was conducted in Enugu State of Nigeria. The State lies between Latitude 7º 29' and 8º 55' North of the equator and Longitude 6º 26' and 7º 28' East of the Greenwich meridian. It has 17 Local Government Areas (LGAs) divided into three Agricultural zones (Enugu-North, Enugu-East and Enugu-West) and covers an estimated land area of 7,161kilometre square (Enugu State Ministry of Information (ESMI), 2019). Enugu State has a population of 3,267,837 (National Population Commission (NPC), 2006) but the projected population as at 2020 using 3.2% growth rate (World Bank, 2019) was 5,078,975. The State experiences annual rainfall of between 1500mm – 2100mm and mean temperature of 30.6°C (ESMI, 2019). The rural people of Enugu State are predominantly farmers.

Sampling Procedure and Sample Size

A five-stage sampling technique was used to select respondents for the study. In the first stage, Enugu-North agricultural zone was purposively selected due to the presence of a large number of cocoyam farmers in the zone. There are six LGAs and eight extension blocks in the zone. In the second stage, four LGAs were randomly selected. Third stage involved selection of one extension block from each of the LGAs selected. The fourth stage was random selection of two extension cells from each of the extension blocks to get eight extension cells. The fifth stage was proportionate selection of two hundred and forty-five (245) cocoyam farmers using Taro Yamane (1967) formula based on the list of registered cocoyam farmers obtained from Enugu State Agricultural Development Programme (ENADEP).

Method of Data Collection and Analysis

Primary data used for the study were collected using semi-structured questionnaire complemented with an interview schedule to obtain information on socio-economic characteristics of the farmers, the recommended cocoyam production technologies adopted and effects of recommended cocoyam production technologies on output of the cocoyam farmers. Data collected were analyzed using descriptive statistics (such as the mean, standard deviation, frequency distribution count and percentage) and multiple regression analysis.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Respondents

As revealed in the Table 1, about half (49.8%) of the respondents were within the age bracket of 51–70 years with a mean age of 56 years. This implies that most of the cocoyam farmers were aged but still able to undertake farming activities. This finding is in contrast with the work of Uwandu *et al*., (2018) who reported that majority of farmers in their study area were within the youthful and middle age. More so, more than half (55.1%) of the respondents were males, while 44.9% of them were females implying that males were more involved in cocoyam farming than female which could be due to the tedious nature of farming. Majority (82.4%) of the respondents were married which implies that cocoyam production in the study area was mainly undertake by married individuals this could be attributed to the need to pro-create and provide cheap family labour required for farming activities. This finding agrees with Odoemekun and Anyim (2019) who reported that majority of farmers married purposely for pro-creation of young ones. More than half (56.3%) of the respondents had household size between 5–10 people with a mean of 6 persons. This implies that the farmers had fairly large household size which is an advantage in terms of farm labour supply.

Table1: Distribution of respondents based on their socio-economic background (n = 245)

Variables	Frequency	Percentages (%)	Mean
Age (years)			
< 31	9	3.7	56
31 – 50	84	34.2	
51 – 70	122	49.8	
> 70	30	12.3	
Sex			
Male	135	55.1	
Female	110	44.9	
Marital status			
Married	202	82.4	
Widowed	32	13.1	
Single	4	1.6	
Divorced	7	2.9	
Household size			
< 5	98	40.0	6
5 – 7	87	35.5	
8 – 10	51	20.8	
> 10	9	3.7	
Educational status			
Primary	102	41.6	9
Secondary	79	32.2	
Tertiary	25	10.3	
Non-formal	39	15.9	
Experience (years)			
< 11	55	22.4	24
11 – 20	66	26.9	
21 – 30	54	22.0	
31 – 40	48	19.6	
> 40	22	9.1	
Farm size (hectares)			
< 1.1	217	88.6	0.82
1.1 – 2.0	28	11.4	
Access to credit			
Yes	50	20.4	
No	195	79.6	
Extension contacts			
Yes	119	48.6	
No	126	51.4	
Cooperative membership			
Yes	64	26.1	
No	181	73.9	

Source: Field Survey, 2022

Table 1 further revealed that majority (84.1%) acquired formal education (primary, secondary and tertiary) with a mean of 9 years of formal schooling. This implies that the farmers were

literate which could help them to make better decisions as regards adoption of technologies. Most (68.5%) of the respondents had farming experience between 11 – 40 years with a mean of 24 years of farming. This implies that the farmers had been into farming for long period of time which could enhance their favourable perception about adopting recommended cocoyam technologies. This agrees with Olaosebikan *et al*. (2019) who reported that majority of the respondents in their study area had long years of farming experience which help them to make informed decisions about their farms. Majority (88.6%) of the respondents had farm size of less than one hectare with a mean of 0.82 hectare. This implies that majority of the cocoyam farmers were operating on a small-scale which could be attributed to competitive nature of farmland in the study area.

Just a few (20.4%) had access to credit. This implies that majority of the farmers had no access to credit which could negatively affect their adoption of recommended technologies. About half (48.6%) of the respondents had contact with extension agents, while 51.4% had no contact. This implies that some of the respondents had contact with extension agents which could influence their decision to adopt recommended cocoyam technologies. More so, majority (73.9%) of the respondents were not members of cooperatives, while only 26.1% were members. This implies that there was poor participation of the farmers in cooperative societies which could play a significant role in adoption of recommended cocoyam technologies in the study area.

Adoption of recommended cocoyam technologies by the respondents

The result in Table 2 presents the recommended cocoyam technologies adopted by the respondents in the study area. It revealed that there was higher adoption of all the recommended cocoyam technologies by majority of the farmers. The top most recommended technologies adopted among others are fertilizer application (NPK 15:15:15) after planting (99.6%), timely planting between May – June (99.2%), planting method using heap and ridge top (98.8%) and harvesting by digging around cocoyam plant at about 30cm (98.8%). This implies that the farmer adopted all the recommended cocoyam technologies in the study area. This is in corroboration with the report of National Root Crops Research Institute (NRCRI) (2013) that farmers adopted recommended cocoyam technologies developed and transferred to them to boost production.

Table 2: Distribution of respondents based on recommended cocoyam technologies adopted

Recommended cocoyam technologies*	Adopted (%)	Not Adopted (%)
Fertilizer application (NPK 15:15:15) after weeding	244 (99.6)	1 (0.4)
Timely planting between May – June	243 (99.2)	2 (0.8)
Planting method using heap and ridge top	242 (98.8)	3 (1.2)
Harvesting by digging round Cocoyam Plant at about 30cm	242 (98.8)	3 (1.2)
Pest control by pesticides	240 (98.0)	5 (2.0)
Weed control by herbicides	240 (98.0)	5 (2.0)
Cocoyam intercropping technique	228 (93.1)	17 (6.9)
Use of Cocoyam mini-sets of about 25g	224 (91.4)	21 (8.6)
Mulching using crop residues	222 (90.6)	23 (9.4)
Plant spacing of 1m x 1m	204 (83.3)	41 (16.7)

Source: Field Survey, 2022

Note: * Multiple Responses and numbers in parentheses are the percentages

Recommended Cocoyam Technologies Adoption on Respondents' Output

The result of regression estimate as presented in Table 3 revealed coefficients of determination (R^2) value of 0.7728 which implies that 77% variation in the output of the respondents were explained by the independent variables included in the model, while the remaining 23% unaccounted could be due to error or other variables not captured in the model. The F–statistic value of 16.84 was significant at 0.01 probability level implying perfect fit of the model and goodness at predicting the observed data. The result also revealed that out of eighteen (18) variables included in the model, thirteen (13) variables were significant at 0.01 and 0.05 probability levels, respectively. Twelve variables such as farm size, labour usage, agrochemical, timely planting, planting method, cocoyam inter-cropping, cocoyam mini-sett, weed control, mulching, extension contact, membership of cooperative and access to credit were positive and significant, therefore had direct influence on the output of cocoyam farmers, while fertilizer usage was negative and significant, thus had inverse influence on the output of cocoyam farmers.

The coefficient for farm size (0.1150) was positive and statistically significant ($P<0.05$) probability level. This implies that a unit increase in farm size as a result of adoption of recommended cocoyam production technologies will lead to 11.5% increases in the output of

cocoyam farmers. This meet the a priori expectation because it is anticipated that complete adoption of the cocoyam recommended production technologies package will boost farmers' returns which will invariably lead to the expansion of farm land and thus increase in the output of farmers.

The coefficient for labour usage (0.0020) was positive and significant (P< 0.05) probability level. This implies that a unit increase in labour usage as a result of the adoption of recommended cocoyam production technologies will lead to about 0.2% increases in the output of cocoyam farmers. This meet the apriori expectation. As a result of the adoption of recommended cocoyam production technologies, it is envisaged that farmers may likely increase the size of farm land to accommodate increase in returns. This will necessitate more labour, which if properly utilized, will increase farmers output.

The coefficient for timely planting (0.7086) was positive and significant (P<0.01) probability level. This implies that a unit increase in timely planting will leads to about 71% increase in the output of cocoyam farmers. Timely of planting is a crucial cultural farming practice that can significantly affect crop performance and yield. This meet the a *priori expectation* because timely planting is expected to improve cocoyam's strong establishment, giving them ample time to grow to their full potential and lessen other environmental stress.

Table 3: Regression estimates on effects of recommended cocoyam technologies on output

Variables	Coefficient	Standard error	t-values
Farm size	0.1150	0.0560	2.05**
Labour usage	0.0020	0.0009	2.39**
Seed rate	3.15e-07	5.99e-07	0.53
Inorganic fertilizer application	-0.0001	0.0002	-2.04**
Agrochemical application	0.0644	0.0206	3.13***
Timely planting	0.7086	0.1015	6.98***
Planting spacing 1mx1m	-0.1393	0.0576	-2.42**
Planting method	0.2943	0.1399	2.10**
Cocoyam inter-cropping	0.1300	0.0610	2.13**
Cocoyam mini-sett 25g	0.1209	0.0592	2.04**
Organic fertilizer application	-0.1140	0.0989	-1.15
Weed control	0.2874	0.0717	4.01**
Mulching	0.2129	0.0643	3.31**
Pest control	0.0249	0.1356	0.18
Harvesting method	0.1466	0.1022	1.44
Extension contacts	0.2158	0.0541	3.99***
Cooperative membership	0.1527	0.0697	2.19**
Access to credit	0.1601	0.0761	2.10**
Constant	5.0223	0.2242	22.40***
R-squared	**0.7728**		
Adj R-squared	**0.7388**		
F-statistics	**16.84*** **		

Source: Field survey, 2022

Note *, ** and * implies significant at 1%, 5% and 10% probability level, respectively**

The coefficient for cocoyam mini-set (0.1209) was positive and significant (P<0.01) probability level. This implies that a unit increase in cocoyam mini set adoption will leads to about 12% increases in the output of cocoyam farmers. This meet the a *priori* expectation because adopting the recommended cocoyam mini-sett techniques will help the farmer to produce large quantities of planting materials in the shortest possible time, which lessen the competition for cocoyam corms as food and planting materials. This is expected to improve their productivity.

The coefficient for cocoyam inter-cropping (0.1300) was positive and significant (p<0.01) probability level. This implies that a unit increase in cocoyam inter-cropping adoption will leads

to about 13% increases in the output of cocoyam farmers. Adoption of recommended intercropping practice will help the farmers to diversify their sources of income while maintaining same level of output per hectare.

The coefficient for weed control (0.2874) was positive and statistically significant at 0.01 probability level. This implies that a unit increase in weed control will leads to about 29% increases in the output of cocoyam farmers. This meet the a *priori* expectation because weed competes with planted crop for nutrient, soil air and water as well as harbouring pest. Therefore, adoption of recommended weed control strategies by cocoyam farmers is expected to improve sanitary condition towards pests and diseases thereby improving the productivity of the farmers.

The coefficient for mulching (0.2129) was positive and significant (P< 0.01) probability level. This implies that a unit increase in mulching will leads to about 21% increases in the output of cocoyam farmers. Mulch on cocoyam is expected to enhance the activity of soil organisms and reduce evaporation of water from the soil. Thus, the result is in line with the expected *a priori,* because adoption of recommended mulching practices is expected to create favourable condition for cocoyam optimal growth.

The coefficient for extension contacts (0.2158) was positive and significant (P<0.01) probability level. This implies that a unit increase in extension contact will leads to an increase of about 22% in farmers' output. Extension agent facilitates the dissemination of recent innovation in agriculture to farmer in order to improve their productivity. As expected, increase in extension contact can bring the result or method demonstration of cocoyam production technologies to farmer is expected to enhance the adoption of the technology which will invariably improve the output of farmers.

The coefficient for membership of cooperative (0.1527) was positive and significant (P<0.01) probability level. This implies that a unit increase in membership of cooperative will leads to about 15% increases in the output of cocoyam farmers. This shows that cooperative membership could positively influence adoption decisions of a farmer in relation to improved technologies dissemination. Cooperative society is an instrument which facilitates access to credit and extension linkages that could help in adoption of recommended cocoyam production technologies.

The coefficient for access to credit (0.1601) was positive and significant (P< 0.01) probability level. This implies that a unit increase in access to credit will leads to about 16% increases in

the output of cocoyam farmers. It is a general fact that access to credit by farmers is one of the most important means of improving farm productivity. Credit provide the means for innovation adoption, thus the higher a farmer has access to credit, the higher the capacity to adopt recommended cocoyam production technologies for increase output.

The coefficient for inorganic fertilizer usage (-0.0001) was negative and statistically significant at 0.01 probability level. This implies that a unit increase in inorganic fertilizer usage as recommended cocoyam production technologies will leads to about 0.01% decrease in the output of cocoyam farmers. Excessive fertilizer application especially inorganic fertilizer tends to have significant effects on crop under production, thus the need to strictly follow the recommended rate in order to realize the expected output.

CONCLUSION AND RECOMMENDATIONS

Based on the findings of the study, it was concluded that the cocoyam farmers were aged but still active in production, married and educated with at least secondary education. However, there was poor access to credit, fair contact with extension agents and poor cooperative membership. The farmers adopted all the recommended cocoyam production technologies with little variation. Thus, adoption level was high. There was significant effects of the recommended cocoyam production technologies on output of the farmers. It was recommended that drastic sensitisation should be carried out by relevant research institutes and extension agencies to scale-up adoption of recommended cocoyam technologies for increased output in Enugu Nigeria at large. The farmers should organize themselves into cooperative societies in order to harness the benefits accrued from cooperative participation such as access to credit, extension services and training in relation to cocoyam production.

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YEM ŞALGAMI *(Brassica rapa* L.)'NIN KARABUĞDAY (*Fagopyrum esculentum* Moench) ÜZERİNDEKİ ALLELOPATİK ETKİSİ

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Özet
Bitkilerde sentezlenen ikincil metabolitler çevresinde bulunan bitkileri direk veya dolaylı, olumlu ya da olumsuz yönde etkilemektedir. Allelopati olarak bilinen bu etki, ikincil metabolit içeren bitki kısımlarının toprağa bırakılmasıyla kendisinden sonra gelen ürünün çimlenme durumunu ve bitki gelişimini etkilemektedir. *Brassica rapa* (L)'nın da dahil olduğu Brassicaceae üyeleri, glukozinolatlar, hidroksisinnamik asitler ve flavonoidler dahil olmak üzere bir çok ikincil metabolit içerir. Yem şalgamı (*Brassica rapa* L.) kışlık olarak yetiştirilen, Turpgiller familyasına ait, tek yıllık bir türdür. Yumru ve ot amaçlı iki tipi bulunan yem şalgamının yaprakları ve yumruları hayvan beslemede kullanılmaktadır. Çalışmanın materyalini oluşturan karabuğday (*Fagopyrum esculentum* Moench) Kuzukulağıgiller (Polygonaceae) familyasının bir türüdür ve köşeli buğday olarak da bilinmektedir. Yetiştiriciliğine ülkemizde yeni yeni başlanan karabuğday; Çin Rusya, Ukrayna, Kanada, ABD, Japonya, Fransa, Kazakistan gibi dünyanın birçok ülkesinde yetişmektedir. Bu çalışmada, yem şalgamından elde edilen ekstraktların karabuğday tohumlarının çimlenme parametreleri ve fenolojik özelliklerinde meydana getirdiği değişiklikler araştırılmıştır. Yem şalgamı 2022 yılı Kasım ayında Bilecik Şeyh Edebali Üniversitesi, Tarımsal Araştırma ve Uygulama arazisinde ekilmiş ve Mayıs başında hasat edilmiştir. Hasat edilen bitki 500 gr tartılarak 3 litre saf su içerisinde 7 saat süre ile bekletilmiş ve % 100 'lük çözelti olaral kabul edilmiştir. Diğer deney gruplarında bu ekstrakt seyreltilerek %25, %50, %75'lik çözeltiler hazırlanmıştır. Ektraktlar deney gerçekleşene kadar buzdolabında +4°C sıcaklıkta saklanmıştır. Saf su ile sulanan örnekler ise kontrol grubunu oluşturmuştur. Üç tekrarlı olarak gerçekleştirilen deney 25/23 °C sıcaklık, %60 nem ve 16/8 saat fotoperiyotta 21 gün boyunca devam etmiştir. Radikulanın kurutma kağıdına değdi an çimlenmenin başlangıcı olarak kabul edilmiş ve çimlenme başladıktan sonra her gün çimlenen tohum sayıları kaydedilmiştir. Deney sonunda örneklere ait % çimlenme, kök ve gövde uzunluğu, kök ve gövde yaş-kuru ağırlığı ölçülmüş; tohum canlılık indeksi, kök ve gövde biyokütlesi hesaplanmıştır. Sonuç olarak, çalışmada farklı miktarlarda ekstrakt içeren çözeltilerle sulanan karabuğday örnekleri arasında istatistiksel açıdan önemli değişimler olduğu belirlenmiştir. %75 oranında yem şalgamı içeren ekstraktın diğer deney

gruplarına göre özellikle çimlenme parametrelerinde, gövde uzunluk, gövde yaş ve kuru ağırlığı ile gövde biyokütlesini olumlu etkilediği tespit edilmiştir.

Anahtar Kelimeler: Yem Şalgamı, Karabuğday, Allelopati, Fenolojik Parametreler

ALLELOPATIC EFFECT OF FORAGE TURNIP (*Brassica rapa* L.) ON BUCKWHEAT (*Fagopyrum esculentum* Moench)

Abstract
Secondary metabolites synthesized in plants affect the surrounding plants directly or indirectly, positively or negatively. This effect, known as allelopathy, affects the germination status and plant development of the subsequent product by releasing plant parts containing secondary metabolites into the soil. Members of the Brassicaceae, including *Brassica rapa* (L), contain many secondary metabolites, including glucosinolates, hydroxycinnamic acids, and flavonoids. Forage turnip (*Brassica rapa* L.) is an annual species belonging to the Crucifer family, grown as a winter crop. The leaves and tubers of forage turnips, which have two types, tubers and herbs, are used for animal feeding. Buckwheat (*Fagopyrum esculentum* Moench), which constitutes the material of the study, is a species of the Sorrel family (Polygonaceae) and is also known as angular wheat. Buckwheat, whose cultivation has just started in our country, is grown in many countries around the world, such as China, Russia, Ukraine, Canada, the USA, Japan, France, and Kazakhstan. In this study, the changes caused by extracts obtained from forage turnips on the germination parameters and phenological characteristics of buckwheat seeds were investigated. Forage turnips were planted in Bilecik Şeyh Edebali University, Agricultural Research and Application Land, in November 2022 and harvested at the beginning of May. The harvested plant was weighed at 500 g and kept in 3 liters of pure water for 7 hours. It was considered a 100% solution. In other experimental groups, this extract was diluted, and 25%, 50%, and 75% solutions were prepared. The extracts were stored in the refrigerator at +4°C until the experiment was performed. Samples irrigated with pure water comprised the control group. The experiment, which was carried out in triplicate, continued for 21 days at 25/23 °C, 60% humidity, and a 16/8-hour photoperiod. The moment the radicle touched the blotting paper was considered the beginning of germination, and the number of germinated seeds was recorded every day after germination started. At the end of the experiment, % germination, root and stem length, and root and stem fresh-dry weight of the samples were measured; seed viability index and root and stem biomass were calculated. As a result, it was determined that there were statistically significant changes between buckwheat samples irrigated with solutions containing different amounts of extract. It was determined that the extract containing 75% fodder turnip had a positive effect on germination parameters, stem length, stem fresh and dry weight, and stem biomass compared to other experimental groups.
Keywords: Forage Turnip, Buckwheat, Allelopathy, Phenological Parameters

1. GİRİŞ

Yem şalgamı (*Brassica rapa* L.) kışlık olarak yetiştirilen tek yıllık bir türdür. Turpgiller familyasında yer alan bitkinin tarımı dünyanın çoğu yerinde yapılmaktadır. Yem şalgamının yaprakları ve yumruları hayvan beslemede kullanılmaktadır. Bitkinin yumru ve ot amaçlı iki tipi bulunmaktadır (Denen, 2019). Türkiye'de kaba yem açığının kapatılması amacıyla son yıllarda ot tipi yem şalgamı tarımı yaygın hale gelmeye başlamıştır. gelmektedir. Bitkinin kuraklığa dayanımının iyi olması ve sulandığında ise dekardan 10-15 ton arasında verim alınması bitkiyi cazip kılmaktadır (Anonim, 2022a). Bitki ayrıca -10 °C sıcaklığa kadar dayanabilmektedir. Yem şalgamı %95.0 yaprak, %5.0 ise kökten oluşmaktadır. Yoncaya eşdeğer ham protein oranına (%18-22), Macar fiği ve yaygın fiğden ise yüksek ot verime sahip olduğu bilinmektedir. (Anonim, 2022b). Diğer taraftan yem şalgamı erken dönemde yüksek su oranına sahiptir. Bu durum bitkinin bu dönemde silaj olarak değerlendirilmesine imkân sağlamaktadır. Dolayısıyla hasat sonrasında besin madde kayıplarının önüne de geçilmiş olunmaktadır (Koch ve Karakaya, 1998). Bitki ayrıca, erken dönemde hasada gelmektedir. Bu nedenle kendinden sonra gelecek bitkiye uzun vejetasyon dönemi bırakmaktadır.

Karabuğday, (*Fagopyrum esculentum* Moench.), Polygonaceae (Kuzukulağıgiller) familyasından Fagopyrum cinsine ait tek yıllık otsu bir bitki türüdür. Karabuğday büyüme ve gelişmesini kısa sürede tamamlar. Tahıllardan ayıran temel yapısal farklılık dikotil bir bitki olması ve yüksek rakımlarda kısa sürede gelişmeye adapte olabilme özelliğinin bulunmasıdır. İklim şartları uygun olduğu müddetçe, topraktan talebi oldukça azdır ve hemen hemen her çeşit toprakta yetişebildiği için verimli olmayan bölgelerde ve marjinal topraklarda yetiştirilmektedir (Leblebici, 2019).

Bitkilerdeki ikincil metabolit ürünü olan bileşikler biyolojik aktivite açısından büyük bir çeşitliliğe sahiptir. Bitkilerin kendileri için fitotoksik özellikte olan ve bitkiden uzaklaştırılan bu bileşikler aslında bitkilerin savunma mekanizmalarının bir parçasıdır ve bitkiler ikincil metabolitleri bir şekilde yaşadıkları ortama bırakarak bünyelerinden uzaklaştırırlar. Ortama bırakılan ikincil metabolitler çevresinde bulunan bitkilere direk veya dolaylı, olumlu ya da olumsuz yönde etki etmektedir. Allelopati olarak bilinen bu etki, ikincil metbolit içeren bitki kısımlarının toprağa bırakılması ile ortamda kendisinden sonra gelen ürünün çimlenme ve bitki gelişimini etkilemektedir. Bitkilerin sahip oldukları ikincil metabolitler toprak mikroorganizmaları üzerinde de etkilidir. Nitekim toprak mikroorganizmaları, ekosistemin

kalitesi ve tarımsal ekosistemlerin verimliliğinde çok önemli bir rol oynar. Farklı ekosistemlerin oluşum sürecinde, azot ve karbon döngüsüyle beraber toprak oluşumunda önemli etkileri bulunmaktadır. Mikroorganizmalar ve bunların modifiye formları aynı zamanda insanların enfeksiyonlardan korunması, bitkilerde hastalığa neden olan patojenlerden kaynaklanan verim kaybının azaltılması gibi hususlar bakımından da önem teşkil etmektedir.
Bu çalışmada Yaprak tipi yem şalgamının karabuğday tohumlarının çimlenme parametreleri ve fenolojik özelliklerinde meydana getirdiği değişiklikler (allelopatik) incelenmiştir.

2. MATERYAL VE YÖNTEM

Yem şalgamı (*Brassica rapa* L. "Lenox") 21/11/2022 tarihinde Bilecik Şeyh Edebali Üniversitesi, Tarımsal Araştırma ve Uygulama arazisinde ekilmiş ve Mayıs başında (tam çiçeklenme dönemi) hasat edilmiştir. Hasat edilen bitki 500 gr tartılarak 3 litre saf su içerisinde 7 saat süre ile bekletilmiş ve % 100 'lük çözelti olarak kabul edilmiştir. Diğer deney gruplarında bu ekstrakt seyreltilerek %25, %50, %75'lik çözeltiler hazırlanmıştır. Ektraktlar deney gerçekleşene kadar buzdolabında +4°C sıcaklıkta saklanmıştır. Saf su ile sulanan örnekler ise kontrol grubunu oluşturmuştur. Çimlenme çalışmasında karabuğdayın (*Fagopyrum esculentum* Moench) "Güneş" çeşidi kullanılmıştır.



Şekil 1. Yem şalgamı ekstraktlarının hazırlanması

Çalışma Bilecik Şeyh Edebali Üniversitesi, Tarımsal Araştırma ve Uygulama arazisinde bulunan laboratuvarda ve Tesadüf Parselleri Deneme Desenine göre 4 tekrar yürütülmüştür. Çimlenme deneylerinde karabuğday buğday bitkisine ait tohumlar 12 cm çapındaki petri kapları içinde ve iki kat kurutma kâğıdı üzerinde çimlendirilmiştir. Petri kapları içerisindeki karabuğday tohumları, yem şalgamından elde edilen ekstraktlar ile her petriye 6 ml verilecek

şekilde gün aşırı sulanmış ve radikulanın kurutma kâğıdına değdiği an çimlenmenin başlangıcı kabul edilmiştir. Deney 25/23 °C sıcaklık, %60 nem ve 16/8 saat fotoperiyotta 21 gün boyunca devam etmiştir. Ççimlenme başladıktan sonra her gün çimlenen tohum sayıları kaydedilmiştir. Deney sonunda örneklere ait %çimlenme (ÇO), kök ve gövde uzunluğu, kök ve gövde yaş-kuru ağırlığı, tohum canlılık indeksi (TCİ), kök (KB) ve gövde biyokütlesi (GB)hesaplanmıştır.

ÇO: ((Çimlenen tohum sayısı/Toplam tohum sayısı) × 100) (Kayaçetin vd., 2018).

TCİ: ((Kök uzunluğu+gövde uzunluğu) × çimlenme oranı) (Böhm, 1979).

KB: ((Kuru kök ağırlığı × petri kabının alanı)/10-8) (Işık ve Çalıseki, 2017).

GB: ((Kuru gövde ağırlığı × petri kabının alanı)/10-8) (Işık ve Çalıseki, 2017).

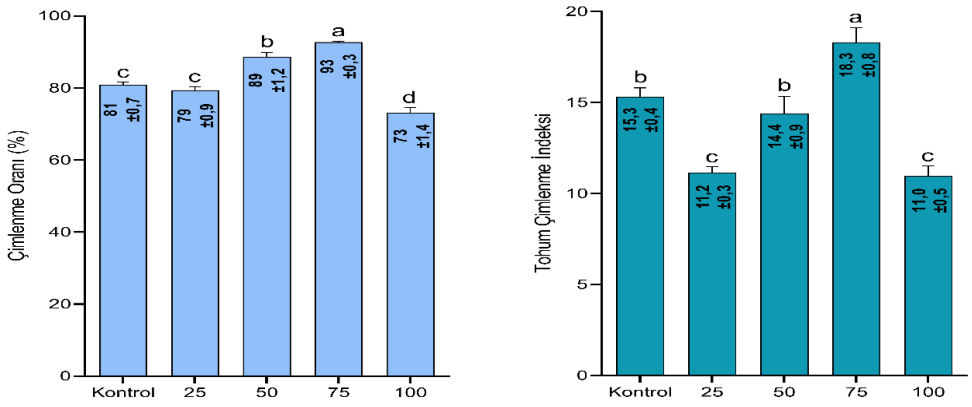
Verilerin analizi SPSS 21.0 istatistik paket programı ile Tesadüf Parselleri Deneme Desenine göre analiz edilmiş, farklılıkların belirlenmesinde Duncan testi uygulanmıştır.

3. BULGULAR VE TARIŞMA

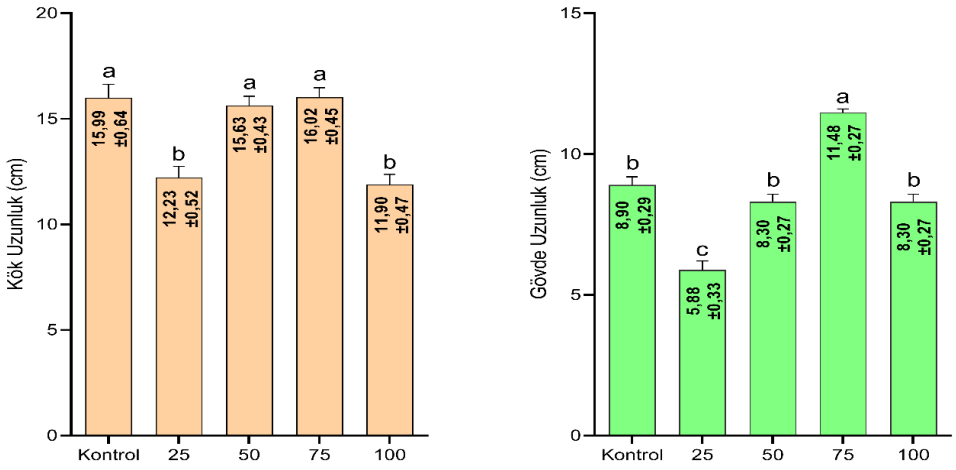
Karabuğday bitkisinin çimlenme oranı, tohum çimlenme indeksi, kök yaş-kuru ağırlığı, gövde yaş-kuru ağırlığı, kök-gövde uzunluğu ve kök-gövde biyokütle verileri şekil 2, 3, 4 ve 5'de verilmiştir. Her özellik bakımından da işlemler arasında istatistiksel olarak çok önemli ($p<0.01$) farklılıklar olmuştur.

Tüm özellikler incelendiğinde, kontrol ve %100 yem şalgamına göre %25, %50 ve %75 yem şalgamı ekstraktı karabuğday tohumlarının ve fidelerinin gelişimlerini olumlu yönde etkilemiştir. Bu durum %100 yem şalgamı ekstraktının bitkide toksik etki yaptığı ve çimlenme ve fide gelişimin olumsuz etkilediğini göstermektedir. Ayrıca genel olarak %75 yem şalgamı ekstarktı diğer işlemlere göre daha iyi performans sergilemiştir. Dolayısıyla yem şalgamının %75 dozundaki ekstraktı karabuğdayın gelişimine pozitif katkı sağlayarak çimlenme ve fide gelişimine olumu yönde etkilediği görülmektedir. Yem şalgamı bitkisi sekonder matabolit içeriği bakımından oldukça zengindir. Yavuz ve Gülümser (2022) yem şalgamının toplam fenolik, toplam flavonoid ve kondanse tanen içeriklerinin sırasıyla 6.56 mg GA g^{-1}, 3.48 mg QE g^{-1} ve %%2.17 olduğunu bildirmişlerdir. Dolayısıyla bitki içermiş olduğu bu içerikler sayesinde karabuğday bitkisinin gelişimine olumlu yönde katkı sağlamıştır. Bitkilerde bulunan biyoaktif bileşenler diğer bitkiler ile etkileşimleri esnasında o bitkilere olumlu ya da olumsuz etkiler ortaya çıkarabilir. Bu konuda yapılan çalışmalarda sonuçlar farklılık ihtiva etmektedir. Ghiyasi ve ark. (2016) sirken (*Chenopodium album* L.) bitkisinin kolzanın (*Brassica napus* L.)

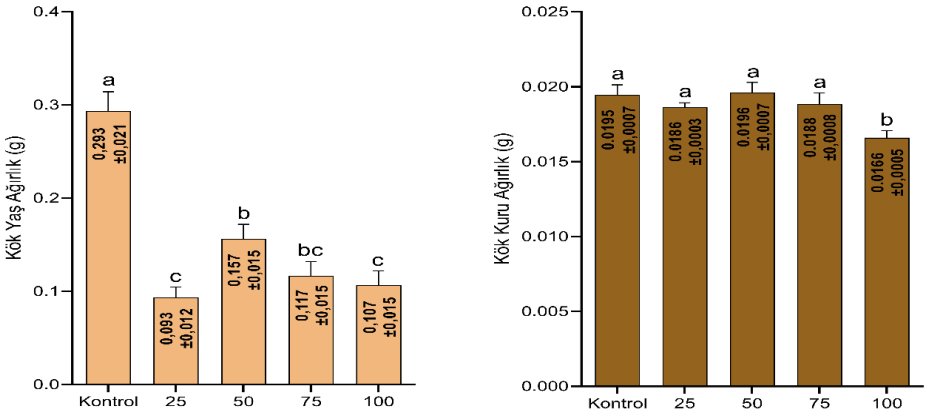
çimlenme ve fide gelişimi üzerindeki etkilerinin belirlenmesi amacıyla yürüttükleri çalışma sonucunda sirken ekstraktlarının kolzanın çimlenme ve fide gelişimini olumsuz etkilediği belirlenmiştir. Yıldız (2019) ısırgan ve karalahana yaprak ekstraktlarının ayçiçeği, soya ve mısır tohumlarının çimlenme ve fide gelişimi üzerine çok önemli allelopatik etkiye sahip olduğunu ortaya koymuştur. Zeren, (2015) Türkiye'de doğal olarak yayılış gösteren bazı tıbbi ve aromatik bitkilerin ekmeklik buğday tohumlarının çimlenme ve gelişmesi üzerine allelopatik etkilerini belirlemek amacıyla yürütülen bir çalışmada, ekstrakt dozlarının arttıkça bitkinin gelişiminin azaldığını bildirmiştir. Türkmen ve Işık, (2016) adi fiğ (*Vicia sativa*), tüylü fiğ (*Vicia villosa*), Macar fiği (*Vicia pannonica)*, koca fiğ (*Vicia narbonenesis*) ve tüylü meyveli fiğ (Vicia villosa spp.) ekstraktlarının (0, 0,25, 0,50, 1, 2, 4, 8, 16, 24) horozibiği (*Amaranthus retroflexus*) tohumlarının çimlenmesi üzerine etkilerinin belirlemek için yaptıkları bir çalışma sonucunda tüylü fiğ ve meyveli tüylü fiğ ekstraktının %4'lük dozu ve adi fiğ ekstraktının %8'lik dozu çimlenmeyi %100 engellediğini, buna karşılık tüm fiğ türlerinin %16'lık ve %24'lük dozlarının horozibiği tohumlarının çimlenmesini %100 engellediğini tespit etmişlerdir. Söz konusu çalışmalarla mevcut çalışma arasındaki farklılıklar kullanılan türlerden kaynaklanmış olabilir. Nitekim her bitki içermiş olduğu sekonder metabolitler bakımından farklılık ihtiva etmektedir. Ayrıca her bitkinin kendinden sonra gelen bitki üzerindeki etkisi de farklı olabilmektedir.



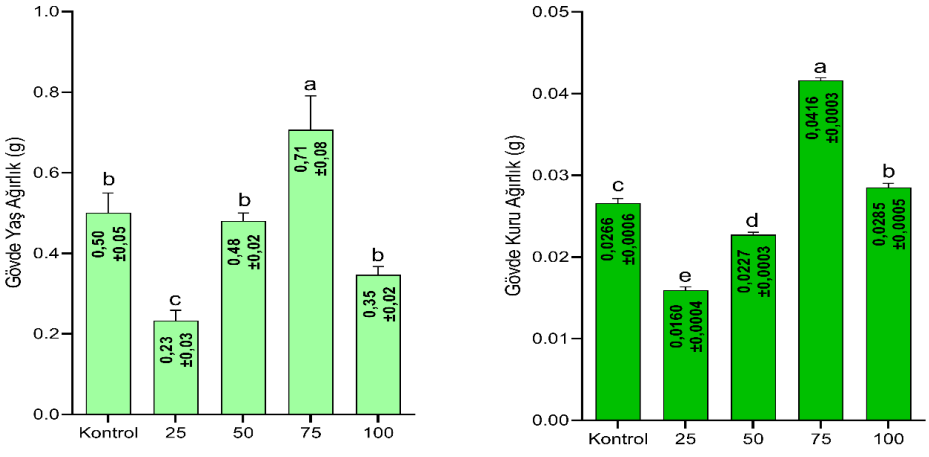
Şekil 2. Karabuğday örneklerine ait çimlenme oranı ve tohum çimlenme indeksi (**: $p<0.01$)



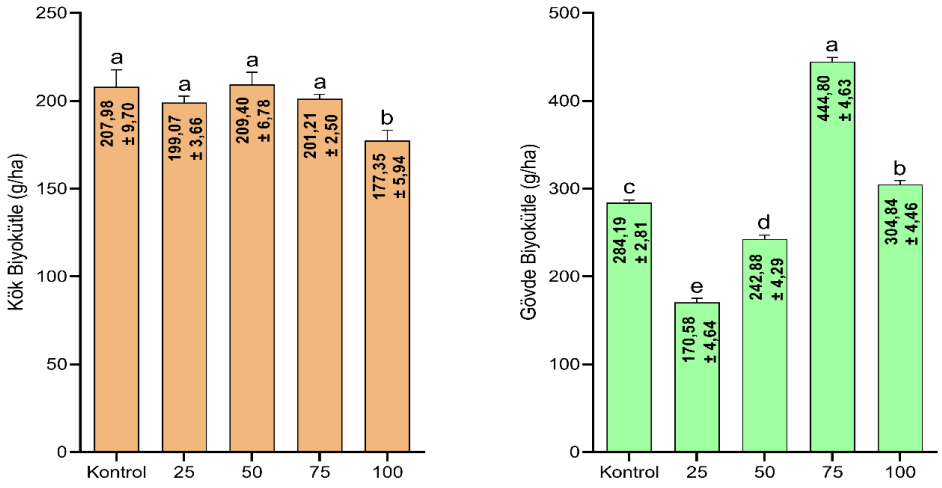
Şekil 3. Karabuğday örneklerinin kök ve gövde uzunlukları (**: p<0.01)



Şekil 4. Karabuğday örneklerinin kök yaş ve kuru ağırlıkları (**: p<0.01)



Şekil 5. Karabuğday örneklerinin gövde yaş ve kuru ağırlıkları (**: p<0.01)



Şekil 6. Karabuğday örneklerinin kök ve biyokütleleri (**: $p<0.01$)

4. SONUÇ

Çalışmada farklı miktarlarda ekstrakt içeren çözeltilerle sulanan karabuğday örnekleri arasında istatistiksel açıdan önemli değişimler olduğu belirlenmiştir. %75 oranında yem şalgamı içeren ekstraktın diğer deney gruplarına göre özellikle çimlenme parametrelerinde, gövde uzunluk, gövde yaş ve kuru ağırlığı ile gövde biyokütlesini olumlu etkilediği tespit edilmiştir**.**

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STANDARTLAŞTIRILMIŞ YAĞIŞ EVAPOTRANSPIRASYON İNDEKSİ KULLANARAK BİLECİK İLİ KURAKLIK ANALİZİ VE BUĞDAY VERİMİ ARASINDAKİ İLİŞKİ

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Özet
Günümüzde, artan sıcaklıklar ve yağış rejimindeki değişikliklerle etkisi giderek daha fazla hissedilmeye başlanan kuraklık etkisi insanoğlunun tüm hayati faaliyetlerini etkilemektedir. Kuraklık, yağış rejiminin normallerin altında gerçekleştiği bir doğal afet durumunu ifade eder. Bu olgu, tarım sektörünü büyük ölçüde etkileyen ve ciddi sonuçlara yol açan bir sorundur. Bu durum, bitki verimliliğini düşürerek ürün kayıplarına neden olurken, bitkinin su gereksinimlerini de arttırarak daha fazla su kullanımına ihtiyaç doğurmaktadır. Kuraklığın zamanı, süresi ve şiddeti de önceden bilinemediğinden dolayı kuraklık analizi yapılırken olasılık ve istatistiksel metotlar kullanılmaktadır. Standartlaştırılmış Yağış Evapotranspirasyon İndeksi (SPEI)'de, iklim değişkenlerini izlemek ve kuraklık koşullarını değerlendirmek için kullanılan önemli yöntemlerden biridir. Bu indeks, yağış ve buharlaşma (evapotranspirasyon) verilerini dikkate alarak mevsimsel ve uzun vadeli kuraklık analizleri yapmaktadır. SPEI, belirli bir bölgenin iklim koşullarını standartlaştırır ve istatistiksel olarak değerlendirir, böylece kuraklık olaylarının şiddeti, süresi ve sıklığı hakkında bilgi sahibi olmamızı sağlar. Bu indeks, çeşitli sektörlerde, özellikle tarım, su kaynakları yönetimi ve çevre planlaması alanlarında, kuraklık risklerini anlamak ve müdahale stratejileri geliştirmek için kullanılmaktadır. Bu çalışmada, Türkiye'de tarımsal üretimde önemli payı olan buğday bitkisi verimi üzerindeki kuraklık etkisinin ne düzeyde olduğu ve Bilecik ilinin kuraklık durumun ne olduğu ortaya koyulmaya çalışılmıştır. Çalışmada, Bilecik Meteoroloji İl Müdürlüğü'nden alınan 1992-2022 yılları arasındaki 30 yıllık yağış ve sıcaklık verileri kullanılarak 1, 3, 6, 9 ve 12 aylık periyotlar için Standartlaştırılmış Yağış Evapotranspirasyon İndeksi (SPEI) yöntemi kullanılarak kuraklık analizi yapılmıştır. Elde edilen sonuçlardan Bilecik ilinin belirtilen yıllar arasındaki kuraklık durumu belirlenmiş ve 12 aylık periyotlarda en kurak yılın 2013 yılı olduğu tespit edilmiştir. 2004-2022 yılları arasındaki buğday verimlerine bakarak iklim koşullarının bitkisel verim üzerindeki etkileri tespit edilmiş ve kuraklığa bağlı olarak bitkisel üretim verimlerinin düştüğü gözlenmiştir.

Anahtar Kelimeler: Kuraklık, Yağış, Sıcaklık, Standartlaştırılmış yağış evapotranspirasyon indeksi, buğday

RELATIONSHIP BETWEEN BILECIK PROVINCE DROUGHT ANALYSIS AND WHEAT YIELD USING STANDARDIZED Precipitation EVAPOTRANSPIRATION INDEX

Abstract
Nowadays, the effect of drought, whose effects are increasingly felt with increasing temperatures and changes in the precipitation regime, affects all vital activities of human beings. This phenomenon is a problem that greatly affects the agricultural sector and causes serious consequences. While this situation reduces plant productivity and causes product losses, it also increases the water requirements of the plant and creates a need for more water use. Since the time, duration and severity of drought cannot be known in advance, probability and statistical methods are used when analyzing drought.The Standardized Precipitation Evapotranspiration Index (SPEI) is one of the important methods used to monitor climate variables and evaluate drought conditions. This index performs seasonal and long-term drought analyses by taking into account precipitation and evapotranspiration data. SPEI standardizes and statistically evaluates the climatic conditions of a given region, thus providing us with information about the severity, duration and frequency of drought events.This index is used to understand drought risks and develop response strategies in various sectors, especially in the fields of agriculture, water resource management and environmental planning. In this study, it was tried to reveal the effect of drought on wheat yield, which has an important share in agricultural production in Turkey, and the drought situation in Bilecik province. Drought analysis was carried out using the Standardized Precipitation Evapotranspiration Index (SPI) method for 1, 3, 6, 9 and 12 month periods using 30-year precipitation and temperature data between 1992 and 2022, obtained from Bilecik Meteorology Station. From the results obtained, the drought situation in Bilecik province between the specified years was determined and it was determined that the driest year in 12-month periods was 2013. By looking at wheat yields between 2004 and 2022, the effects of climatic conditions on crop yields were determined and it was observed that crop production yields decreased due to drought.
Keywords: Drought, Precipitation, Temperature, Standardized Precipitation Evapotranspiration Index, Wheat

1. GİRİŞ

Günümüzde, iklim değişikliğinin dünya genelindeki etkileri giderek artmaktadır. Özellikle kuraklık, tarım ve su kaynakları üzerinde önemli bir baskı unsuru olarak ortaya çıkmaktadır. İklim değişikliğinin etkisi altında, kuraklık olgusu sadece meteorolojik bir durumdan öte, yaşam alanlarımızı ve temel kaynaklarımızı kökten etkileyen bir olgudur. Kuraklık uzun süreli bir afet olup kendisini yavaşça hissettirmektedir (Yetmen 2013). Başka bir tanımlamaya göre ise, kuraklık klimatik değişmeler sonucunda yağış miktarındaki azalmaya bağlı olarak bitki, toprak ve diğer organizmaların su ihtiyacının karşılanamayacak kadar azalması sonucu ortaya çıkan afettir (Dinç vd. 2016). Diğer ekstrem olayların (sel, hortum ve kasırgalar gibi) aksine, kuraklık yavaş ve istikrarlı bir şekilde gelişmekte olup başlangıcını ve sonunu belirlemek kolay değildir (WMO, 2016).

Kuraklık, özellikle tarım sektörünü ciddi şekilde etkileyen ve tarımsal üretkenliği azaltan bir doğal afettir. Yağış döngüsündeki bozulmalar, su kaynaklarının azalması ve toprak verimliliğindeki düşüş, tarım alanlarında sürdürülebilirliği tehdit etmektedir. Ayrıca, su kaynaklarının azalması ve kuraklık, tarımsal üretimin kalitesini ve miktarını da olumsuz etkileyerek gıda güvenliği riskini artırmaktadır.

Dellal (2012) 2050 yılına gelindiğinde iklim değişikliğine bağlı verimdeki azalmalar nedeniyle üretim miktarının buğdayda % 8.18, arpada % 2.24, mısırda % 9.11, pamukta % 4.53 ve ayçiçeğinde % 12.89 oranında azalacağını ön görmüştür. Demir (2013) ise gelecek 30 yılda beklenen sıcaklık artışı özellikle yaz aylarında (0.6-0.8°C) yağlı tohum bitkileri yetiştiriciliğinde önemli problemleri beraberinde getirebileceğini bildirmiştir.

Kuraklık, sadece yağış miktarındaki azalma ile değil, aynı zamanda toprak nemi, su rezervleri, bitki örtüsü ve iklim değişkenleri gibi bir dizi faktörün bir araya gelmesiyle ortaya çıkan karmaşık bir fenomendir. Bu nedenle, etkilerini en düşük seviyelere indirebilmek amacıyla izlenmesi gerekir ve şiddeti artmadan önlemi alınmalıdır. Kuraklık belirleme indisleri, farklı değişkenleri bir araya getirip analiz ederek kuraklık durumlarını tespit etmekte ve değerlendirmede kritik bir rol oynamaktadır.

Kuraklık belirleme indisleri, meteorolojik, hidrolojik ve tarımsal faktörleri bir araya getirerek kuraklık riskini değerlendirmektedir. Bunlar arasında Standart Yağış İndeksi (SPI), Standartlaştırılmış Yağış ve Evapotranspirasyon İndisi (SPEI), Palmer Kuraklık Şiddeti Endeksi (PDSI), Bitki Stres İndeksi (PSI) gibi indeksler yaygın olarak kullanılmaktadır. Bu

indeksler, farklı ölçeklerde kuraklık seviyelerini belirlemekte ve su kaynaklarının durumunu anlamada karar vericilere rehberlik etmektedir.

Bu çalışmada da Standartlaştırılmış Yağış ve Evapotranspirasyon İndisi (SPEI) kullanarak Bilecik ilinin 1992-2022 yılları arasındaki kuraklık analizi yapılmıştır. Elde edilen kuraklık analiz sonuçları 2004-2022 yılları arasındaki buğday verimi ile kıyaslanarak kuraklığın bitkisel üretim üzerindeki etkisinin durum değerlendirmesi yapılmıştır.

2. MATERYAL VE YÖNTEM

Bilecik ili, Marmara Bölgesi'nin güneydoğusunda; Marmara, Karadeniz, İç Anadolu Bölgesi ve Ege Bölgelerinin kesim noktaları üzerinde yer almaktadır. 9° ve 40° 31' kuzey enlemleri ile 29° 43' ve 30° 41' doğu boylamları arasında bulunan Bilecik ilinin toplam yüzölçümü 4307 km^2, çalışmanın yapıldığı merkez ilçenin yüzölçümü ise 841km^2'dir. Bilecik ilinin geçit bölgesinde bulunması, su kaynakları ve farklılık gösteren topografyasına paralel olarak 3 farklı iklim tipi görülmektedir. Genel olarak Merkez, Gölpazarı, Osmaneli ve Söğüt İlçelerinde Marmara Bölgesi; Bozüyük, Pazaryeri ve Yenipazar ilçelerinde ise İç Anadolu Bölgesi iklimleri geçerlidir. Ayrıca Gölpazarı, Osmaneli ve Söğüt ilçelerinin Sakarya Irmağı kıyı şeridinde mikro-klima iklim bölgeleri görülmektedir. Bilecik ili uzun yıllık iklim verilerine bakıldığında yıllık ortalama yağış miktarı 459.6 mm, ortalama sıcaklık ise 12.5 °C olarak gerçekleşmiştir (Tablo 1).

Tablo 1. Bilecik ili 1939-2022 yılları arası ortalama iklim verileri

	Ocak	Şubat	Mart	Nisan	Mayıs	Haziran	Temmuz	Ağustos	Eylül	Ekim	Kasım	Aralık	Yıllık
Ortalama sıcaklık (ºC)	2.5	3.7	6.4	11.5	16.2	19.9	22.1	22.1	18.5	13.9	9.1	4.6	12.5
Ortalama en yüksek sıcaklık(ºC)	6.0	7.9	11.4	17.1	22.0	25.8	28.4	28.6	24.9	19.4	13.6	8.1	17.8
Ortalama en düşük sıcaklık(ºC)	-0.3	0.4	2.4	6.7	10.9	14.2	16.3	16.4	13.2	9.6	5.6	1.9	8.1
Ortalama güneşlenme süresi (saat)	3.1	3.7	4.7	6.3	8.0	9.5	10.5	9.9	8.1	5.5	4.0	2.9	6.4
Ortalama yağışlı gün sayısı	14.4	13.0	13.0	10. 8	10.3	8.1	3.9	3.4	5.1	8.4	9.7	13.2	113.8
Aylık toplam yağış miktarı ortalaması (mm)	50.6	42.8	47.1	41.9	47.1	42.9	19.6	13.8	22.4	39.8	36.4	55.2	459.6

SPEI, kuraklığı tespit etmede yaygın olarak kullanılan ve kuraklığın belirlenmesinde hem yağış hem de potansiyel evapotranspirasyonu (PET) hesaba katan bir analiz yöntemidir. SPEI; Serrano, Beguveria ve Moreno tarafından geliştirilmiş, yağış ve sıcaklık verilerine dayalı bir

yöntemdir. Sıcaklık değişkenliği ile kuraklık değerlendirmesi yapabilmektedir. SPEI hesaplaması, SPI hesaplama yöntemine dayalıdır. Farklı zaman ölçeklerinde hesaplanan, basit bir su dengesi metodolojisi olan aylık yağış ve potansiyel evapotranspirasyon (P - ETo) farkı kullanılmaktadır (Çamalan ve ark., 2017). Düzenli ve eksiksiz sıcaklık ve yağış verilerine gereksinim duyulmaktadır (Fuchs, 2012). SPEI, sıcaklıkta meydana gelen değişkenlik ve aşırılıkların olası etkilerini açıklayabilmektedir. SPEI'da 1-48 ay arasında değişen bir zaman ölçeğinde hesaplama yapılabilir (Vicente Serrano ve ark., 2010). SPEI, PET'i modellemek için kullanılan, Thornthwaite, Penman–Monteith, Hargreaves, Turc denklemi gibi yöntemlerden herhangi birine bağlı değildir (Anonim, 2022). Fakat orijinal formülasyonunda Thornthwaite yöntemi kullanılmıştır. (Vincante - Serrano, 2014).

$$Di = Pi - PETi$$

Eşitlikte; D:farkı; P:yağış miktarını; PET: potansiyel evapotrasnpirasyonu, i: ay zaman ölçeğini ifade etmektedir.

SPEI kullanılarak elde edilen değerler tablo 2'deki kuraklık kategorisine göre sınıflandırılarak değerlendirme yapılmaktadır.

Tablo 2. SPEI kuraklık kategorisi

SPEI Değerleri	Kuraklık Kategorisi
≥ 2.00	Aşırı Nemli
1.50-1.99	Çok Nemli
1.00-1.49	Orta Nemli
0.50-0.99	Hafif Nemli
-0.49-0.49	Normale Yakın
-0.99 - -0.50	Hafif Kurak
-1.49 - -1.00	Orta Kurak
-1.99 - -1.50	Şiddetli Kurak
≤ -2.00	Aşırı Kurak

Yağış ve sıcaklık verilerine dayalı, su dengesini baz alarak hesaplama yapan bir yöntem olan standart yağış ve evapotranpirasyon indisi; farklı zaman ölçeklerinde, en az 30 yıllık dönemler için düzenli ve eksiksiz yağış ve sıcaklık verileriyle hesaplama yapan bir yöntemdir. Bu çalışmada, Bilecik Meteoroloji İstasyonundan alınan 1992-2022 yılı verileri kullanılarak SPEI

yöntemine göre kuraklık analizi yapılmıştır. SPEI yöntemiyle hesaplama yapmak için SPEI yazılımı kullanılmış ve 1, 3, 6, 9 ve 12 aylık periyotlar için kuraklık analizi yapılmıştır.

Kuraklığın bitkisel üretim üzerindeki etkilerini belirlemek için buğday bitkisi seçilmiş ve TUİK'ten Bilecik ili Merkez ilçesine ait 2004-2022 yılları arasındaki veriler alınmıştır. Elde edilen bitkisel üretim verileriyle kuraklık kategorisi karşılaştırılmış ve kuraklığın verim üzerindeki etkileri yorumlanmıştır. Karşılaştırmada buğday bitkisinin vejetasyon dönemi olan 9 aylık periyottaki (Kasım-Temmuz) kuraklık değerlerine bakılmıştır.

3. BULGULAR VE TARIŞMA

Bu çalışmada, Bilecik iline ait 1 aylık, 3 aylık, 6 aylık, 9 aylık ve 12 aylık SPEI zaman serilerine bağlı kuraklık değerleri elde edilmiştir.

SPEI yazılımı kullanılarak elde edilen 1 aylık sonuçlar 1992-2022 yılları arasında 136 ayın normal, 118 ayın nemli 106 ayın ise kurak geçtiğini göstermiştir. Kuraklığın en yüksek olduğu ay 2010 yılı ağustos ayı (-2.39) aşırı kurak tespit edilirken, nemin en yüksek olduğu ay ise 2005 yılı Eylül ayı (2.51) olmuş ve aşırı nemli olarak tespit edilmiştir (Çizelge 1). Genel olarak bir değerlendirme yaptığımızda aylık kuraklığın normale yakın geçtiği belirlenmiştir.

	Ocak	Şubat	Mart	Nisan	Mayıs	Haziran	Temmuz	Ağustos	Eylül	Ekim	Kasım	Aralık
1992	-1,07	0,67	1,13	-0,03	-0,68	0,85	1,26	-0,57	0,01	0,2	1,36	0,82
1993	-0,59	0,23	-0,55	-0,23	1,34	-1,24	-0,09	0,79	0,01	-2,22	1,43	-0,85
1994	-0,31	0,61	-1,31	-1,46	-0,55	-0,21	-0,58	-0,24	-2,36	-0,06	1,77	0,47
1995	1,31	-1,66	1,21	0,19	-1,42	-0,96	1,79	0,2	0,81	0,73	1,28	-0,93
1996	0,03	-0,84	1,27	0,61	0,08	-0,39	-0,38	-0,12	0,76	1,26	-1,11	-0,22
1997	-0,4	-0,05	0,19	1,67	-0,49	0,27	0,1	2,09	0,45	1,62	-0,39	0,78
1998	-0,36	-0,59	0,89	-0,66	1,95	0,51	0,29	-1,17	0,12	-0,07	0,59	0,86
1999	-1,33	0,91	0,01	-0,23	-0,93	1,07	0,47	0,52	0,25	-1,09	0,59	-1,51
2000	1,06	-0,09	1,54	2,15	0,47	-1,09	-0,39	0,61	-0,24	0,32	-1,29	-0,54
2001	-1,82	-0,43	-2,05	1,19	0,79	-0,92	-0,91	0,74	-0,81	-1,18	1,65	2,42
2002	-0,12	-1,15	-0,87	0,63	-0,18	-0,85	1,29	0,21	1,15	0,07	-0,26	-0,1
2003	-0,99	1,84	-0,01	0,28	-0,44	-1,84	-0,89	-0,36	0,77	1,18	-0,55	0,65
2004	1,28	0,69	-0,34	0,53	-0,42	0,55	0,22	0,3	-0,98	-0,83	0,51	-0,68
2005	-0,08	0,22	0,16	-0,11	-1,32	-0,44	1,69	-0,75	2,51	-0,07	0,91	-0,89
2006	0,76	0,54	-0,68	-1,75	-0,07	-1,19	0,18	-1,64	0,91	-0,3	0,45	-0,78
2007	1,12	-1,43	-0,29	-0,7	-0,19	0,5	-1,01	-1,23	-1,12	-0,19	1,34	0,82
2008	-0,43	-0,92	0,45	-0,01	-0,23	-0,07	-0,97	-1,22	1,13	-0,19	0,48	-0,21
2009	-0,29	1,14	0,14	-0,47	-1,07	0,28	-0,92	0,34	0,27	-1,56	0,09	-0,06
2010	0,34	1,19	-0,01	0,06	-0,92	0,54	-1,28	-2,39	0,36	2,24	-2,09	0,16
2011	-1,02	-0,61	0,31	1,71	0,89	0,72	-0,35	0,84	-0,49	0,67	-0,22	0,21
2012	1,42	1,66	1,71	-0,49	1,59	-0,89	-1,75	0,43	-1,67	-0,85	-0,43	0,77
2013	-1,25	-1,01	0,39	-0,38	-1,86	-0,75	-0,2	-0,75	-0,42	1,45	-0,78	-0,71
2014	-1,89	-1,44	-0,48	0,19	1,34	0,69	1,63	1,01	1,01	0,15	0,15	0,94
2015	1,73	1,24	0,52	0,73	0,1	1,75	-1,09	-0,89	-0,09	0,94	-1,41	-1,04
2016	1,48	-0,56	-0,61	-1,82	1,53	-1,12	0,36	0,82	0,11	-0,85	-0,03	1,19
2017	0,43	-1,38	-1,59	0,72	0,89	0,68	-0,65	0,39	-1,85	0,49	-0,39	0,19
2018	-0,59	-0,75	-0,05	-1,88	1,29	-0,24	-0,03	0,19	1,24	0,28	-0,04	1,51
2019	-0,04	0,96	-1,6	0,05	-0,43	1,95	1,21	0,27	-0,55	-1,04	-1,05	0,69
2020	0,29	0,72	-1,04	-0,15	0,76	1,77	-0,82	-0,28	-1,34	-0,8	-0,84	-1,93
2021	0,65	-0,45	1,98	1,02	-0,2	0,62	1,09	-0,37	0,49	-0,36	-0,25	-0,19
2022	0,55	0,81	-0,15	-1,08	-0,97	1,18	1,48	2,29	-0,09	0,09	-1,24	-1,68

Aşırı Nemli	Çok Nemli	Orta Nemli	Hafif Nemli	Normal	Hafif Kurak	Orta Kurak	ŞiddetliKurak	Aşırı Kurak

Çizelge 1. Bilecik ili SPEI 1 aylık kuraklık şiddetleri

3 aylık periyotlara göre yapılan kuraklık analiz sonuçlarına göre 143 ayın normal, 114 ayın nemli, 101 ayın ise kurak geçtiği tespit edilmiştir. 3 aylık periyotlarda kuraklığın en yüksek olduğu ay 2014 yılı Şubat ayı (-2.3)olmuş ve aşırı kurak olarak tespit edilmiştir. Nemin en yüksek olduğu ay ise 2005 Kasın ayı (2.51) aşırı nemli olarak gözlenmiştir (Çizelge 2). Bu verilerde bize 3 aylık periyotlarda kuraklığın normale yakın geçtiğini göstermektedir.

	Ocak	Şubat	Mart	Nisan	Mayıs	Haziran	Temmuz	Ağustos	Eylül	Ekim	Kasım	Aralık
1992	-	-	0,39	0,86	0,23	0,09	0,69	0,85	0,28	0,39	0,94	1,47
1993	0,97	0,38	-0,47	-0,3	0,43	-0,21	-0,11	-0,7	0,14	-0,99	-0,15	-0,57
1994	0,22	-0,43	-0,45	-1,12	-2,11	-1,33	-0,91	-0,58	-1,62	-1,12	0,29	1,02
1995	1,63	-0,05	0,32	-0,25	0,17	-1,19	-0,35	0,37	1,1	0,72	1,06	0,53
1996	0,19	-1,1	0,24	0,57	0,94	-0,14	-0,68	-0,62	0,37	0,99	0,63	0,21
1997	-1,02	-0,45	-0,18	1,17	1	0,84	-0,29	1,04	0,98	1,49	1,05	1,43
1998	0,03	0,04	-0,07	-0,25	1,42	1,17	1,54	0,02	-0,28	-0,52	0,04	0,55
1999	0,17	0,37	-0,25	0,37	-0,69	0,14	0,47	0,96	0,34	-0,49	-0,3	-1,21
2000	-0,16	-0,56	1,31	2	2,01	1,06	-0,89	-0,79	-0,18	0,02	-0,98	-1,04
2001	-1,95	-1,68	-2,07	-0,42	0,23	0,37	-0,68	-0,76	-0,56	-1,07	-0,01	1,9
2002	2,44	1,75	-1,13	-0,76	-0,22	-0,48	-0,31	-0,02	1,15	0,7	0,52	-0,4
2003	-0,78	0,5	0,66	1,16	-0,15	-1,23	-1,93	-1,77	0,23	0,91	0,74	0,8
2004	0,52	1,24	0,84	0,49	-0,14	0,22	0,03	0,41	-0,45	-1,15	-0,79	-0,72
2005	-0,24	-0,43	0,13	0,1	-0,68	-1,07	-0,12	0,29	2,48	2,32	2,51	-0,23
2006	0,24	0,01	0,34	-1	-1,65	-1,75	-1,07	-1,41	0,38	0	0,41	-0,58
2007	0,17	-0,84	-0,46	-1,49	-0,82	-0,36	-0,26	-0,37	-1,99	-1,29	0,05	0,88
2008	1,02	-0,14	-0,55	-0,35	0,01	-0,44	-0,76	-0,87	0,51	0,38	0,66	-0,2
2009	-0,09	0,29	0,58	0,45	-0,82	-0,73	-0,81	-0,09	-0,06	-0,74	-0,77	-0,88
2010	0,03	0,7	0,85	0,67	-0,5	-0,92	-1,47	-1,63	-0,97	1,63	1,44	1,76
2011	-1,62	-0,83	-0,77	1,03	1,51	1,57	0,68	0,58	-0,18	0,25	-0,14	0,22
2012	0,46	1,51	2,32	1,48	1,49	0,11	0,03	-1,08	-1,45	-1,33	-1,71	-0,37
2013	-0,43	-0,71	-1,09	-0,66	-0,89	-1,49	-1,65	-1,01	-0,77	0,7	0,48	0,42
2014	-1,84	-2,3	-2,03	-1,07	0,67	1,02	1,59	1,28	1,27	0,75	0,55	0,49
2015	1,19	1,79	1,69	1,22	0,64	1,62	1,3	1,14	-0,89	0,26	-0,33	-0,8
2016	-0,84	-0,31	0,13	-1,67	-0,18	-0,69	0,33	-0,44	0,32	-0,37	-0,37	0,17
2017	0,84	0,35	-1,31	-1,21	0,13	0,97	0,58	0,33	-1,09	-0,32	-0,71	-0,01
2018	-0,48	-0,63	-0,78	-1,54	-0,24	-0,52	0,41	-0,29	0,97	0,86	0,77	0,89
2019	0,95	1,52	-0,23	-0,19	-1,21	1,51	1,85	1,88	0,21	-1,09	-1,96	-0,84
2020	-0,12	0,9	0,05	-0,19	-0,27	1,55	1,57	1,28	-1,4	-1,53	-1,95	-2,11
2021	-1,34	-1,2	1,3	1,41	1,44	0,65	0,55	0,62	0,52	-0,2	-0,31	-0,68
2022	-0,15	0,49	0,64	-0,2	-1,35	-0,13	1,05	1,93	1,19	0,7	-1,06	-1,77

Aşırı Nemli	Çok Nemli	Orta Nemli	Hafif Nemli	Normal	Hafif Kurak	Orta Kurak	ŞiddetliKurak	Aşırı Kurak

Çizelge 2. Bilecik ili SPEI 3 aylık kuraklık şiddetleri

6 aylık periyotlar için yapılan yapılan kuraklık analiz sonuçları çizelge 3'de verilmiştir. Elde edilen sonuçlar 129 ayın normal, 122 ayın nemli, 104 ayın ise kurak geçtiğini göstermektedir. Bu sonuçlar doğrultusunda Bilecik ilin 6 aylık periyotlar için kuraklığın normal olduğu gözlenmiştir. 2006 yılı Şubat ayı (2.52) aşırı nemli olurken, 2012 yılı kasım ayı (-3.73) aşırı kurak tespit edilmiştir.

	Ocak	Şubat	Mart	Nisan	Mayıs	Haziran	Temmuz	Ağustos	Eylül	Ekim	Kasım	Aralık
1992	-	-	-	-	-	0,41	1,01	0,55	0,05	0,56	1,19	1,07
1993	0,77	0,82	1,14	0,54	0,53	-0,42	-0,44	-0,42	-0,26	-1,01	-0,81	-0,48
1994	-0,53	-0,47	-0,91	-0,61	-1,73	-1,34	-1,46	-1,6	-1,99	-1,73	-0,19	0,16
1995	0,56	0,07	1,07	1,24	0,01	-0,63	-0,57	0,09	0,07	0,33	1,09	0,98
1996	0,6	0,3	0,53	0,44	-0,17	0,14	-0,16	0,04	-0,04	0,51	0,19	0,25
1997	0,21	0,16	-0,06	-0,02	0,41	0,62	0,65	1,34	1,06	1,31	1,35	1,36
1998	1,32	0,78	1,29	-0,25	1,13	0,93	1,04	0,97	0,52	0,61	-0,07	0,15
1999	-0,31	0,11	0,23	0,27	-0,23	0,03	0,47	0,09	0,13	-0,23	0,36	-0,84
2000	-0,55	-0,65	-0,19	1,53	1,48	1,48	1,25	1,35	0,47	-0,75	-1,92	-1,09
2001	-1,81	-1,8	-2,32	-1,77	-1,33	-1,39	-0,89	-0,59	-0,23	-1,51	-0,69	1,17
2002	1,23	0,88	1,35	1,94	1,27	-1,18	-0,88	-0,44	0,56	0,33	0,39	0,56
2003	0,02	0,52	-0,02	0,17	0,23	-0,39	-0,39	-1,28	-0,95	-0,24	-0,28	0,58
2004	0,92	1,03	1,15	0,65	0,85	0,75	0,25	-0,09	-0,29	-1,01	-0,53	-0,97
2005	-0,99	-0,88	-0,65	-0,24	-0,89	-0,67	-0,15	-0,48	2,6	2,42	2,47	2,4
2006	2,39	2,52	-0,09	-0,53	-1,13	-1,11	-1,49	-1,74	-1,26	-0,89	-0,58	-0,3
2007	0,01	-0,25	-0,92	-0,87	-1,32	-0,53	-1,32	-0,97	-1,29	-1,32	-0,33	-0,05
2008	-0,02	-0,16	0,38	0,56	-0,18	-0,66	-0,89	-0,79	-0,12	-0,28	0,11	0,07
2009	0,13	0,54	0,09	0,12	-0,38	-0,06	-0,34	-0,81	-0,77	-1,37	-0,98	-0,87
2010	-0,56	-0,19	-0,27	0,39	0,17	0	-0,57	-1,38	-1,41	1,19	0,89	0,97
2011	0,89	0,9	1,35	-0,66	0,7	0,92	1,13	1,46	0,87	0,44	0,17	-0,06
2012	0,38	0,65	1,72	1,39	1,99	1,57	1,13	0,41	-0,77	-1,11	-3,73	-1,08
2013	-1,25	1,53	-1,19	-0,84	-1,25	-2,03	-1,6	-1,3	-1,81	-0,4	-0,22	-0,15
2014	-0,86	-1,16	-1,29	-1,96	-1,56	-0,67	0,63	1,32	1,41	1,32	1,14	1,11
2015	1,13	1,19	1,45	1,72	1,69	1,93	1,72	1,14	0,69	0,84	0,49	-1,26
2016	-0,49	-0,52	-0,71	-1,61	-0,46	-0,35	-1,04	-0,67	-0,46	-0,26	-0,26	0,19
2017	0,25	-0,36	-0,91	-0,14	0,29	-0,03	-0,54	0,03	0,06	-0,04	-0,53	-0,63
2018	-0,69	-0,96	-0,68	-1,33	-0,77	-0,92	-0,9	-0,62	0,32	0,83	0,52	1,07
2019	1,08	1,19	0,61	0,58	0,57	1,12	1,42	1,08	0,98	0,67	0,53	-0,64
2020	-0,87	-0,61	-0,79	-0,33	0,49	1,27	1,11	0,69	0,49	0,23	-0,32	-3,09
2021	-2,26	-1,96	-0,95	-0,04	0,34	1,25	1,36	1,41	0,59	0,02	0,07	-0,26
2022	-0,35	-0,05	-0,26	-0,35	-0,53	0,41	0,57	1,09	0,8	0,99	0,92	-0,23

Aşırı Nemli	Çok	Orta	Hafif	Normal	Hafif Kurak	Orta	ŞiddetliKurak	Aşırı

Çizelge 3. Bilecik ili SPEI 6 aylık kuraklık şiddetleri

9 aylık periyotlarda yapılan analiz sonuçlarına göre 130 ay normal, 112 ay nemli,110 ay ise kurak olarak tespit edilmiştir. En kurak 9 ay (-2.19) 2001 yılı Mart ayı aşırı kurak, 2011 Haziran ayı (1.71) ise çok nemli bulunarak en nemli 9 ay olmuştur. 9 aylık dönemlerde yapılan analizler sonucu Bilecik ilinin normal bir kuraklık sınıfında olduğunu göstermiştir.

	Ocak	Şubat	Mart	Nisan	Mayıs	Haziran	Temmuz	Ağustos	Eylül	Ekim	Kasım	Aralık
1992	-	-	-	-	-	-	-	-	0,21	0,74	1,12	1,09
1993	0,97	1,06	0,78	0,48	0,84	0,75	0,39	-0,07	-0,52	-0,99	-0,48	-0,71
1994	-0,65	-0,79	-0,64	-1,05	-1,35	-1,41	-1,02	-1,59	-1,87	-1,81	-1,64	-0,79
1995	0,11	-0,23	0,23	0,28	0,06	0,21	0,88	0,09	0,19	0,03	1,01	0,46
1996	0,39	0,41	0,91	0,66	0,61	0,33	0,02	-0,57	0,05	0,56	0,6	0,14
1997	-0,19	-0,15	0,09	0,63	0,54	0,47	-0,19	0,83	0,88	1,5	1,51	1,58
1998	1,19	1,12	1,21	1,1	1,22	1,48	0,85	0,8	0,39	0,28	0,75	0,8
1999	0,61	0,07	-0,02	-0,19	-0,25	0,26	0,49	0,33	-0,05	-0,12	-0,12	-0,8
2000	-0,31	-0,07	-0,01	0,71	0,69	0,53	0,92	0,79	0,98	0,69	0,5	-0,23
2001	-2,42	-2,09	-2,19	-1,59	-1,54	-1,72	-1,99	-1,39	-1,59	-1,35	-0,54	1,27
2002	0,98	0,55	0,65	0,84	0,68	0,79	1,51	0,91	-0,11	-0,19	0,15	0,3
2003	-0,21	0,45	0,69	0,49	0,36	-0,68	-0,84	-0,78	-0,45	0,34	-0,45	-0,12
2004	0,14	0,41	0,76	0,93	0,86	0,95	0,56	0,76	0,16	-0,56	-0,66	-0,88
2005	-1,01	-0,63	-0,71	-0,82	-1,16	-1,07	-0,29	-0,59	2,63	2,45	2,36	2,24
2006	2,36	2,46	2,4	2,31	2,23	-1,05	-1,03	-1,52	-0,87	-1,26	-1,77	-1,92
2007	-0,61	-0,89	-0,5	-0,77	-0,64	-0,89	-0,93	-1,23	-1,35	-1,76	-0,92	-0,33
2008	-0,22	-0,36	-0,34	-0,28	-0,21	0,06	-0,08	-0,69	-0,44	-0,52	0	-0,24
2009	-0,31	0,15	0,27	0,21	0,14	-0,31	-0,33	-0,46	-0,36	-0,82	-1,56	-1,62
2010	-1,08	-0,26	-0,27	-0,21	-0,46	-0,69	-0,43	-0,76	-0,69	1,21	0,56	0,58
2011	0,29	0,3	0,56	1,1	1,35	1,71	-0,19	0,74	0,42	0,73	0,95	0,91
2012	0,63	0,81	0,99	0,93	0,93	1,17	1,32	1,17	1,27	0,77	0,05	-0,75
2013	-1,09	-1,25	-1,97	-1,35	-1,81	-1,72	-1,55	-1,45	-2,11	-0,75	-0,86	-1,39
2014	-1,92	-1,59	-1,36	-0,75	-0,31	-0,84	-0,84	-0,32	0,39	0,77	1,22	1,43
2015	1,61	1,53	1,46	1,39	1,25	1,78	1,99	1,86	1,31	1,13	0,67	0,19
2016	0,31	0,16	-0,92	-1,27	-0,62	-0,91	-1,14	-0,68	-0,36	-1,14	-1,14	-0,27
2017	0,34	-0,58	-0,53	-0,42	-0,34	-0,04	0,21	0,27	-0,75	-0,74	-0,48	0,07
2018	-0,36	-0,75	-0,94	-1,35	-1,04	-0,78	-1,03	-0,82	-0,16	-0,04	0,27	0,87
2019	1,15	1,02	0,86	0,85	0,73	1,28	1,65	1,67	0,79	0,37	-0,17	0,49
2020	0,52	0,73	-0,51	-0,87	-0,74	0,49	0,82	1,07	0,43	-0,03	-0,57	-1,16
2021	-0,75	-0,94	-1,25	-0,8	-0,85	-0,29	0,27	0,49	1,07	0,67	0,85	0,15
2022	-0,08	0,23	0,05	-0,49	-0,65	-0,25	0,35	1,12	0,96	0,69	0,27	-0,36
Aşırı Nemli	**Çok Nemli**	**Orta**	**Hafif**	**Normal**	**Hafif**	**Orta**	**Şiddetli**	**Kurak**	**Aşırı**			

Çizelge 4. Bilecik ili SPEI 9 aylık kuraklık şiddetleri

12 aylık periyotlarda yapılan analiz sonuçları çizelge 5'de verilmiştir. Çizelgede Aralık ayı değerlerine baktığımızda hangi yılın kurak yada nemli olduğu hakkında bilgi sahibi olmaktayız. Sonuçlar incelendiğinde 2005 yılının aşırı nemli (2.45), 2013 yılının ise aşırı kurak olduğu (-2.11) tespit edilmiştir. Analizin yapıldığı 1992-2022 yıllarını değerlendirdiğimiz zaman Bilecik ili Merkez ilçesi için 9 yılın normal, 11 yılın nemli, 11 yılın ise kurak geçtiği gözlenmiştir.

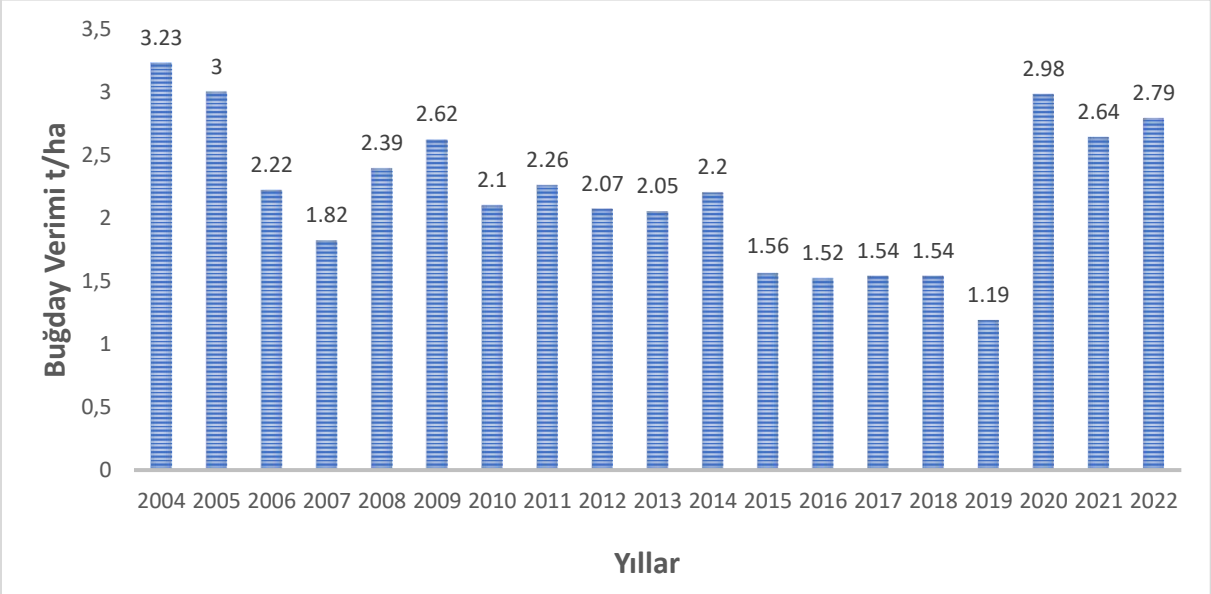
	Ocak	Şubat	Mart	Nisan	Mayıs	Haziran	Temmuz	Ağustos	Eylül	Ekim	Kasım	Aralık
1992	-	-	-	-	-	-	-	-	-	-	-	1,2
1993	1,2	1,03	0,76	0,68	1,02	0,58	0,38	0,46	0,42	-0,31	-0,26	-1,07
1994	-0,87	-0,61	-0,79	-1,1	-1,48	-1,19	-1,35	-1,43	-1,65	-1,47	-1,69	-1,13
1995	-0,51	-1,15	-0,47	-0,15	-0,21	-0,35	0,11	0,07	0,58	0,92	0,92	0,52
1996	0,23	0,41	0,41	0,45	0,64	0,73	0,36	0,24	0,16	0,58	-0,07	0,16
1997	0,09	0,26	-0,02	0,31	0,23	0,41	0,46	0,81	0,68	1,05	1,37	1,59
1998	1,48	1,31	1,4	0,95	1,42	1,41	1,49	1,09	1,02	0,25	0,68	0,72
1999	0,46	0,71	0,54	0,56	-0,27	0	0,01	0,11	0,09	-0,04	0,04	-1,01
2000	-0,14	-0,4	0,02	0,8	0,95	0,44	0,35	0,27	0,1	0,54	0,12	0,42
2001	-0,42	-0,45	-1,43	-1,86	-1,68	-1,61	-1,77	-1,62	-1,67	-2,28	-1,72	0,35
2002	0,79	0,56	0,74	0,53	0,34	0,36	0,65	0,51	1,09	1,35	1,06	-0,46
2003	-0,66	0,31	0,45	0,28	0,26	0,11	-0,25	-0,39	-0,7	-0,11	-0,15	-0,15
2004	0,69	0,29	0,22	0,21	0,23	0,72	0,84	0,84	0,41	-0,23	0,19	-0,37
2005	-0,71	-0,74	-0,61	-0,84	-0,87	-1,13	-0,83	-0,97	2,44	2,34	2,44	2,45
2006	2,29	2,23	2,22	2,32	2,19	2,03	1,99	2,04	-0,9	-0,99	-1,47	-1,48
2007	-1,25	-1,69	-1,53	-1,22	-1,14	-0,63	-0,83	-0,82	-1,36	-1,46	-1,43	-0,71
2008	-1,12	-0,76	-0,57	-0,46	-0,39	-0,52	-0,58	-0,63	0,02	0,12	-0,16	-0,68
2009	-0,54	0,09	0,02	-0,17	-0,24	-0,1	-0,13	-0,05	-0,54	-0,79	-1,13	-1,12
2010	-0,81	-0,66	-0,69	-0,6	-0,49	-0,68	-0,78	-1,08	-1,08	1,12	0,79	0,87
2011	0,55	0,06	0,11	0,58	0,86	1,09	1,19	1,39	1,31	-0,17	0,52	0,54
2012	0,99	1,28	1,49	1,09	1,22	0,89	0,84	0,72	0,59	0,27	0,34	0,55
2013	-0,13	-0,95	-1,39	-1,31	-1,99	-1,95	-1,93	-1,88	-1,71	-0,92	-1,28	-2,11
2014	-2,48	-2,11	-2,25	-1,85	-0,59	-0,25	-0,25	-0,09	0,36	-0,27	0,08	0,68
2015	1,31	1,56	1,67	1,85	1,53	1,75	1,62	1,49	1,24	1,49	1,39	0,9
2016	0,84	0,38	0,14	-0,55	-0,01	-1,12	-1,04	-0,83	-0,82	-1,47	-1,47	-1,34
2017	-0,53	-0,7	-0,94	-0,33	-0,52	0	-0,15	-0,29	-0,62	-0,18	-0,28	-0,88
2018	-1,11	-0,72	-0,36	-1,06	-0,81	-1,07	-1,08	-1,09	0,3	-0,31	-0,17	0,48
2019	0,59	0,86	0,62	0,91	0,53	1,27	1,46	1,46	0,97	0,78	0,71	0,29
2020	0,39	0,28	0,37	0,25	0,49	0,36	0,06	-0,09	-0,25	-0,11	0,02	-1,12
2021	-0,89	-1,11	-0,19	0,07	-0,09	-0,73	-0,5	-0,57	-0,26	-0,08	0,19	0,71
2022	0,67	0,83	0,33	-0,29	-0,34	-0,05	0,04	0,54	0,33	0,55	0,44	-0,07

Aşırı Nemli	Çok	Orta	Hafif	Normal	Hafif Kurak	Orta	ŞiddetliKurak	Aşırı

Çizelge 5. Bilecik ili SPEI 12 aylık kuraklık şiddetleri

İklim olaylarının bitkisel verim üzerine olan etkilerini belirlemek üzere elde edilen kuraklık analiz sonuçlarıyla Bilecik ili Merkez ilçesinin buğday üretim verimleri karşılaştırılmıştır. Karşılaştırma yapmak için buğday bitkisinin vejetasyon dönemi olan 9 aylık periyot (Kasım-Temmuz) için kuraklık değerleri dikkate alınmıştır. Bunun için çizelge 4'deki temmuz ayı değerlerine bakılmıştır. Bilecik ili için buğday verimleri incelendiğinde en yüksek verim 2004 yılında (3.23 t/ha), en düşük verim ise 2019 yılında (1.19 t/ha) gerçekleşmiştir. Araştırmanın yapıldığı 2004-2022 yılları arasındaki ortalama verim ise 2.20 t/ha olarak hesaplanmıştır. Bitkisel üretim verimlerini kuraklık analiz sonuçlarıyla karşılaştırdığımızda en yüksek verimin elde edildiği 2004 yılının hafif nemli, en düşük verimin elde edildiği 2019 yılının ise çok nemli geçtiği tespit edilmiştir. Su bitkisel üretimde verim arttırıcı en önemli girdilerden biri olsa da zamansız ve aşırı su verim düşmesine sebep olabilmektedir. 2019 yılının da nemli geçmesine

rağmen en düşük verimin elde edilme sebebi hasat öncesi haziran ve temmuz aylarının aşırı nemli geçmiş olması sonucuna varılmıştır. Genel bir değerlendirme yaptığımızda buğday verim ortalamasının altında kalan yılların genelde kurak, ortalamanın üstünde verim elde edilen yılların ise normal ve nemli geçtiği tespit edilmiştir. Yapılan benzer çalışmalarda da araştırmacılar kuraklığın ve hasat öncesi gelen aşırı nemin bitkisel verimi olumsuz etkilediğini bildirmişlerdir (Gürkan ve ark. 2016, Tong ve ark. 2017, Şimsek ve ark. 2008).



Çizelge 6. Bilecik ili Merkez ilçesi 2004-2022 yılları arası Buğday verimi

4. SONUÇ

Bu çalışmada, Bilecik ili Merkez ilçesinin SPEI yöntemi kullanılarak 1,3,6,9 ve 12 aylık periyotlarda kuraklık analizi yapılmıştır. Elde edilen sonuçlar Bilecik ilinin genelde normale yakın bir kuraklık sınıfında olduğu gözlenmiştir. Buğday verimi ile kuraklık sonuçlarını karşılaştırdığımız zaman da kuraklığın yüksek olduğu yıllarda buğday verimin genel olarak ortalamanın altında kaldığı ve zamansız gelen yağışlarında bitkisel üretim verimini olumsuz etkilediği sonucuna varılmıştır.

Küresel iklim değişikliği ve bunun beraberinde getirdiği en büyük doğal afet olan kuraklık insan yaşamını olumsuz etkilemektedir. Özellikle kuraklığın etkisiyle bitkisel üretimin azalması bunun aksine artan dünya nüfusuyla gıda talebinin artması küresel anlamda bir krize neden olmaya başlamıştır. Bu durum önceden tahmin edilerek etkilerini ve şiddetini azaltacak önemler

alınabilir. Bunun için geliştirilen kuraklık indisleri sayesinde uzun yıllık iklim sonuçları kullanılarak elde edilen veriler ve yapılan tahminler ile bir veri bankası oluşturulup, tüm canlı yaşamını en başta da tarımsal faaliyetleri ve su kaynaklarını etkileyecek olan bu doğal afete karşı gerekli önlemler vaktiyle alınabilir.

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ÖZET
Türkiye'de son yıllarda üretilmeye başlanan anavatanı tropikal ormanlar bölgesi olan Pitaya *(Hylocereus spp.)'* nın bazı kaynaklara göre Meksika, Güney Amerika; bazılarına göre Tayland ve Vietnam olduğu belirtilmektedir. Bu meyvenin lider üreticisi ve ihracatçısı Vietnam olarak bilinmektedir. Tropik iklim meyveleri arasında yer alan Pitaya *(Hylocereus spp.), Hylocereus* cinsi çeşitli kaktüs türlerine ait olan bir bitkidir. Birçok ülkede yaygın olarak tüketilen pitaya bitkisi besleyici özelliklere ve zengin içeriğe sahiptir. Meyveleri gıda sanayisinde dondurma, meyve suyu, şarap yapımı ve kurutmalık olarak işlenmektedir. Kabuklarından gıda boyası yapılabilirken, çekirdeklerinin zengin yağ içeriği nedeniyle ilaç sanayisinde ve tatlandırıcı olarak da kullanılabilmektedir. Ayrıca çiçekleri yenilebilir ve çay olarak tüketilmektedir. Doğal gıda takviyesi şeklinde fonksiyonel gıda olarak, bebek mamaları yapımında ve doğal gıda boyası olarak da kullanılmaktadır. Beslenme uzmanları tarafından 'süper besinler' olarak adlandırılan, halk arasında da ejder meyvesi olarak bilinen pitaya meyvesi içerdiği protein, lif, karbonhidrat, C ve B vitaminleriyle doğal gıda desteği görevi görmektedir. Çözülebilir lifler, potasyum ve düşük şeker oranıyla Tip 2 diyabet hastalığının da önemli destekçilerindendir. Pitaya meyvesindeki yüksek C vitamini, Omega-3 ve omega-6 gibi doymamış yağ asitleri bakımından zengin olan meyve bu meyve bağışıklık sistemini güçlendirmekte, hücre yenilenmesini hızlandırmakta ve güçlü antioksidan özellik göstererek vücuda serbest radikallerin girmesini önleyerek hastalıklardan korumaktadır. İçeriğindeki yüksek kalsiyum miktarı ile kemik gelişimine destek olmakta, kan basıncını düşürme özelliği göstermektedir. Kan basıncını düşürmesinden dolayı da yüksek tansiyon gibi rahatsızlıkların önüne geçerek iyileşme sürecine destek olmaktadır. İçerdiği pinen maddesi ile solunum sistemimizde biriken katran ve toksin oluşumlarını çözerek temizlemektedir. Metabolizmayı hızlandırarak metabolik yaşı geri sardırıcı etkisi bulunmaktadır. Bol miktarda likopen içeren bu meyve, yüksek tansiyon riskini önleyerek kalp ve damar hastalıklarına yakalanma riskini azaltmaktadır. Kalorisi yok denecek kadar az ve lifli yapıda olması sayesinde zayıflamaya yardımcı olmakta ve vücuttaki cilt kuruluğuna karşı da nem dengesini korumaktadır. Meyvesinde bulunan potasyum sayesinde özellikle göz kuruluğuna karşı faydalı olan bir meyve olarak bilinmektedir. Pitaya *(Hylocereus spp.)*'nın da insan sağlığı açısından önemi gün geçtikçe yapılan çalışmalarla artacaktır.
Anahtar Kelimeler: Pitaya *(Hylocereus spp.),* Ejder meyvesi, Beslenme, Sağlık

PITAYA *(Hylocereus spp.)*' IMPORTANCE OF IN HUMAN HEALTH

ABSTRACT
Pitaya *(Hylocereus spp.)*, which has started to be produced in Turkey in recent years, its homeland is the tropical forest region. According to some sources, it is stated that Mexico, South America; according to some, Thailand and Vietnam. The leading producer and exporter of this fruit is known as Vietnam. Pitaya *(Hylocereus spp.)*, which is among the tropical climate fruits Dec.) is a plant belonging to various cactus species of the genus *Hylocereus.* The pitaya plant, which is widely consumed in many countries, has nutritious properties and rich content. Its fruits are processed in the food industry as ice cream, fruit juice, wine making and drying. While food coloring can be made from the shells, it can also be used in the pharmaceutical industry and as a sweetener due to the rich fat content of the kernels. In addition, its flowers are edible and consumed as tea. It is also used as a functional food in the form of natural food supplements, in the production of baby food and as a natural food coloring. Pitaya fruit, called 'superfoods' by nutritionists and popularly known as dragon fruit, acts as a natural food support with the protein, fiber, carbohydrates, C and B vitamins it contains. Decoction of the pitaya fruit and decoction of the pitaya fruit. Decoction of the pitaya fruit. decoction of the pitaya fruit. Decoction of the pitaya fruit. Decoction of the pitaya Soluble fiber is also an important supporter of Type 2 diabetes with its potassium and low sugar content. The fruit rich in high vitamin C, Omega-3 and omega-6 unsaturated fatty acids in pitaya fruit, this fruit strengthens the immune system, accelerates cell regeneration and protects against diseases by preventing the entry of free radicals into the body by showing strong antioxidant properties. With the high amount of calcium in its content, it supports bone development and shows the ability to reduce blood pressure. Due to the fact that it reduces blood pressure, it also supports the healing process by preventing ailments such as high blood pressure. With the pinene substance it contains, it dissolves and cleans the tar and toxin formations accumulated in our respiratory system. It has the effect of rewinding metabolic age by accelerating metabolism. This fruit, which contains a large amount of lycopene, reduces the risk of developing cardiovascular diseases by preventing the risk of high blood pressure. It has almost no calories, and thanks to its fibrous structure, it helps to lose weight and protects the moisture balance against skin dryness in the body. Thanks to the potassium contained in its fruit, it is known as a fruit that is especially useful against dry eyes. Pitaya *(Hylocereus spp.)* the importance of human health will increase day by day with the studies carried out.
Keywords: Pitaya *(Hylocereus spp.)*, Dragon fruit, Nutrition, Health

1. INTRODUCTION

Pitaya, which is included in the genus *Hylocereus* of the *Cactaceae* family of the *Caryophyllales* team, has been cultivated in Mersin in recent years in Turkey, harvested in Antalya, Adana and Muğla, its production area has been expanded and its homeland is the tropical forest region, has been attracting attention in recent years. In Turkey, Dragon fruit or Pitaya (*Hylocereus spp*.) this fruit, called as dragon fruit, strawberry pear, pitahaya, tuna, nopal, pitajaya etc. in the world. It is known by many different names. This difference may be caused by the amount of production, its value in countries, its prevalence and the external appearance of the fruit. In addition, because the flowers bloom at night, are fragrant and showy, they are called the ‘Queen of the Night' (Gunasena et al., 2007).

Pitaya's (*Hylocereus spp.)* its homeland is the tropical and subtropical regions of Central and South America and Mexico, but the natural growing areas of this species are known as Southern Mexico, Guatemala, Costa Rica, El Salvador, Venezuela, Colombia, Ecuador, Nicaragua, Panama, Brazil and Uruguay (Gunasena et al., 2007). This species, which has a wide distribution area from tropical and subtropical regions of America to Asia, Australia and the Middle East, is currently being cultivated in at least 25 countries (Gunasena et al., 2007). Pitaya cultivation is very new in our country, as in some countries, but it is grown in the open and under cover in microclimatic areas located on the Mediterranean coast from Izmir to Hatay. Pitaya fruit, which is attractive to consumers due to its exotic appearance, is gaining popularity worldwide due to its nutritional and medicinal properties (Kong et al., 2012). It is considered as a fruit species that has gained an important economic value worldwide due to its nutritional values (Rifat et al., 2019).

Pitaya (*Hylocereus spp*.); it is one of the cactus species with a climbing structure and it is a fruit species that started to be consumed as fresh fruit in the later processes that spread to the world as the first ornamental plant (Gunasena et al., 2007). The most grown and consumed species are *Hylocereus polyrhizus* (Red pitaya), *Hylocereus undatus* (White pitaya) and *Hylocereus megalanthus* (Yellow pitaya) (Le Bellec et al., 2006). Thanks to their high adaptability ability, they are able to adapt quickly to different environmental conditions. These plants, which are

xerophytes or succulents in the Cactaceae family, can also have good tolerance to high and low temperatures, drought and adverse soil structure. Plants belonging to this family are able to store the water they receive due to having a waxy surface. In addition to having few or no leaves, root structure and opening the stomata at night to absorb carbon dioxide increase the ability to adapt to harsh conditions (Luders and McMahon, 2006; Mizrahi, 2014; Perween et al., 2018).

Recently, coconut, papaya, pineapple and mango types of tropical fruits have been widely found in grocery stores and local Sundays in our country, but recently it is possible to find Dragon fruit in small quantities. The fact that it is attractive in terms of color and appearance, and the sales price is also high, has further increased the interest of manufacturers in this type. Besides fresh consumption, Pitaya has a wide variety of uses. As it can be consumed as a table food, Pitaya fruit, which is used in the food industry, especially in fruit juice, ice cream, yogurt, jelly, marmalade, jam, sugar, fruit chips and cake making, is very rich in nutrients, vitamin C (ascorbic acid), iron, some flavonoids and antioxidants. However, it can also be consumed as a dietary fruit in terms of its low fat content, high water content and being a good source of fiber. Pitaya fruit, which is known to be consumed as a product that helps reduce blood sugar in diabetes mellitus and is effective in cancer diseases, cholesterol control and lowering high blood pressure, is also preferred in food presentations in the paint industry because the ornamental plant has an interesting shape of the fruit peel (Soydal, 2018; Gunasena et al., 2007).

2. NUTRITIONAL VALUE OF PITAYA and ITS EFFECTS ON HEALTH

The nutritional value of pitaya varies according to the species, origin, ecology and harvest time (Gunasena et al., 2007). Pitaya has a mixed taste of melon, kiwi, pear, and the white type tastes like a mixture of unripe kiwi and pear, the red one tastes like sweeter fruits such as strawberries, melon, kiwi, but the yellow type tastes more intense and sweeter than the other two types (Anonymous 2020a).

Although the nutritional composition and phytochemical properties of red pitaya (*Hylocereus polyrhizus*) differ significantly due to the influence of growing environmental conditions

(Mallik et al., 2018) contains significant amounts of minerals such as potassium, phosphorus, sodium and magnesium. Due to this nutrient content, it is higher than mangosteen, mango, pineapple and all vitamin sources (Nomura et al., 2005). Compared to other fruits, a ripe pitaya fruit has a higher total soluble solids and is a good source of minerals, glucose, fructose, dietary fiber and vitamins (Liaotrakoon, 2013). Fresh pitaya fruit, known for its rich vitamin C, phosphorus, calcium and antioxidant contents, contains 82.5-83.0% moisture, 0.16-0.23% protein, 0.21-0.61% fat and 0.7-0.9% fiber (Nurul et al., 2014).

100 g of ripe pitaya fruit (55 grams of which can be eaten) contains 80-90 g of water, 9-14 g of carbohydrates, 0.15-0.5 g of protein, 0.1-0.6 g of fat, 0.3-0.9 g of fiber, 0.4-0.7 g of ash, 35- 50 kcal, 6-10 mg of calcium, 0.3-0.7 mg of iron, 16-36 mg of phosphorus in daily nutritional values. When examined in terms of vitamins; 0.2-0.45 mg niacin (vitamin B3), 4-25 mg ascorbic acid (vitamin C), trace amounts of carotene (vitamin A), thiamine (vitamin B1), riboflavin (vitamin B2) are seen in Table 1 (Anonymous 2020b).

Table 1. Nutritional Values of Red Pitaya (100 gr)

Foods	**Nutritional Value Per 100g**
Protein	2,0 g
Calcium	5.7 mg
Potassium	57 mg
Magnesium	28 mg
Ascorbic Acid-Vitamin C	50 mg
Vitamin E	106 mg
Phosphor	23 mg
Retinol-Vitamin A	20 mg
Iron	3.4 mg
Copper	31 mg
Zinc	14 mg
Thiamine -Vit B1	48.9 mg
Lycopene	14.35 mg

The benefit of Tue, one of the nutrients found in 100 gr of red pitaya fruit, is that it helps to build and repair tissues, make enzymes and release energy to the body. Calcium is effective for strong and healthy bones in the human body. Potassium regulates blood pressure and the cardiovascular system by helping carbohydrate metabolism. Magnesium regulates body temperature, detoxification and energy. Ascorbic Acid-Vitamin C strengthens the immune system, heals bruises and cuts faster. Vitamin E helps in skin and hair care by protecting the body against toxins. Phosphorus contributes to tissue formation. Retinol-Vitamin A improves skin health in body detoxification. It contains iron, red blood cell production and energy for the body. Copper provides benefits for a healthy bone, tissue and thyroid gland. Zinc improves brain function and controls appetite. Thiamine-Vitamin B1 helps in the metabolism of carbohydrates, while Lycopene protects the body from damage by making it healthy.

When the nutritional components contained in Pitaya fruit, which has multiple health benefits due to the vitamins, minerals and fibrous structure they contain, are examined in Table 2, it is seen that the values of its fruit are slightly higher compared to other tropical fruits, strawberries, pineapples, bananas, kumquats, avocados and pomegranate fruits, as well as the phenolic content and antioxidant activity (Rodrigues et al., 2018).

Table 2. Some of the main components are found in pitaya fruit

Component	Quantity
Flavonoids	Red fleshy 46,29±2,47 mg /100 g FW White fleshy 26,71±4,46 mg /100 g FW (Senadheera et al., 2015).
Betalains	42.71±2.48 mg/100 g fresh fruit (Rodriguez et al., 2015).
Hydroxynamates	A small amount of hydroxycynamic acid (Mahattanatawee et al., 2006).
Carotenoids	1.4 mg/100 gr (Charoensiri et al., 2009).
Lycopene	3,4 mg/100 g (Harivaindaran et al., 2008).
Linoelic and Linolenic acids	Seeds rich with essential fatty acids (Sonawane, 2017).
Vitamin C	For the white fruit 31.11 ± 3.85 mg / 100g FW For the red fruit 20.00 ± 1.33 mg / 100g FW (Weiss et al., 1994).
Phosphorus (P) and Calcium (Ca)	P 22,5 mg/100 g ve Ca 8,5 mg/100 g (Crane and Balerdi, 2005).

The function of flavonoids, some of the main components found in pitaya fruit, is effective on brain cells and blood vessels, reducing the risk of heart disease and maintaining blood pressure (Nobel et al., 2002). Betalains can fight oxidative stress and have the ability to suppress cancer cells. It strengthens the immune system by lowering LDL cholesterol (Sushmitha et al., 2018). Hydroxynamates help prevent cancer (Ruzainah et al., 2009). Carotenoids cause a decrease in the risk of cancer and cardiovascular diseases (Aghajanpour et al., 2017). Linolenic and linolenic acids reduce triglycerides and the risk of cardiovascular disease (Wichienchot et al., 2010). Vitamin C strengthens the immune system and stimulates the activity of other antioxidants in the body (Duarte and Lunec, 2005), while Phosphorus (P) and Calcium (Ca)

play an important role in tissue formation by helping to strengthen bones (Choo and Yong, 2011).

Due to the important benefits of pitaya fruit, it has different uses and can be used in ice cream, juice and wine making, and food coloring can be made from its peels. Its flowers are edible and consumed as tea, while its seeds are rich in fat content and are evaluated in the pharmaceutical industry and as a sweetener. In addition, due to the most important fruit pigments betacyanin and betaxanthin in fruit, it is used in jelly, jam, yogurt and cosmetic industries, as well as functional food in the form of natural food supplements, baby food.

3. CONCLUSIONS and RECOMMENDATIONS

In addition to the medicinal use of pitaya, the use of *Hylocereus* fruits for purposes such as dried fruits, herbal tea, dessert making, fruit juice and nutritional supplements has gained popularity in the world in recent years.

In the studies, Pitaya (*Hylocereus spp*.) it has been found that its fruits have many beneficial effects on health, such as improving digestion, lowering cholesterol, strengthening the immune system, preventing the proliferation of cancer cells and preventing heart disease. Taking into account the research results on pitaya, the following suggestions can be made.

Regular consumption of fruits, including vegetables and pitaya, can help protect against chronic diseases and maintain good health. Pitaya can be consumed in many environments due to its easy transportation compared to other fruits. Especially for children's consumption, foods with a low pulp content, such as school canteens and fast food restaurants, can be sold to pitas or added to menus in places where they are sold.

Pitaya fruits, which have a high antioxidant capacity and contain many bioactive compounds, should be introduced to the field of medicine and pharmacy by conducting studies on pharmaceutical active ingredients.

Turkey has the potential to become the leading country in its exports due to the fact that it has a favorable climate for the pitaya plant. Pitaya fruit can be used to increase the variety of agricultural products and activate dormant agricultural land. It is proposed to promote pitaya cultivation, to expand its use in the food sector, to increase its exports by making good agricultural practices and to use it as a functional nutrient in the field of health.

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STARKS GOLD KİRAZ ÇEŞİDİNDE BAZI AMİNOASİTLERİN FARKLI BİTKİ ORGANLARINA GÖRE DEĞİŞİMİ

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ÖZET
Kiraz, taze tüketilmesine ilave olarak gerek amatör gerekse endüstriyel boyutta meyve suyu, marmelat ve reçel gibi çok farklı ürünlere dönüştürülen popüler meyve türlerindendir. Ancak buna rağmen özellikle bazı grup kimyasallarca karakterizasyonuna yönelik çalışmalar hala oldukça sınırlıdır. Bu çalışmada, ülkemizin en popüler çeşidi olan 0900 Ziraat çeşidine tozlayıcı olarak kullanılan ve meyveleri taze tüketimden daha çok işlenerek tüketilen Starks Gold çeşidinin farklı kısımları bazı aminoasitlerce karakterize edilmiştir. İncelenen aminoasitler miktar yönüyle; yaprak> sap> meyve şeklinde sıralanmıştır. Bu durum, yaprakların temel üretim merkezi konumunda olduğunu doğrularken, meyvelerin ise taşınım merkezi pozisyonunda olduğunu göstermiştir. İncelenen aminoasitlerin yapraktaki miktarlarına ilişkin sıralama; fenilalanin> Tirozin> arginin> triptofan> aspartat> valin> glisin> glutamat> prolin> histidin> sistin> lösin> metiyonin> glutamin şeklinde olmuştur. Yapraktan, sap yoluyla meyveye aktarılan aminoasit döngüsü incelendiğinde; sapa aktarım esnasında kaybın yüksek, saptan meyveye aktarım esnasında ise kaybın düşük olduğu gözlemlenmiştir. Bu durum yapılan temel bileşen analizlerinde de gözlemlenmiş olup, yüksek değerlerin elde edildiği kısımda bitki organlarından yaprak görülürken, daha düşük değerlerin elde edildiği düzlemde ise sap ve meyve kısımları birbirine yakın konumda pozisyon almışlardır. Sonuçlar doğrultusunda, farklı kiraz kısımlarının çeşitli aminoasit profiline sahip olduğu görülmüştür. Yaprak yüksek aminoasit içeriği ile öne çıkarken, sağlıklı ve dengeli beslenme açısından, diyet içerisine kiraz yaprağı ilavesi önerilebilir. Miktar olarak birbirine daha yakın olan kısımlardan meyvenin tüketimi, işleme yoluyla yılboyuna yayılabilir. Sap kısmı ise bitki çayı karışımları içerisine dahil edilebilir. Elde edilen sonuçların, kirazın değerlendirilmesinde, çeşitlilik sağlayabileceği düşünülmektedir.

Anahtar Kelimeler: *Prunus avium*, Pedisel, Aminoasit, Bi-plot

AMINOACIDS VARIATION ACCORDING TO DIFFERENT PLANT ORGANS IN CHERRY Cv. STARKS GOLD

ABSTRACT
Cherries are one of the most popular fruit varieties that are processed into many different products such as fruit juice, marmalade and jam, both domestically and commercially, into a wide range of goods including jam, marmalade, and fruit juice in addition to being eaten fresh. However, there are currently very few research available on the characterisation of certain chemical groups such as aminoacids. In this study, different parts of the Starks Gold, which is used as pollinator for the 0900 Ziraat that is the most popular variety in our country, and whose fruits are consumed more processed than fresh, were characterized in terms of some amino acids. The amino acids examined were ranked as leaf > stem > fruit regarding their amount. This confirms that the leaves are the main production center, while the fruits are the transportation center. The order of the amounts of the examined amino acids in the leaf was; phenylalanine> Tyrosine> arginine> tryptophan> aspartate> valine> glycine> glutamate> proline> histidine> cystine> leucine> methionine> glutamine. The analysis of the amino acid cycle from the leaf to the fruit through the stem reveals that there was a large loss during the transfer to the stalk from the leaf and a low loss during the transfer from the stem to the fruit and lower loss during the transfer from the stalk to the fruit. Principal component analysis also revealed this pattern: in the region with high values, leaves were distributed among the plant parts, whereas in the region with lower values, the stalk and fruit were grouped together. According to the results, it was seen that different cherry parts had various amino acid profiles. While the leaf stands out with its high amino acid content, it may be recommended to add cherry leaf to the diet in terms of healthy and balanced nutrition. By processing, consumption of fruit can be in abundance throughout the year and the stalk can be included in herbal tea mixtures. It is thought that the results obtained may provide diversity in the evaluation of cherries.
Keywords: *Prunus avium*, Pedicel, Aminoacid, Bi-plot

1. GİRİŞ

Tüketicilerin sağlık üzerine pozitif etkiler barındıran, fonksiyonel gıdalara eğilimi giderek artmaktadır (Baker et al., 2022). Bu bağlamda çeşitli ve zengin biyokimyasal içeriğe sahip türlerden birisi olan kiraza, günlük diyet içerisinde yer verilmesinin oksidatif stresi baskıladığı, kronik rahatsızlıklara iyi geldiği, diyabetik, kardiyovasküler ve kanser türevlerini engellemek üzere pozitif etki gösterdiğinin altı çizilmektedir (Gonçalves et al., 2019; Fonseca et al., 2022; Arbizu et al., 2023). Yapılan bir çalışmada, kirazda on sekiz mineral ve yüz on yedi uçucu bileşenin bulunduğu vurgulanırken, kirazın farklı formata sahip ürünlerin içerisinde kullanım potansiyelinin oldukça yüksek olduğu belirtilmiştir (Nunes ve ark., 2022). Ancak, bu pozitif etkileri sağlayan biyokimyasalların, kalıtım dereceleri oldukça düşük olup, çevresel faktörlere hassasiyetleri yüksektir (Mertoğlu, 2022). Bu sebeple, çeşitlerin maksimum fayda sağladığı ekolojilerde yetiştirilmesi son derece önemlidir (Palmieri ve ark., 2017). Dolayısı ile bu tip çalışmaların periyodik olarak, mümkün olduğunca fazla çeşitle ve farklı ekolojilerde planlanması önem arz etmektedir.

Sevilerek tüketilmesine ilave olarak sanayinin farklı kollarına entegre olan kiraz türünün üretimine ülkemiz Dünya'da liderlik etmektedir. 2015 yılında (535. 000 ton), %20'sini tek başımıza karşıladığımız kiraz türünde, 2021 yılında Dünya üretimindeki payımız %25'e yükselmiş durumdadır (690 000 ton). Ancak, ihracat miktarımız henüz 70.000 ton dolaylarında olup, potansiyelimizin oldukça altındadır (FAO, 2021). Bu bağlamda, meyve haricinde kalan kısımlarının da değerlendirilmesi, arzulanan ihracat düzeylerinin yakalanmasında önemli hale gelebilir. Kiraz bitkisine ait yapraklar sarma, sapları ise alternatif tıp olarak yıllardır değerlendirilmektedir (Faienza ve ark., 2020; Maxiselly ve ark., 2022).

Amino asitler, proteinlerin ana bileşeni olmalarının yanı sıra 12.000'den fazla sekonder metabolitte çeşitliliği sağlayan ve omurga görevi gören basit organik moleküllerdir (Thirumurugan ve ark., 2018). Aminoasitler, gerek direk gerekse dahil oldukları bileşikler vasıtası ile bitkilerde büyüme ve gelişmeden, biyotik ve abiyotik stres koşullarına dayanım da dahil olmak üzere hemen her biyolojik olayın içerisinde yer almaktadır (Khan ve ark., 2019; Cai ve Aharoni, 2022). Bitkilerdeki rollerinin yanı sıra, amino asitler insan beslenmesinde de önemli görevler üstlenmekte olup, sağlıklı gelişim ve yaşam için son derece önemlidirler (He ve Wu, 2020). Bu çalışma kapsamında, ülkemizde beyaz kiraz olarak bilinen ve yetiştiriciliği en yaygın yapılan ve Dünya'da Türk kirazı olarak bilinen 0900 Ziraat çeşidine tozlayıcı olarak

kullanılan Starks Gold çeşidinin, farklı kısımlarında bazı aminoasitlerin nasıl değişim gösterdiğinin tespit edilmesi amaçlanmıştır.

2. MATERYAL ve METHOD

Çalışma 2022 yılında yürütülmüş olup, materyal olarak, MaxMa-14 anacına aşılı, 5m*4m dikim mesafelerine sahip, damla sulama yöntemi ile sulanan ve Eskişehir ekolojisnde yetiştirilen 11 yaşlı Starks Gold çeşidi bitkileri kullanılmıştır. Örneklemeler, meyvelerin olgunlaştığı Temmuz ayı içerisinde yapılmış olup, aminoasitlerin tayini ücrete tabi gerçekleştirilmiştir.

Araştırma, tesadüf parselleri deneme desenine göre tasarlanarak, üç tekerrürlü olarak yürütülmüştür. İncelenen özelliklerin, farklı bitki kısımları arasında istatistiksel olarak önemli farklılıklar gösterip göstermediği Minitab-17 paket programında, one-way ANOVA prosedürü kullanılarak tespit edilmiştir. Çeşitler arası farklılıkların ortaya çıkarılmasında, Tukey çoklu karşılaştırma testi kullanılmıştır (Zar, 2013).

3. BULGULAR ve TARTIŞMA

Bitkilerde tat ve aromanın şekillenmesinde son derece önemli olan biyokimyasallar aynı zamanda farklı fizyolojik olaylara entegre olmuş olmaları bakımından da oldukça önemlidirler. Çalışma kapsamında incelenen on dört amino asidin bitkilerin, yaprak, meyve sapı ve meyvede nasıl değişim gösterdiğine dair sonuçlar Çizelge 1'de verilmiştir. İncelenen aminoasitler miktar yönüyle; yaprak> sap> meyve şeklinde sıralanmıştır. Bu durum, yaprakların temel üretim merkezi konumunda olduğunu doğrularken, meyvelerin ise taşınım merkezi pozisyonunda olduğunu göstermiştir. Benzer durum daha önce kirazda yürütülen farklı çalışmalarda da rapor edilmiştir (Golubkina ve ark., 2020). İncelenen aminoasitlerin yapraktaki miktarlarına ilişkin sıralama; fenilalanin> tirozin> arginin> triptofan> aspartat> valin> glisin> glutamat> prolin> histidin> sistin> lösin> metiyonin> glutamin şeklinde olmuştur. Yapraktan, sap yoluyla meyveye aktarılan aminoasit döngüsü incelendiğinde; sapa aktarım esnasında kaybın yüksek, saptan meyveye aktarım esnasında ise kaybın düşük olduğu gözlemlenmiştir. Kızılcık ile yürütülen benzer bir çalışmada da, aminoasit miktarı yaprakta meyveye göre daha yüksek düzeyde tespit edilirken, taşınım esnasında %50'den fazla azalma görüldüğü bildirilmiştir (Antoniewska-Krzeska ve ark., 2022).

Çizelge 1. İncelenen aminoasitlerin farklı bitki organlarına göre değişimi

	Yaprak	**Meyve Sapı**	**Meyve**
Fenilalanin	638,44^{A}	113,32^{B}	85,85^{C}
Tirozin	370,08^{A}	64,02^{B}	46,11^{C}
Arginin	322,14^{A}	54,85^{B}	38,03^{C}
Triptofan	259,64^{A}	54,82^{B}	42,08^{C}
Aspartat	242,53^{A}	42,26^{B}	30,98^{C}
Valin	225,44^{A}	43,68^{B}	38,74^{C}
Glisin	211,62^{A*}	35,44^{B}	27,16^{C}
Glutamat	196,33^{A}	25,37^{B}	25,48^{C}
Prolin	190,29^{A}	26,33^{B}	22,19^{C}
Histidin	171,46^{A}	28,54^{B}	19,61^{C}
Sistin	166,83^{A}	21,94^{B}	17,57^{C}
Lösin	144,32^{A}	22,56^{B}	19,57^{C}
Metiyonin	138,90^{A}	28,21^{B}	22,14^{C}
Glutamin	118,34^{A}	25,84^{B}	17,55^{C}

*:Her satırda farklı harflerle gösterilen ortalamalar arasındaki fark istatistiksel olarak önemlidir

Amino asitler, proteinlerin ana bileşeni olmalarının yanı sıra 12.000'den fazla sekonder metabolitte çeşitliliği sağlayan ve omurga görevi gören basit organik moleküllerdir (Thirumurugan ve ark., 2018). Aminoasitler, gerek direk gerekse dahil oldukları bileşikler vasıtası ile bitkilerde büyüme ve gelişmeden, biyotik ve abiyotik stres koşullarına dayanım da dahil olmak üzere hemen her biyolojik olayın içerisinde yer almaktadır (Khan ve ark., 2019; Cai ve Aharoni, 2022). Bitkilerdeki rollerinin yanı sıra, amino asitler insan beslenmesinde de önemli görevler üstlenmekte olup, sağlıklı gelişim ve yaşam için son derece önemlidirler (He ve Wu, 2020).

4. SONUÇ ve ÖNERİLER

Yapılan çalışma ile kiraz türüne ait ancak standartın dışında sarı kabuk ve meyve et rengine sahip Starks Gold çeşidinin, yaprak, meyve ve sapında değişen oranlarda ancak tamamında

önemli miktarlarda aminoasit bulunduğu kanaatine varılmıştır. Bu durum, dengeli beslenme açısından, kirazın farklı kısımlarınında katma değer katılarak işlenebileceği potansiyelinde olduğunu göstermiştir. Ayrıca çalışma sonucunda, yaprağın temel üretim yeri iken meyvenin ise taşınım noktası olduğu gözlemlenmiştir. Benzer çalışmaların, farklı çeşitlerin dahil edilerek, farklı ekolojilerde tekrar edilmesinde fayda olduğu düşünülmektedir.

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ÖZET
İklim ve toprak koşulları, başarılı sebze yetiştiriciliği için temel bir gerekliliktir. Ancak, bu koşullarda meydana gelen değişiklikler bitkileri strese sokmakta, bu da büyüme ve gelişmelerini olumsuz yönde etkilemektedir. Bu stres faktörlerinden biri, kireç stresidir. Özellikle kireçli topraklarda bitki gelişimini en fazla etkileyen beslenme bozukluklarından biri, demir (Fe) eksikliğidir. Bu tür topraklarda yüksek bikarbonat konsantrasyonları ve/veya yüksek alkalin pH değerleri, demirin bitkiler ve mikroorganizmalar için kullanılamaz hale gelmesine neden olmaktadır. Bitkiler, bu sorunu aşmak için rizosferdeki demiri elde etme ve asimile etme yeteneklerini artırmak amacıyla özel mekanizmalar geliştirerek iki farklı strateji mekanizması kullanmaktadırlar. Strateji II, tahıllar grubu tarafından kullanılırken, diğer bitki türleri, özellikle sebzeler, Strateji I'i benimsemektedirler. Strateji I grubu bitkiler, toprakta yarayışlı olmayan demiri (Fe III) çözebilmek ve kullanılabilir demir (Fe II) haline getirebilmek için bazı fitokimyasal maddeler üretirler. Bu maddeler arasında organik asitler (örneğin, sitrik asit, malik asit, fitik asit) bulunmakta ve bu asitler, bulunduğu ortamın pH'sını düşürerek demir şelat redüktaz enziminin çalışmasını arttırmaktadırlar. Bu enzim, demirin indirgenmesini sağlayarak demiri yarayışlı hale getirmekte ve bitkilerin topraktan daha etkili bir şekilde almasına yardımcı olmaktadır. Ancak Strateji I bitkilerinin tamamı Fe eksikliği durumunda bu mekanizmayı kullanamayabilir. Bitkilerin topraktan demiri etkili bir şekilde alabilme yeteneği "Fe-etkin" terimi ile ifade edilmekte ve bu yetenek toprak koşullarına, bitki türüne ve diğer faktörlere bağlı olarak değişmektedir. Bu çalışma, kireç stresinin çeşitli sebze türleri üzerindeki etkisini incelemekte olup, besin maddelerinin kullanılabilirliği, fizyolojik tepkiler ve büyüme performansındaki değişikliklere odaklanmaktadır. Araştırma, sebzelerin kireç zengini topraklarda karşılaştığı zorlukları açığa çıkarmayı ve yüksek toprak pH ve kireç içeriği nedeniyle oluşan besin eksikliklerini aşmada bitkiler tarafından kullanılan uyum mekanizmalarını anlamayı amaçlamaktadır.
Anahtar Kelimeler: Demir eksikliği, Toprak pH değeri, Strateji I, Sebze.

THE EFFECTS OF LIME STRESS IN VEGETABLES

ABSTRACT
Climate and soil conditions are essential prerequisites for successful vegetable cultivation. However, changes occurring in these conditions can subject plants to stress, negatively affecting their growth and development. One such stress factor is lime stress. Among the various nutritional disorders that significantly impact plant growth in lime-rich soils, iron (Fe) deficiency stands out. In such soils, high concentrations of bicarbonates and/or elevated alkaline pH values render iron unavailable for plants and microorganisms. To overcome this challenge, plants have developed specific mechanisms to enhance their ability to acquire and assimilate iron in the rhizosphere. Plants employ two different strategy mechanisms, where Strategy II is utilized by the grasses group and Strategy I is adopted by other plant species, especially vegetables. Strategy I group plants produce certain phytochemical substances to solubilize and convert non-beneficial iron (Fe III) in the soil into usable iron (Fe II). Among these substances are organic acids (such as citric acid, malic acid, phytic acid), which, by reducing the pH of their environment, enhance the activity of iron chelate reductase enzyme. This enzyme facilitates the reduction of iron, rendering it more accessible and beneficial for plants to uptake effectively from the soil. However, it is important to note that not all Strategy I plants can utilize this mechanism efficiently in the case of iron deficiency. The ability of plants to efficiently acquire iron from the soil is described as "Fe-efficient" and can vary depending on soil conditions, plant species, and other factors. This study focuses on examining the impact of lime stress on various vegetable species, with a specific emphasis on nutrient availability, physiological responses, and growth performance. The research aims to uncover the challenges that vegetables face in lime-rich soils and to understand the adaptation mechanisms employed by plants to overcome nutrient deficiencies resulting from high soil pH and calcium carbonate content.
Keywords: Iron deficiency, Soil pH, Strategy I, Vegetable.

1. GİRİŞ

Demir bitki büyüme ve gelişimi için esansiyel bir mikroelementtir. Topraklar genellikle yüksek miktarda Fe içerir, ancak alkali topraklarda bitkilerin alımı için Fe'nin uygunluğu çok sınırlıdır. Demir (Fe) eksikliği, alkali ve/veya kalkerli topraklarda yetiştirilen bitkileri etkileyen yaygın bir beslenme bozukluğudur, çünkü bu ortamlarda Fe'nin düşük çözünürlüğü mevcuttur (Lindsay, 1991). Bitkiler, Fe eksikliğine yanıt olarak iki farklı strateji geliştirmiştir: Strateji II, Poaceae türlerinde görülürken, iki çenekli ve çim olmayan tek çenekli türlerde Strateji I mekanizması görülmektedir (Marschner vd., 1986). Her iki stratejide de Fe eksikliği, topraktan Fe alımını artırmayı amaçlayan çeşitli mekanizmaları tetiklemektedir. Strateji II türlerinde, fitosideroforların sentezi ve rizosfere salgılanması artmakta, aynı zamanda bir Fe (III)–fitosiderofor kompleksi taşıma sisteminin indüksiyonu meydana gelmektedir (Kobayashi vd., 2006). Strateji I bitkileri, kök Fe alımı için iki aşamalı bir mekanizma indüklemektedir; bu, bir Fe (III) redüktazın (Chaney vd., 1972) ve bir Fe (II) taşıyıcısının (Eide vd., 1996) indüksiyonunu içermektedir. Örneğin, domates gibi iki çenekli türler (Strateji I bitkileri), Fe eksikliğine kök FeIII-şelat redüktaz aktivitesinin arttırılması, ortamın asidifikasyonu, şelatör ve redüktanların rizosfere salınımı ve kök uçları ile kök tüylerinin arttırılması gibi yanıtlar vermektedir (Marschner ve Römheld, 1994). Bununla birlikte, kireçli toprak çözeltisindeki yüksek bikarbonat konsantrasyonu, Strateji I bitkilerinde Fe alımını ve Fe'nin gövde ve yapraklara taşınmasını inhibe eder (Mengel, 1995), bitkilerde ciddi Fe eksikliği belirtilerine neden olur.

Bu yanıta ek olarak, Strateji I bitkileri, topraktan demir alımını artırmak için toprak pH'sını düşürme ve Fe (III) çözünürlüğünü artırma amacıyla rizosfere proton salgısı artırma (Schmidt, 1999; Zocchi vd., 2007), fenoliklerin salgısı, ve flavin bileşiklerinin birikimi ve/veya salgısı (Susín vd., 1994) ile organik asitlerin salgısı gibi bir dizi fizyolojik tepki geliştirmişlerdir (Abadía vd., 2002).

Bitkilerdeki Fe eksikliğini önlemek ve/veya hafifletmek için poliamin-karboksilik asit türevlerinden elde edilen sentetik Fe şelatlarının kullanımı, tarımsal uygulamalar açısından en etkili yöntemdir (Lucena, 2006). Ancak, bu ürünler pahalıdır ve etkili olabilmeleri için büyüme döngüsü boyunca tekrarlanan uygulamaları gerektirmektedir. Bu nedenle, yalnızca yüksek ekonomik değere sahip mahsullere uygulanmaktadır. Sentetik Fe şelatlarının toprak

uygulaması, bu bileşiklerin kötü çözünürlüğü (Hyvönen vd., 2003) ve toprak profili boyunca hareketlilikleri ile ilişkili çevresel riskleri içermektedir (Rombolà, 2002).

Son yıllarda, üretimdeki yenilikler, mahsul verimini ve kalitesini sağlamak zorunda olan düşük maliyetli ve çevre dostu sistemlere doğru evrim geçirmektedir. Bazı araştırıcılar, bitki beslenmesinde biyostimülanların kullanımını, büyüme düzenleyicileri veya metabolizma arttırıcılar olarak önermişlerdir (Filippini ve Bonfiglioli, 2005; Schiavon vd., 2008). Hormon içeren ürünler, humik maddeler veya amino asitler olmak üzere biyostimülanlar genellikle üç ana gruba ayrılmaktadır. Üçüncü grup biyostimülanlar, bitki veya hayvan kökenli organik matrisin kimyasal ve/veya enzimatik hidrolizi ile elde edilebilen peptitlerin ve serbest amino asitlerin karışımlarını içermekte ve bileşimleri oldukça değişebilmektedir (Maini, 2006). Birkaç çalışma, amino asit içeren ürünlerin küçük miktarlarda uygulanmasının genellikle bitki metabolizmasını, azot ve karbon metabolizmasını ve bitkilerin abiyotik ve biyotik streslere karşı direncini iyileştirdiğini bulmuştur (Maini, 2006; Kauffman vd., 2007; Schiavon vd., 2008; Paradikovic´ vd., 2011).

2. BAZI SEBZE TÜRLERİNDE YAPILAN ÇALIŞMALAR

Bitkilerin Fe beslenmesi üzerinde biyostimülan etkisini değerlendiren bazı çalışmalar bulunmaktadır. Sánchez-Sánchez vd. (2005), amino asitlerin ve FeEDDHA'nın karışımlarının toprak uygulamasının domates bitkisinde yaprak Fe konsantrasyonunu artırdığını ve bazı kalite parametrelerini hafifçe iyileştirdiğini gözlemlemiştir.

Gamiz vd. (1998) tarafından yapılan çalışmalar, amino asitlerin farklı sentetik Fe şelatları ile birlikte eklenmesinin kuşkonmaz bitkilerinde kök ve sürgün büyümesini, klorofil sentezini uyardığını göstermiştir. Amino asitlerin bitki Fe beslenmesi üzerindeki olumlu etkileri, amino asitlerin bitkiler için doğal şelatörler ve Fe'yi bitkilere etkili taşıyıcılar olarak işlev gösterme yeteneğinden (Ashmead, 1986) ve/veya demir metabolizması ve bitki fizyolojisi üzerindeki etkilerinden (Rombolà vd., 2000) kaynaklanabilmektedir.

Yapılan bir çalışmada, bitki ve hayvan kaynaklı amino asitleri içeren iki ticari ürünün, kireçli ve normal besin çözeltisi ortamlarında yetiştirilen domates fidelerinin demir (Fe) beslenmesi üzerindeki etkilerini incelenmiştir (Cerdán vd. 2013). Hayvan kaynaklı amino asit içeren ürünün yaprak ve kök uygulamaları bitki gelişimini olumsuz etkilerken, Fe beslenmesi üzerinde olumlu bir etkisi gözlemlenmemiştir. Diğer yandan, bitki kaynaklı ürünün uygulanması bitki gelişimini teşvik etmiş ve özellikle amino asitlerin köklere doğrudan uygulandığı durumlarda,

bitki kaynaklı ürünle muamele edilen domates fidelerinde belirgin bir şekilde kök artışı tespit edilmiştir. Ayrıca yaprak FeIII-şelat redüktaz aktivitesi, klorofil konsantrasyonu, yaprak Fe konsantrasyonu ve FeII:Fe oranında artış gözlemlenmiştir.

Çoban ve Aras (2023), orta derecede kireçli toprakta yetiştirilen hıyar fidelerinde yaptıkları çalışmada, farklı okzalik asit (OA) ve askorbik asit (AsA) dozlarının etkisini incelemişlerdir. Çalışmanın sonucunda kireçli toprakta yetiştirilen hıyar fidelerine uygulanan 100 ppm AsA ve 3 mmol OA'nın fide kalitesi ile ksilem kanal çapını arttırdığını tespit etmişlerdir.

3. SONUÇ

Kireçli topraklarda yapılan tarımın verimliliğini artırmak ve bitki sağlığını korumak için birtakım önlemler alınması veya çeşitli uygulamalar yapılması gerekmektedir. Şelatlı Fe gübreleri kullanmak, toprak pH'ını düşürmek için organik madde (Hümik asit ve Fülvik asit gibi) eklemek, çiftlik gübresi ve solucan gübresi gibi organik gübreler kullanmak, yetiştirme ortamına toprak düzenleyicileri (kükürt) eklemek, faydalı mikroorganizmalar kullanmak, dayanıklı sebze anaçları ve uygun sebze türleri kullanmak kireçli topraklarda yapılan yetiştiricilikte alınabilecek önlemler arasında yer almaktadır.

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GÜNÜMÜZDE SEBZE ÜRETİMİNDE KULLANILAN MODERN TOPRAKSIZ TARIM SİSTEMLERİ

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ÖZET
Tarım topraklarının heterojen yapısı, patojenlere yatkınlığı, tek türlü üretim sistemlerinde bozulma eğilimi göstermesi ve verimsiz, tuzlu veya sodik olabilmesi durumları bitkisel üretimi olumsuz yönde etkilemektedir. Ayrıca dünya nüfusunun hızla artışı ve iklim değişikliğinin olumsuz etkilerinin baş göstermesi, tarım sektörünü birtakım dönüşümlere zorlamaktadır. Bu dönüşümün tarımsal üretimdeki sonuçlarından biri de topraksız sebze yetiştiriciliğinin artış göstermesidir. Topraksız tarım sistemleri son yıllarda büyük ilgi ve popülerlik kazanmış ve sebze üretimine bakış açısını değiştirmiştir. Topraksız tarım, geleneksel toprak kullanımının dışında bitkilerin yetiştirildiği modern bir tarım yöntemidir. Bu yöntem sayesinde, bitkilerin büyüdüğü ortam, su, besin maddeleri ve ışık ihtiyacı özel olarak kontrol edilerek bitki gelişim koşullarının optimizasyonu sağlanmaktadır. Topraksız tarım, su ve substrat kültürü olarak ikiye ayrılmakta; genellikle küçük habitüslü sebzelerin yetiştiriciliğinde su kültürü yöntemi, büyük habitüslü sebzelerin yetiştiriciliğinde ise substrat kültürü yöntemi tercih edilmektedir. Topraksız tarım sistemleri içerisinde sıklıkla kullanılan büyüme ortamları arasında kaya yünü, perlit ve hindistan cevizi lifi yer almaktadır. Diğer yandan yüzen su kültürü, besleyici film tekniği ve aeroponik gibi su kültürü sistemleri ise genellikle yapraklı sebzelerin üretimi için tercih edilmektedir. Bitkilerin beslenmesini sağlamak amacıyla, son teknolojiye sahip tam otomatik fertigasyon sistemleri yetiştiricilikte kilit rol oynamaktadır. Bu sistemler, bitkiler için hem besin temini hem de sulama aracı olarak görev yaparak besin solüsyonunu hassas bir şekilde hazırlamak ve iletmekten sorumludur. Topraksız tarımda atık suyun etkili bir şekilde yönetilmesi önem arzetmektedir. Kök bölgesinden drene olan besin çözeltisi kolayca toplanıp geri dönüştürülebilir ve böylece su kullanım etkinliği önemli ölçüde arttırılabilir. Ancak geri dönüşümü sağlanan besin çözeltisinin içerisinde oluşan patojenlerin yayılmasını önlemek için çeşitli filtrasyon yöntemlerinin uygulanması gerekmektedir. Topraksız tarım sistemleri, çeşitli tarım uygulamaları için çok yönlü bir yaklaşım sunarak sera sebze yetiştiriciliğinin gelişimini sağlamıştır. Besinlerin hassas dağıtımı, atık su yönetimi ve sulama kontrolünün yanı sıra gelişmiş teknolojilerin entegrasyonunu mümkün kılmaktadır. Bu çalışma, modern tarımın temel taşı haline gelmiş ve kaynakların verimli kullanılmasını sağlayan topraksız sebze yetiştiriciliğindeki ana prensipleri açıklamayı hedeflemektedir.
Anahtar Kelimeler: Su kültürü, Substrat kültürü, Modern tarım, Sebze.

CURRENTLY SOILLESS CULTURE SYSTEMS IN VEGETABLE PRODUCTION

ABSTRACT
The heterogeneous nature of agricultural soils, susceptibility to pathogens, tendency to degrade in monoculture systems, and potential issues like infertility, salinity, or sodicity have all negatively impacted plant production. Furthermore, the rapid growth of the global population and the adverse effects of climate change have compelled the agricultural sector to undergo significant transformations. One of the outcomes of this transformation in agricultural production is the increasing adoption of soilless vegetable cultivation. Soilless farming systems have garnered substantial interest and popularity in recent years, reshaping the perspective on vegetable production. Soilless agriculture represents a modern approach to farming where plants are cultivated without traditional soil usage. This method allows for precise control of the growing environment, including water, nutrients, and light, to optimize the conditions for plant growth. Soilless farming typically falls into two categories: hydroponics for the cultivation of smaller-sized vegetables and substrate culture for larger ones. Common growth media used in soilless agriculture include rock wool, perlite, and coconut fiber, while water culture systems like floating hydroponics, nutrient film technique, and aeroponics are frequently chosen for leafy vegetables. To ensure proper nutrition for the plants, state-of-the-art fully automated fertigation systems play a pivotal role in cultivation. These systems are responsible for preparing and delivering nutrient solutions, serving as both nutrition and irrigation for the plants. Effective management of wastewater in soilless agriculture is of paramount importance. Nutrient solutions that drain out from the root zone can be readily collected and recycled, significantly increasing water use efficiency. However, to prevent the spread of pathogens within the recycled effluents, various filtration methods must be implemented. Soilless farming systems offer a versatile approach to various agricultural practices and have revolutionized greenhouse vegetable cultivation. Their ability to facilitate precise nutrient distribution, efficient wastewater management, and irrigation control, along with the integration of advanced technologies, has made them a cornerstone of modern agriculture. This study aims to elucidate the fundamental principles of soilless vegetable cultivation, which have become an integral part of modern agriculture, promoting efficient resource utilization.
Keywords: Hydroponics, Substrate Cultivation, Modern Agriculture, Vegetable.

1. GİRİŞ

Topraksız kültür, son 30-40 yılda hızla gelişen, ağırlıklı olarak seralarda uygulanan modern bir yetiştirme teknolojisidir. Ticari düzeyde topraksız tarım uygulama konusundaki ilgi, 1960'ların sonlarına doğru artmaya başlamış ve bu dönemde Besleyici film tekniği İngiltere'de tanıtılmış ve Danimarka'da büyüme ortamı olarak kayayünü kullanılmaya başlanmıştır. Takip eden yıllarda, özellikle enerji krizi nedeniyle buhar sterilizasyonu alternatifi olarak birçok ülkede kayayünü kullanımında büyük bir genişleme yaşanmıştır. Topraksız tarım, 2000'lerde metil bromür (MeBr) alternatifi olarak önem kazanmıştır (Resh, 1991; Savvas, 2003; Raviv ve Lieth, 2008; Tüzel vd., 2019). Günümüzde ticari üretimi yapılan sebzelerin çoğu, tam otomatik iklim kontrolü özelliklerine sahip yüksek teknolojili sera yapılarında yetiştirilmektedir (Hong ve Gruda, 2020). Ancak topraksız tarım, daha yüksek başlangıç maliyetleri ve teknik bilgi gerektirir. Bu nedenle, ülkeler arasında, topraksız tarımın genişlemesi konusunda farklılıklar bulunmaktadır; ortalama sera büyüklüğü işletme başına yüksek olan ülkelerde daha fazla yaygındır. Diğer yandan, topraksız tarım, çoğu Akdeniz ülkesinde olumlu doğal koşullara dayalı olarak düşük teknolojili seralarda yavaş bir şekilde ilerlemektedir (Savvas, 2002; Gül, 2017). Son yıllarda Akdeniz ülkelerinde jeotermal enerji varlığının sera ısıtma maliyetini düşürmesi nedeniyle modern seralarda artış kaydedilmiştir (Karaman ve Kurunç, 2004). Topraksız kültür terimi genellikle bitkilerin, kök ortamı olarak toprak kullanılmadan yetiştirilmesi yöntemlerini ifade etmektedir (Savvas, 2003; Gruda vd., 2016). Topraksız kültür sistemleri (TKS), avantajları nedeniyle modern sera endüstrisinin önemli bir teknolojik bileşeni olarak kabul edilmektedir. TKS'nin temel avantajı, bitkinin doğal bir ortam olan heterojen, patojen barındıran, monokültür sistemlerinde bozulan ve verimsiz, tuzlu veya sodik olabilen topraktan bağımsız olmasıdır. TKS'de kök ortamı olarak topraktan bağımsızlık, fiziksel ve kimyasal özelliklerin hem kök ortamında hem de patojen kontrolünde daha etkili bir şekilde optimize edilmesine olanak tanımakta ve toprak fümigasyonu uygulamadan patojenlere karşı daha etkili bir kontrol sağlamaktadır. Bunun sonucunda, daha yüksek verimler, makul üretim maliyetleri, minimal pestisit kullanımı ve yüksek ürün kalitesi elde edilebilmektedir (Gruda vd., 2018; Savvas ve Gruda, 2018).

Topraksız kültürde kök bölgesinden dışarı akan besin çözeltisi kolayca toplanıp geri dönüştürülebilmektedir, Bu da su kullanım verimliliğini önemli ölçüde artırmakta ve gübre artıklarından kaynaklanan çevresel etkileri minimize etmektedir. TKS, besin çözeltisini kök

ortamı olarak kullanan su kültürü sistemlerini ve bitki büyümesi için uygun oranlarda hava ve suyu tutabilen gözenekli büyüme ortamlarındaki yetiştirme yöntemlerini içermektedir. TKS, açık veya kapalı olabilmektedir; açık sistemlerde drene olan besin çözeltisi sistemden uzaklaştırılırken, kapalı sistemlerde drenaj çözeltisi toplanıp, sistem içerisinde yeniden kullanılmaktadır (Savvas ve Gruda, 2018). Açık sistemde kök sistemiyle temas halinde olan besin çözeltisi yalnızca bir kez kullanılır. Bu sistemin en büyük avantajı, besin çözeltisinin düzenli olarak değiştirilmesi nedeniyle bitki sisteminde enfeksiyon riskinin olmamasıdır (Jones, 2005). Besin çözeltisinin düzenli olarak geri dönüştürüldüğü kapalı sistemlerin en büyük dezavantajı ise elektrik kesintilerinin sistemin çalışmasında olumsuz etkileri bulunmasıdır (Lee ve Lee, 2015).

2. TOPRAKSIZ TARIM TEKNİKLERİ

Topraksız tarım, farklı yetiştirme yöntemleri ve teknikler içeren 2 kategoriye ayrılmaktadır. Başlıca topraksız tarım yöntemleri Tablo 1'de gösterilmektedir (Gül, 2020).

Tablo 1. Topraksız tarım sistemlerinin sınıflandırılması

Su Kültürü	Substrat Kültürü
Derin Su Kültürü	Taban Kum Kültürü
Yüzen Su Kültürü	Yataklarda Yetiştiricilik
Besleyici Film Tekniği	Torbalarda Yetiştiricilik
Aeroponik	Saksılarda Yetiştiricilik

Yukarıda belirtilen topraksız tarım tekniklerinde, genellikle küçük habitüslü sebzelerin yetiştiriciliğinde su kültürü yöntemi, büyük habitüslü sebzelerin yetiştiriciliğinde ise substrat kültürü yöntemi tercih edilmektedir. Topraksız tarım sistemleri içerisinde sıklıkla kullanılan büyüme ortamları (substratlar) arasında kaya yünü, perlit ve hindistan cevizi lifi yer almaktadır. Diğer yandan derin su kültürü, yüzen su kültürü, besleyici film tekniği ve aeroponik gibi su kültürü sistemleri ise genellikle yapraklı sebzelerin üretimi için tercih edilmektedir. Ancak bazı ülkelerde derin su kültürü yöntemiyle domates ve kavun gibi sebze türleri yetiştiriciliği yapılmaktadır. Tabloda yer alan su kültürü sistemleri arasında en sık kullanılan teknikler; yüzen su kültürü, besleyici film tekniği ve aeroponik sistemleridir. Yüzen su kültürü, bitkilerin hafif plastik malzemeden yapılmış genişletilmiş polistiren gibi delikli levhalar üzerine yerleştirilerek bunların besin çözeltisinin yüzeyinin üzerinde yüzmesine izin verilmesi esasına dayanmaktadır

(Savvas vd., 2013). Bitki başına düşen besin çözeltisi hacminin yüksek olması nedeniyle iyi bir havalandırma kapasitesine sahiptir. Özellikle besin çözeltisi sıcaklığı yüksek olduğunda kök bölgesinde oksijen bulunabilirliği sınırlıdır (Savvas ve Gruda, 2018). Bitki köklerinin, kanallar boyunca akan besin çözeltisinin sığ bir akışında yer alması sistemi besleyici film tekniğidir (Van Os vd., 2008). Bitki başına düşen besin çözeltisi hacminin düşük olması nedeniyle yüksek havalandırma kapasitesine gerek olmamaktadır. Teknik bir arıza durumunda bitkilerin tepkisi kısa sürede görülebilmektedir. Aeoropik ise bitki köklerinin kapalı kutular içinde veya diğer türdeki konteynerlerde büyüdüğü ve sürekli veya periyodik olarak besin çözeltisinin ince damlalar halinde bitki köklerine püskürtüldüğü bir sistemdir (Kratsch vd., 2006). Su kültürü yetiştiriciliğinde dikkat edilmesi gereken hususlar arasında; bitkilerin ayakta durmaları için desteklenmeleri, köklerin karanlık bir ortamda bulunmaları ve köklerin oksijen ihtiyacının karşılanması yer almaktadır.

Ticari topraksız tarım işletmelerinde torba kültüründe yer alan büyüme ortamları kullanılmaktadır. Torbaya paketlendiğinde substrat maliyeti artmasına rağmen, torba kültürü substratın standartlaştırılmasına ve kolay taşınmasına olanak tanıdığı için en yaygın yetiştirme tekniğidir. Bu durum işgücü maliyetlerini ve kurulum hatalarını en aza indirmektedir. Torbalar, ısıyı yansıtmak için dışları beyaz, içleri ise alg gelişimini önlemek için siyah renkte üretilmektedir (Savvas ve Gruda, 2018).

3. SONUÇ

Topraksız kültür, girdilerin (besin, pestisit ve su) kullanımını optimize ederek, hastalıkları daha etkili bir şekilde kontrolünü sağlamakta ve iklim koşullarından bağımsız olarak ürün artışını mümkün kılmaktadır. Birçok avantajı ve dezavantajı olmasına rağmen, dünya genelinde verimli toprakların insan faaliyetleri nedeniyle giderek azalmasıyla birlikte, dünya nüfusunu beslemek amacıyla kitlesel sebze üretimi için yeni alternatif teknolojiler ve teknikler arayışı kaçınılmaz hale gelmektedir.

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TARIM SULAMA SULARINDA BULUNAN AĞIR METALLERİN BELİRLENMESİNDE KEMOSENSÖR OLARAK KULLANILABİLME POTANSİYELİ OLAN FLORESANS BİLEŞİKLER

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ÖZET
Ülkelerin tarım toplumundan sanayi toplumuna geçmesi ile artan endüstriyel faaliyetler sonucu ortaya çıkan atık sular ve bu atık suların kontrolsüz olarak çevreye ve su kaynaklarına bırakılması çevreye ve o çevredeki canlılara toksik ve mutajenik etki yapmaktadır. Çok çeşitli endüstriyel faaliyet gösteren seramik, metal, kâğıt, deri, boya ve tekstil gibi üretim yapan sanayi faaliyetlerinden kaynaklanan atık sular fazla miktarda ağır metal içermektedir. Toprakta ve suda ortaya çıkan bu çevre kirliliği hem insan hem de doğada bulunan canlı yaşamını tehlikeye atmaktadır. Ağır metallerle kirlenmiş sular ile yapılan tarımsal sulama faaliyetleri sonucunda bu ağır metaller tarımsal topraklarda birikmektedir. Ağır metal ile kirlenmiş sular ile sulanan bitkiler hem sulama kaynaklı hem de toprakta birikmiş ağır metal kaynaklı olarak bu ağır metalleri bünyelerinde biriktirmektedirler. Bu tarım ürünlerini tüketen insan ve diğer canlılar bu ağır metalleri bünyelerine almaktadırlar. Bununla beraber artan insan nüfusu ve artan teknolojik ihtiyaçlar sanayi faaliyetlerini kaçınılmaz hale getirmiştir. Tarımsal sulama sularında yaygın olarak bulunan kurşun, bakır, krom, alüminyum, civa gibi ağır metallerinde toksik etkilere sahip metaller olduğu bilinmektedir. Bu ağır metallerin immün sistem, sindirim sistemi, kalp, böbrek ve çağımızın en önemli toplumsal sağlık sorunlarından olan Demans, Alzheimer gibi nörolojik hastalıklara neden oldukları bilinmektedir. Son yıllarda yapılan birçok araştırmada bu ağır metal iyonların tespiti için uygun yöntem geliştirilmesi üzerine yoğunlaşmıştır. Bu çalışmalarda özellikle toksik ağır metal katyonların belirlenmesi için seçici floresans kemosensörler geliştirilmiş ve tasarlanmıştır. Bu tür kemosensör moleküllerin yapılarında yapılan çeşitli modifikasyon sonucunda istenilen ağır metal iyonlarına karşı hassas ve seçici olması sağlanabilir. Literatürde tarımsal sulamada kullanılan sulardaki ağır metallerin tespitinde kullanılabilme potansiyeli olan floresans kemosensörlere ait çalışma bulunmamaktadır. Bu çalışmada tarımsal sulama sularında bulunan ağır metallerin tespitinde kullanılabilme potansiyeli olan farklı molekül yapısına sahip floresans kemosensör özelliğine sahip farklı organik bileşikler özetlenmiştir. Böylece tarımsal sulama sularında bulunan ağır metallerin tespitinde kullanılabilecek floresans kemosensörler konusunda çalışma yapmak isteyebilecek araştırmacılar için temel bir kaynak oluşturulması amaçlanmıştır.
Anahtar Kelimeler: Tarımsal Sulama Suyu, Ağır Metaller, Kemosensör, Floresans Bileşikler

THE POTENTIAL CHEMOSENSOR FLUORESCENT COMPOUNDS FOR THE DETERMINATION OF HEAVY METALS AS CONTAINED IN AGRICULTURAL IRRIGATION WATER

ABSTRACT
Wastewater generated as a result of increasing industrial activities as countries transition from an agricultural society to an industrial society, and the uncontrolled release of these wastewaters into the environment and water resources, have toxic and mutagenic effects on the environment and the living things in that environment. Wastewater resulting from industrial activities that produce a wide range of industrial activities such as ceramics, metal, paper, leather, paint and textiles contains large amounts of heavy metals. This environmental pollution, which occurs in soil and water, endangers both human and living creatures in nature. As a result of agricultural irrigation activities carried out with water contaminated with heavy metals, these heavy metals accumulate in agricultural soils. Plants irrigated with water contaminated with heavy metals accumulate these heavy metals in their bodies, both from irrigation sources and from heavy metals accumulated in the soil. Humans and other living creatures that consume these agricultural products absorb these heavy metals. However, increasing human population and increasing technological needs have made industrial activities inevitable. It is known that heavy metals such as lead, copper, chromium, aluminum and mercury, which are commonly found in agricultural irrigation waters, have toxic effects. It is known that these heavy metals cause immune system, digestive system, heart, kidney and neurological diseases such as Dementia and Alzheimer's, which are among the most important social health problems of our age. Many studies conducted in recent years have focused on developing appropriate methods for the detection of these heavy metal ions. In these studies, selective fluorescence chemosensors were developed and designed especially for the determination of toxic heavy metal cations. As a result of various modifications made in the structures of such chemosensory molecules, they can be made sensitive and selective towards the desired heavy metal ions. There are no studies in the literature on fluorescence chemosensors that have the potential to be used in the detection of heavy metals in water used for agricultural irrigation. In this study, different organic compounds with fluorescence chemosensor properties with different molecular structures that have the potential to be used in the detection of heavy metals in agricultural irrigation waters are summarized. Thus, it is aimed to create a basic resource for researchers who may want to work on fluorescence chemosensors that can be used in the detection of heavy metals in agricultural irrigation water.
Keywords: Agricultural Irrigation Water, Heavy Metals, Chemosensor, Fluorescent Compounds

1. GİRİŞ

Sanayi devrimiyle beraber artan endüstriyel faliyetler, endüstriyel faliyetler sonucu ortaya çıkan atık sular, nüfüs, motorlu taşıtların eksoz gazları, aşırı fosil yakıt kullanımı, maden yatakları, arıtma çamurları, mevcut tarım alanlarında yanlış uygulamaları bağlı olarak aşırı gübre ve zirai ilaç kullanımı sonucu çevre, su ve toprakta canlı yaşamını olumsuz etkileyen ağır metal kirliliğine neden olmaktadır [1.]

Son yıllarda yapılan birçok araştırmada bu ağır metal iyonların tespiti için uygun yöntem geliştirilmesi üzerine yoğunlaşmıştır. Bu güne kadar yapılan çalışmalarda sulu ortamda ağır metallerin tespit edilmesi için kullanılabilen çok farklı kemosensör, biyosensör ve enzim moleküller tasarlanmıştır. Bu çalışmalarda özellikle toksik ağır metal katyonların belirlenmesi için seçici floresans sensörler geliştirilmiş ve tasarlanmıştır [2].

Genel olarak kemosensör bileşik tasarımında temel amaç kemosensörün belirli bir ağır metal iyonuna karşı hassas seçici yanıt göstermesidir. Ayrıca geniş ağır metal konsantrasyon aralığı için nicel bir analize uygun olmasıdır [3].

Özellikle sulu ortamdaki ağır metallerin tesipiti için kullanılabilecek; sentezi kolay, yeni, seçimli bir kemosensör geliştirilmesi ile yeni uygulamalar hem organik kimya, analitik kimya ve biyokimya gibi kimya dallarını için önemli çalışma alanını oluşturmaktadır. Bu kirliliğin erken tespiti ve gerekli arıtma işlemlerinin uygulanarak bu atık suların doğaya verilmesi ile mevcut sınırlı su kaynaklarının verimli kullanılması ile sürdürülebilir tarım uygulaması sağlanmış olacaktır. Ayrıca tarımsal sulamada kullanılan suların kirliliği sonucu ortaya çıkan sağlık ve çevre sorunlarının engellenmesi mümkün olacaktır [4].

2. TARIMSAL SULAMA SULARINDA BULUNAN AĞIR METALLER

Çeşitli endüstriyel ve tarımsal faaliyetler sonucunda çevrede ortaya çıkan ağır metal kirliliği sonucunda nörolojik hastalıklar, kanser, sindirim sistemi sorunlar, üreme sorunları gibi çok çeşitli sağlık ve yaşamsal sorunlara neden olmaktadır [5].

Ağır metal tanımı doğal olarak yer kabuğunda bulunan fiziksel olarak yoğunluğu 5 g/cm^3'den büyük olan toksik ve çevre kirliliğine neden olan metallerdir. Demir, kobalt, nikel, krom, civa, arsenik kadminyum gibi 70 dan fazla metal bu gruba girmektedir. Ağır metallerin yüksek

yoğunlukları nedeniyle düşük konsantrasyonlarda maruz kalınması durumunda bile canlı organizmada toksik etki göstermektedir. Ağır metaller çok farklı çevre koruma yönetmeliğinde çevre kirleticileri listesinde yer almaktadır[6].

Bazı ağır metaller sınır değerler aşılmadığı müddetçe insan ve hayvan metabolizmasında önemli rol oynamaktadır. Örneğin demir insan vücudunda oksijen taşınmasında hayati rol oynayan bir metaldir. Eksikliğinde anemi adı verilen kan hastalığı ortaya çıkmaktadır [7].
Çinko, bakır, demir, molibden, mangan ve nikel izin verilen sınırlar dahilinde bitkiler için mikro besin kabul edilmektedir. Aşağıda Tablo 1'de bazı ağır metallerin ekolojik sınıflandırılması gösterilmektedir [1].

Tablo 1. Bazı Ağır Metallerin Ekolojik Sınıflandırılması [1].

Tablo 1. Bazı ağır metallerin ekolojik olarak sınıflandırılması

Element	Özgül Ağırlık (g/cm^3)	Canlılar İçin Gerekliliği	Kirleticilik Durumu
As	2,3	X	✓
Cu	8,9	✓	✓
B	2,3	✓	✓
Hg	13,6	X	✓
Zn	7,1	✓	✓
Fe	7,9	✓	✓
Cd	8,5	X	✓
Co	8,9	✓	✓
Cr	7,2	✓	✓
Pb	11,3	X	✓
Mn	7,4	✓	X
Mo	10,2	✓	✓
Ni	8,9	✓	✓

Ağır metaller yer kabuğunda, toprakta ve suda doğal olarak bulunmakla beraber ağır metal kirliliğinin asıl nedeni endüstriyel faaliyetler sonucu ortaya çıkan atık sular, aşırı gübre ve zirai ilaç kullanımı gibi yanlış tarımsal uygulamalar, atık su arıtma tesisleri, demir, çelik çimento, seramik gibi ağır metal bileşiklerinin hammadde olarak kullanıldığı endüstriyel faaliyetler ve fosil yakıt kullanımı gibi insan kaynaklı faaliyetlerdir [8].
İnsan kaynaklı faaliyetler sonucunda insan kaynaklı sebeplerle ortaya çıkıp çeşitli yollarla tarımsal sulama sularına karışarak toksik ağır metal kirliliğine neden olan ağır metaller ile ilgili

Çevre ve Orman Bakanlığının Toprak Kirliliğinin Kontrolü Yönetmeliğine göre Toprakta Ağır Metal Sınır Değerleri aşağıda Tablo 2.'de gösterilmiştir [9].

Tablo 2. Toprakta Ağır Metal Sınır Değerleri [9]

Ağır Metal (Toplam)	PH 5- 6 mg/kg Fırın Kuru Toprak	pH>6 mg/kg Fırın Kuru Toprak
Kurşun	50 **	300 **
Kadmiyum	1 **	3 **
Krom	100 **	100 **
Bakır*	50 **	140 **
Nikel*	30 **	75 **
Çinko *	150 **	300 **
Civa	1 **	1,5 **

Bitkiler bünyelerinde topraktan ve sudan aldıkları ağır metalleri biriktirirler Tarım ve Orman Bakanlığının TARIMDA KULLANILAN ORGANİK MİNERAL VE MİKROBİYAL KAYNAKLI GÜBRELERE DAİR YÖNETMELİK'te yer alan bitki bünyesinde bulunmasına izin verilen ağır metal sınır değerleri Tablo 3.'de gösterilmiştir.

Tablo 3. Ağır Metal Sınır Değerleri [10]

Kadmiyum	Cd	3
Bakır	Cu	450
Nikel	Ni	120
Kurşun	Pb	150
Çinko	Zn	1100
Civa	Hg	5
Krom	Cr	350
Kalay	Sn	10

3. TARIMSAL SULAMA SULARINDA BULUNAN AĞIR METALLERİN TESPİTİNDE KULLANILAN YÖNTEMLER

Ağır metal katyonların biyolojik ortamda ve diğer örneklerde seçici olarak saptanması oldukça yarattığı sorunları engellemek için önem arz etmektedir. Büyük çevresel ve sağlık sorunlarına neden olan ağır metallerin su kaynaklarında tayin edilmesi için voltametrik, kromatografik veya spektroskopik yöntemler kullanılarak yapılmaktadır. Ağır metal iyonlarının tespiti için kılcal elektroforez, indüktif eşleşmiş plazma-atomik emisyon spektrometresi (ICPAES), atomik

absorpsiyon spektroskopisi (AAS), toplam yansıma X-ışını florimetrisi (TXRF), atomik emisyon spektroskopisi, yüksek performanslı sıvı kromatografisi (HPLC), anodik sıyırma voltammetrisi gibi analiz yöntemleri kullanılmaktadır [11-12]. Bu analiz yöntemleri düşük derişimlerdeki ağır metallerin iyonlarının seçici ve hassas analizlerinin yapılmasına izin versede pahalı cihazlar gerektiren karmaşık analiz yöntemleri olmaları gibi analiz kısıtları pratik kullanımda önemli sorun oluşturmaktadır [13].

Günümüzde yaygın olarak kullanılmaya başlanan floresans teknolojisi çevre, farmakoloji, biyoloji, fizyoloji ve biyomedikal uygulamalar gibi farklı alanlarda önemli bir rol oynamaktadır[14].

Florimetrik yöntemlerin diğer yöntemlere göre Co^{2+},Zn^{2+},Cu^{2+},Hg^{2+},Ag^{+},Ni^{2+},Cr^{3+}, Al^{3+},Pd^{2+},Fe^{3+},Pt^{2+},Mn^{2+},Sn^{2+}, Cd^{2+} gibi ağır metal katyonlarının nicel ve nitel olarak tespitinde daha basit, seçici, daha düşük maliyetli ve daha hassas olmaları nedeniyle çok avantajlıdır.

Bu ağır metallerin suçul ortamda ve toprakta seçici olarak hassas tanınması kanser, Demans, Alzheimer, üreme sorunları gibi toplumsal yaşamı etkileyen hastalıkların önlenmesinde de önemli rol oynamaktadır [15].

4. AĞIR METALLERİN TESPİTİNDE FLORESANS KEMOSENSÖR OLARAK KULLANILAN HETEREOHALKALI BİLEŞİKLER

Halkada en az bir heteroatom içeren halkalı bileşiklere heterohalkalı organik bileşikler olarak adlandırılırlar. Heterohalkalı bileşiklerde halkada yer alan en yaygın hetero atomlar oksijen, kükürt ve azottur. Heterohalkalı bileşikler antikanserojenik, antiülserojenik, antifungal, anti-inflamatuar, anti-nöropatik, antihistaminik, antihipertansif, analjezik, antitüberküloz, antioksidan, antiviral ve antibakteriyel etki gibi çok farklı önemli biyolojik etkilere sahip organik bileşiklerdir [16].

Bir heterokhalkalı organik bileşiğin tarımsal sulama sularında bulunan ağır metallerin tespitinde kemosensör olarak kullanılabilmesi için belirli bir ağır metal iyonuna karşı seçici olması, suda iyi çözünmesi ve belirli metal iyonu ile etkileşime girdiğinde ölçülebilir floresans değişiklik oluşturması gerekmektedir [17].

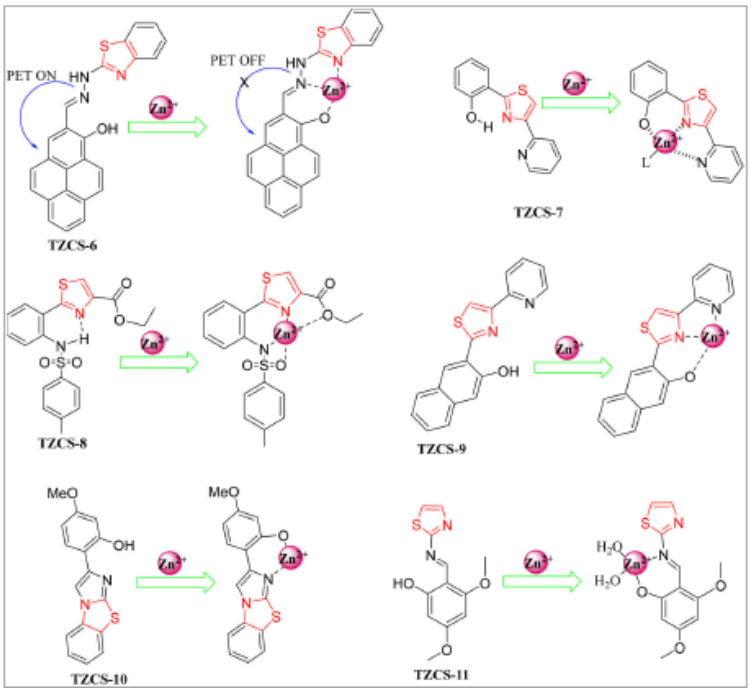
Son yıllarda yapılan çalışmalarda çok farklı molekül yapısına ve fonksiyonel gruba sahip Schiff bazları, tiyoüre, piridin, rodamin, triazol, piren, kumarin, imidazol, diaminomaleonitril,

naftoksazol, pirimidin, tiyofen, tiyoeter gibi heterohalkalı bileşikler ağır metallerin tanınmasında floresans kemosensör olarak kullanılmak amacıyla tasarlanmış, sentezlenmiş ve floresans kemosensör özellikleri incelenmiştir [18].

Çalışmamızda yapılan literatür çalışması sonucunda literatürde tarımsal sulamada kullanılan sulardaki ağır metallerin tespitinde kullanılabilme potansiyeli olan floresans kemosensörlere ait çalışma bulunmadığı görülmüş bu nedenle tarımsal sulama sularında bulunan ağır metallerin (Hg^{2+}, Cu^{2+}, Cd^{2+}, Pb^{2+}, Zn^{2+}, Cr^{3+}, Ni^{2+}) tespitinde kullanılabilme potansiyeli olan farklı molekül yapısına ve fonksiyonel gruba sahip floresans kemosensör özelliğine sahip farklı organik bileşiklerin molekül yapıları özetlenmiştir.

4.1. Zn^{+2} Tespitinde Kullanılan Floresans Kemosensör Bileşikler

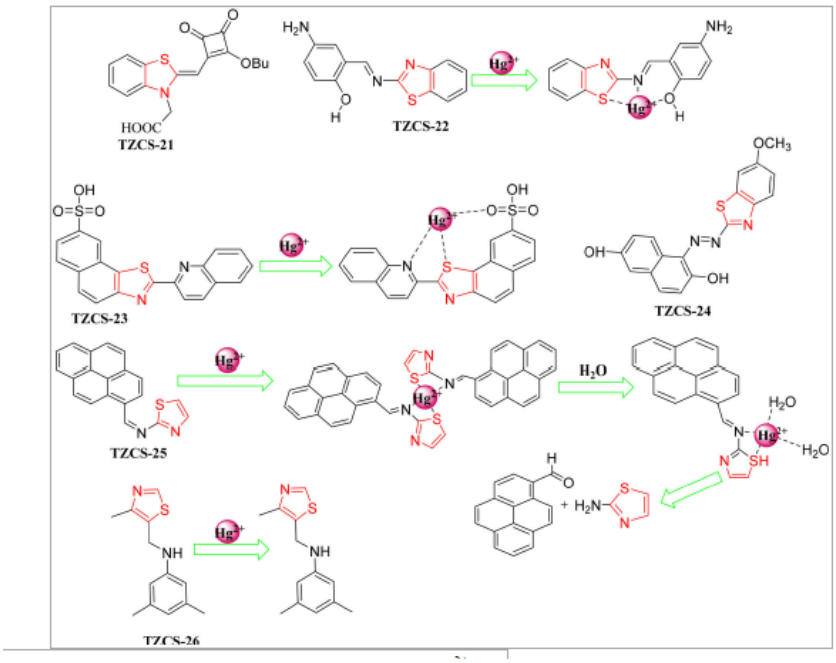
Zn^{+2} Tespitinde kullanılan antrasen ve benzotiyazol türevi heterohalkalı floresans kemosensör bileşikler Şekil 1.'de gösterilmiştir.



Şekil 1. Zn^{+2} Tespitinde kullanılan antrasen ve benzotiyazol türevi heterohalkalı floresans kemosensör bileşikler [19].

4.2. Hg^{+2} Tespitinde Kullanılan Floresans Kemosensör Bileşikler

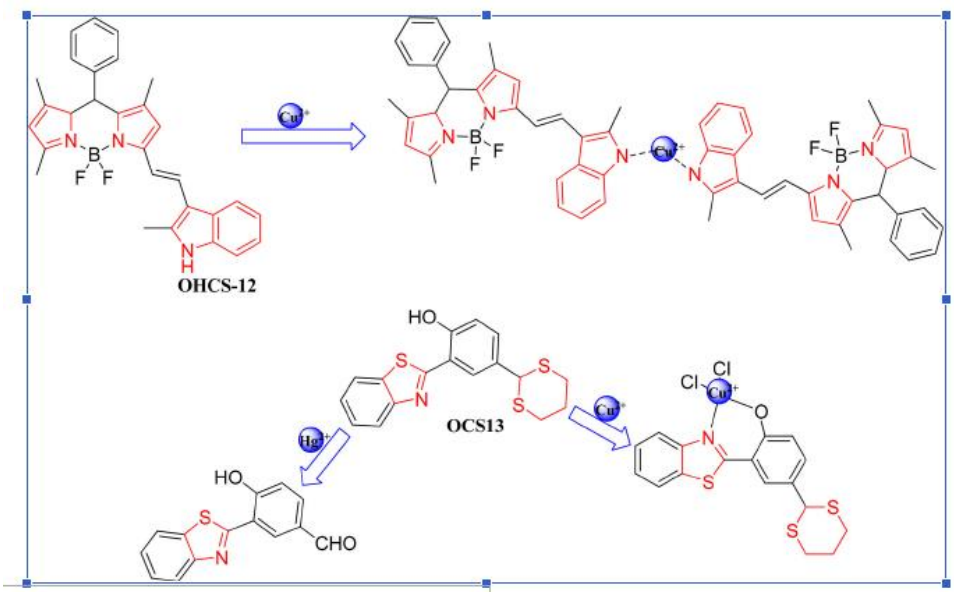
Hg^{+2} Tespitinde kullanılan benzotiyazol ve tiyazol türevi heterohalkalı floresans kemosensör bileşikler Şekil 2.'de gösterilmiştir.



Şekil 2. Hg^{+2} Tespitinde kullanılan tiyazol ve benzotiyazol türevi heterohalkalı floresans kemosensör bileşikler [19,20].

4.3. Cu^{+2} Tespitinde Kullanılan Floresans Kemosensör Bileşikler

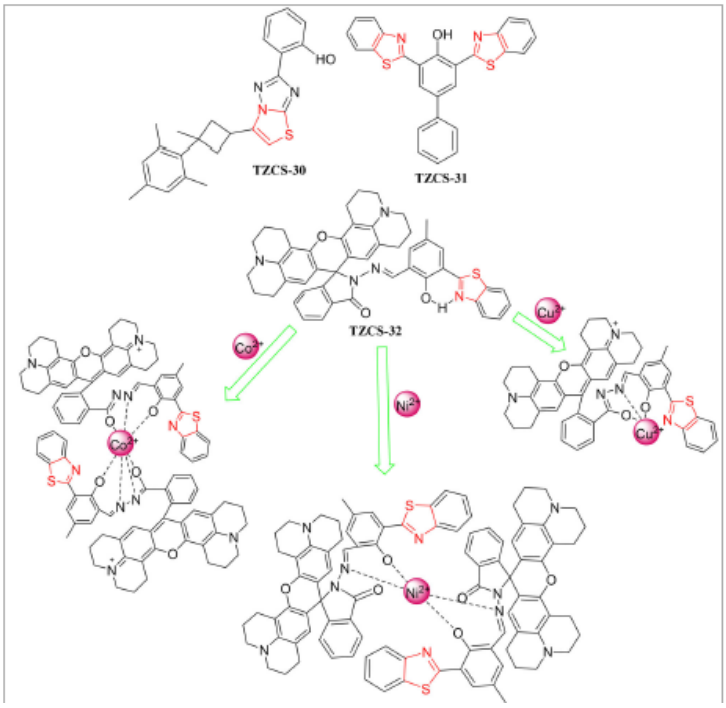
Cu^{+2} Tespitinde kullanılan azol, benzotiyazol ve indol türevi heterohalkalı floresans kemosensör bileşikler Şekil 3.'de gösterilmiştir.



Şekil 3. Cu^{+2} Tespitinde kullanılan azol, benzotiyazol ve indol türevi heterohalkalı floresans kemosensör bileşikler [19,21].

4.4 Ni^{+2} Tespitinde Kullanılan Floresans Kemosensör Bileşikler

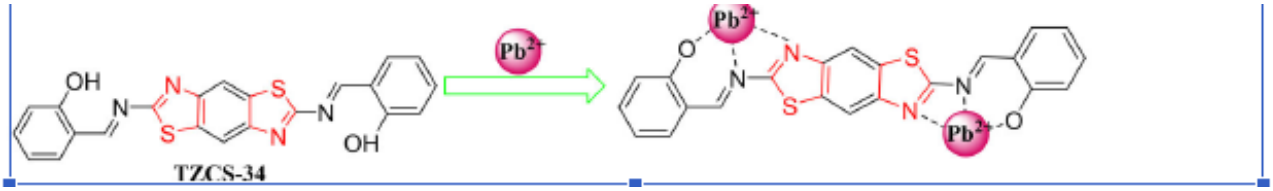
Ni^{+2} Tespitinde kullanılan benzotiyazol türevi heterohalkalı floresans kemosensör bileşikler Şekil 4.'de gösterilmiştir.



Şekil 4. Ni^{+2} Tespitinde kullanılan benzotiyazol türevi heterohalkalı floresans kemosensör bileşikler [19,22].

4.5 Pb^{+2} Tespitinde Kullanılan Floresans Kemosensör Bileşikler

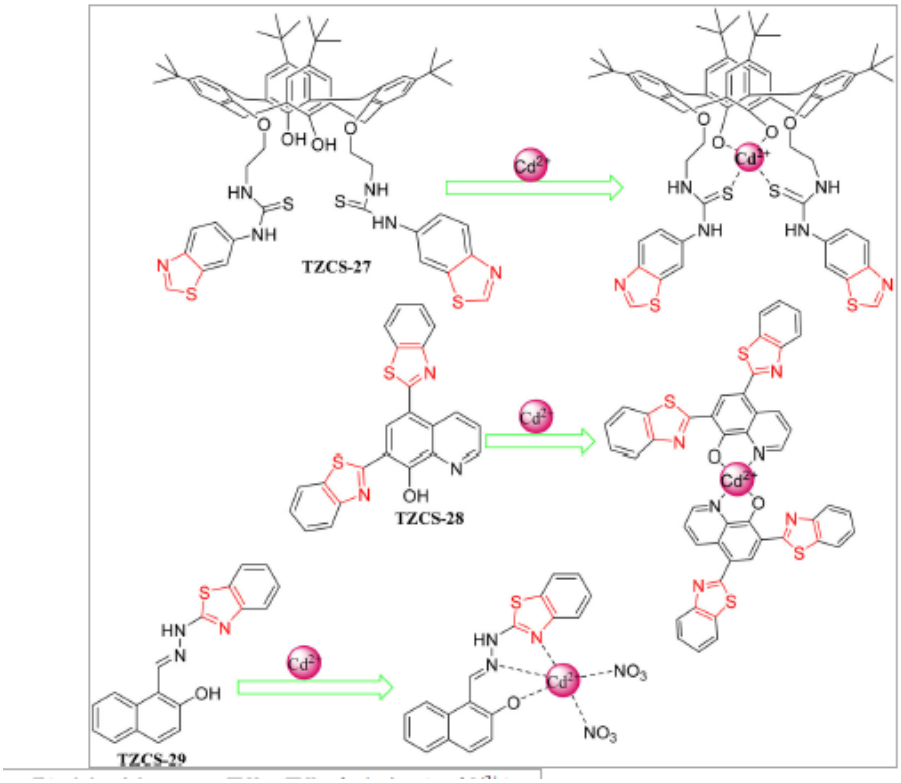
Ni^{+2} Tespitinde kullanılan benzotiyazol türevi heterohalkalı floresans kemosensör bileşik Şekil 5.'de gösterilmiştir.



Şekil 5. Pb^{+2} Tespitinde kullanılan benzotiyazol türevi heterohalkalı floresans kemosensör bileşikler [19,23].

4.6 Cd^{+2} Tespitinde Kullanılan Floresans Kemosensör Bileşikler

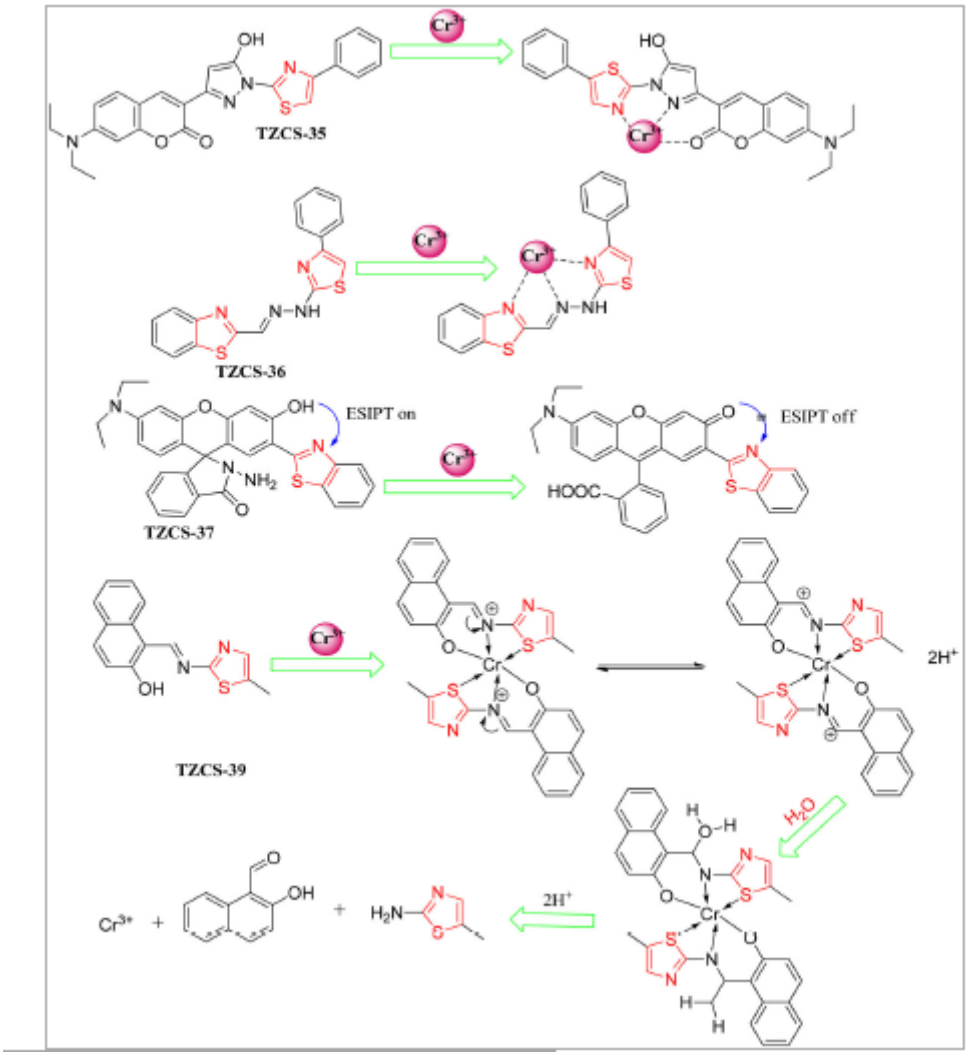
Cd^{+2} Tespitinde kullanılan kalikseren, benzotiyazol ve naftalen türevi heterohalkalı floresans kemosensör bileşikler Şekil 6.'de gösterilmiştir.



Şekil 6. Cd^{+2} Tespitinde kullanılan kalikseren, benzotiyazol ve naftalen türevi heterohalkalı floresans kemosensör bileşikler [19,24].

4.7 Cr^{+3} Tespitinde Kullanılan Floresans Kemosensör Bileşikler

Cr^{+3} Tespitinde kullanılan naftalen, tiyazol ve benzotiyazol türevi heterohalkalı floresans kemosensör bileşikler Şekil 7.'de gösterilmiştir.



Şekil 7. Cr^{+3} Tespitinde kullanılan naftalen, tiyazol ve benzotiyazol türevi heterohalkalı floresans kemosensör bileşikler [19, 25].

5. SONUÇ ve TARTIŞMALAR

Literatürde tarımsal sulamada kullanılan sulardaki ağır metallerin tespitinde kullanılabilme potansiyeli olan floresans kemosensörlere ait çalışma bulunmamaktadır. Bu çalışmada tarımsal sulama sularında bulunan ağır metallerin (Hg^{2+}, Cu^{2+}, Cd^{2+}, Pb^{2+}, Zn^{2+}, Cr^{3+}, Ni^{2+})) tespitinde kullanılabilme potansiyeli olan farklı molekül yapısına sahip floresans kemosensör özelliğine sahip farklı güncel organik bileşikler ve seçici oldukları ağır metaller incelenmiştir. Böylece tarımsal sulamada kullanılan kullanılan sulardaki ağır metallerin tespitinde kullanılabilme

potansiyeli olan floresans kemosensörler üzerinde çalışmak isteyebilecek araştırmacılar için temel bir kaynak oluşturulması amaçlanmıştır. Genel olarak yarattığı çevre sorunları ve sağlık sorunları nedeniyle sudaki ağır metallerin tespitinde kullanılabilecek floresans kemosensör tasarımı, sentezi, fotofiziksel özelliklerinin incelenmesi ve metal iyonlarına karşı göstermiş olduğu floresans özelliklerin belirlenmesi yoğun bir şekilde çalışılan araştırma konusudur. Önümüzdeki yıllarda çalışmalar özellikle yaşamsal etkileri nedeniyle tarımsal sulama sularında bulunan ağır metallerin tespiti için kullanılabilecek floresans kemosensör tasarımı, sentezi ve karakterizasyonu üzerine çalışma yürütülebilecek geniş bir alan bulunulmaktadır. Tarımsal sulama sularında bulunan ağır metallerin tespiti için kulanılabilecek floresans kemosensör sentezi, floresans özelliklerinin belirlenmesi ve sudaki ağır metallerin tanınmasındaki davranışlarının belirlenmesi ilgi çekici bir çalışma alanı olmaya devam edecektir.

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AHŞAP MALZEMEDE ÖLMEZ BİTKİ EKSTRAKTI KULLANIMI VE TERMOGRAVİMETRİK ANALİZ (TGA) ÜZERİNE ETKİLERİ

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ÖZET
Ekosistemin canlılığı, ahşap endüstrisinde yeni organik koruyucu/üst yüzey işlem maddeleri elde edilmesi, geliştirilmesi ve yeni emprenye metotlarının belirlenmesi insanlığın geleceği açısından hayati önem taşımaktadır. Ahşap, doğru kullanım şartları altında birçok endüstride önemli hizmetler sağlayabilir. Ancak, elverişsiz kullanım ortamları ve yangın ahşaba kolayca zarar verebilir. Bu yüzden ahşabın yangın geciktiricilerle muamele edilmesi hayati öneme sahip bir işlemdir. Yanmayı geciktirici kimyasal maddeler ağaç malzemeye tamamen yanmazlıktan koruma özelliği kazandıramazlar. Bununla birlikte, odunun tutuşmasını güçleştirip, yanma olayı başladıktan sonra ateşin hızla yayılmasını geciktirebilirler. Çalışma kapsamında tarihi ahşap eserlerin yangın etkilerine karşı korunması ve tüm ahşap eserlerin restorasyonunda insan/çevre sağlığında olumlu yapı sergileyecek koruyucuların kullanımı çalışmanın ana temasını oluşturmuştur. Bu kapsamda tıbbi aromatik bitki türlerinden ve yangın etkilerine dayanıklı olarak nitelenen ölmez out (Mitr) tercih edilmiş ve odun türü olarak ladin (*Picea orientalis*) tercih edilmiştir. Ölmez bitkisi (Mitr) ekstaktı elde edilmiş ve % 1,%3, %5 konsantrasyonları hazırlanmak suretiyle emprenye işlemi ASTM D 1413-76 esaslarına uygun olarak gerçekleştirilmiştir. Emprenye işleminden hemen sonra ahşap malzemede tutunan madde miktarı belirlenmiştir. Termogravimetrik analiz (TGA)testleri gerçekleştirilerek yanma değişimleri belirlenmiştir. Deney sonuçlarına göre; başlangıç sıcaklığı, dönüm noktası sıcaklığı ve son sıcaklık değerlerinde kontrol gruplarına oranla ciddi bir değişim olmamasına rağmen, ağırlık kaybı yüzdesi ve kalıntı miktarı yüzdesi bütün emprenyeli grup periyotlarında artış göstermiştir. Kontrol örneğine oranla en yüksek ikinci tutunma %5 ölmez bitki ekstraktında (% 0,98), ağırlık kaybı (% 62.05) kalıntı miktarı ise %20.37 olarak gerçekleşmiştir.
Anahtar Kelimeler: İnsan/Çevre sağlığı, Tıbbi Aromatik Bitki, Ekolojji, TGA, Ahşap

USE OF IMMORTAL PLANT EXTRACT IN WOOD MATERIAL AND ITS EFFECTS ON THERMOGRAVIMETRIC ANALYSIS (TGA)

ABSTRACT

The vitality of the ecosystem, obtaining and developing new organic preservatives/surface treatment materials in the wood industry and determining new impregnation methods are of vital importance for the future of humanity. Under the right conditions of use, wood can provide important services in many industries. However, unfavourable usage environments and fire can easily damage the wood. Therefore, treating wood with fire retardants is a vital process. Fire retardant chemicals cannot provide complete fireproofing protection to wood materials. However, they can make it harder for wood to ignite and delay the rapid spread of fire once combustion has begun.

Within the scope of the study, the main theme of the study was the protection of historical wooden artefacts against the effects of fire and the use of preservatives that will have a positive effect on human/environmental health in the restoration of all wooden artefacts. In this context, immortelle (Mitr), which is one of the medicinal and aromatic plant species and is characterized as resistant to fire effects, was preferred and spruce (*Picea orientalis*) was preferred as the wood type. Immortal plant (Mitr) extract was obtained and 1%, 3%, 5% concentrations were prepared and the impregnation process was carried out in accordance with ASTM D 1413-76 principles. Immediately after the impregnation process, the amount of substance adhering to the wood material was determined. Combustion changes were determined by performing thermogravimetric analysis (TGA) tests. According to the test results; Although there was no significant change in the initial temperature, turning point temperature and final temperature values compared to the control groups, the percentage of weight loss and the percentage of residue increased in all impregnated group periods. Compared to the control sample, the second highest adhesion was in the 5% immortelle plant extract (0.98%), the weight loss (62.05%) and the amount of residue was 20.37%.

Keywords: Human/Environmental health, Medicinal Aromatic Plant, Ecology, TGA, Wood

1. GİRİŞ

Dubey ve ark. (2012) Ekosistemin canlılığı, ahşap endüstrisinde yeni organik koruyucu/üst yüzey işlem maddeleri elde edilmesi, geliştirilmesi ve yeni emprenye metotlarının belirlenmesi insanlığın geleceği açısından hayati önem taşımaktadır.

Fosil yakıtlar hariç biyokütle, tarım, orman ve deniz ürünlerini içeren bütün organik atıklar ile lağım suyunu ve siyah likörden elde edilen pulpu da içeren bir terimdir. Bir enerji kaynağı olarak biyokütle iki yönden önemlidir. (Demirbaş,2000).

Özdemir (2020). Emprenye yöntemlerinde alternatif metotlar geliştirilmektedir. Empenye sürecine bağlı olarak sıvı akışkanlığını sağlamak ve tutunma (retensiyon) oranını artırmak için biyolojik, kimyasal, mekanik ve fiziksel işlemlerin yanında, kurutma, buharlama, oyma ve vakum basıncı uygulama gibi yöntemler de kullanılmaktadır.

Hastaoğlu ve ark. (1989) Odun dünyadaki en eski hammaddedir ve hala geniş kullanım alanına sahiptir. Ayrıca % 85'e kadar uçucu madde ihtiva ettiğinden dolayı katı yakıtlar içinde en fazla gaz ürün odundan elde edildiğini bildirmiştir. Brunc ve ark. (2003) Odun gibi yenilenebilir enerji kaynaklarının kullanılmasındaki artış sera gazının etkisinin önemli nedenlerinden biri olan CO2 problemini çözmek içindir. Bu avantajından dolayı günümüzde fosil yakıtlar biyokütle ile yer değiştirdiğini tespit etmişlerdir.

Odun ve selülozik materyallerde yanmayı önlemek için birçok yanmayı geciktirici kimyasal madde kullanılmaktadır. Yanmayı geciktirici kimyasal olarak bor bileşiğine dayalı ürünler, duman bastırıcı özelliklerinden dolayı yalnız veya birlikte kullanılmaktadır. (Baysal, 1994).

Çalışmanın amacı tarihi ahşap mimari eserlerde, restorasyonlarda, insan/çevre sağlığının ön plana çıktığı alanlarda, iç/dış mekânlarda, çok çeşitli coğrafi şartlarda, biotik/abiotik koşullarda kullanımı ve ahşapla ilgili tüm yapı/eserlerin yangın karşısında geciktiricilik sağlaması çalışmanın ana hedefini oluşturmuştur Ekolojik yapı içinde iklim değişikliğinin sürekliliği, buna bağlı olarak sıcaklıkların artması ile bunlarla mücadelede sentetik/kimyasal yapıların kullanımından çok doğal (organik) malzemelerin kullanımını ön plana çıkarmış ve ekolojik ortamda yetişen ölmez bitkisi (Mitr) tercih edilmiştir. Bu bitkinin çeşitli çözelti konsantrasyonlarıyla (%1,%3,%5) emprenye işlemi ahşap malzemeye uygulanmış ve akabinde termogravik (TGA) deneyleri gerçekleştirilmiştir.

2. MATERYAL VE YÖNTEM

2.1. Materyal

Çalışma kapsamında ülkemiz türlerinden doğu ladini odunu (*Picea orientalis (L) Link*.) tercih edilmiş olup, emprenye malzemesi olarak ölmez bitkisi kullanılmıştır. Çalışmada TS 2470, 2471 standartları temel alınarak deney örekelerinin ardaksız, mantarsız, çürük, budaksız olmasına özen gösterilmiştir.

2.2. Yöntem

2.2.1. Deney örneklerinin hazırlanması

Termogravimetrik analizinde (TGA) bütün ana kütlenin tamamını temsil edecek biçimde numune alınmış ve Willey değirmeni yardımıyla öğütme işlemi 40 ve 60 mesh'lik (250 1847 mikron) elek üzerinde kalan örnekler elde edilmiş kaplara konmuştur (Tutuş ve ark, 2010).

2.2.2. Emprenye Yöntemi

Emprenye işlemi ASTM D 1413-76 esaslarına göre gerçekleştirilmiştir. Emprenye işleminde tam kuru hale getirilen odun örnekleri (103±5 ºC) 24 saat bekleme işleminin ardından 30 dakika vakum/30 dakika difüzyon işlemine tabi tutulmuştur .

2.2.3.Termogravimetrik Analiz (TGA)

Termogravimetrik TGA analizi ASTM E1131-08'e göre 40 mesh elekten geçen 60 meshlik elekten geçmeyen yaklaşık 10 mg odun unu, 50 mL/dk. Akış hızındaki nitrojen gazı altında, 10 °C/dk. sıcaklık artış hızı ile 25 °C'den 700 °C'ye çıkarılarak uygulanmıştır. Deney sonucunda, en yüksek sıcaklık noktasında numunede meydana gelen yüzde ağırlık kaybı, anlık ağırlık kaybı miktarının en yüksek olduğu zaman dilimi, hızlı piroliz sıcaklık noktası değerleri incelenmiştir. edilmiştir (ASTM,E1131-08 2014).

2.2.4. Özüt (Ekstrakt) Hazırlama

Tıbbi aromatik bitki türleri Erzurum'dan ilinden temin edilerek Artvin Çoruh Üniversitesi laboratuvarında sabit ağırlığa gelmesi için 1-2 ay süreç aralığında kuruma gerçekleştirilmiştir. 1-2 ay kuruma işleminin ardından kesicili öğütücüden geçirilmek suretiyle toz hale gelmesi sağlanmıştır. (Ceylan,2017).

2.2.5. % Tutunma Miktarı (Retensiyon)

Emprenye işleminden sonra tam kuru oduna oranla kalan madde miktarı (tkoao-% retensiyon) belirtilen formülden hesaplanmıştır (Baysal 2003)

$$R(\%) = \frac{Moes - Moeö}{Moeö} x100$$

Moes= Emprenye sonrasında deney örneğinin tam kuru ağırlığı (g)

Moeö= Emprenye öncesinde deney örneğinin tam kuru ağırlığı (g)

3. BULGULAR VE TARTIŞMA

3.1.Çözelti Özelliği

Çözelti özellikleri Tablo 1' de verilmiştir.

Tablo 1. Çözelti Özellikleri

Konsantrasyon ve Madde		**Çözücü Madde**	**Sıcaklık (ºC)**	**pH**		**Yoğunluk (g/ml)**	
				EÖ	**ES**	**EÖ**	**ES**
1%	Ölmez Bitki Ekstraktı	Su	22ºC	6.10	6.10	0.875	0.875
3%				5.95	5.95	0.850	0.850
5%				6.01	6.01	0.890	0.890

EÖ: Emprenye öncesi **ES**: Emprenye sonrası

Emprenye öncesi ve gerek sonrasında pH/yoğunluklarında değişim gerçekleşmemiştir. Asidik/bazik yapının odunun gerek anatomik ve gerekse teknolojik özelliklerinde yapısında olumlu/olumsuz yönde etkili olduğu literatürlerde bildirilmiştir.

3.2.Tutunma Miktarı (%)

Tutunma (net kuru emprenye maddesi miktarı-%) değerleri Tablo 2 'de verilmiştir.

Tablo 2. Tutunma miktarı ve ve Duncan Testi Analiz Sonuçları

Odun Türü	Konsantrasyon	Tutunma (%)	HG
Doğu Ladini	%1	0.58	A
	%3	0.45	C
	%5	0.50	B

En yüksek tutunma (retensiyon) % 1 konsantrasyonda (% 0.58), en düşük tutunma % 3 konsantrasyonda (%0.45) gerçekleşmiştir.

3.2. Termogravimetrik Analiz Sonuçları (TGA)

Doğu ladini odununun %1, %3, %5 ölmez bitki ekstraktı ile emprenyesi yapılmış örneklerde termogravimetrik (TGA) analiz sonuçları Tablo 3'te verilmiştir.

Tablo 3. Termogravimetrik Analiz Sonuçları

Konsantrasyon	Başlangıç Sıcaklığı (°C)	Dönüm noktası (°C)	Son sıcaklık (°C)	Ağırlık Kaybı (□y) (%)	550 °C deki kalıntı miktarı (%)
Kontrol	318.20	374.40	395.00	68.22	16.10
%1 Ekstrakt	322.85	368.41	390.01	69.82	20.55
%3 Ekstrakt	328.15	371.10	393.49	69.95	20.67
%5 Ekstrakt	327.37	369.56	394.11	70.37	19.95

Kontrol grubu için ağırlık kaybı (□y) % 68.22 iken, en yüksek ağırlık kaybı %5 ekstraktlı grupta % 70.37 olarak gerçekleşmiştir. 550 °C deki kalıntı miktarı (%) ise kontrol grubu için %16.10 iken %3 ekstrakta %20.67 bulunmuştur.

4. SONUÇLAR

Ölmez bitki ekstraktı doğu ladini odununda TGA analizi sonuçlarına göre kısmen olumlu etki göstermiştir. Tıbbi aromatik bitki türlerinden biri olan bu bitkinin iç/dış mekanlarda yangın etkilerine karşı kullanılabileceği söylenebilir. Hemiselülozlar ve bazı ekstraktiflerin termal dayanımına etkisi sonucu ortaya çıktığı söylenebilir. Zira literatürde de bilindiği üzere içerisinde daha fazla ekstraktif madde içeren iğne yapraklı ağaçların termal dayanımı yapraklı ağaçlara kıyasla daha zayıf olduğu bildirilmiştir.

Tan ve ark. (2022) yapılan çalışmada TGA analizi yanında aynı emprenye maddesinin farklı yüzdeliklerinde çalışılmış ve sonrasında LOI deneyleri yapılmıştır. TGA analizinde benzer sonuçlar bulunmasına rağmen bir yerde alevli yanmayı ortaya koyan LOI değerlerinde kontrol gruplarına nazaran belirgin iyileşme gözlemlediğini bildirmiştir.

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ÇEŞİTLİ DOĞAL YAĞLARIN AHŞAP MALZEME KORUNUMUNDA KULLANIMI VE AHŞAP MALZEMENİN BAZI MEKANİK ÖZELLİKLER ÜZERİNDE ETKİLERİ

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ÖZET
Ahşap gerek tek başına gerekse metal, taş gibi nesneler ile kombinasyonu ile birlikte insanoğlunun varoluşundan itibaren onun hayatında olan bir maddedir. İnsanoğlu yaşam koşullarını ahşapla uyumlu bir ilişki içinde modern günlere taşımıştır. Bu uyumu ana hatları ile görebileceğimiz taşınmaz ahşap eserleri; binalar, yapılar, taşınır ahşap eserler ise; mobilyalar, ev gereçleri, müzik aletleri gibi eserler oluşturur. Bu eserlere ek olarak arkeolojik alanlardan (gömü/sualtı) ya da kazılardan çıkan eserler de dahil olmaktadır. Kültür varlıklarımızın büyük bir çoğunluğunu, yaşanılan toplulukların kültürünü, ideallerini, sembollerini yansıtan mesleki, teknik eserler, yaratıcı faaliyetler ve sanatsal ürünlerinin büyük bir kısmını ahşap eserler oluşturmaktadır. Bu yüzden de insan yaşamı ve kültürü hakkında bilgi veren ve gelecek için korunmaya değer görülen her türlü ahşap eser için odunun yapısını bilmek de oldukça önemlidir. Bu araştırma kapsamında ahşap malzemenin çok çeşitli kullanım yerlerinde (ahşap evler, tarihi mekanlar, restorasyon vb) doğal yağlı koruyucularla korunması ve insan/çevre sağlığında olumlu yönde etkiler oluşturacağı planlanmasına yönelik olarak gerçekleştirilmiştir. Emprenye işleminde doğal (organik) saf çay ağacı yağı ve lavanta yağı tıbbi aromatik özellikleri nedeniyle tercih edilmiştir. Odun türü olarak sarıçam (*Pinus sylvestris* L.) ve kayın odunu (*Fagus orientalis* Lipsky) kullanılmıştır. Emprenye işleminde vakumlu emprenye metodu ASTM D 1413-76 standardı esas alınmış, emprenye işlemini takiben ahşap malzemede tutunma (retensiyon) miktarı belirlenmiştir. Akabinde dinamik eğilme direnci (şok) ve eğilme direnci deneyleri gerçekleştirilmiştir. Deney sonuçlarına göre; sarıçam odununda en yüksek eğilme direnci değeri saf çay ağacı yağında 93.27 N/mm^2, kayın odununda en yüksek eğilme direnci 125.31 N/mm^2 belirlenirken; en yüksek retensiyon kayın odunu lavanta yağı emprenyesinde % 41.89 belirlenmiştir.
Anahtar Kelimeler: Doğal Yağlar, İnsan/Çevre sağlığı, Eğilme Direnci, Restorasyon

USE OF VARIOUS NATURAL OILS IN WOOD MATERIAL PROTECTION AND THEIR EFFECTS OF WOOD MATERIALS ON SOME MECHANICAL PROPERTIES

ABSTRACT
Wood is a substance that has been in the life of human beings since their existence, either alone or in combination with objects such as metal and stone. Human beings have brought their living conditions to modern days in a harmonious relationship with wood. Immovable wooden works where we can see this harmony in outline; buildings, structures and movable wooden works; creates works such as furniture, household appliances and musical instruments. In addition to these artifacts, unearthed from archaeological sites (burial/underwater) or excavations are also included. Wooden works constitute the majority of our cultural assets, professional and technical works, creative activities and a large part of artistic products that reflect the culture, ideals and symbols of the communities we live in. Therefore, it is very important to know the structure of wood for all kinds of wooden artifacts that provide information about human life and culture and are considered worth preserving for the future. This research was carried out with the aim of protecting wooden materials with natural oil preservatives in a wide variety of usage areas (wooden houses, historical places, restoration, etc.) and planning to have positive effects on human/environmental health. Natural (organic) pure tea tree oil and lavender oil were preferred in the impregnation process due to their medicinal and aromatic properties. Scots pine (*Pinus sylvestris* L.) and beech wood (*Fagus orientalis Lipsky* L.) were used as wood types. In the impregnation process, the vacuum impregnation method ASTM D 1413-76 standard was taken as basis, and the retention amount in the wood material was determined following the impregnation process. Subsequently, dynamic bending resistance (shock) and bending resistance tests were carried out. According to the test results; The highest bending resistance value in Scots pine wood was 93.27 N/mm^2 in pure tea tree oil, and the highest bending resistance value in beech wood was 125.31 N/mm^2; The highest retention was determined as 41.89 % in lavender oil impregnation in beech wood.
Keywords: Natural Oils, Human/Environmental Health, Bending Resistance, Restoration

1. GİRİŞ

Ekolojik ortamda nüfusun hızlı artışı ve bu parametrelere oranla orman kaynağının hızlı azalma süreci devam edegelmektedir. Ahşabın maksimum düzeyde korunmasıyla çok çeşitli kullanım alanları oluşacak ve bununda ötesinde ahşap materyal üzerinde yıkımlayıcı faktörlerin daha da belirgin olmasıyla geniş kullanım alanlarının sağlanabilmesi yeni metotların gelişim sürecine bağlıdır (Bayraktar ve ark. 2022).

Normal olarak uygulanan odun koruma süreci çeşitli biyositlerin (arsenik, krom vb.) ahşap malzemeye emprenye ilkesine dayanmaktadır. Ahşap malzemenin bozulmasının önlenmesi, mikroorganizma faaliyetinin büyüme/gelişim ortamının kısıtlanması sürecine dayanmaktadır (Koski 2008)

Emprenye Çevre örgütleri emprenye materyallerinin çevresel zararlarından dolayı bu materyallerin yasaklanması gerektiğini bildirmektedirler. Son yıllar içinde insan ve çevreyle dost materyallerin kullanımı artmaktadır. (Tomak ve ark. 2011; Koski 2008).

Rowell ve Banks (1985), bu yöntemleri su iticilik sağlayan, boyutsal kararlılık sağlayan ve hem su iticilik hem de boyutsal kararlılık sağlayan yöntemler (MMA, PEG ve bütilen oksit muameleleri) şeklinde üç öbekte toplanmıştır.

Royal sisteminde odunun suda çözünen bir emprenye maddesi ile emprenye işlemini takiben yağın kullanıldığı ikinci bir emprenye işlemi yapılmaktadır (Treu ve ark. 2001). Bu şekildeki bir sistemde daha dayanıklı ürünler elde etmenin yanı sıra zehirli maddelerin çevreye yıkanmasının azaltılması da sağlanabilmektedir (Treu ve ark. 2004).

Her ne kadar su itici maddeler tam anlamıyla su alımını azaltmasa da, odunun dış hava koşullarında kullanılmasında en etkili maddelerden biridir. Su itici maddeler, odunda mantar ve mikroorganizmaların gelişimi için ihtiyaç duyduğu rutubet miktarını düşürerek, mantarlara ve renklemelere karşı odunu korurlar (Williams ve Feist 1999).

Doğal yağlar kuruyan, yarı-kuruyan ve kurumayan yağlar olmak üzere 3 gruba ayrılmıştır. Bezir yağı gibi kuruyan yağlar hava ile elastik bir film tabakası oluşturmakta; tall yağı gibi yarı-kuruyan yağlar, kuruyan yağlara göre daha yavaş okside olmakta ve polimerleşmekte, ancak yağ yapışkan bir hal almaktadır. (Koski 2008).

Wang ve Cooper (2005b), soya yağının odunla oluşturabileceği olası bir bağlanmayı araştırmıştır. Emprenye edilen örneklerin ekstraksiyona tabi tutulduktan sonra, odunla bağ

yapabildiğini ve düşük çözünürlük özelliği sergilediğini bulmuşlardır. Dolayısı ile yağ işlemlerinin etkinliği, yağın özelliklerine, absorbe edilen yağ miktarına, yağın odundan yıkanmasına ve emprenye yönteminin süre ve sıcaklığına bağlı olarak değişkenlik göstermektedir (Wang ve Cooper 2005a)

Yağlar genellikle daldırma veya vakumlu emprenye ile oduna kolaylıkla uygulanabilmektedir. Odun koruma yöntemleri arasında klasik adıyla bilinen sıcak-soğuk kazan tank yöntemi ya da son yıllarda CIRAD ve FCBA tarafından geliştirilen ve "ısıl biyo-yağ yöntemi (biooleotermal process)" olarak isimlendirilen sıcak yağ muamelesi tekniğinde, küçük odun örneklerinin yağı iyi ve yeknesak bir şekilde absorbe etmesinin (Lyon ve ark. 2007; Podgorski ve ark. 2008)

Çalışma kapsamında doğal yağları kullanmak suretiyle zaten organik olan ahşap malzemenin insan/çevre içinde daha sağlıklı ortam oluşturması ve böylelikle iç/dış tüm mekanlarda bu doğal materyallerin yaygın kullanımı gerçekleşecektir. Özellikle doğal yağ türevleri ahşap malzeme korunumunda, tarihi ahşap eser restorasyonlarında, lokanta, kafe vb mekanlarda kullanımının gerçekleşme düzeyinin belirlenmesi amacıyla bazı mekanik özellikleri belirlenmiştir.

2. MATERYAL VE YÖNTEM

2.1.Materyal

Çalışma kapsamında ülkemiz türlerinden sarıçam odunu (*Pinus sylvestris* L.) ve doğu kayını odunu (*Fagus orientalis Lipsky* L.) odunları tercih edilmiş olup, emprenye malzemesi olarak saf çay ağacı yağı ve lavanta yağı kullanılmıştır. Çalışmada TS 2470, 2471 standartları temel alınarak deney örekelerinin ardaksız, mantarsız, çürük, budaksız olmasına özen gösterilmiştir.

2.2. Yöntem

2.2.1. Deney örneklerinin hazırlanması

Hava kurusu rutubete (% 12) sahip örnekler, ağacın diri odun kısımlarından, yıllık halkaların geniş yüzeye dik gelecek şekilde 20×20×300 mm ölçüsünde TS ISO 3129, TS ISO 13061 ilkelerine göre hazırlanmış, tüm numunelerde çatlak, budak, ardak, küf, çürüklük vb. kusurlar olmamasına özen gösterilmiş; diri odun kısmından elde edilen numunelerin yıllık halka yapısının yüzeye (radyal) olacak şekilde olmasına dikkat edilmiştir.

2.2.2. Emprenye Yöntemi

Emprenye işlemi ASTM D 1413-76 esaslarına göre gerçekleştirilmiştir. Emprenye işleminde tam kuru hale getirilen odun örnekleri (103±5 ºC) 24 saat bekleme işleminin ardından 30 dakika vakum/30 dakika difüzyon işlemine tabi tutulmuştur.

2.2.3. Eğilme Direnci Testleri

Eğilme direncinde TS 2474/1976 standardı esas alınmıştır. Örnekler 20x20x300 mm boyutlarında hazırlanmıştır. Örnekler klimatize edilerek (20 ± 2 ºC/ % 65 ± 5 bağıl nemde) %12 rutubet miktarına getirilmiştir. Deneyler yapılmadan önce tüm örnekler hava kurusu hale getirilmiş ve ± 0,01 mm duyarlığa sahip olan dijital bir kumpasla her iki kalınlık ölçümü (radyal/teğet) suretiyle değerler alınmıştır. Daha sonra üniversal test makinesinin yükleme mekanizmasının hızı 1,5±0,5 dakikada kırılacak şekilde ayarlanmıştır. Aşağıda verilen eşitlik yardımıyla eğilme direnci hesaplanmıştır.

2.2.4. % Tutunma Miktarı (Retensiyon)

Emprenye işleminden sonra tam kuru oduna oranla kalan madde miktarı (tkoao-% retensiyon) belirtilen formülden hesaplanmıştır (Baysal 2003)

$$R(\%) = \frac{Moes - Moeö}{Moeö} x100$$

Moes= Emprenye sonrasında deney örneğinin tam kuru ağırlığı (g)

Moeö= Emprenye öncesinde deney örneğinin tam kuru ağırlığı (g)

3. BULGULAR VE TARTIŞMA

3.1. % Retensiyon

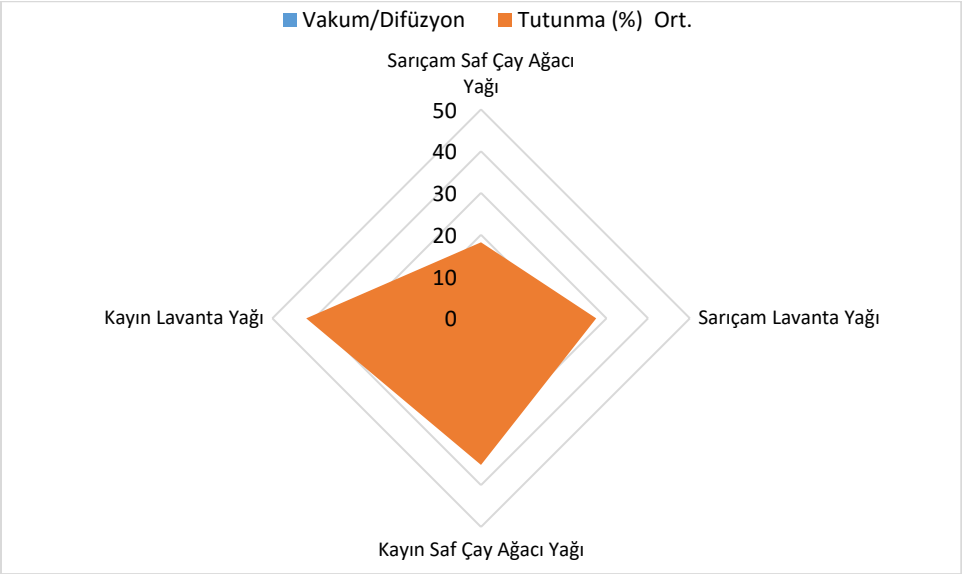
% retensiyona ilişkin Duncan testi sonuçları Tablo 1' de, bunlara ilişkin değişim grafiği Şekil 1 ‘de verilmiştir.

Tablo 1. Odun Türlerinde Tutunma Miktarları (%) ve Duncan Testi Sonuçları

Emprenye Maddesi	**Odun Türü**	**Vakum/Difüzyon**	**Tutunma (%)**		
			Ort.	**St. Sp**	**HG**
Saf Çay Ağacı Yağı	Sarıçam	30 Dakika/ 30 Dakika	18.17	1.15	D
Lavanta Yağı			27.56	2.89	C
Saf Çay Ağacı Yağı	Kayın		35.14	4.79	B

Lavanta Yağı			41.89	3.78	A

HG: Homojen gruplar (**p<0.05** yanılma olasılığı)



Şekil 1. Retensiyon Değişimi (%)

Tablo ve grafik incelendiğinde en yüksek tutunma miktarı kayın odunu lavanta yağı emprenyesinde (% 41.89), en düşük tutunma düzeyi sarıçam odununda Saf Çay Ağacı Yağı emprenyesinde (% 18.17) gerçekleşmiştir.

Kaçamer (2010) İmersol Aqua ve tanalith-E İle emprenye edilmiş isıl işlemli ağaç malzemede en yüksek retensiyon oranını en yüksek retensiyon oranı (%1,53) Imersol AQUA ile emprenye edilen göknar odununda gerçekleştiğini bildirmiştir.

Delibaş (2003) Tall oil'in değerlendirilmesi" adlı yüksek lisans tezinde Türkiye'de üretilen tall yağının reçine asitlerinin bağlayıcı olarak uygun olmadığını, tall yağı ile melas harmanlandığında optimum tall yağı yüzdesini %25 olarak bulduğunu bildirmiştir.

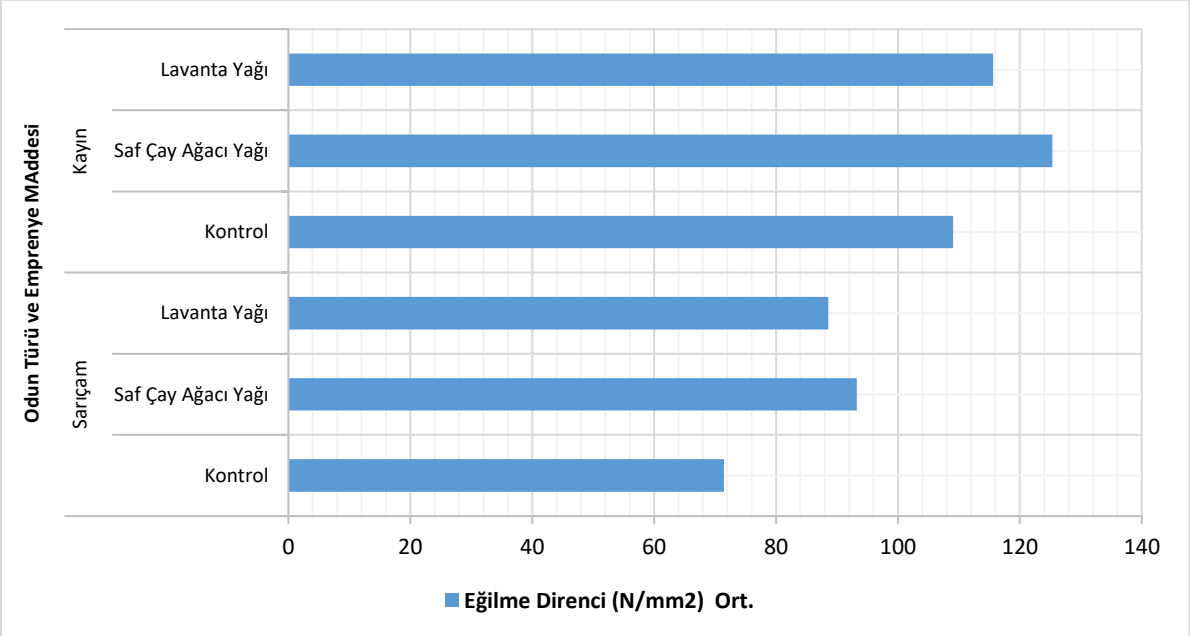
3.2. Eğilme Direnci (N/mm^2)

Eğilme direnci ilişkin Duncan testi sonuçları Tablo 2' de, bunlara ilişkin değişim grafiği Şekil 2 'de verilmiştir.

Tablo 2. Eğilme Direnci (N/mm^2)

Emprenye Maddesi	**Odun Türü**	**Vakum/Difüzyon**	**Eğilme Direnci (N/mm^2)**		
			Ort.	**St. Sp**	**HG**
Kontrol	Sarıçam	30 Dakika/ 30 Dakika	71.45	1.07	F
Saf Çay Ağacı Yağı			93.27	2.45	D
Lavanta Yağı			88.56	2.37	E
Kontrol	Kayın		109.04	1.67	C
Saf Çay Ağacı Yağı			125.31	3.49	A
Lavanta Yağı			115.64	4.28	B

HG: Homojen gruplar (**p<0.05** yanılma olasılığı)



Şekil 2. Eğilme Direnci Değişimi (N/mm^2)

Deney sonuçlarına göre; sarıçam odununda en yüksek eğilme direnci değeri saf çay ağacı yağında 93.27 N/mm^2, kayın odununda en yüksek eğilme direnci saf çay ağacı yağında 125.31 N/mm^2 belirlenmiştir.

Tjeersama ve ark. (2005) emprenye edilen örnekler maksimum %20 ağırlık artışı verecek şekilde muamele edildiğini, uza ile emprenye edilen örneklerin 36 ay süreyle dış koşullarda toprakla temas halinde bırakılmasında ağırlık kayıpları oldukça düşük (< %3) bulunmuştur. Mantar çürüklük testleri ise yine çok başarılı çıkmıştır. Eğilmede elastikiyet modülünde de iyileşmeler gözlenirken, eğilme direncinde yaklaşık %10 civarında azalmalar olduğunu bildirmiştir. Panov ve ark. (2010), OsO4 kullanarak bezir yağını epoksitlendirerek odun hücre çeperi bileşenleri ile bağ yapmasını sağlamış ve 90-200 kg/m3 gibi düşük retensiyon değerlerinde odunun hidrofobikliği arttırılmıştır. Yine Linogard olarak adlandırılan, odun içine penetre olan ve kuruyan bir bezir yağı türevinin Linotech yöntemiyle oduna verildiğinde, odunu hidrofobik hale getirdiği ve su alımını engellediği bildirilmektedir.

4. SONUÇLAR

Doğal olan lavanta yağı ve saf çay ağacı yağı ahşap malzeme üzerinde ciddi anlamda tutunma (retensiyon) göstermiş, mekanik özelliklerden biri olan eğilme direnci değerinde artış sağlamıştır. Yağlı emprenye maddeleri kullanım yeri ve amaca yönelik olarak kullanılabilir.

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SOĞANLI SÜS BİTKİLERİNDE UÇUCU YAĞLAR VE KOKU-ESTETİK İLİŞKİSİ

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ÖZET
Soğanlı süs bitkileri, bahçecilik ve peyzaj dünyasında önemli bir yere sahiptir. Bu bitkilerin kokusal özellikleri, peyzaj tasarımında, estetik bir deneyim yaratmada önemli bir rol oynamaktadır. Soğanlı süs bitkileri, soğan adı verilen özgün bir yapıya sahiptir. Bu soğanlar, bitkinin yaşamsal fonksiyonlarını desteklerken aynı zamanda enerji ve besin depolama organları olarak görev yapar. Soğanlar, bitkinin büyümesi ve gelişmesi sırasında uçucu yağlar üretmektedir. Bu uçucu yağlar, bitkinin kokusal özelliklerini oluşturan kimyasal bileşenleri içermektedir. Soğanlı süs bitkilerinin uçucu yağlar içermesi, bitkilerin kokusal çeşitliliğini ve bahçe tasarımındaki estetik ilişkiyi etkileyen önemli bir faktördür. Bu bitkilerin soğanları, birtakım uçucu yağlar içermektedir ve bu yağlar bitkilerin kokusal özelliklerini oluşturan bileşenleri barındırmaktadır. Kokusal çeşitlilik, bu bitkilerin farklı türleri arasında büyük ölçüde değişmektedir. Bu çalışma, Türkiye'de üretilen soğanlı kesme çiçek türlerinden zambak, glayöl, lale, nergis, frezya, sümbül, anemon, alstroemeria, ornithogalum, zantedeschia, iris ve ranunculus türlerinde bulunan koku bileşenleri üzerine yapılan araştırmaları derlemekte ve bu koku bileşenlerinin estetikle ilişkisini incelemektedir. Sonuç olarak, soğanlı süs bitkileri, kokusal özellikleri ile bahçe düzenlemesi ve peyzaj tasarımında önemli bir rol oynamaktadır. Bu bitkilerin uçucu yağları, bitkilerin kokusal çeşitliliğini ve estetik ilişkisini etkilemektedir. Bahçe tasarımında bu bitkilerin kokusal özelliklerinin ve estetik katkılarının dikkate alınması, peyzajın zenginliğini artırabilir ve farklı duyusal deneyimler sunabileceği düşünülmektedir.
Anahtar Kelimeler: Uçucu Yağlar, Soğanlı Bitkiler, Kesme Çiçek, Estetik

VOLATILE OILS IN ORNAMENTAL BULBOUS PLANTS AND THE RELATIONSHIP BETWEEN SCENT AND AESTHETICS

ABSTRACT
Ornamental bulbous plants hold a significant place in the world of gardening and landscaping. The olfactory characteristics of these plants play an important role in creating an aesthetic experience in landscape design. Ornamental bulbous plants have a unique structure known as bulbs, which serve as storage organs for energy and nutrients while supporting the vital functions of the plant. These bulbs produce essential oils during the growth and development of the plant. These essential oils contain chemical components that constitute the olfactory characteristics of the plant. The presence of essential oils in ornamental bulbous plants is a crucial factor that influences the diversity of scents and the aesthetic relationship in garden design. The bulbs of these plants contain various essential oils, and these oils house the components responsible for the olfactory properties of the plants. The olfactory diversity varies significantly among different species of these plants. This study compiles research on the fragrance components found in ornamental cut flowers, including lilies, gladioli, tulips, daffodils, freesias, hyacinths, anemones, alstroemerias, ornithogalums, calla lilies, irises, and ranunculuses, which are produced in Turkey. It examines the relationship between these fragrance components and aesthetics. In conclusion, ornamental bulbous plants play a vital role in garden and landscape design through their olfactory features. The essential oils of these plants influence the olfactory diversity and aesthetic contributions of the plants. Consideration of the olfactory properties and aesthetic contributions of these plants in garden design can enhance the richness of landscapes and provide different sensory experiences.
Keywords: Essential Oils, Bulbous Plants, Cut Flowers, Aesthetics

1. GİRİŞ

Soğanlı süs bitkileri, bahçecilik ve peyzaj dünyasında önemli bir yere sahiptir (Uzun, 2021). Bu bitkilerin kokusal özellikleri, peyzaj tasarımında, estetik bir deneyim yaratmada önemli bir rol oynamaktadır. Soğanlı süs bitkileri, soğan adı verilen özgün bir yapıya sahiptir. Bu soğanlar, bitkinin yaşamsal fonksiyonlarını desteklerken aynı zamanda enerji ve besin depolama organları olarak görev yapmaktadır (Tantan vd., 2019). Soğanlı bitkiler, toprak üstü organlarının büyüme mevsimini tamamladıktan sonra kuruyarak ölmelerine rağmen, yaşamlarını toprak altında sürdürebilen iki veya çok yıllık bitkiler olarak adlandırılmaktadır. Toprak altı organlarının temel fonksiyonu, besin maddelerini, gıda kaynaklarını ve nemi mevsimsel gelişme ve büyüme için depolamak ve türlerin hayatta kalmasını sağlamaktır (Sargın vd., 2013). Bu gövdeler, her yıl merkezlerine yakın kısımlarından sürgün verebilmekte ve sonrasında çiçeklenme aşamasına geçmektedir. Çiçeklenme açısından türler arasında dinlenme periyodu farklılık göstermektedir. Doğal olarak yetişebilmeleri için vegetasyon ve dinlenme periyotlarının birbirini izlemesi gerekmektedir. Soğanlı bitkilerde soğan oluşumu toprak altında, diğer bitkilerde ise toprak seviyesinde ya da toprak üzerinde gerçekleşmektedir (Zencirkıran, 2002). Soğanlı bitkiler güz soğanları ve bahar soğanları olmak üzere iki gruba ayrılmaktadır. Sonbaharda dikilen ve baharda çiçek açanlara güz soğanları, ilkbaharda dikilen ve yazın çiçek açanlara bahar soğanları olarak bilinmektedir (Özhatay, 2009).

Soğanlı bitkiler, genellikle güzel, renkli ve gösterişli çiçeklere sahip olmaları, güzel kokuları, geniş ekolojik toleransları, kolay yetiştirilebilmeleri ve toprağa dikildikten çok kısa bir süre sonra çiçek vermeleri nedeniyle peyzaj alanlarında yaygın olarak tercih edilmektedir (Kılıçarslan ve Dönmez, 2016). Soğanlı bitkilerin yer örtücü bitkilerle birleştirilmesiyle estetik kombinasyonlar oluşturulabilir. Tasarımda, yer örtücü bitkilerle soğanlı bitki türleri arasındaki yükseklik ilişkisinin dikkate alınması önemlidir (Evans, 2005). Yer örtücü türler, soğanlı bitkilerin yarı yüksekliğinden daha fazla olmamalıdır. Ayrıca, yer örtücüler, soğanın gövdesine destek sağlar ve yağmurların veya sulama suyunun sıçrayarak çiçeklerin çamurlanmasını engellemektedir (Leholm, 1998; Evans, 2005). Soğanlı bitkilerin gösteri ve sergi amaçlı kullanımında, özellikle laleler en yaygın olarak tercih edilen türlerdir. Laleleri, sümbül, nergis ve muscari gibi bitkiler izlemektedir. Bu türleri, büyük ve gösterişli çiçekleri olan Dahlia, Fritillaria, Lilium, Crocus gibi türler takip etmektedir. Tasarımda, tek başlarına veya küçük

gruplar halinde kullanılabilecekleri gibi, bazı türler büyük gruplar halinde de kullanılabilmektedir (Leeds, 2001; Evans, 2005). Koku bahçelerinde soğanlı bitkilerin kullanımında, gösterişli çiçeklerinin yanı sıra hoş kokulara sahip olanlar tercih edilebilmektedir. Beyaz kâğıt görünümlü ve açık sarı çiçekli Narcissus türleri, kokulu çiçekleriyle etkileyici bir görünüm sunar. Yaz aylarında çiçek açan Lilium türleri ise mükemmel kokularıyla vazgeçilmez bitkiler arasında yer almaktadır (Relf, 1997; Leeds, 2001).

Soğanlar, bitkinin büyümesi ve gelişmesi sırasında uçucu yağlar üretmektedir. Bu uçucu yağlar, bitkinin kokusal özelliklerini oluşturan kimyasal bileşenleri içermektedir. Soğanlı süs bitkilerinin uçucu yağlar içermesi, bitkilerin kokusal çeşitliliğini ve bahçe tasarımındaki estetik ilişkiyi etkileyen önemli bir faktördür. Kokusal çeşitlilik, bu bitkilerin farklı türleri arasında büyük ölçüde değişmektedir (Demir ve Çelikel, 2020). Soğanlı bitkilerde bulunan uçucu yağlar genellikle bitkinin soğanlarında ve bazen diğer kısımlarında bulunan sekonder bileşiklerdir. Bu uçucu yağlar, bitkilerin kendilerine özgü kokularını oluşturan kompleks karışımlardır (Gutterman, 1997). Soğanlı bitkilerin uçucu yağları, bitkinin türüne ve cinsine bağlı olarak farklılık göstermektedir, bu durum ise bitkinin koku profilini belirlemektedir. Bu bağlamda çalışmada, Türkiye'de üretilen soğanlı kesme çiçek türlerinden ''Zambak, Glayöl, Lale, Nergis, Frezya, Sümbül, Anemon, Alstroemeria, Ornithogalum, Zantedeschia, İris ve Ranunculus'' türlerinde bulunan koku bileşenleri ve bu koku bileşenlerinin estetikle olan ilişkisini ortaya koymayı amaçlamaktadır.

2. ÇALIŞMA KAPSAMINDA İNCELENEN ÇİÇEK TÜRLERİ VE ANA KOKU BİLEŞENLERİ

Çiçekler, doğanın estetik zenginliğini ifade ederken aynı zamanda insanların çevreleriyle kurdukları duyusal bağda önemli bir rol oynamaktadır. Bu bağlamda, çiçeklerin görsel estetik değerlendirmesi genellikle renk, desen ve form üzerinden yapılırken, koku bileşenleri de çiçeklerin estetik algısını güçlendiren ve duyusal deneyimi zenginleştiren unsurlar olarak karşımıza çıkmaktadır (Kılıçaslan ve Dönmez, 2016). Çiçeklerin sahip olduğu bu koku bileşenleri, peyzaj tasarımında ve bitki seçiminde önemli bir rol oynamaktadır. Koku bileşenleri, çiçeklerin kullanıldığı alanın genel estetik algısını etkileyerek, görsel deneyimi tamamlayıcı bir unsur olarak öne çıkmaktadır (Altuntaş, 2020). Belirli koku bileşenleri,

çiçeklerin bulunduğu alanın duyusal çekiciliğini artırabilir ve izleyiciler üzerinde olumlu bir etki bırakabilmektedir. Bu anlamada soğanlı türlerin bu etkilerinden faydalanılarak peyzaj alanlarında yaygınlaştırılması gerekmektedir.

Çiçeklerin koku bileşenleri, çeşitli sınıflar altında toplanarak geniş bir yelpazede sunulmaktadır. Bu sınıflandırma, çiçeklerin karmaşık koku profillerini anlamak ve açıklamak amacıyla bir temel oluşturmaktadır (Kishimoto vd., 2019). Terpenoidler içerisinde yer alan linalool ve geraniol, ile sesquiterpenoidler, farnesen gibi, bu kategori içinde bulunmaktadır. Fenolik bileşenler, aromatik bitkilerin belirgin kokularını oluşturan unsurları içermektedir. Eugenol ve vanilin gibi örnekler, çiçeklerin karakteristik kokusunu şekillendiren önemli fenolik bileşenlere örnek olarak verilmektedir (Herman, 2005). Alifatik bileşenler, çiçeklerin doğal yağlarında bulunan basit hidrokarbonları içerir ve aldehitler ile ketonlar gibi bileşenler, çiçek kokularına çeşitlilik ve derinlik katmaktadır. Aromatik bileşenler, fenolik halkalar içeren ve çiçeklerin özgün kokularını belirleyen bileşenleri içermekte ve bu grup, çeşitli esterler ve alkol türlerini içererek çiçeklerin koku profilinin zenginliğine katkıda bulunmaktadır (Nieelsen ve Bloor, 1997). Nitrojen bileşenleri, az miktarda bulunmalarına rağmen, çiçeklerin belirgin kokularına katkı sağlar. Pirrol, indol ve aminler bu gruba örnek teşkil etmektedir (Oksiijenli bileşenler, alkol, ester ve ketonlar gibi oksijen içeren bileşenlerden oluşur ve çiçek kokularının karmaşıklığına ve çeşitliliğine önemli bir boyut ekler ve bu gruba ait olan linalool ve benzaldehit gibi bileşenler, çiçek kokularının genel karakterini belirlemektedir (Sharmeen vd., 2021). Bu çalışma, belirli çiçek türlerinin koku bileşenleri üzerine odaklanmaktadır. "Zambak, Glayöl, Lale, Nergis, Frezya, Sümbül, Anemon, Alstroemeria, Ornithogalum, Zantedeschia, İris ve Ranunculus" gibi çiçek türleri, sahip oldukları özgün koku profilleri ile incelenmiştir. Her bir tür, kendine has kimyasal bileşenleri içeren koku profilleri ile karakterize edilmektedir. Çiçek türleri ve bu türlere ait ana koku bileşenleri Çizelge 1'de sunulmuştur.

Çizelge 1. Çiçek türleri ve ana koku bileşenleri

Çiçek Türü	Koku Bileşenleri
Zambak (*Lilium candidum*)	Linalool, geraniol, benzaldehit, farnesen (Kong vd., 2012; Hohnson vd., 2016).
Glayöl (*Gladiolus grandiflorus*)	Beta-ionone, safranal (Jisha, 1999; Suzuki vd., 2008).
Lale (*Tulipa gesneriana*)	Eugenol, α-pinene, benzaldehit (Oyama-Okubo ve Tsuji, 2013).
Nergis (*Narcissus tazetta*)	Galantamin, narcissin, linalool (Baranauskienė ve Venskutonis, 2022)
Frezya (*Freesia spp*.)	Linalool, metil antranilat (Huang vd., 2018).
Sümbül (*Hyacinthus orientalis*)	p-Metil anizaldehit, benzaldehit, linalool (Anonis, 1985).
Anemon (*Anemone coronaria*)	Linalool, α-pinene, anemonin (Jürgens ve Dettörl, 2004; Kumar vd., 2021).
Alstroemeria (*Alstroemeria hybrida* L.)	Linalool, geraniol, izoeugenol (Aros vd., 2015).
Ak yıldız (*Ornithogalum umbellatum*)	α-pinene, β-pinene, sabinen (Kumar vd., 2021).
Gala çiçeği (*Zantedeschia rehmannii*)	Benzaldehit, metil antranilat, linalool (Wei vd., 2016).
İris (*Iris germanica* L.)	α-irone, β-irone, izoeugenol (Cai vd., 2023).
Ranunculus (*Ranunculus spp*.)	Linalool, benzaldehit, ranunculin (Jürgens ve Dettörl, 2004).

Bu tabloda verilen bileşenler, çiçek türlerinin uçucu yağlarında bulunan ana koku bileşenlerini temsil etmektedir (Path vd., 1998; Johnson vd., 2016). Her bir bileşen, çiçek türünün benzersiz kokusunu oluşturan ve peyzaj tasarımında duyusal deneyimi zenginleştiren önemli faktörleri olarak yansımaktadır. Ayrıca, bu koku bileşenleri parfümeri sanayisinde yaygın olarak kullanılmakta olup, çeşitli parfüm formülasyonlarında özgün ve çekici aromalar elde etmek için değerlendirilmektedir (Jürgens ve Dettörl, 2004). Çiçeklerin doğal ve çeşitli koku profilleri, parfümeri dünyasında çeşitli kullanım alanlarına ilham kaynağı olmaktadır. Bu bileşenler, parfüm endüstrisinde çeşitli notaların ve esansların oluşturulmasında önemli rol oynamaktadır, bu da kullanıcıya farklı ve özgün koku deneyimleri sunmaktadır.

3. KOKU VE ESTETİK İLİŞKİSİ

Koku ve estetik arasındaki karmaşık ilişki, duyusal deneyimi zenginleştiren ve estetik değeri etkileyen bir bağlam içerisindedir (Altman vd., 2022). Bu bağlam, özellikle çiçekler, bitkiler ve parfümler üzerinden incelendiğinde, bir dizi önemli noktayı içermektedir:

- Duygusal bellek ve koku ilişkisi: Koku, bireyin zihinsel ve duygusal belleğiyle güçlü bir şekilde ilişkilidir. (Goodness vd., 2016).
- Kültürel etkiler ve estetik tercihler: Koku algısı, bireysel tercihlerin yanı sıra kültürel etkiler tarafından da belirlenir. Bireyin belirli bir çiçeğin kokusunu çekici bulması, genel estetik anlayışını etkileyebilir. Aynı zamanda, kültürel bağlamın belirli kokuların güzellik ve çekicilikle ilişkilendirilmesinde önemli bir rol oynadığı gözlemlenmektedir (Santogostini vd., 2014).
- Bitki çeşitliliği ve estetik zenginlik: Farklı bitki türlerinin farklı koku profilleri, doğal ortamları zenginleştirir ve estetik bir çeşitlilik sunar. Bahçe tasarımında veya peyzaj düzenlemelerinde, farklı kokuların bir araya getirilmesi, mekanın estetik çekiciliğini artırabilir ve kullanıcıların duygusal deneyimini zenginleştirebilir (Pichersky ve Dudareva, 2007).
- Parfüm ve kozmetik sanatındaki rolü: Koku, parfüm ve kozmetik sanatında merkezi bir konuma sahiptir. Parfümler, çiçek, meyve ve diğer bitki özlerinin özenle kombinasyonuyla oluşturulan karmaşık koku profillerine sahiptir. Bu parfümler, estetik bir deneyim sunarak kullanıcıların kendilerini özel ve çekici hissetmelerine katkıda bulunur (Huss vd., 2018).

  Bitkilerin estetik değeri ve kokuları: Bitkilerin görsel güzellikleri yanı sıra kokuları da estetik değeri artırabilir. Çiçeklerin ve bitkilerin özgün kokuları, peyzaj tasarımında, bahçe düzenlemesinde ve iç mekan bitki kullanımında görsel estetiği tamamlayarak, deneyimi zenginleştirebilir (Goodness vd., 2016). Sonuç olarak, koku estetiği, duyusal deneyimlere derinlik katan, duygusal bağlar kuran ve genel estetik algıyı etkileyen önemli bir unsurdur. Çiçeklerin ve bitkilerin özgün kokuları, insanların çevreleriyle duygusal ve estetik açıdan bağ kurmalarına katkıda bulunmaktadır.

4. SONUÇ VE ÖNERİLER

Sonuç olarak, soğanlı süs bitkileri, kokusal özellikleri ile bahçe düzenlemesi ve peyzaj tasarımında önemli bir rol oynamaktadır. Bu bitkilerin uçucu yağları, bitkilerin kokusal çeşitliliğini ve estetik ilişkisini etkilemektedir. Bahçe tasarımında bu bitkilerin kokusal

özelliklerinin ve estetik katkılarının dikkate alınması, peyzaj düzenlemelerinin zenginliğini artırabilir ve bireylere farklı duyusal deneyimler sunabileceği düşünülmektedir. Çiçek türlerine ait koku bileşenlerinin çeşitliliği, peyzaj mimarları ve bahçe tasarımcıları için önemli bir araç olabilmektedir. Özellikle belirli koku profillerinin belirli duygu durumlarını tetikleyebileceği göz önüne alındığında, çiçeklerin koku bileşenleriyle oynayarak çevresel deneyimi daha da zenginleştirmek mümkündür. Bu bağlamda, çiçek türlerinin koku profilleri, bir bahçe veya peyzaj projesi için özel olarak seçilerek duyusal bir deneyim tasarlanabilir. Mesela, bir dinlenme alanında rahatlatıcı etkisi olan çiçek türleri kullanılabilirken, bir etkinlik mekânında enerji veren kokular tercih edilebilir. Bu nedenle peyzaj tasarımcılarının bitki seçiminde sadece görsel değil, aynı zamanda kokusal çeşitliliği de değerlendirmeleri gerekmektedir. Bu durum insanların, çevresel deneyimini zenginleştirirken, çiçeklerin sadece güzellikleriyle değil, aynı zamanda özgün kokularıyla da etkileşime girmelerine olanak tanıyacaktır. Ayrıca, bu koku bileşenlerinin bitki sağlığı ve ekosistem üzerindeki etkilerini değerlendiren araştırmalara olan ihtiyaç da göz ardı edilmemelidir.

5. TEŞEKKÜR

Çalışmada ismi geçen doktora öğrencisi İlknur ESKİMEZ 100/2000 Sürdülebilir Tarım (Yenilikçi-İyi Tarım Uygulamaları) tematik alanında doktora yapmaktadır. Öğrencimize maddi desteğini esirgemeyen Yükseköğretim Kuruluna teşekkür ederiz.

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STANLEY ERİK ÇEŞİDİ'NİN (*Prunus domestica* L.) ISPARTA EKOLOJİK KOŞULLARINA ADAPTASYONU

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ÖZET
Tarımsal faaliyetlerinin verimliliğini etkileyen en önemli unsur, ekolojik koşulların uygunluğu olup, farklı türlere ve tür içi çeşitlere ait adaptasyon denemeleri oldukça kıymetlidir. Yörenin değişmesine parallel olarak, iklimsel özelliklerde de değişimler gözlemlenmektedir. Ekolojik faktörlerin kümülatif etkisi altında gen düzeyinde şekillendirilen fizyolojik regülasyon, bitkilerin fenolojisinde, morfolojisinde, pomolojisinde ve biyokimyasal özelliklerinde önemli değişimlere sebep olmaktadır. Meyve türleri ve türlerin çeşitleri üzerine yürütülen adaptasyon çalışmaları, çeşitli ekolojik koşullara uygun tür/çeşit varyasyonlarının belirlenmesine yardımcı olur. Bu durum, üretimin sürdürülebilir ve ekonomik olması bakımından önemli olup, tarım sektörünün geleceğine, ülke ekonomisine ve gıda güvenliği gibi kritik öneme sahip parametrelere önemli katkılar sağlar. Tüm bu sebeplere istinaden yürütülen bu çalışmada, erik türünün Stanley çeşidi, Isparta'nın Atabey ilçesinde yetiştirilerek, bazı önemli özellikler yönüyle karakterize edilmiştir. Bitki başına verimin 22.75 kg/ağaç$^{-1}$ olduğu bu çeşitte, meyve pomolojik özelliklerinden; meyve eni, meyve boyu ve meyve ağırlığı, sırasıyla 37.20 mm, 49.24 mm ve 37.44 g^{-1} olarak belirlenmiştir. CIE parametrelerine göre belirlenen meyve kabuk rengi sonuçlarına göre, L*, a* ve b* değerleri sırasıyla 22.32, 6.31 ve 3.67 olarak ölçülmüştür. Benzer sonuçlar meyve et rengi bakımından ise 48.47, -2.43 ve 42.23 şeklinde bulunmuştur. Ayrıca meyve eti sertliği, 1.81 kg cm^{2-} olarak ölçülürken, ortalama çekirdek ağırlığı ise 1.99 g olarak tartılmıştır. Sonuç olarak, erik türüne ait Stanley çeşidi tarımının, çalışılan yörede ekonomik ve sürdürülebilir şekilde yürütülebileceği kanaatine varılmıştır. Çalışma sonuçlarının, benzer çalışmalara altlık olabileceği ve üretimi/ıslahı noktasında çekimser tavır sergileyen çiftçi/ıslahçı bireyleri teşvik edebileceği düşünülmektedir.
Anahtar Kelimeler: *Prunus domestica*, Stanley, Adaptasyon, Kalite, Verim

ADAPTATION OF STANLEY PLUM VARIETY TO THE ECOLOGICAL CONDITIONS OF ISPARTA

ABSTRACT
The appropriateness of ecological circumstances is the primary element influencing how efficiently agricultural operations are carried out. Consequently, it is highly advantageous to conduct adaptation experiments across various species and intraspecific varieties. Variations in climate traits are also noted in tandem with changes in the area. Significant alterations in the phenology, morphology, pomology, and biochemical characteristics of plants are brought about by physiological control that is created at the gene level under the combined influence of ecological variables. Finding species/variety variants appropriate for different ecological circumstances is aided by studies on fruit species and adaptations. The future of the agricultural industry, the national economy, and crucial factors like food safety are all greatly impacted by this, particularly in terms of sustainable and cost-effective production. In this study carried out based on all these reasons, the Stanley variety of plum was grown in the Atabey district of Isparta and characterized with some important features. Fruit pomological parameters of this cultivar, whose yield per plant is 22.75 kg/tree-1, include fruit width, fruit length, and fruit weight, which were measured to be 37.20 mm, 49.24 mm, and 37.44 g^{-1}, respectively. The CIE parameters were used to calculate the fruit skin color findings, and the L*, a*, and b* values were found to be 22.32, 6.31, and 3.67, respectively. Comparable findings for the color of the fruit flesh were 48.47, -2.43, and 42.23. Furthermore, the average seed weight was determined to be 1.99 g, and the hardness of the fruit flesh was tested to be 1.81 kg cm^2. As a result, it was concluded that the cultivation of the Stanley variety of plum can be carried out economically and sustainably in the studied region. It is thought that the results of the study can serve as a basis for similar studies and encourage farmer/breeder individuals who have an abstaining attitude towards production/breeding.
Keywords: *Prunus domestica*, Stanley, Adaptation, Quality, Yield.

1. GİRİŞ

Erik, Rosaceae familyasının, Prunus cinsine giren önemli sert çekirdekli meyve türlerinden biridir (Özvardar ve Önal, 1990). Erik, çeşitli iklim bölgelerine uyum sağlama yeteneği ve zengin tür çeşitliliği sayesinde dünya genelinde geniş bir alana yayılmıştır. Bu yayılma olanağı hem tür sayısının fazlalığı hem de bu türlerin farklı iklimlere adapte olabilen olmalarından kaynaklanmaktadır (Usenik vd., 2008). Genel olarak, eriğin anavatanının Anadolu, Hazar Denizi çevresi ve Kafkasya olduğu kabul edilmektedir (Özbek, 1978). Erik türleri gen merkezlerine göre üç ana grupta sınıflandırılmaktadır. Bu sınıflandırmaya göre dünya genelinde yetiştirilen üç önemli erik türü vardır. Bunlar arasında yer alan can erikleri (Myrobolan) (*Prunus cerasifera* Ehrh.), özellikle Avrupa'da geniş bir şekilde yetiştirilmektedir. Japon grubu (*Prunus salicina* Lindl.), Japonya kökenli olan ve genellikle büyük, etli meyveleri ile bilinen bir erik türüdür. Diğer bir grup ise Avrupa grubu (*Prunus domestica* L.) olup, genellikle Avrupa kökenli erikleri ile bilinmekte ve Avrupa eriği çeşitli türlerde ve renklerde meyve yapılarına sahiptir (Özçağıran vd., 2011). Bu genetik çeşitlilik, eriklerin farklı coğrafyalarda ve ekolojik koşullarda başarıyla adapte olabilmelerine imkân tanımaktadır. Son yıllarda özellikle Japon ve Can grubu eriklerin üretiminde önemli artışlar gözlemlenmiştir. Ülkemiz, 2019 yılında 317.946 ton, 2020 yılında ise 329.056 ton erik üretimi gerçekleştirmiş, bu sayede Dünya erik üretiminde 7. sırada yer almıştır (FAO, 2021). Ülkemiz, 2020 yılında 22.546 (2020 yılında ihraç edilen taze erik - bin USD - trademap) düzeyinde taze erik ihracatı gerçekleştirmiştir (FAO, 2021). 100 gram taze erik meyvesinde bulunan besin öğeleri arasında karbonhidrat, potasyum, fosfor, sodyum, demir ve kalsiyum bulunmaktadır. Ayrıca A, Thiamin B1, Riboflavin B2, Niacin B, C ve E vitaminlerinin de içermektedir. Erikler, sadece lezzetli olmalarının ötesinde, sağlık açısından faydalı özelliklere de sahiptir. Yüksek antioksidan içeriği sayesinde vücudu serbest radikallerin neden olduğu hücresel hasara karşı korumaktadır (Şengün ve Yücel, 2015). Tarımsal faaliyetlerinin verimliliğini etkileyen en önemli unsur, ekolojik koşulların uygunluğu olup, farklı türlere ve tür içi çeşitlere ait adaptasyon denemeleri oldukça kıymetlidir. Yörenin değişmesine paralel olarak, iklimsel özelliklerde de değişimler gözlemlenmektedir. Ekolojik faktörlerin kümülatif etkisi altında gen düzeyinde şekillendirilen fizyolojik regülasyon, bitkilerin fenolojisinde, morfolojisinde, pomolojisinde ve biyokimyasal özelliklerinde önemli değişimlere sebep olmaktadır (Bayraç ve Doğan, 2016). Bu çalışmanın amacı, Isparta ili Atabey ilçesinde Stanley erik çeşidinin bazı meyve kalite parametreleri açısından değerlendirmektir.

2. MATERYAL ve YÖNTEM

Bu çalışma, Isparta ili Atabey ilçesinde bulunan Elma Tarıma ait meyve plantasyonunun bulunduğu deneme arazisinde yürütülmüştür. Çalışmada kullanılan 3 yaşındaki, Stanley erik çeşidi, 5×5 dikim mesafesinde doku kültürü yöntemi kullanılarak çoğaltılmış ve Myrobolan anacı üzerine aşılı olarak dikilmiştir. Ağaçlarda şekil budaması olarak goble tipi budama sistemi uygulanmıştır. Araştırma alanının gübreleme, hastalık ve zararlılarla mücadelesi gibi teknik ve kültürel işlemler standart olarak düzenli bir şekilde yapılmaktadır. Meyveler 21 Ağustos 2021 tarihinde hasat edilmiştir. Hasat edilen meyveler, pomolojik ölçümler için bekletilmeden Isparta Uygulamalı Bilimler Üniversitesi, Bahçe Bitkileri bölümüne ait Pomoloji laboratuvara getirilmiştir. Meyve ağırlığı ve çekirdek ağırlığı, Vibra AJH-42OCE adlı 0.001 gram hassasiyetine sahip elektronik terazi ile, meyve eni ve boyu ise 0.01 mm hassasiyetine sahip dijital kumpas kullanılarak ölçülmüştür. Meyve eti sertliği, FT-327 adlı dijital el penetrometresi ile, meyve kabuk ve meyve eti renk değerleri ise Minolta CR-400 renk ölçer kullanılarak belirlenmiştir (Zar, 2013). Araştırma, tesadüf parselleri deneme desenine göre 4 tekerrürlü ve her tekerrürde 15 meyve olacak şekilde tasarlanmıştır. İncelenen özellikler için Minitab-23 paket programından yararlanılmış ve ortaya çıkan farklılıkların değerlendirilmesinde TUKEY çoklu karşılaştırma testi kullanılmıştır (Kandemir, 2019).

3. BULGULAR VE TARTIŞMA

Erik, sofralık ve kurutmalık olarak çeşitli biçimlerde tüketilebilen önemli meyve türleri arasında yer almaktadır (Beyhan, 2005). Bu meyve, tüketici beğenisi ve algısına bağlı olarak farklı üretim yöntemlerine tabi tutularak çeşitlilik göstermektedir. Tüketici tercihleri doğrultusunda yapılan üretim, eriklerin farklı kullanım alanlarına hitap etmesine ve çeşitli pazar segmentlerinde talep bulmasına olanak tanımaktadır (Eskimez vd., 2020). Çalışma kapsamında incelenen parametrelere ait bilgiler Çizgelge 1'de sunulmuştur. Bu bağlamda meyve eni ortalama (37,20 mm), meyve boyu (49,74 mm), tohum ağırlığı (1,99 g^{-1}), sertlik (1,81 kg^{-1}), ortalama ağaç başına verim ise (22,75 kg^{-1}) olarak tespit edilmiştir.

Ertekin ve diğerleri (2006) tarafından Antalya (Korkuteli) bölgesinde gerçekleştirilen çalışmada ise Stanley ve Frenze 90 olmak üzere iki farklı erik çeşidinde elde edilen sonuçlar incelenmiştir.

Stanley çeşidi için meyve eni 29,16-38,55 mm, meyve boyu 39,39-60,76 mm, meyve ağırlığı 18,53-37,89 g, tohum ağırlığı 0,99-2,46 g ve meyve eti sertliği 0,32-0,96 kg aralığında bulunmuştur. Blugaristan koşullarında yapılan farklı bir çalışmada aynı çeşitte ortalama meyve ağırlığı 35,7 g, tohum ağırlığı 1,68 g, toplam verim miktarı ise 2122 kg/ha olarak bildirilmiştir (Vitanova vd., 2008). Ordu koşullarında bu çeşitte yapılan çalışmada ise meyve eni (45,31 mm), meyve boyu (56, 25 mm) ve meyve ağırlığı (74,88 g) olarak bildirilmiştir (Ateş vd., 2022). Çorlu koşullarında Stanley çeşidinin meyve ağırlığı 41.63 g olarak tespit rapor edilmiştir (Alkış, 2010). Malatya'daki çalışmada Stanley çeşidi için meyve ağırlıkları 24.45 g ile 70.29 g arasında değişen değerler elde edilmiştir (Çöçen vd., 2019). Georgia koşullarında yapılan bir başka çalışmada, Stanley çeşidi için meyve ağırlığı 50.4 g olarak bildirilmiştir (Maglakelidze vd., 2017). Literatürdeki çalışmalarla sonuçlarımız kıyaslandığında bazı parametrelerin literatürle benzer sonuçlar gösterdiği tespit edilmişken bazıları daha farklı bulunmuştur. Bu farklı sonuçların olası nedenleri üzerine düşünüldüğünde, iklim koşulları, toprak özellikleri, yetiştirme teknikleri, sulama yöntemleri ve benzeri faktörlerin önemli etkilerinin olabileceği düşünülmektedir. Her bölgenin kendine özgü ekosistemine ve iklimine bağlı olarak, bitkilerin büyüme ve gelişme özellikleri farklılık gösterebilmektedir. Bu nedenle, çeşitli coğrafi bölgelerde yapılan çalışmalardan elde edilen sonuçların karşılaştırılmasında iklim vb. faktörlerin dikkate alınması gerekmektedir.

Çizelge 1.Meyvelerin bazı pomolojik özellikler bakımından incelenmesi

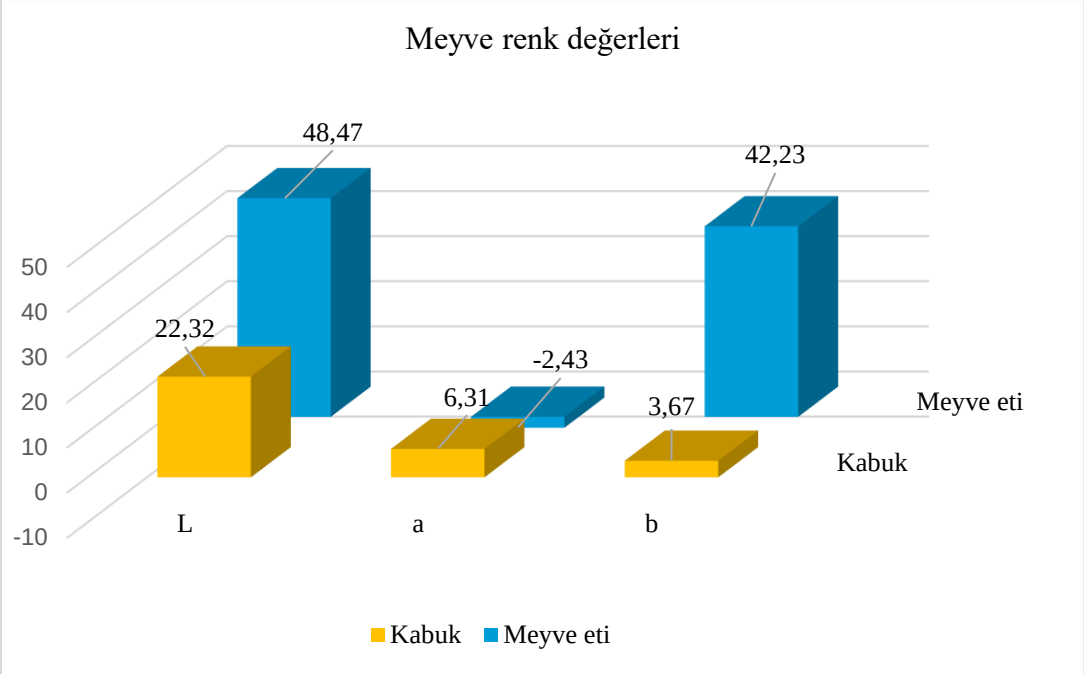
Meyve eni (mm)	Meyve boyu (mm)	Meyve ağırlığı (g^{-1})	Tohum ağırlığı ($g^{-1)}$	Sertlik (kg^{-1})	Verim (kg/ağaç $^{-1}$)
37,20	49,74	37,44	1,99	1,81	22,75

Meyve renginin değişimi, genellikle klorofilin parçalanması, karotenoidlerin sentezi ve antosiyaninlerin birikmesi gibi biyokimyasal olaylarla ilişkilidir. Olgunlaşma sürecinde, klorofil miktarındaki azalma, yeşil rengin kaybolmasına ve meyvenin diğer pigmentlerinin ortaya çıkmasına neden olmaktadır. Meyve rengi, hasat zamanını belirlemede önemli bir kriterdir. Olgunlaşma sürecinde meyve rengindeki değişiklik, meyvenin tüketime hazır hale geldiğini göstermekte, bu durum, tüketicilere ve üreticilere doğru hasat zamanını belirlemede yardımcı olmaktadır. Bu bağlamda çalışmada, meyve kabuk ve meyve eti ile ilgili bir grafik

sunulmuştur (Grafik 1). Buna göre meyve kabuk L*, a*, b* değerleri sırasıyla (22,32-6,31-3,67) olarak bulunurken, meyve eti renk değerleri (48,47-(-2,43)-42,23) olarak tespit edilmiştir. Ordu koşullarnda aynı çeşit için meyve kabuk renk değerleri L* değeri 32.46, a* değeri 8.67, ve b* değeri 9.08 olarak tespit edilmiştir. Daha önce, Antalya ilinde Stanley çeşidi için L* değeri 29.650-40.830, a* değeri 0.600-4.890, b* değeri -10.250 ile -2.670 arasında rapor edilmiştir (Ertekin ve ark., 2006).

Bu çalışmada belirlenen meyve kabuğu ve meyve eti renk değerleri, Ordu ve Antalya'da yapılan önceki çalışmaların literatür bilgisi ile karşılaştırıldığında bazı benzerlikler ve farklılıklar ortaya çıkmaktadır. Bu farklılıkların nedenleri, coğrafi koşullar, iklim, toprak özellikleri, yetiştirme teknikleri gibi birçok faktöre bağlı olabileceğini düşündürmektedir (Bayraç ve Doğan, 2016). Meyve renklerini etkileyen bu faktörlerin anlaşılması, meyve kalitesinin ve verimliliğin artırılmasına yönelik daha etkili tarım uygulamalarının geliştirilmesine katkı sağlayabilir. Aynı zamanda renk değerlerini karşılaştırırken, gece ve gündüz sıcaklık farklarının meyve renk oluşumunda potansiyel bir öneme sahip olduğunu unutmamak gerekir. Bu durum, meyve gelişim sürecinde ortaya çıkan biyokimyasal ve fizyolojik değişikliklerin sıcaklık faktörleri tarafından etkilenebileceğini göstermektedir. Gece ve gündüz sıcaklıkları arasındaki farklar, özellikle renk pigmentlerinin sentezi ve birikimi üzerinde etkili olabilmektedir (Rencüzoğulları vd., 2016). Sonuç olarak, bu çalışmanın elde ettiği renk değerleri ile literatürdeki diğer çalışmaların bulguları arasındaki benzerlikler ve farklılıklar, meyve renklerinin geniş bir faktör yelpazesinden etkilendiğini göstermektedir. Bu tür çalışmalar, tarım alanında sürdürülebilir ve verimli üretim yöntemlerinin belirlenmesine katkı sağlayabilir.

Grafik 1. Meyvelerin renk değerleri bakımından incelenmesi



4. SONUÇ ve ÖNERİLER

Tüketici talepleri doğrultusunda yeni çeşit ve genotiplerin geliştirilmesi için adaptasyon çalışmaları, tarım sektöründe kritik bir öneme sahiptir. Bu çalışmalar, sürdürülebilir tarım ve ıslah faaliyetlerinin çevresel, ekonomik ve sosyal sürdürülebilirlik ilkelerine uygun olarak yürütülmesini amaçlamaktadır. Bu çalışmaların asıl amaçları arasında verimliliği artırmak, doğal kaynakları korumak, çevresel etkileri azaltmak ve çiftçilerin yaşam kalitesini iyileştirmek bulunmaktadır. Bu bağlamda, araştırmaların, gelecekteki tarımsal üretimi güvence altına almak ve gıda güvenliğini sağlamak açısından büyük bir stratejik önemi bulunmaktadır. Her bölgenin özel ekolojik koşullarına uygun çeşit ve genotiplerin belirlenmesine yönelik çalışmalar, tarımın sürdürülebilirliği için hayati öneme sahiptir. Tüketici taleplerine cevap verebilecek, dayanıklı, verimli ve kaliteli ürünler elde etmek, tarım sektörünün rekabet gücünü arttırmaktadır. Söz konusu çalışmalar, sadece bölgesel tarımın gelişimine katkıda bulunmakla kalmaz, aynı zamanda genel anlamda tarımın sürdürülebilirliğine de önemli katkılar sağlamaktadır. Bu nedenle, meyve yetiştiriciliğindeki adaptasyon çalışmalarının, değişen tüketici talepleri ve ekolojik faktörlere uyum yeteneği göz önüne alındığında stratejik bir öneme sahip olduğunu vurgulamak mümkündür. Bu bağlamda, her bir bölgenin özelliklerine uygun çeşitlerin ve genotiplerin belirlenmesi amacıyla yapılan adaptasyon çalışmalarının devam etmesi gerekmektedir.

5. TEŞEKKÜR

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İRİ SEGMENT (BEEF) DOMATESLERDE OLD-GOLD CRİMSON (*ogc*), *hp-1* ve *hp-2* GENLERİNİN MEYVE KALİTE PARAMETRELERİ ÜZERİNE ETKİLERİ

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ÖZET
Bu araştırmada beef (iri) domateslerde (*Solanum lycopersicum*) old-gold crimson (*ogc*), *hp-1* ve *hp-2* genlerinin meye kalitesi üzerine etkileri araştırılmıştır. Araştırma sonuçlarına göre genotiplerin C vitamini içeriğinin 10.83-21.06 mg/100 g, likopen miktarının 5.21-18.5 mg/100 g, B-karoten miktarının 1.05-7.69 mg/100g, toplam fenolik madde içeriğinin 0.62-1.3 mg/g, antioksidan kapasitesinin ise %33.77-97.30 arasında, pH değerinin 4.43-4.89, EC seviyesinin 4.97-7.00 mS/cm, titre edilebilirlik asit seviyesinin %0.39-0.94 arasında değişim gösterdiği belirlenmiştir. Meyvelerdeki L* değerlerinin 36.26-44.74, a* değerleri 27.94-41.77, b* değerleri 21.14-41.78, Chroma değerinin 35.08-57.34, Hue açısının 37.17-54.50 arasında değişim gösterdiği görülmüştür. Bu çalışma sonuçlarına göre yukarıda belirtilen genlerin domatesin meyve kalitesi üzerine farklı etkilerinin olabileceği belirlenmiştir.
Anahtar Kelimeler: *Solanum lycopersicum*, Likopen, old-gold crimson *(ogc), hp-1* ve *hp-2*

EFFECTS of OLD-GOLD CRIMSON (*ogc), hp-1* and *hp-2* GENES on FRUIT QUALITY PARAMETERS in LARGE SEGMENT (BEEF) TOMATOES

ABSTRACT
In this study, the effects of the ogc, hp-1, and hp-2 genes on the fruit quality of beefsteak *(Solanum lycopersicum)* tomatoes were investigated. The study examined the individual effects of these genes as well as their effects when present together in the same genotype. According to the research results, the C vitamin content of genotypes ranged from 10.83 to 21.06 mg/100 g, lycopene content ranged from 5.21 to 18.5 mg/100 g, B-carotene content ranged from 1.05 to 7.69 mg/100g, total phenolic content ranged from 0.62 to 1.3 mg/g, and antioxidant capacity ranged from 33.77% to 97.30%. The pH value was determined to be between 4.43 and 4.89, EC level between 4.97 and 7.00 mS/cm, and titratable acidity level varied from 0.39% to 0.94%. The L* values of the fruits ranged from 36.26 to 44.74, a* values from 27.94 to 41.77, b* values from 21.14 to 41.78, chroma value from 35.08 to 57.34, and hue angle from 37.17 to 54.50. According to the results of this study, it is evident that the mentioned genes have different effects on the fruit quality of tomatoes.
Keywords: *Solanum lycopersicum*, Likopen, old-gold crimson *(ogc), hp-1* ve *hp-2*

1.GİRİŞ

Domates, sofralık ve çeşitli kullanım alanları (salça, sos, ketçap, püre) ile ülkemizde ve dünyada tüketilen sebzelerin başında gelmektedir. Açık ve örtüaltı yetiştiriciliği ile dünyada, 57.2 milyon hektar alanda 1.1 milyar/ton yaş sebze üretimi içinde, yaklaşık 182 milyon/tonluk üretimle ilk sırada yer almaktadır (FAO, 2021). Ülkemizde 2022 yılı itibari ile 80 bin ha alanı örtüaltı olmak üzere toplamda 718 bin ha alanda sebze yetiştirilmektedir. Bu türler içerisinde domates 13 milyon ton ile dünya domates üretiminde 3. sırada yer almaktadır (TUİK 2022).

Domates özellikle likopen, beta karoten ve flavanoidler bakımından oldukça zengindir. Son yıllarda yapılan araştırmalarda likopenin ve karotenoidlerin anti-oksidatif faaliyetleri ve anti-kanser fonksiyonlarından dolayı insan sağlığı üzerinde olumlu etkilerinin olduğu belirlenmiştir (Omoni & Aluke, 2005; Rao & Rao, 2007; Raiola vd., 2014; Seçgin vd., 2018).
Likopen; havuç, karpuz, kuşburnu, kestane kabağı, pembe greyfurt, papaya ve pembe guava gibi diğer sebze ve meyvelerde, hatta bazılarında domatesten daha fazla bulunmasına rağmen yıl içinde tüketim miktarı göz önüne alındığında "likopenin kaynağı" domates olarak kabul edilmektedir. Likopen, olgun kımızı domates meyvesinde oldukça yüksek miktarda bulunmaktadır (Sönmez & Ellialtıoğlu, 2014; Figueiredo-González vd., 2016 ; Figueiredo-González vd., 2017). Bu bulunan likopen ve diğer antioksidatif özelliğe sahip bileşenlerin türlere hatta çeşitlere göre, meyvenin olgunluğuna, yetiştirme koşullarına ve hasat öncesi ve sonrası işleme göre önemli ölçüde değişiklik gösterdiği bildirilmiştir (Stahl vd., 2002). Yapılan araştırmalara göre domatesin tadı ve aroması üzerinde etkili olan 400'ün üzerinde etken olup, bunların 30 tanesinin aroma oluşumunda çok daha etkin olduğu belirlenmiştir. Uçucu ve değişken aroma maddelerinin ve organik asitlerin yanında şekerler, serbest aminoasitler ve mineral tuzların da domatesin tadının oluşumunda rol oynamaktadır.

Domates meyvelerindeki koyu renk tonun yoğunluğu ile likopen miktarının varlığı doğru orantılıdır. Meyve ne kadar koyu renkli olursa, likopen içeriği de o kadar yüksek olur. Nitekim, morumsu kahverengi domateslerin 185 mg kg-1 likopen içeriğine sahip olduğu ve bu değerin kırmızı renkli domateslerden daha yüksek olduğu tespit edilmiştir (Park vd., 2018). Ayrıca likopenin yanı sıra diğer karotenler (örneğin β-karoten), C ve E vitamini ve diğer fenolik

bileşikler de domatesin içersinde bulundurduğu diğer antioksidantlardır (Lopez vd., 2000; Aksoy vd., 2017).

Tüm bu içerikler göz önünde bulundurulduğunda domatesin insan beslenmesinde önemli bir tür olduğu söylenebilir. Ancak bu içerikler tüm domates türü ve çeşitlerde eşit oranda olmayıp, farklılık göstermektedir. Bu içerikler daha önce yapılan araştırmalarda farklı genler ile yönetildiği bazı genleri içeren domateslerin daha yüksek antioksidant kapasitesine sahip olabileceği belirlenmiştir. Örenğin; *hp1-2* geni içeren domateslerin koyu yeşil renk içerdiği meyve gelişimi sırasında hem likopen hem de β-karoten birikiminin artmasına neden olduğu (Yen vd., 1997; Powel vd., 2012). *hp1* ve *hp2*'nin ayrı lokuslar olduğuna, *hp1*'in kromozom 2'de ve *hp2*'nin kromozom 1'de yer aldığı belirlenmiştir (Yen vd., 1997; Myers & Chetelat, 2001). Bu genlerin yavaş tohum çimlenmesi, erken yaprak dökülmesi gibi istenmeyen pleiotropik etkileri neden olduğuda bilinmektedir (Stommel, 2006). Bu genlerin yanında Old crimmson (*ogc*) geni, kırmızı meyveli domatesleri geliştirmek için ıslah programlarında daha yaygın olarak kullanılmaktadır. Önceki çalışmalara göre, *ogc* geninden elde edilen olgun meyve, sıradan domateslerden nispeten daha yüksek seviyelerde (yaklaşık 3 kat) karotenoid içerdiği belirlenmiştir (Ronen vd., 2000).

Tüm özelliklerin yanında domateste aranan diğer bir özellik ise tat ve aromdadır. Ancak son yıllarda yapılan ıslah çalışmaları genel olarak verim üzerine yoğunlaşmış olup, içerdiği besin elmentleri, antioksidant nitelikleri hep ıslah çalışmalarında gözardı edilmiştir. Ancak günümüzde tüketici bilincinin artması, meyve ve sebze tüketiminde fonksiyonel olması, tat aroma gibi niteliklerin istenmesiyle ıslah stratejelerinde önemli değişimler yaşanmaktadır.

Domates meyve iriliklerine göre; tekli, salkım, kiraz, koktely ve iri tipler olarak sınıflandırılmaktadır. Bu grup içersinde özellikle örtüaltı yetiştiriciiğinde kullanımı hızla yaygınlaşan iri (beef) segment domateslerin ıslahı da hız kazanmıştır. Ancak diğer tiplere göre iri tip domateslerde tat ve aroma daha düşük olabilmektedir. Buda artan bu trendi olumsuz etkileyebilmektedir. Bu nedenle iri olan domateslerde tat, aroma değerleri iyi olan ve besleyici içeriği yüksek olan çeşitlerlerin daha fazla talep edileceği düşünülmektedir.

Bu nedenle araştırmada tat, aroması ve besleyeci niteliği daha yüksek olabilecek yeni hibrit iri segment (beef) domates adaylarına ebeveyn olabilecek hatlar belirlenmeye çalışılmıştır. Bu

kapsamda *ogc*, *hp1*, *hp2* genleri içeren hatlar ile bu genleri içermeyen domates (beef) hatları karşılaştırılmıştır.

2.MATERYAL VE METOT

2.1.DENEME YERİ VE MATERYAL

Çalışmada materyal olarak beef (iri segment) 10 adet domates (*Solanum lycopersicum*) genotipi kullanılmıştır. Araştırma materyali Enza Zaden Türkiye (EZTR) gen havuzu içerisinden old-gold crimson (*ogc*), *hp-1* ve *hp-2* genlerinin varlığına yönelik olarak spesifik markerlere göre 1000 adet genotip içerisinden seçilmiştir. Çalışma Antalya ilinin Serik ilçesine bağlı Yukarıkocayatak köyünde Enza Zaden Tarım Ar-Ge şirketine ait plastik seralarda yürütülmüştür.

Genotiplerin tohumları 2:1 torf: perlit ortamı hazırlanarak 150'lik viyoller içerisine ekilmiştir. Fideler 3-4 gerçek yapraklı hale gelince, iki sıra arası 100 cm, çift sıra arası 50 cm ve sıra üzeri 40 cm olacak şekilde tahtalara dikilmiştir. Denme tesadüf blokları deneme desenine göre 4 tekerrürlü olarak ve her tekerrürde her genotipten 10 adet bitki olacak şekilde dikilmiştir. Deneme süresince kültürel işlemler bir yandan devam ederken (ipe alma, dolama, budama gibi), bitki ve meyvede yapılacak ölçüm ve gözlemler de bu aşamada gerçekleştirilirmiştir. Denemede gübreleme ve sulama fertigasyon sistemine göre damlama sulama yapılarak gerçekleştirilmiştir. Deneme sürecinde en yüksek aylık ortalama sıcaklık değeri Mayıs (21.7°C) ayında, en yüksek ortalama nispi nem miktarı ise Nisan (%75.52) ayı olarak kaydedilmiştir. Araştırmada meyve kalite analizleri Isparta Uygulamalı Bilimler Üniversitesi, Ziraat Fakültesi, Bahçe Bitkileri Bölümü Laboratuvarlarında gerçekleştirilmiştir.

2.2. ARAŞTIRMADA İNCELENEN ÖZELLİKLER

2.2.1. MEYVE SUYU PH MİKTARI

Meyvelerin pulp haline getirilmesi ve süzülmesi sonrasında elde edilen meyve suyunda pH, Milwaukee marka MW150 model cam elektrotlu dijital pH metre kullanılarak ölçülmüştür.

2.2.2. MEYVE SUYU EC MİKTARI

Meyvelerin pulp haline getirilmesi ve süzülmesi sonrasında elde edilen meyve suyunda elektriksel iletkenlik EC metre ile ölçülmüş ve sonuçlar mS/cm olarak verilmiştir.

2.2.3.TİTRE EDİLEBİLEN ASİT MİKTARI (TA)

Katı meyve sıkacağı yardımıyla çıkartılan meyve suyundan (tekerrürde 3 adet meyve) 10 mL alınmış ve 0.1 N'lik sodyum hidroksit (NaOH) çözeltisi ile pH değeri 8.1 oluncaya kadar Milwaukee marka MW150 model pH metre kullanılarak titre edilmesi ile belirlenmiştir. Sonuçlar harcanan baz (NaOH) üzerinden sitrik asit cinsinden aşağıdaki formüle göre hesaplanmış ve % olarak verilmiştir (Cemeroğlu, 1992).

2.2.4. ASKORBİK ASİT (C VİTAMİNİ) TAYİNİ

100 g örnek ağırlığına eşit miktarda %2'lik oksalik asit çözeltisi eklenerek homojen bir karışım elde edilmiştir. Bu karışımdan 30 g alarak %2'lik oksalik asit çözeltisi ile 100 ml'ye tamamlanmıştır. Örnekler iyice çalkalandıktan sonra filtre edilmiştir. Filtre edilen örneklerden 10 ml alınarak 2,6 diklorofenolindofenol çözeltisi ile pembe renk oluşumuna kadar titrasyon işlemi gerçekleştirilmiştir (Cemeroğlu, 1992).

2.2.5. LİKOPEN VE ß-KAROTEN TAYİNİ

Ekstraksiyon hazırlığı için tam olum aşamasındaki domates meyvlerinden 1g alınarak, 16 ml aseton: hekzan karışımı (4:6) ile homojenizatörde 2 dk boyunca homojenize edilmiştir. Hazırlanan ekstraksiyonun üst kısmındaki hekzan fazı mikropipet yardımı ile alınarak spektrofotometrede 663, 645, 505 ve 453 nm dalga boylarında okumalar yapılmıştır. Okumalar tamamlandıktan sonra likopen ve ß-karoten miktarları Nagata ve Yamashita (1992)'e göre hesaplanmış ve sonuçlar mg/100 g olarak ifade edilmiştir.

2.2.6. TOPLAM FENOLİK MADDE TAYİNİ

Toplam fenolik madde tayininde Folin Ciocaltaeu kolorimetrik yöntemi modifiye edilerek spektrofotometrik yöntem ile belirlenmiştir (Swain ve Hillis, 1959).

2.2.7. TOPLAM ANTİOKSİDAN MADDE MİKTARI

Toplam antioksidan madde miktarını belirlemek amacı toplam fenolik madde tayini için hazırlanan stok halindeki ekstratlar kullanılmıştır. Toplam antioksidan madde miktarı (serbest radikalleri indirgeme kapasitesi) DPPH (1,1-diphenly-2-picrylhdrazy) metodu modifiye edilerek spektrofotometrik yöntem ile belirlenmiştir.

2.3.VERİLERİN DEĞERLENDİRİLMESİ

Çalışma, tesadüf blokları deneme desenine göre 4 tekerrürlü olacak şekilde kurulmuştur. Denemeden elde edilen veriler SPSS 23 paket programı kullanılarak varyans analizine tabi tutulmuş, önemli çıkan ortalamalar arasındaki farklılıklar %5 önem seviyesinde Duncan çoklu karşılaştırma testi kullanılarak belirlenmiş ve ortalamalar arası farklılıklar farklı harflerle gösterilmiştir.

3. BULGULAR VE TARTIŞMA

3.1. LİKOPEN VE B-KAROTEN MİKTARI

Likopen ve B-karoten olgun domates meyvelerinde önemli miktarda biriken bir karotenoid olup doğrudan meyve rengini etkileyen renk pigmentlerindendir. Yapılan araştırmalarda domates kabuğunda likopen miktarı tür ve çeşitlere bağlı olmakla birlikte 2.5-15 mg/100 g arasında (McCollum, 1995; Sharma ve Le Maguer, 1996; Nguyen ve Schwartz, 1999; Shi ve Maguer, 2000; Takeoka vd., 2001; Dewanto vd., 2002; Seybold vd., 2004), β-karotenin ise genellikle 1.09-2.53 mg/100 g (Dar ve Sharma., 2011) arasında değişim gösterdiği belirlenmiştir.

Araştırmamızda likopen ve β-karoten oluşumunda genotiplerin birbirlerinden farklı değeler içerdiği ve bu durumun istatistiki açıdan önemli olduğu belirlenmiştir. Sonuçlara göre içerisinde renk oluşumunu etkileyen herhangi bir gen bulunmayan kontrol grubu olan (43851-43856-43858-43863) genotiplerin likopen değerleri 5.21-9.77 arasında değişim gösterirken *ogc* geni içeren grup (43864-43871-43910) 13.64-15.20, *hp1* geni içerenler 11.27-13.58 arasında likopen içerirken en yüksek değer 18.50 ile *hp2* geni içeren 43872 nolu hattan elde edilmiştir. Yine β-

karoten miktarları *hp2* geni içeren 43872 nolu genotipte 7.69 ile en yüksek bulurken bunu *ogc* geni içeren 43864 nolu genotip 3.28 ile takip etmiştir (Çizelge 1). Bu durum meyvede koyu yeşil renk oluşumunu teşvik eden *hp2* genin daha sonra oluşan likopen ve β-karoten üzerine de çok olumlu olarak etkide bulunduğunu göstermektedir.

3.2. TOPLAM FENOLİK VE ANTİOKSİDANT MADDE MİKTARI

Sebzeler arasında domatesler antioksidanların kaynağı olarak bilinir ve karotenoidlerin (likopen, β-karoten ve lutein) yanı sıra flavonoidlerin de antioksidan fayda sağlamada önemli bir grup polifenol olduğu doğrulanmıştır (Stewart vd., 2000; Slimestad & Verheul 2005; Luthria vd., 2006). Domatesinin antioksidan içeriği için yapılan bir çalışmada genotiplerin toplam fenolik madde miktarının 47,80-141,8 mg/100 g arasında (Kaur vd., 2013), değiştiği belirlenirken diğer araştırmacılar tarafından yapılan çalışmalarda ise toplam fenolik madde miktarının 326.6–1203.5 mg kg−1 (Kavitha vd., 2014) ve 123.61-175.42 mg GAE kg-1 FW (Asensio vd., 2019) aralığında tespit etmişlerdir. Athindorou ve ark., (2021) ise Kıbrıs yerli domates genotiplerinde toplam fenolik madde miktarını 5.36-8.87 mg GAE 100 g-1 arasında belirlemişlerdir.

Çalışmamızda toplam fenolik miktarı bakımından genotiplerin birbirlerinden farklı değeler içerdiği ve bu durumun istatistiki açıdan önemli olduğu belirlenmiştir. Sonuçlara göre içerisinde renk oluşumunu etkileyen herhangi bir gen bulunmayan kontrol grubu olan (43851-43856-43858-43863) genotiplerin toplam fenolik değerleri 0.62-0.85 arasında değişim gösterirken *ogc* geni içeren grup (43864-43871-43910) 0.75-0.83 değerleri arasında değişim göstermiştir. Toplam fenolik içeren en yüksek değer 1.3 ile *hp2* geni içeren 43872 nolu hattan elde edilmiştir ve bunu sırasıyla *hp1* geni içeren değerleri 0.90-0.94 arasında değişen 43869-43868 nolu hatlar izlemiştir (Çizelge 1). Toplam antioksidant içeriği bakımından kontrol genotiplerin 33.77-64.14, *ogc* geni içerenlerin 55.38-97.30, *hp1* geni içerenlerin 82.0-87.26, *hp2* içeren genotipin ise 89.09 değerine ulaştığı belirlenmiştir. Sonuçlar incelendiğinde renk pigmenti genine sahip genotiplerin daha yüksek antioksidant kapasitesine sahip olduğu belirlenmiştir.

3.3. VİTAMİN C MİKTARI

Domateste meyve biyokimyasal içeriklerinin (iç kalite özellikleri) diğer bir önemli bileşeni C vitamini kapasitesi olup, diğer antioksidantlar gibi oldukça önemlidir. Domateste vitamin C kapasitesinin belirlenmesi amacıyla araştırmacılar tarafından yürütülen çalışmalarda vitamin C miktarlarının 11.6-39.7 mg/100 g (Hanson vd., 2004), 8.0-15.6 mg/100g (Frusciante vd., 2007), 11,08-16,8 gl/100g (Kaya, 2012) olduğu belirlenirken Doğan (2019) erkenci domates hatlarında bazı biyokimyasal özelliklerin belirlenmesi üzerinde yaptığı bir çalışmasında vitamin C miktarının 10.50-28.78mg/100g arasında değişim gösterdiğini belirlemiştir (Bhandari vd., 2016).

Araştırmamızda C vitamini oluşumunda genotiplerin birbirlerinden farklı değeler içerdiği ve bu durumun istatistiki açıdan önemli olduğu belirlenmiştir. Çalışma sonucunda genotiplerin vitamin C değerleri 10.83-21.06 mg/100g arasında değişim göstermiştir. Sonuçlara göre içerisinde renk oluşumunu etkileyen herhangi bir gen bulunmayan kontrol grubu olan (43851-43856-43858-43863) genotiplerin vitamin C değerleri 12.76-21.06 arasında değişim gösterirken *ogc* geni içeren grup (43864-43871-43910) genotipleri 10.83- 17.33 aralığında ve *hp1* geni içerenler 19.76-20.48 arasında değişim göstermiştir. *hp2* geninin ait olduğu 43872 nolu genotip 19.47 değer arasında yer almıştır (Çizelge 1). Araştırma sonuçlarına göre *ogc*, *hp1* ve *hp2* geni içeren genotiplerin vitamin C içeriği üzerine belirgin bir etkisinin olmadığı belirlenmiştir. Ancak araştırma sonuçlarımızdan elde etmiş olduğumuz vitamin C değerleri literatürlere göre yüksek çıkmıştır. Bu durumun genotip etkisinin yanında yetiştirme koşullarının da etkili olabileceği yönündedir.

Çizelge1. Genotiplerin bulundurdukları genlere göre meyvede likopen ve β- karoten, toplam fenolik, antioksidan ve vitamin C içerikleri

	Genler			Likopen	B- Karoten	Fenolik	Antioksidan	Vitamin C
Genotipler	*ogc*	*hp1*	*hp2*	(mg/100g)	(mg/100g)	(mg/g)	(%)	(mg/100g)
43851	-	-	-	7,25 f	2,15 f	0,85 c	59,20 d	17,30 d
43856	-	-	-	9,77 e	1,16 ı	0,79 de	42,49 f	21,06 a
43858	-	-	-	5,21 h	1,63 h	0,81 cd	64,14 c	18,77 c
43863	-	-	-	5,60 g	1,05 i	0,62 f	33,77 g	12,76 f
43864	+	-	-	15,2 b	3,28 b	0,81 cd	56,03 e	13,91 e
43868	-	+	-	13,58 c	2,94 d	0,94 b	87,26 a	19,76 b
43869	-	-	-	11,27 d	3,16 c	0,90 b	82,09 b	20,48 a
43871	+	-	-	13,64 c	1,86 g	0,75 e	55,38 e	10,83 g
43872	-	-	+	18,5 a	7,69 a	1,3 a	89,09 a	19,47 b
43910	+	-	-	15,2 b	2,27 e	0,83 cd	97,30 a	17,33 d

* Aynı sütunda farklı harflerle gösterilen ortalamalar arasındaki farklılık %5 hata seviyesinde önemlidir (P<0.05).

3.4. MEYVE SUYU EC MİKTARI

Domates meyvelerinde EC değeri, meyve içindeki elektriksel iletkenliğin sebebi ve mevcut besin elementlerinin konsantrasyonu hakkında bilgi verir nitelikte olan bir değişkendir. Meyvede besin elementi içeriğine etki eden birçok faktör vardır. Bunlar; topraktaki besin elementi miktarı ve dağılımı, ekolojik faktörler, toprak tuzluluğu ve genotipik özelliklerdir. Domates meyvesinin element içeriği üzerine farklı anaçların ve besin kaynaklı EC seviyelerinin etkisinin araştırıldığı bir çalışmada EC düzeylerinin belirli bir noktaya kadar artmasıyla P, K, Mn ve Zn içerikleri artış gösterirken, Ca, Mg, Fe ve B elementleri azalma gösterildiği kaydedilmiştir (Söylemez & Akyürek, 2017). Yerel domates genotiplerinin seleksiyonu ve morfolojik karakterizasyonu üzerine yapılan başka bir çalışmada meyve suyu EC değerlerinin 3.46-5.08 mS/cm arasında değiştiği tespit edilmiştir (Kurt, 2019). Yapılan diğer çalışmalarda, domates meyvelerinde meyve suyu EC değerlerinin 4.5 ds/m-1-5.9 ds/m-1 (Tüzel vd., 2009) ve 2.7 ds/m-1 -en 3.2 ds/m-1 (Bozköylü ve Daşgan, 2010), değerleri arasında değişim gösterdiği belirlenmiştir.

Araştırmamızda meyve suyu EC miktarı oluşumunda genotiplerin birbirlerinden farklı değeler içerdiği ve bu durumun istatistiki açıdan önemli olduğu belirlenmiştir. Araştırma sonuçlarına göre 43910 nolu *ogc* geni içeren genotip EC değeri en yüksek çıkarken yine *ogc* geni içeren 43864 nolu başka bir genotipte ise en düşük EC değeri ölçülmüştür. Bu durum EC ile renk pigmenti oluşturan genotipler arasında direkt bir ilişkinin olmadığı yönündedir. Bu durumun daha çok genotip ve çevre etkisinden kaynaklandığı düşünülmektedir.

3.5. MEYVE SUYU PH DEĞERLERİ

Meyve suyu pH sı meyve asitliği ile ilişkili olup, tat ve aroma nitelikleri yönünden önemli bir yer tutmaktadır. Farklı araştırmacılar tarafından yapılan çalışmalar sonucunda pH değerlerinin 4.34-4.92 (Saka, 2023), 4.13-4.60 (Açharya vd., 2018), 4.19-4.49 (Aoun vd., 2013), 4.37-4.58 (Figueiredo vd., 2017), 4.11-5.46 (Kumar vd., 2016), 4.1-4.6 (Liu vd., 2017), 4.24-4.49 (Peixoto vd., 2018), arasında değiştiği bildirilmiştir.

Araştırmamızda olgun meyveden alınan meyve suyu pH değerleri arasındaki farklılığın istatistiki açıdan önemli olduğu belirlenmiştir. Sonuçlara göre pH değeri 4.43- 4.89 aralığında tespit edilmiştir. Sonuçlara göre içerisinde renk oluşumunu etkileyen herhangi bir gen bulunmayan kontrol grubu olan (43851-43856-43858-43863) genotiplerin pH değerleri 4.74-4.89 arasında değişim gösterirken *ogc* geni bulunduran (43864-43871-43910) nolu genotiplerde 4.43-4.73, *hp1* geni bulunduran (43868-43869) genotiplerde 4.66-4.67 arasında ve *hp2* geni bulunduran 43872 nolu genotipte ise bu değerin 4.85 olduğu belirlenmiştir (Çizelge 2).

Meyve suyu pH değerlerinin *ogc, hp1* ve *hp2* geni bulunduran genotiplerde kontrol gruplarına göre daha düşük seviyde görüldüğü, dolayısıyla biraz daha asitli olduğu kanaatine varılmıştır. Ancak bunun yukarıda belirtilen genler ile direkt bir ilişkisinin olmadığı daha çok genotip çevre etkisinden kaynaklandığı düşünülmektedir.

3.6. TİTRE EDİLEBİLİR ASİTLİK MİKTARI

Olgun domateslerin lezzetini organik asitler, pigmentler ve 400'ü aşkın aroma komponenti vermektedir (Cemeroğlu vd., 2003). Asitlik genotiplere ve yetiştirme koşullarına göre değişim gösterebilmektedir. Nitekim; yapılan bir araştırmada %0.27-0.40 arasında (Doğan, 2019), başka çalışmalarda %0.34-0.43 (Renna vd., 2019), %0.38-.053 (Scarano vd., 2020), %0.26-0.57 (Saka, 2023) arasında belirlenmiştir.

Bu çalışmada ise titre edilebilir asitlik miktarı oluşumunda genotiplerin birbirlerinden farklı değeler içerdiği ve bu durumun istatistiki açıdan önemli olduğu belirlenmiştir. Titre edilebilir asitlik değerlerinin renk oluşumunu etkileyen herhangi bir gen bulunmayan kontrol grubu olan (43851-43856-43858-43863) genotiplerde %0.39-0.57 arasında değişim gösterdiği tespit edilirken, *ogc* geni içerenlerde (43864-43871-43910) %0.39-0.94 arasında, *hp1* geni içeren (43868-43869) %0.640-0.644, *hp2* geni içeren 43872 nolu genotipte ise bu değer %0.46 olarak belirlenmiştir (Çizelge 2). Yaptığımız çalışma sonucunda genotiplerimizin titre edilebilir asitlik değerlerinin %0.39-0.94 olarak belirlendiği ve sonuçlarımızın yapılan diğer çalışmalarla desteklendiği görülmektedir. Yine bu sonuç içerisinde özellikle *ogc* geni içeren 43910 nolu genotipin en yüksek değeri aldığı ancak yine *ogc* geni içeren 43864 nolu genotipin ise en düşük değeri alması bu durumun renk pigmenti oluşturan genler ile bir ilişkisinin olmadığı yönünde olup, TA üzerine başka faktörlerin etkili olabileceği düşünülmektedir.

Çizelge 2. Genotiplerin bulundurdukları genlere göre meyvelerde EC (mS/cm) pH ve TA (%) değerleri

Genotipler	Genler			EC (mS/cm)	PH	TA (%)
	ogc	*hp1*	*hp2*			
43851	-	-	-	5,45 c	4,89 a	0,367 e
43856	-	-	-	6,60 ab	4,81 ab	0,573 c
43858	-	-	-	6,35 b	4,74 bc	0,573 c
43863	-	-	-	5,70 c	4,86 ab	0,392 de
43864	+	-	-	4,97 d	4,73 bc	0,396 de
43868	-	+	-	6,70 ab	4,67 cd	0,640 b
43869	-	+	-	5,30 cd	4,66 cd	0,644 b
43871	+	-	-	5,55 c	4,56 d	0,584 bc
43872	-	-	+	5,47 c	4,85 ab	0,446 d
43910	+	-	-	7,00 a	4,43 e	0,943 a

* Aynı sütunda farklı harflerle gösterilen ortalamalar arasındaki farklılık %5 hata seviyesinde önemlidir (P<0.05).

3.7. MEYVE KABUK RENGİ

Renk ölçümlerinin değerlendirmesinde L* değeri parlaklığı, + a* değeri kırmızı, - a * değeri yeşil, + b* sarı ve - b* değeri mavi rengi temsil etmektedir. C* değeri meyve kabuğunun canlılığını-donukluğunu ifade ederken Hue açısı, a* ve b* değerlerinin kesiştiği noktadan geçen doğrunun X ekseni ile yaptığı açıyı ifade etmektedir. Açı 0° olduğunda kırmızı, 90° olduğunda sarı, 180° olduğunda yeşil ve 270° olduğunda mavi renge karşılık geldiği bilinmektedir. Farklı araştırmacıların domates üzerine yaptıkları çalışmalarda L* değerlerinin 36.95-45.68 (Borghesi vd., 2011), 32.0-38.6 (Bhandari vd., 2016), 40.56-45.07 (Gözükara ve Kaplan, 2017), arasında değişim gösterdiği bildirilmiştir. Bizim sonuçlara göre L değeri açısından en yüksek değer 44.79 ile *hp2* geni içeren genotipte belirlenirken en düşük değerler 36.21, 36.48 ve 36.51 ile sırasıyla hp1, *ogc* ve kontrol grubu genotiplerinde belirlenmiştir.

Çalışma sonucunda almış olduğumuz bulguların bu bildirişlerle örtüştüğü görülmekte ve çalışmamızı desteklendiği anlaşılmaktadır (Çizelge 3).Yine domates meyve kabuk rengi üzerine yapılan çalışmalar incelendiğinde a* değerlerinin, 21.1-25.0 (Hernandez vd., 2007) ve 24.70-34.29 (Viskelis vd., 2015) arasında değiştiği tespit edilmiştir. Bizim sonuçlarımıza göre konrtol grubu 27.33-32.52, renk pigmeni oluşumunu etkileyen genotiplerin (*ogc, hp1, hp2*)

36.48-44.74 arasında değişim gösterdiği belirlenmiştir. Domateste b* değerleri ile ilgili yapılan bazı araştırmalarda; 13.8-27.0 (Bhandari vd., 2016), 30.3-41.0 (Renna vd., 2018) arasında değişim gösterdiği tespit edilmiştir.

Bu araştırmada kontrol grubu genotiplerin b* değerlerinin 21.14-26.82, pigment içeren grubun ise 31.47-41.78 arasında değiştiği belirlenmiştir (Çizelge 3). Yapılan araştırmalarda chroma değerlerinin 39.20-47.23 (Şayan ve Yücel, 1988; Altun, 2011; Viskelis vd., 2015; Gözükara ve Kaplan, 2017) aralığında olduğu belirlenmiştir. Bu araştırmada chroma değerleri konrol grupta 35.08-47.29, pigment geni içeren grupta 48.88-57.86 arasında, hue açısı ise yine kontrolde 37.17-46.36, pigment geni içerende 42.96-54.50 arasında değişim göstermiştir.

Tüm bu sonuçlar incelendiğinde renkte parlaklık (L*), kırmızılık (a*), canlılık (Chroma) gibi domates meyvesinin albenisini etkileyen değerler bakımından renk pigmentlerinin oluşumunu etkileyen *ogc*, *hp1* ve *hp2* gibi genlerin oldukça etkili olduğu sonucuna varılmıştır.

Çizelge 3. Genotiplerin bulundurdukları genlere göre meyve kabuk renk değerlerindeki değişimler

	Genler							
Genotipler	*ogc*	*hp1*	*hp2*	L*	a*	b*	Chroma	Hue
43851	-	-	-	38,70 cd	27,94 e	26,82 e	38,84 de	43,80 cde
43856	-	-	-	36,51 e	32,52 cd	34,22 cd	47,29 c	46,36 bcd
43858	-	-	-	37,75 de	29,33 de	26,83 e	39,84 d	42,18 e
43863	-	-	-	40,94 b	27,94 e	21,14 f	35,08 e	37,17 f
43864	+	-	-	36,48 e	30,58cde	34,03 cd	45,88 c	47,86 b
43868	-	+	-	36,26 e	41,77 a	39,93 ab	57,86 a	43,51 cde
43869	-	+	-	40,01 bc	29,73 de	42,68 a	51,56 b	54,50 a
43871	+	-	-	40,09 bc	33,16 c	31,47 d	45,79 c	43,88 cde
43872	-	-	+	44,74 a	38,21 b	41,78 a	57,34 a	46,70 bc
43910	+	-	-	37,48 de	40,35 ab	37,34 bc	55,11 ab	42,96 de

* Aynı sütunda farklı harflerle gösterilen ortalamalar arasındaki farklılık %5 hata seviyesinde önemlidir (P<0.05).

4. SONUÇ

Araştırma iri domateslerin (beef) meyve kalitsini artırmaya yönelik olup, bu kaliteyi etkilediği düşünülen hp1, hp2 ve ogc genleri içeren genotipler üzerindeki etkileri araştırılmıştır. Sonuçlara göre meyvede bu genlerin olmasıyla özellikle likopen, beta karoten, fenolik madde, TA gibi meyvede kaliteyi pozitif yönde etkileyen parametreler üzerinde çok etkilerinin olduğu belirlenmiştir. Bundan sonraki araştırmada yapılacak ıslah çalışmaları için kullanılacak bu parametrelerin hızlı seleksiyon kriterleri içerisinde yer almasının güvenilir olacağı kanısına varılmıştır.

5. TEŞEKKÜR

Araştırmayı destekleyen TUBITAK 1507 (Proje no:3191183) birimine teşekkür ederiz.

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SELENYUM UYGULAMALARININ KADMİYUM STRES KOŞULLARINDA LÜPEN (*Lupinus Albus* L) BİTKİSİNDE VE TOPRAKTA MİKRO ELEMENT İÇERİĞİNE ETKİSİ

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ÖZET
Mikro besin elementleri bitkiler için metabolik süreçlerde yer alan mutlak gerekli besin elementleridir. Mikro besin elementlerinin gereken miktardan düşük oranda alınması büyüme ve gelişmeyi bozar. Kadmiyum, yüksek mobiliteye sahip bir ağır metaldir. Bu nedenle, düşük miktarlarda toprakta bulunduğunda bitkilere önemli düzeyde fitotoksik etkiye sahiptir. Kadmiyum özellikle mikro besin elementleri üzerinde alımı engelleyici etkiye sahiptir. Bu engelleyici etki kadmiyum ile Fe, Zn, Mn ve Cu arasındaki antagonistik etki nedeniyledir. Selenyum bitki ve hayvanlar için gerekli bir elementtir. Selenyum bitkiler için mutlak gerekli bir element olmamasına rağmen, düşük miktarda uygulanan selenyum bitkilerde gelişmeyi teşvik etmekle birlikte stres koşullarına karşı direnç mekanizması sağlamaktadır. Özellikle ağır metal, kuraklık,soğuk gibi abiyotik stres koşullarında direnci artırmaktadır. Kadmiyum nedeniyle oluşan stres şartlarında, bitkinin antioksidatif savunma mekanizmasında aktif rol oynayan selenyum mikro besin element içeriğinde de etkili olmaktadır. Bu amaçla Cd nitrat ($Cd(NO_3)_2.4H_2O$) formunda 0-25-50 mg/kg Cd verilerek, oluşturulan ağır metal stres şartlarında, sodyum selenat (Na_2SeO_4) formunda 0-2,5-5-10 mg/kg Se'nin sera koşullarında uygulanmasının Lüpen *(Lupinus albus* L) bitkisinin ve yetişme ortamının mikro besin (Fe, Zn, Cu ve Mn) elementi içeriğine etkisi araştırılmıştır. Çalışmanın sonuçlarına göre kadmiyum'un 25 ve 50 mg/kg düzeylerinde lüpen bitkisinin kök, yaprak kısımlarında ve toprak Fe, Zn, Cu ve Mn içeriğinde kontrol uygulamasına göre, önemli düzeyde düşüş meydana gelmiştir. Bununla birlikte kadmiyumun 25 ve 50 mg/kg düzeylerinde selenyum'un 5 mg/kg düzeydeki uygulaması yaprakta, kökte ve toprakta Fe, Zn ve Mn içeriğinde artışa neden olmuştur.
Anahtar Kelime: Ağır metal stres, Lüpen*(Lupinus Albus* L), Micro element, Selenyum.

EFFECT OF SELENIUM APPLICATIONS ON MICRO ELEMENT CONTENT IN LUPINUS (Lupinus Albus L) AND SOIL UNDER CADMIUM STRESS CONDITIONS

ABSTRACT
Micronutrients are absolutely essential nutrients involved in main metabolic processes. Taking micronutrients in lower than required amounts impairs growth and development. Cadmium is a heavy metal with high mobility. Therefore, it has a significant phytotoxic effect on plants when present in soil in low amounts. Cadmium has an inhibitory effect especially on micronutrients. This inhibitory effect is due to the antagonistic effect between cadmium and Fe, Zn, Mn and Cu. Selenium is an essential element for plants and animals. Although selenium is not an absolutely essential nutrient for plants, selenium applied in low amounts promotes growth in plants and provides a resistance mechanism against stress conditions. It increases resistance especially in abiotic stress conditions such as heavy metals, drought and cold. Under stress conditions caused by cadmium, selenium, which plays an active role in the antioxidative defense mechanism of the plant, is also effective in the micronutrient content. For this purpose, by giving 0-25-50 mg/kg Cd in the form of cadmium nitrate ($Cd(NO_3)_2.4H_2O$), under heavy metal stress conditions, 0-2.5-5-10 mg/kg Se in the form of sodium selenate (Na_2SeO_4). The effect of applying in soil on the micronutrient (Fe, Zn, Cu and Mn) element content of the Lupine (Lupinus albus L) plant. and its growing environment was investigated. According to the results of the study, a significant decrease occurred in the Fe, Zn, Cu and Mn contents of the lupine plant in the roots, leaf parts and soil at 25 and 50 mg/kg levels of cadmium. However, the application of cadmium at 25 and 50 mg/kg levels and selenium at 5 mg/kg caused an increase in the Fe, Zn and Mn contents in the shoot, root and soil.
Keywords: Heavy metal stress, Lupine*(Lupinus Albus* L), Micro element, Selenium,

GİRİŞ

Bitkinin hayatta kalması ve gelişmesi için çeşitli mineral elementlere ihtiyaç vardır ve bunlar genellikle bitkide mevcut miktarlara göre sınıflandırılır. Daha düşük miktarlarda ihtiyaç duyulan elementlere mikro besinler denir. Bunlar demir(Fe),çinko (Zn), mangan (Mn), bakır (Cu), molibden(Mo), bor (B), klor (Cl) (Kacar, 1994). Sodyum, silikon, selenyum, vanadyum ve kobalt tüm bitkiler için olmasa da bazı bitkiler için faydalı olduğu görülmüştür ve bu nedenle genellikle mikro besinler olarak kabul edilmezler (Fageria ve ark., 2011). Cd yerkabuğunda bulunan inorganik bir mineraldir. Aynı zamanda Cd çok küçük miktarda yüksek fitotoksik etkiye sahip bir ağır metaldir. Düşük konsantrasyonlarda yüksek fitotoksik etkiye sahip olması mobilitesinin oldukça yüksek olmasından kaynaklanmaktadır. Cd bitkide su alımını etkiler bu nedenle de bitkinin hem makro hem de mikro besin elementlerinin alınmasına da etki etmektedir (Hasanuzzaman ve Fujita 2013). Yapılan bir çok çalışmada kadmiyumun alımını engel oluşturmasında kadmiyum ile mikro besin elementleri arasında aynı taşıyıcı ile taşındıkları için aralarındaki rekabet ve antagonistik etki nedeniyle alımda azalmanın oluştuğunu ifade etmektedirler (Mourato ve ark., 2019). Selenyum'un abiyotik stres koşullarında düşük dozlarda uygulanması bitkide stres direncinin oluşmasına neden olmaktadır (Hu ve ark., 2014). Selenyum, bitkiler için mutlak gerekli bir element olmamasına rağmen, kadmiyum toksisitesi şartlarında stres etkisini azaltmaktadır. Selenyum ile yapılan çalışmalarda örneğin Zhao ve ark., (2019) yürüttükleri çalışmada krom (Cr) stres koşullarında uygulanan selenyum'un Çin lahanasında (*Brassica campestris L. ssp. Pekinensis)* mikro besin elementlerinden (Fe, Zn, Cu, Mn, Na ve Ca) alımında artışa neden olmuştur. Kadmiyum'un tek başına çeltik bitkisinin dokularında Ca, Mg, Mn, Cu ve Zn alımını engellediğini; buna karşılık selenyum uygulaması kadmiyum bulunan şartlarda Ca, Mg, Mn, Cu ve Zn alımında artışa neden olduğu tespit edilmiştir (Feng ve ark. 2013). Bu çalışmanın amacı kadmiyum uygulamasının lüpen *(Lupinus Albus L)* bitkisinde ve toprakta mikro besin elementi içeriğine etkisini araştırmaktır. Bununla birlikte, kadmiyum stres koşullarında, selenyum uygulamasının mikro besin elementi içeriğine etkilerini ortaya koymaktır.

MATERYAL VE YÖNTEM

MATERYAL

Yürütülen Sera denemesinde 2.5 kg kapasiteli saksılara toprak tartılarak 8 tohum ekilmiş, çimlenmeden sonra 5 bitkiye seyreltilmiştir. Kadmiyum (Cd) için 0- 25-50 mg/kg Cd olacak şekilde kadmiyum nitrat ($Cd(NO_3)_24H_2O$) formunda, Selenyum (Se) için 0-2.5-5-10 mg/kg Se olacak şekilde sodyum selenat (Na_2SeO_4) formunda uygulanmıştır. Lüpen bitkisi ülkemizde kaba yem üretimi için genel olarak yonca, korunga, fiğ, üçgül, mısır, tarımı yapılırken, bakla, yem bezelyesi ve lüpen bitkileri de bu amaçla ilgi duyulan bitkiler grubunu oluşturmaktadır (Okuyucu ve Okuyucu, 2008). Ülkemiz lüpen üretimi Ege, Marmara ve İç Anadolu bölgelerinde yapılmaktadır. İç Anadolu yöresinde ise Konya ilinde yapılmaktadır. Konya ilinde yapılan üretimin de yaklaşık %85'lik kısmı Doğanhisar İlçesinde yapılmaktadır (TÜİK, 2020). Genel olarak serin iklim bitkisi olan lüpenin, sert kışlara dayanıklılığı zayıftır. Akdeniz ülkelerinde kışlık, diğer ülkelerde ise genel olarak yazlık ekim tercih edilir. Türkiye'de lüpen (*Lupinus albus* L.) acı bakla, delice bakla, gavur baklası, kurt baklası, mısır baklası, yahudi baklası en yaygın ismi Termiye olarak bilinmektedir. Yüksek protein oranı ve diğer baklagillerin yetişmediği marjinal alanlarda yetiştirilebilme özelliğine sahip olan lüpen, Leguminosae familyasının önemli cinslerinden birini oluşturan bir baklagil bitkisidir. Bitkinin vejetatif aksamlarından yeşil gübre ve kaba yem, tohumlarından da insan ve hayvan besin maddesi olarak yararlanılmaktadır (Yorgancılar ve ark., 2020).

YÖNTEM

Bitki örneklerinin alınması ve analize hazırlanması

Bitki örnekleri hasat edildikten sonra mineral besin elementleri ve ağır metal analizleri için laboratuara getirilmiştir. Laboratuara getirilen bitki örnekleri İbrikçi ve ark.(1994) 'ın bildirdiği yönteme göre yıkanmış ve 70^0C ayarlı etüvde sabit ağırlığa gelinceye kadar kurutulmuştur. Paslanmaz çelik değirmende öğütülerek analize hazır hale getirilmiştir.

Bitkide mikro besin elementlerinin belirlenmesi

Analize hazı hale getirilen bitki kök ve sürgün örneklerinde nitrik asit-perklorik asit karışımında yaş yakma işlemi yapıldı. Elde edilen ekstrakda Fe,Zn ,Cu ve Mn atomik absorpsiyon spektrofotometresi kullanılarak belirlendi (Kacar, 1994).

Toprakta mikro besin elementlerinin Belirlenmesi

Yetiştirtirme ortamının, mikro besin element içeriği belirlenirken bir miktar toprak örneği DTPA ile ekstrakte edilerek atomik absorbsiyon spektrofotometre (A.A.S.) cihazı ile Fe, Zn Cu ve Mn içeriği belirlenmiştir (Lindsay ve Norvell, 1978).

İstatistik Analiz

Çalışmadan elde edilen bulgular, SPSS 13.0 istatistik paket programında faktöriyel deneme desenine göre varyans analizine tabi tutulmuş ve uygulamalar arasındaki fark Duncan çoklu karşılaştırma testi ($p<0.05$) ile belirlenmiştir (Düzgüneş ve ark., 1987).

BULGULAR VE TARTIŞMA

Farklı düzeylerde kadmiyum ve selenyum dozlarında lüpen bitkisinin sürgünlerinde mikro besin elementi içeriğine etkisi istatistiksel olarak ($p< 0.05$) önemli bulunmuştur.Uygulama düzeyleri olarak Cd_0(0 mg/kg),Cd_1(25 mg/kg) ve Cd_2(50 mg/kg) verilerek oluşturulan stres koşullarında sırası ile Se_0(0mg/kg), Se_1(2,5 mg/kg), Se_2(5mg/kg) ve Se_3(10 mg/kg) verilerek bitkide mikro besin elementi içeriğine etkileri incelenmiştir. Lüpen bitkisinin sürgünlerinde Cd uygulama düzeylerine bağlı olarak sırası ile Fe, Zn, Cu ve Mn içeriğinde önemli düşüş görülmüştür. Bununla birlikte tek başına Cd_1 ile karşılaştırıldığında, Cd_1düzeyinde Se_1 ve Se_2 düzeyleri yaprak Zn ve Mn içeriğinde artışa neden olmuştur. Tek başına Cd_2 düzeyine göre, Cd_2 ile Se_2 birlikte uygulandığında yaprak Fe, Zn ve Mn içeriğinde artışa neden olmuştur.

Şekil 1. Kadmiyum selenyum uygulamalarının lüpen bitkisinin yapraklarında mikro besin elementi içeriğine etkisine dair tanımlayıcı istatistikler ve karşılaştırma sonuçları

	Selenyum (Se)	**Cd_0**	**Cd_1**	**Cd_2**
Fe	**Se_0**	89,13±8,68ab*	88,67±6,49ab	72,01±5,57cd
Yaprak	**Se_1**	89,90±12,67ab	82,96±5,72b	58,47±2,72de
	Se_2	98,11±4,16a	82,88±7,58b	91,76±19,72ab
	Se_3	88,50±2,28b	76,07±6,07bc	54,36±2,19e
	Selenyum	***Kadmiyum***	***Selenyum x Kadmiyum***	
Önem düzeyi	F(3, 24) = 5,04	*F(2, 24) = 12,29*	*F(6, 24)* =2,85	
	p< 0.001	*P< 0.001*	*P= 0.03*	
	Se_0	33,16±1,41a	28,46±0,76bc	29,83±0,72b
Zn	**Se_1**	25,51±0,89e	30,70±2,25ab	26,55±1,55de
Yaprak	**Se_2**	26,78±1,47de	30,47±3,35ab	32,81±1,35a
	Se_3	28,21±1,25de	28,65±0,93de	26,97±0,48de
	Selenyum	***Kadmiyum***	***Selenyum x Kadmiyum***	
***Önem düzeyi*:**	*F(3, 24) = 10,01*	*F(2, 24) = 2,49*	*F(6, 24) = 9,06*	
	p< 0.001	*P=0,103*	*P< 0.001*	
	Se_0	13,37±0,45a	11,98±0,10b	10,84±0,30c
Cu	**Se_1**	9,95±0,12cd	6,99±0,25e	8,64±1,10cd
Yaprak	**Se_2**	9,82±0,29cd	12,27±0,94ab	10,83±0,67c
	Se_3	10,09±0,73cd	9,97±0,19d	3,50±2,20f
	Selenyum	***Kadmiyum***	***Selenyum x Kadmiyum***	
Önem düzeyi	*F(3, 24) = 37,23*	*F(2, 24) = 19,27*	*F(6, 24) = 13,95*	
	p< 0.001	*P< 0.001*	*P< 0.001*	
	Se_0	3149±305b	2928± 55,44 cd	2686±334d
Mn	**Se_1**	4059± 218a	3278±414a	3536±188ab
Yaprak	**Se_2**	3934±498a	3168±112b	3478±284abc
	Se_3	2796±318cd	2786±165cd	3152±297ab
	Selenyum	***Kadmiyum***	***Selenyum x Kadmiyum***	
Önem düzeyi	*F(3, 24) =9,63*	*F(2, 24) = 22,52*	*F(6, 24) = 4,47*	
	p< 0.001	*p< 0.001*	*p< 0.001*	

***a, b, c, d:farklı küçük harflerle gösterilen uygulamalar arasında fark anlamlı (p< 0.05).**

Farklı düzeylerde kadmiyum ve selenyum dozlarında lüpen bitkisinin köklerinde mikro besin elementi içeriğine etkisi istatistiksel olarak (p< 0.05*)* önemli bulunmuştur. Lüpen bitkisinin kök bölgesinde kadmiyum uygulama düzeylerine bağlı olarak sırası ile Fe, Zn, Cu ve Mn içeriğinde

önemli düşüş görülmüştür. Bununla birlikte tek başına Cd_1ve Cd_2 düzeylerine göre,Cd_1 ve Cd_2 ile birlikte uygulanan Se_2 düzeyi kök Fe, Zn ve Mn içeriğinde artışa neden olmuştur.

Şekil 2. Kadmiyum- selenyum uygulamalarının lüpen bitkisinin köklerinde mikro besin elementi içeriğine etkisine dair tanımlayıcı istatistikler ve karşılaştırma sonuçları

	Selenyum (Se)	**Cd_0**	**Cd_1**	**Cd_2**
Fe	**Se_0**	4410±259a	1847±166ef	1533±159f
Kök	**Se_1**	4063±206 b	**2620±471cd**	**3768±585b**
	Se_2	**4530,10±286a**	**4531±593a**	**4397±185a**
	Se_3	2869,33±176c	2236±285cd	2914±97,72cd
	Selenyum	***Kadmiyum***	***Selenyum x Kadmiyum***	
Önem düzeyi	F(3, 24) = 45,54	*F(2, 24) = 40,83*	*F(6, 24)* =15,72	
	p< 0.001,	*P< 0.001*	*p*< 0.001	
	Se_0	29,92±0,69b	27,07±0,01 c	27,57±1,88 c
Zn	**Se_1**	22,20±0,20bc	12,16±0,66 e	12,81±0,74e
Kök	**Se_2**	**32,57±2,09a**	**30,21±0,33 b**	**29,14±0,23bc**
	Se_3	18,55±3,32cd	22,83±1,16 c	13,34±0,61e
	Selenyum	***Kadmiyum***	***Selenyum x Kadmiyum***	
***Önem düzeyi*:**	*F(3, 24) = 244,31*	*F(2, 24) = 48,99*	*F(6, 24) = 18,056*	
	p< 0.001	*P< 0.001*	*P< 0.001*	
	Se_0	16,67±0,84	15,27±0,68	14,84±0,79
Cu	**Se_1**	17,06±0,14	15,38±0,94	15,51±0,85
Kök	**Se_2**	17,45±0,73	17,00±0,11	16,49±1,09
	Se_3	15,02±1,08	15,41±0,56	14,99±0,71
	Selenyum	***Kadmiyum***	***Selenyum x Kadmiyum***	
Önem düzeyi	*F(3, 24) = 9,25*	*F(2, 24) = 6,38*	*F(6, 24) = 1,352*	
	p< 0.001	*P< 0.001*	*P=0,274*	
	Se_0	176,28±2,11a	96,98±1,43ef	81,09±5,16 g
Mn	**Se_1**	134,97±5,55c	43,86±2,11 h	**150,74±6,38b**
Kök	**Se_2**	91,00±11,77fg	**111,43±3,11d**	**173,69±16,70a**
	Se_3	59,68±6,73h	109,02±8,31de	125,86±3,37 c
	Selenyum	***Kadmiyum***	***Selenyum x Kadmiyum***	
Önem düzeyi	*F(3, 24) = 61,96*	*F(2, 24) = 185*	*F(6, 24) =129,45*	
	p< 0.001	*p< 0.001*	*P< 0.001*	

***. a, b, c, d:farklı küçük harflerle gösterilen uygulamalar arasında fark anlamlı (p< 0.05).**

Farklı düzeylerde kadmiyum ve selenyum dozlarında toprakta mikro besin elementi içeriğine etkisi istatistiksel olarak (p< 0.05*)* önemli bulunmuştur. Toprak şartlarında kadmiyum uygulama düzeylerine bağlı olarak sırası ile Fe, Zn, Cu ve Mn içeriğinde önemli düşüş görülmüştür.

Bununla birlikte tek başına Cd_1ve Cd_2 düzeylerine göre,Cd_1 ve Cd_2 ile birlikte uygulanan Se_2 düzeyi toprakta Fe, Zn, Cu ve Mn içeriğinde artışa neden olmuştur.

Şekil 3. Kadmiyum -selenyum uygulamalarının toprakta mikro besin elementi içeriğine etkisine dair tanımlayıcı istatistikler ve karşılaştırma sonuçları

	Selenyum (Se)	**Cd_0**	**Cd_1**	**Cd_2**
Fe	**Se_0**	1,17±0,38abc	0,90±0,09	0,84±0,04bcd
Toprak	**Se_1**	0,87±0,40bc	0,64±0,08	0,91±0,18bc
	Se_2	1,24±0,01a	1,26±0,43ab	1,53±0,01a
	Se_3	0,99±0,01bc	0,95±0,36bc	0,88±0,01bc
	Selenyum	***Kadmiyum***	***Selenyum x Kadmiyum***	
Önem düzeyi	*F(3, 24) = 7,999*	*F(2, 24) = 2,648*	*F(6, 24) =3,545*	
	P=0,001	*P=0,091*	*P= 0,011*	
	Se_0	0,56±0,02b	0,32±0,03cd	0,38±0,01c
Zn	**Se_1**	0,35±0,10cd	0,29±0,05d	0,25±0,03d
Toprak	**Se_2**	0,59±0,08b	0,74±0,12a	0,62±0,10b
	Se_3	0,39±0,04cd	0,35±0,01cd	0,35±0,03cd
	Selenyum	***Kadmiyum***	***Selenyum x Kadmiyum***	
Önem düzeyi	*F(3, 24) = 53,28*	*F(2, 24) = 2,58*	*F(6, 24) = 5,65*	
	p< 0.001	*P=0,096*	*P< 0.001*	
	Se_0	0,97±0,25bcd	0,68±,09de	0,77±0,07cde
Cu	**Se_1**	0,66±0,10de	0,68±,09de	0,68±0,02de
Toprak	**Se_2**	1,07±0,13bc	1,54±0,46a	1,13±0,06b
	Se_3	0,91±0,10bcd	0,58±0,21e	0,69±0,09de
	Selenyum	***Kadmiyum***	***Selenyum x Kadmiyum***	
Önem düzeyi	*F(3, 24) = 19,64*	*F(2, 24) =0,582*	*F(6, 24) = 4,180*	
	p< 0.001	*P=0,566*	*P< 0.015*	
	Se_0	10,60±0,87a	3,72±,67f	5,58±0,22d
Mn	**Se_1**	4,88±0,86de	3,79±0,33f	2,66±0,21f
Toprak	**Se_2**	9,27±,87ab	4,72±0,07e	10,59±0,70a
	Se_3	7,03±0,32c	6,91±0,15c	4,44±0,13e
	Selenyum	***Kadmiyum***	***Selenyum x Kadmiyum***	
Önem düzeyi	*F(3, 24) = 79,12*	*F(2, 24) = 64,81*	*F(6, 24) = 38,99*	
	p< 0.001	*p< 0.001*	*p< 0.001*	

***. a, b, c, d:farklı küçük harflerle gösterilen uygulamalar arasında fark anlamlı (p< 0.05).**

Yapmış olduğumuz çalışmada kadmiyum uygulama düzeylerine bağlı olarak lüpen bitkisinin hem kök hem sürgünlerinde mikro besin elementleri ve toprakta mikro besin elementlerinin içeriğinde düşüş belirlenmiştir.Benzer olarak yürütülen çalışmalarda çeşitli bitkilerde patates (Goncalves ve ark., 2009), soya fasulyesi (Zhi ve ark., 2015), çeltik ((Li ve ark., 2012)

kadmiyumun mineral besin elementi (örneğin Ca, Fe, Zn, Cu ve Mn) içeriğinde azalmaya neden olduğu bulunmuştur. Kadmiyum hücre zarından taşınması için mineral besin elementleri ile aynı taşıyıcılar vasıtası ie hücreye giriş yapmaktadır. Bu rekabet mineral besin elementlerinin alımını etkiler (Qin et al., 2020). Bununla birlikte kadmiyum ile mikro besin elementleri arasındaki antogonistik ve ya sinerjistik etki nedeniyle mikro besin element içeriğini önemli düzeyde etkilemektedir. Örneğin Çinko ve kadmiyum kimyasal olarak benzer grup II-B elementleridir ve Zn, doğada antagonistik bir element olarak kabul edilmiştir.Bitkilere kadmiyum girişini sınırlandırmaktadır (Verbruggen ve ark., 2009). Bir diğer faktör ise kadmiyum toksisitesi bitkinin gelişme ve büyümesini geriletmektedir. Bu durum mineral element içeriğinde artışa neden oluyormuş gibi görünse de gerçekte bu alımdaki artış nedeniyle değil büyümedeki gerilemeden kaynaklanmaktadır (Mourato ve ark., 2019). Yaptığımız çalışmada 25 ve 50 mg/kg kadmiyum bulunan koşullarda, selenyum uygulamasının özellikle 5 mg/kg düzeyi bitkinin mikro besin elementi içeriğinde artışa neden olmuştur. Zembala ve ark.,(2010) kolza bitkisi ile yürüttükleri çalışmada selenyum kadmiyum stres koşullarında antioksidatif enzimlerden SOD' un kofaktörü olan Zn ve Mn içeriğinde artışa neden olmuştur. Selenyum kadmiyum stres koşullarında bitkilerde oluşan oksidatif stres etkisinin azalması için antioksidatif enzimleri (SOD , CAT, APX, GSH-Px) aktivitesinde önemli role sahiptir (Alves ve ark.,2019). Bununla birlikte selenyum kadmiyumun alımında geriletmeye neden olması bir başka neden olmaktadır**.** Çünkü kadmiyum ile selenyum arasında antogonistik etki nedeniyle ortamda selenyum konsantrasyonun artması kadmiyum içeriğinde azalmaya neden olur (Mozafariyan ve ark., 2014). Toprakta ise 25 ve 50 mg/kg kadmiyum bulunan koşullarda selenyum uygulamasının 5 mg/kg düzeyi mikro besin elementlerinin içeriğinde artışa neden olmuştur. Benzer olarak yürütülen çalışmalarda selenyumun toprakta kadmiyum ile termodinamik olarak reaksiyona girmesi ve pH'ya etki etmesi toprak koşullarında kadmiyumun çözünürlüğünü azaltmaktadır (Huang, 2018). Toprakta kadmiyum stres koşullarında, selenyum uygulaması ile mikro besin elementlerinin çözünürlüğünde artış sağlanabilir.

SONUÇ

Lüpen bitkisinde ve toprak içeriğinde kadmiyum düzeyleri mutlak gerekli mikro besin (Fe, Zn ve Cu ve Mn) elementlerinin düşüşe neden olmuştur. Bunun nedeni kadmiyum ile mikro besin elementleri arasında aynı taşıyıcı ile taşındıkları için aralarındaki rekabet ve antagonistik etki

nedeniyledir. Ancak kadmiyum uygulanan koşullarda selenyum konsantrasyonundaki artış mikro besin elementlerinde Fe, Zn ve Mn içeriğinde artışa neden olmuştur. Selenyumun stres koşullarında antioksidatif savunma mekanizmasını harekete geçirme özelliğine sahip elementtir. Lüpen bitkisinde selenyum'un kadmiyum stres koşullarındaki antioksidatif enzimlere etki etmesi sonucu stres şartlarında iyileşmeye sebep olması nedeniyle mikro besin elementlerinin alımında artışa neden olabilir. Bununla birlikte kadmiyum bunun koşullarda selenyum konsantrasyonun artması kadmiyum alımına engel olduğundan stres durumunda iyileşmeye neden olur. Bu da bitkinin büyüme ve gelişmesindeki artışın sonucu olarak mikro besin element içeriğinde artışa neden olabilir. Toprakta selenyum uygulaması toprağın kimyasal özellikleri etkileyerek kadmiyumun topraktaki yarayışlılığına etki etmektedir. Bu durum mikro element içeriğinde artışa neden olabilir.

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ÖZET
Küresel iklim değişikliğiyle birlikte artan hava sıcaklığı ve düzensiz yağış rejimi tüm dünyayı kuraklık tehlikesiyle karşı karşıya bırakmaktadır. Önemli bir abiyotik stres kaynağı olan kuraklık, mahsulün kalitesini ve verimliliğini azaltmakta, dünya çapında gıda güvenliğini tehdit etmektedir. Günümüzde dünya nüfusunun yaklaşık %40'ı su kıtlığı çekmektedir. Kuraklık nedeniyle 2030 yılına kadar 700 milyon insanın farklı bölgelere göç riski söz konusudur. Dünya nüfusunun yaklaşık %10'u açlık çekmekte ve kuraklık stresiyle azalan verimlilik ülkelerin refahını tehlikeye sokmaktadır. Temel besin kaynaklarını etkileyen kuraklık stresi, yaprak boyutunun küçülmesine, gövde bodurlaşmasına ve bitki köklerinin zayıflamasıyla bitki su ilişkilerinin bozulmasına neden olmaktadır. Kuraklık stresi bitkilerde çeşitli fizyolojik ve biyokimyasal süreçleri olumsuz etkilemekte büyümenin ve nihai ürün veriminin azalmasına neden olmaktadır. Kurak koşullara dayanıklı yeni çeşitlerin geliştirilmesi kuraklık stresiyle mücadelede çok önemli bir stratejidir. Ancak genetik kaynakların taranması, kuraklığa karşı toleranslı genotiplerin belirlenmesi ve seleksiyon yoluyla bitki ıslah protokollerin gerçekleşmesi uzun vadeli bir çaba gerektirmektedir. Bu nedenle araştırmacılar kuraklığa toleransı arttırmaya yönelik daha hızlı, ekonomik ve sürdürülebilir stratejiler üzerinde yoğunlaşmıştır. Abiyotik stresle mücadele amacıyla yaygın kullanılan mikro besinler bitkilerin stres savunma mekanizmalarını etkilemekte ve strese karşı dayanıklılığını arttırmaktadır. Yer kabuğunda en çok bulunan temel elementlerden dördüncüsü olan demir, hücre redoks sistemlerinin ana bileşenidir ve stresli koşullarda yaşam döngüsünde önemli rollere sahiptir. Özellikle katalaz (CAT), peroksidaz (POD) ve askorbat peroksidaz (APX) gibi çeşitli antioksidan enzimlerin üretiminde kofaktör olarak görev almaktadır. Bu çalışmada önemli bir mikro element olan demir (Fe)'in bitkinin kuraklık toleransını arttırmadaki ve kuraklık stresinin zararlı etkilerini hafifletmedeki rolüne değinilecektir.
Anahtar Kelimeler: Fe, Kuraklık, Nano-Fe, Antioksidan Enzimler, İklim değişikliği

THE ROLE OF IRON IN DROUGHT TOLERANCE

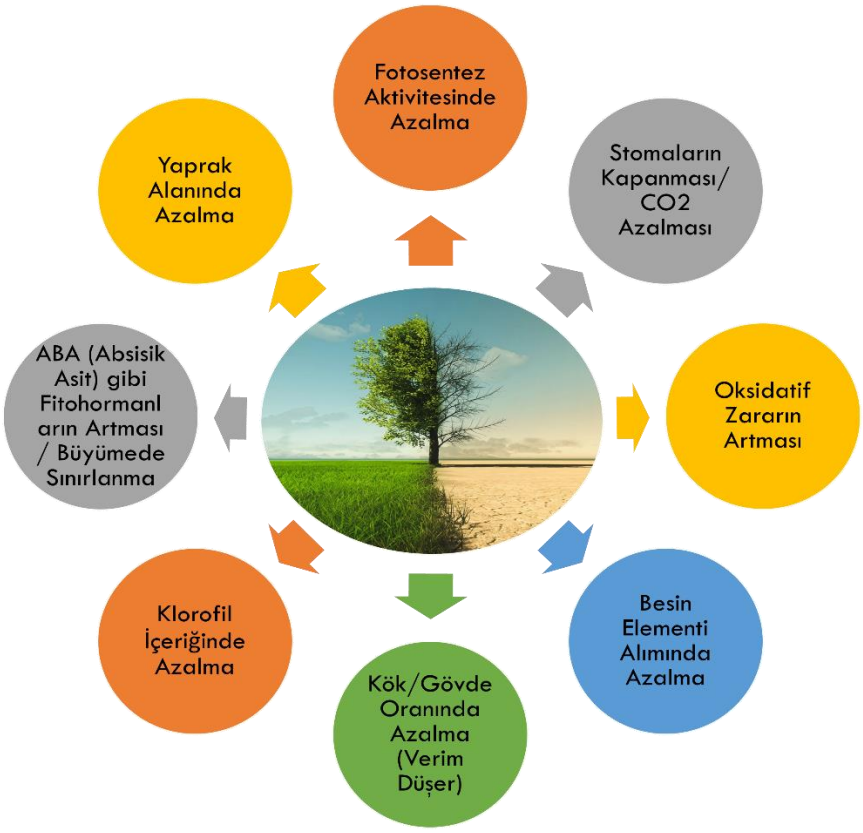
ABSTRACT
Increasing air temperature and irregular precipitation regimes with global climate change put the world at drought risk. Drought, an essential source of abiotic stress, reduces crop quality and productivity and threatens food security worldwide. About 40% of the world's population suffers from water scarcity today. Due to drought, there is a risk of migrating 700 million people to different regions until 2030. About 10% of the world's population suffers from hunger, and the productivity that decreases with drought stress puts the welfare of countries in danger. Drought stress, which affects primary food sources, causes leaf size to decrease, stem stunting, and plant water relations to deteriorate due to the weakening of plant roots. Drought stress negatively affects various physiological and biochemical processes in plants and causes a decrease in growth and final product yield. Developing new varieties resistant to drought conditions is essential in combating drought stress. However, screening genetic resources, identifying drought-tolerant genotypes, and realizing plant breeding protocols through selection requires a long-term effort. For this reason, researchers focused on faster, economical, and sustainable strategies to increase drought tolerance. Micronutrients, widely used to combat abiotic stress, affect the stress defense mechanisms of plants and increase their resistance to stress. Iron, the fourth most abundant element in the earth's crust, is the main component of cell redox systems and has important roles in the life cycle under stressful conditions. It serves as a cofactor in the production of various antioxidant enzymes, especially catalase (CAT), peroxidase (POD) and ascorbate peroxidase (APX). This study will discuss the role of iron (Fe), an important microelement, in increasing the plant's drought tolerance and alleviating the harmful effects of drought stress.
Keywords: Fe, Drought, Nano-Fe, Antioxidant Enzymes, Climate change

GİRİŞ

Bitkiler yaşamları süresince büyüme ve gelişmelerini etkileyen çeşitli abiyotik ve biyotik stres etmenlerine maruz kalmaktadır. Kuraklık, tarımsal üretimi kısıtlayan en önemli çevresel stres faktörlerinden biri olup, ürün verimini ciddi şekilde sınırlandırmaktadır (Farooq ve ark., 2009). Diğer çevresel stres faktörlerine kıyasla, ürün verimliliğini düşüren en yıkıcı abiyotik stres olarak da kabul edilmektedir (Lambers ve ark. 2008). İklim değişikliğiyle birlikte artan hava sıcaklığı ve düzensiz yağış rejimi sonucunda kuraklık dünya çapında bitkisel üretimi tehdit etmektedir (Daryanto ve ark., 2017). Ayrıca küresel iklim değişikliği senaryoları kuraklığın şiddetinin ve sıklığının artacağını ifade etmekte, gelecekte gıda güvenliği sorununun daha şiddetli olacağını öngörmektedir (Li ve ark., 2009; Kogan ve ark., 2019).

KURAKLIK STRESİ

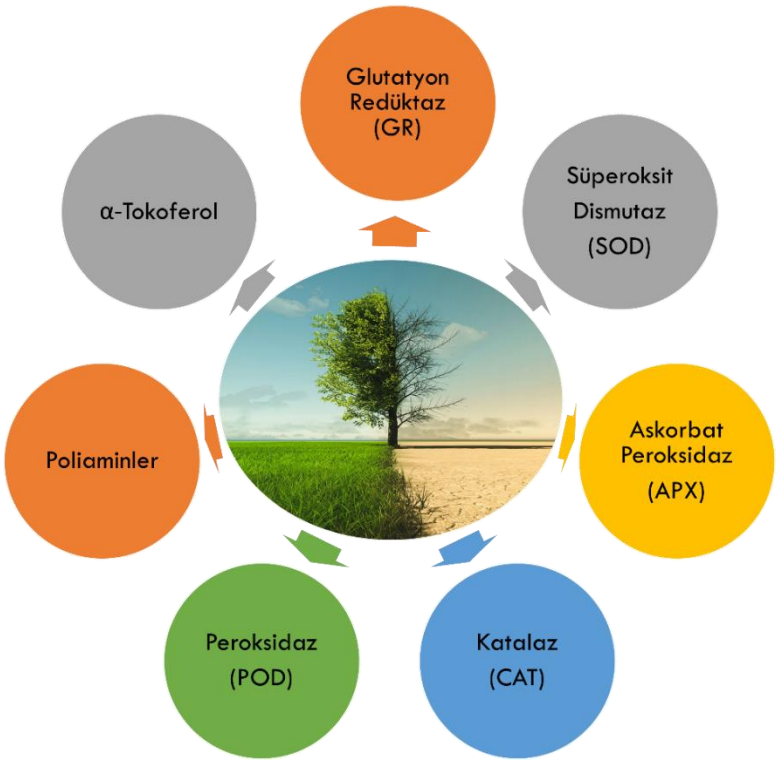
Bitki çeşitlerinin kuraklığa toleranslarındaki farklılıklar, karşılaştıkları su stresinin şiddeti ve süresi verim kayıplarını arttırmaktadır (Öztürk, 2015). Kuraklık stresinin zararlı etkileriyle mücadele etmek için bitkinin metabolizmasında çeşitli morfolojik, fizyolojik ve biyokimyasal değişiklikler meydana gelmektedir (Şekil 1).



Şekil 1: Kuraklık Stresinin Etkileri

Stresle karşılaşan bitki büyüme hızını yavaşlatmakta, suya ulaşmak için gövde uzaması durdurmakta, kök gelişimini arttırmakta, yaprak alanı, yaprak sayısını azalmakta, stomaları daraltarak fotosentez aktivitesini düşürmektedir (Farooq ve ark., 2012). Su kaynağına ulaşamayan bitki köklerinde yüksek miktarda absisik asit (ABA) birikimi olmakta, yüksek aba birikimi potasyum iyon (K+) akışını etkilemekte, yapraklarda biriken absisik asit ısınmaya neden olduğu için terleme kayıplarını arttırmakta ve bunun sonucunda stomaların kapanmasına neden olunmaktadır (Li ve ark., 2020). Ayrıca bitkinin terleme yoluyla su kaybetmesine karşı stomalarını kapatması, karbondioksit alımını azaltmakta ve bu nedenle bitki aktif fotosentez yapamamaktadır (Lawson ve Blatt., 2014).

Normal koşullarda hücrede sürekli denge halinde olan, süperoksit radikali (O2-), hidroksil radikali (OH), hidrojen peroksit (H_2O_2) ve singlet oksijen gibi reaktif oksijen türleri (ROS) strese bağlı olarak dokularda birikmektedir (Büyük ve ark., 2012). ROS'ların dokularda aşırı birikimleri sonucunda yağların oksidasyonu gerçekleşmekte, protein metabolizması bozulmakta ve DNA hasarı ile hücre ölümlerine yol açabilmektedir (Öztürk, 2015). ROS'un toksisitesini azaltmak için bitki hücreleri, düşük moleküler ağırlıklı antioksidanlar gibi koruyucu enzimlerden oluşan güçlü bir antioksidatif savunma mekanizması geliştirmiştir (Şekil 2).



Şekil 2. Antioksidan Savunma Stresi

Enzimatik (süperoksit dismutaz (SOD), peroksidaz (POD), katalaz (KAT), askorbat peroksidaz (APX)) veya enzimatik olmayan (glutatyon, askorbat, tokoferoller, karotenoidler) bu antioksidan molekülleri bitkilerin oksidatif stres ile mücadelede önemli savunma mekanizmalarıdır (Anjum ve ark., 2011; Farooq ve ark., 2012).

KURAKLIK STRESİNDE DEMİRİN KULLANIMI

Kuraklık stresiyle mücadele etmek için stres şartlarında bitkilerde görülen morfolojik, fizyolojik ve biyokimyasal değişikliklerin aydınlatılması ve bitkinin adaptasyon mekanizmalarının iyi anlaşılması gereklidir (Yamaguchi-Shinozaki ve Shinozaki 2006). Ayrıca kurak koşullara dayanıklı yeni çeşitlerin geliştirilmesi kuraklık stresiyle mücadelede çok önemli bir stratejidir. Ancak genetik kaynakların taranması, kuraklığa karşı toleranslı genotiplerin belirlenmesi ve seleksiyon yoluyla bitki ıslah protokollerin gerçekleşmesi uzun vadeli bir çaba gerektirmektedir (Ashraf, 2010). Bu nedenle araştırmacılar kuraklığa toleransı arttırmaya yönelik daha hızlı, ekonomik ve sürdürülebilir stratejiler üzerinde yoğunlaşmıştır. Bitki besin maddelerinin (mikro ve makro) üzerinde yapılan çalışmalar bitki büyüme ve gelişmeyi arttırıcı etkilerinin yanı sıra dışarıdan alınan besin maddelerinin çeşitli abiyotik streslere karşı bitki toleransının arttırılmasında önemli bir rol oynadığını da göstermiştir (Cakmak, 2005; Waraich ve ark., 2014). Kalsiyum (Ca), magnezyum (Mg), kükürt (S), çinko (Zn) ve demir (Fe) gibi bazı besin maddeleri tuzluluk, kuraklık ve ağır metal stresi altında incelendiğinde önemli sonuçlar vermiştir (Tripathi ve ark., 2018; Cakmak, 2005).

Yerkabuğunda en çok bulunan dördüncü ve temel mikro element olan demir, çözünmeyen bir formda bulunması ve büyük ölçüde nötr ve alkali topraklar nedeniyle yüksek bitkiler tarafından kullanılamamaktadır (Shao ve ark., 2007). Demir gibi biyokimyasal ve fizyolojik süreçlerinde önemli görevlere sahip olan mikro elementlerin, abiyotik ve biyotik stres etmenlerinin etkilerinin hafifletilmesinde kullanımı yeni bir yaklaşımdır (Sreelakshmi ve ark., 2021). Enzimler gibi birçok biyokimyasal reaksiyonlar için katalizör görevi gören demir (Fe) bitkilerin büyümesi ve gelişmesi için gerekli bir mikro elementtir (Rout ve Sahoo, 2015). Ayrıca bitkide demir elementinin solunum, fotosentez, kloroplast gelişimi ve klorofil biyosentezi gibi yaşamı sürdüren süreçlerin düzenlenmesinde görevleri mevcuttur (Kim ve Guerinot, 2007). Demir, tuzluluk, kuraklık ve ağır metal stresinin neden olduğu stresin hafifletilmesinde önemli rol

oynamaktadır. Bunun temel nedeni ise, bitkide reaktif oksijen türlerinin (ROS) temizleyicisi olarak görev yapan, katalaz (CAT), peroksidaz ve süperoksit dismutaz (SOD) gibi enzimatik antioksidanları demirin aktive etmesinden kaynaklanmaktadır (Tripathi ve ark., 2018).

Yapılan çalışmalar incelendiğinde, ayçiçeğinde mikro besinlerin uygulanmasının (Fe+Zn+ Cu+Mn) antioksidan enzim konsantrasyonlarının %48-89 düzeyinde arttırdığı ve ayçiçeğinin kuraklığa karşı dayanıklılık geliştirdiği tespit edilmiştir (Rahimizadeh ve ark., 2007). Mısır bitkisi üzerinde yapılan benzer çalışmada ise Se ve mikro besin uygulamasının tek başlarına antioksidan aktivite dahil olmak üzere bitki metabolizmasını etkileyerek kuraklık stresinin mısır verimi üzerindeki olumsuz etkilerini hafifletebileceği belirtilmiştir (Sajedi ve ark., 2011). Kuraklık stresi altında yapraktan yapılan çinko sülfat ve/veya demir sülfat uygulamasının, kuraklık stresinin neden olduğu kayıpların azaltılmasında kullanılabileceği ve her iki mikro besin maddesinin bir araya getirilerek kuraklığa toleransı arttırmada daha etkili olduğu bildirilmiştir (Mannan ve ark., 2022). Benzer şekilde yapraktan eksojen nano-demir uygulamasının kuraklık stresi altında börülce bitkisinde baklada tohum sayısını arttırdığı ifade edilmiştir (Afshar ve ark., 2013).

SONUÇ

Dünyadaki tarım arazilerinin yaklaşık %50'sinin tuzluluk, kuraklık ve ağır metal gibi karmaşık çevresel stres faktörlerinin olumsuz etkilerinden muzdarip olduğu artık bilinmektedir. Bitkilerin stres etmenlerini engelleyici/olumsuz etkilerini ortadan kaldırmak için etkili ve karmaşık biyokimyasal savunma mekanizmaları kullanmaktadır. Kuraklığa toleransı arttırmaya yönelik hızlı, ekonomik ve sürdürülebilir stratejilerden biri olan demir mikro elementi gelecek çalışmalar için umut vericidir. Fe'nin antioksidan savunma sistemi gibi önemli hücresel süreçlerde görev alması nedeniyle stres şartlarında kullanımı etkilidir. Kuraklık stresinin azaltılmasında Fe beslenmesinin önemi hakkında çok fazla şey bilinmese de eksojen uygulamaların stresi hafiflettiği yapılan çalışmalarla kanıtlanmıştır. Fe beslenmesi yoluyla stresin azaltılması alanında kaydedilen büyük ilerlemeye rağmen, hâlâ cevap bekleyen birçok soru mevcuttur. Gelecekte kuraklık stresinde tarımsal verimliliği arttırma sürecine ışık tutabileceği ifade edilebilir.

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FARKLI TOHUM UYGULAMALARININ *Solanum aethiopicum* TÜRÜNDE ÇIKIŞ ÖZELLİKLERİ VE FİDE KALİTESİNE ETKİLERİ

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ÖZET
Bu çalışma Hatay Mustafa Kemal Üniversitesi Fizyoloji laboratuvarında gerçekleştirilmiştir. Sebze yetiştiriciliğinde önemli bir yere sahip olan Solanum cinsine bağlı *Solanum aethipicum* türüne ait tohumlar kullanılarak yürütülmüştür. Sebze yetiştiriciliğinde aşılı fide üretiminde anaç seçimi oldukça önemli bir faktör olarak karşımıza çıkmaktadır. Anaç seçiminde ise türler arası melezler kullanıldığı gibi tür içi anaçlarda kullanılabilmektedir. *Solanum aethiopicum* türü ise özellikle aşılı fide üretimi ve ıslah çalışmalarında stres faktörlerine dayanıklılığı ile tercih edilen yabani bir tür olarak bilinmektedir. Bu kapsamda türe ait tohumlar 3×25 tekerrür×tohum üzerinden torf yetiştirme ortamında çıkış denemesine alınmıştır. Tohumlar çıkış testine alınmadan önce ekim öncesi tohum uygulamalarından GA_3 (250 ve 500 ppm), KNO_3 (%3) uygulamaları yapılmıştır. Sayımlar 20 gün boyunca devam ettirilmiş ve çıkış testi sonrasında ortalama çıkış oranı (%), ortalama çıkış süresi (gün), çıkış indeksi ve çıkış hız katsayısı değerleri alınmıştır. Fide gelişimini tamamlanması ardından fide boy, fide yaş ağırlığı, fide kuru ağırlığı, yaprak sayısı ve gövde kalınlığı ölçümleri gerçekleştirilmiştir. Kontrol tohumlarında çıkış oranı %72 olarak belirlenirken, 500 ppm GA_3 uygulaması ile bu oran %98'lere kadar artış gösterdiği gözlemlenmiştir. 250 ppm GA_3 ve KNO_3 uygulamaları 9.7 gün ile en erken çıkış gösteren uygulama grubu olarak belirlenirken, fide boyu 5.3 cm ile en yüksek 500 ppm GA_3 uygulamasından elde edilmiştir. Fide yaş ağırlığı, fide kuru ağırlığı, gövde kalınlığı ve yaprak sayısı değerleri açısından ise 500 ppm GA_3 uygulamasının kontrol grubu ve diğer ekim öncesi uygulamalara kıyasla öne çıkmıştır. Çıkış hızı indeksi ve çıkış hızı katsayısı bakımından ise 250 ppm GA_3 ve KNO_3 uygulamaları istatistiksel olarak anlamlı olduğu görülmüştür. Fide kalitesini iyileştirici yönü ve en yüksek çıkış oranı değerine sahip olması ile 500 ppm GA_3 uygulamasının çalışmada kullanılan diğer ekim öncesi uygulamalar arasında tür için kullanılması tavsiye edilebilecek en etkin doz ve ekim öncesi tohum uygulaması olduğu belirlenmiştir.
Anahtar Kelimeler: *Solanum aethipicum*, GA_3, KNO_3, priming.

EFFECTS OF DIFFERENT SEED TREATMENTS ON EMERGENCE CHARACTERISTICS AND SEEDLING QUALITY IN *Solanum aethiopicum*

ABSTRACT

This study was carried out in Hatay Mustafa Kemal University Physiology laboratory. It was carried out using seeds belonging to the *Solanum aethiopicum* species, which belongs to the Solanum genus, which has an important place in vegetable cultivation. Rootstock selection is a very important factor in the production of grafted seedlings in vegetable cultivation. In the selection of rootstocks, both interspecific hybrids and intraspecific rootstocks can be used. Solanum aethiopicum species is known as a wild species preferred for its resistance to stress factors, especially in grafted seedling production and breeding studies. In this context, the seeds of the species were tested in peat growing medium with 3×25 replicates×seeds. Before the seeds were taken to emergence test, GA_3 (250 and 500 ppm), KNO_3 (3%) treatments were made as pre-sowing seed treatments. Counts were continued for 20 days and after the emergence test, mean emergence rate (%), mean emergence time (days), emergence index and emergence speed index values were taken. After the completion of seedling development (at the end of 60 days from the beginning of the emergence test), seedling height, seedling fresh weight, seedling dry weight, number of leaves and stem diameter were measured. While the emergence rate of control seeds was determined as 72%, it was observed that this rate increased to 98% with the treatments of 500 ppm GA_3. While 250 ppm GA_3 and KNO_3 treatments were determined as the treatments group showing the earliest emergence with 9.7 days, the highest seedling height was obtained from 500 ppm GA_3 treatments with 5.3 cm. In terms of seedling fresh weight, seedling dry weight, stem diameter and leaf number values, 500 ppm GA_3 treatments stood out compared to the control group and other pre-sowing treatments. In terms of emergence index and emergence speed index, 250 ppm GA_3 and KNO_3 treatments were found to be statistically significant. It has been determined that 500 ppm GA_3 treatments is the most effective dose and pre-sowing seed treatments that can be recommended for the species among other pre-sowing treatments used in the study, as it improves seedling quality and has the highest emergence rate value.

Keywords: *Solanum aethiopicum*, GA_3, KNO_3, priming.

GİRİŞ

Solanaceae familyasının en önemli üyelerinden biri olan patlıcan dünyada 56 milyon ton üretim değerine sahip iken ülkemizde üretim miktarı 832 bin ton olduğu bilinmektedir (TUİK 2021, FAO 2021). Aşılı fide üretiminin önemi göz önüne alındığında aşılı sebze fidesi üretiminde kullanılacak anaç ıslah programlarının yeterli sayıda olmadığı ve bu alanda kullanılacak anaçlarda çeşitliliği arttırmak için farklı türler üzerinde yapılacak çalışmalar önemlidir (Balkaya ve ark., 2015). Çeşitliliğin arttırılmasında en önemli yöntemlerden biri ise türlerin tohum ile fide yetiştiriciliği hakkında detaylı bilgiye sahip olmaktan geçmektedir. Sebze yetiştiriciliğinde kullanılmak üzere aşılama yöntemi ile elde edilecek olan fidelerde seçilecek olan anaçlar kalemin fizyolojik ve morfolojik özellikleri üzerine tesir etmektedir. Bunlar erkencilik, verim, meyve kalitesi, abiyotik ve biyotik streslere dayanım olarak sıralanabilmektedir. Ayrıca aşılı sebze fidesi yetiştiriciliğinde kullanılacak anaçların özelliklerinden tohumlarının homojen fide çıkışı sağlaması, aşı tutma oranını arttırması için hipokotil özelliklerinin iyi olması ve kullanılacak kalem ile iyi bir uyum sağlaması gerekmektedir (Balkaya 2014). Aşılı patlıcan fidesi üretiminde *Solanum torvum, Solanum insanum, Solanum melongena* türlerine ait standart ve hibrit çeşitler kullanılırken, *Solanum melongene*×*Solanum aethiopicum* melezlerinden elde edilen farklı hibrit çeşitler kullanılabilmektedir (Gisbert ve ark., 2011; Balkaya, 2014). Birçok ıslah çalışmasında ise *Solanum aethiopicum* gibi yabani türler kullanılarak geliştirilmek istenen melez bitkilerin dayanıklılığını arttırmak hedeflenmektedir. Örneğin Gisbert ve ark. (2011) yaptıkları çalışmada *S. melongena*×*S. aethiopicum* ile melezlenmesi sonucunda melezlerin anaçlardan daha yüksek oranda çimlenme (% 90) yeteneğine sahip olduğunu ve aşı başarısının (% 100) arttığını belirtmişlerdir.

S. aethiopicum, morfolojik olarak birbirinden farklı olan Shum, Kumba, Aculeatum ve gilo olmak üzere 4 farklı gruptan oluşmaktadır. Meyveleri insan beslenmesinde kullanılmaktadır. Meyve, yaprak ve sürgünlerindeki bu farklılıklardan yola çıkılarak süs bitkisi olarak da kullanılabilmektedir (Lester, 1986; Plazas ve ark., 2014). Türe ait genotiplerin Rize ilimizde tüketildiği ve turuncu patlıcan olarak isimlendirildiği bildirilmiştir (Karataş ve Turan Büyükdinç 2016). Yukarıda belirtilen farklı kullanım alanları ve türe ait yapılan çalışmaların azlığı göz önüne alındığında tohumdan yapılacak yetiştiricilik ile farklı özelliklere sahip genotiplerin tespit edilmesi ve yapılacak farklı tohum uygulamaları ile tohum canlılığının

arttırılmasının yanı sıra bir örnek fide çıkışını arttırmak, fide kalitesini iyileştirilmesini sağlamak gibi amaçlar ile taze tüketim, anaç, ıslah ve süs bitkisi özellikleri için ülkemizdeki çeşitliliğinin artırılması amacıyla Rize bölgesinde yetiştirilen bu genotipin üzerinde çalışması önemlidir. Bu çalışma ile türe ait tohumlara uygulanan 4 farklı ekim öncesi priming uygulamasının tohum canlılığını kontrol grubuna kıyasla ne ölçüde değiştirdiği ve yine kontrol grubuna kıyasla çıkış gücü ve homojenliği üzerine yarattığı etki belirlenmesi amaçlanmış ve ekimden sonraki 60.günde alınacak fide ölçümleri ile yapılan tohum uygulamalarının fide kalitesi üzerine etkilerini belirlemek amaçlanmıştır.

MATERYAL ve YÖNTEM

Çalışma Hatay Mustafa Kemal Üniversitesi Tohum Fizyoloji Laboratuvarında Ocak 2020-Nisan 2020 tarihleri arasında yürütülmüştür. Çalışmada Solanum cinsine bağlı *Solanum aethipicum* türüne ait tohumlar kullanılmıştır. Tohumlar Rize bölgesinden toplanan olgun kırmızı meyvelerden temin edilmiştir (Şekil 1). *Solanum aethipicum* tohumlarında 250 ve 500 ppm GA_3, KNO_3, *Tagates erecta* kullanılarak ekim öncesi farklı tohum uygulamalarının çıkış ve fide özellikleri üzerine etkileri incelenmiştir.



Şekil 1. Çalışmada kullanılan *Solanum aethipicum* türüne ait meyvelerin görüntüsü.

Kontrol (KON): Kontrol grubu herhangi bir uygulama yapılmadan kullanılmıştır.

250 ppm GA_3 uygulaması (HP1): Tohumlar 9 cm'lik petri kaplarında 10 ml 250 ppm GA_3 ile nemlendirilmiş filtre kağıtları arasında 25°C de 24 saat bekletildikten sonra torf yetiştirme ortamına ekilmiştir (Çalışkan ve ark. 2012).

500 ppm GA_3 uygulaması (HP2): Tohumlar 9 cm'lik petri kaplarında 10 ml 500 ppm GA_3 ile nemlendirilmiş filtre kağıtları arasında 25°C de 24 saat bekletildikten sonra torf yetiştirme ortamına ekilmiştir (Çalışkan ve ark. 2012).

KNO_3 uygulaması (OP): Tohumlar 9 cm'lik petri kaplarında 10 ml %3'lük KNO_3 ile nemlendirilmiş filtre kağıtları arasında 25°C de 16 saat bekletildikten sonra torf yetiştirme ortamına ekilmiştir (Demir ve Mavi 2004).

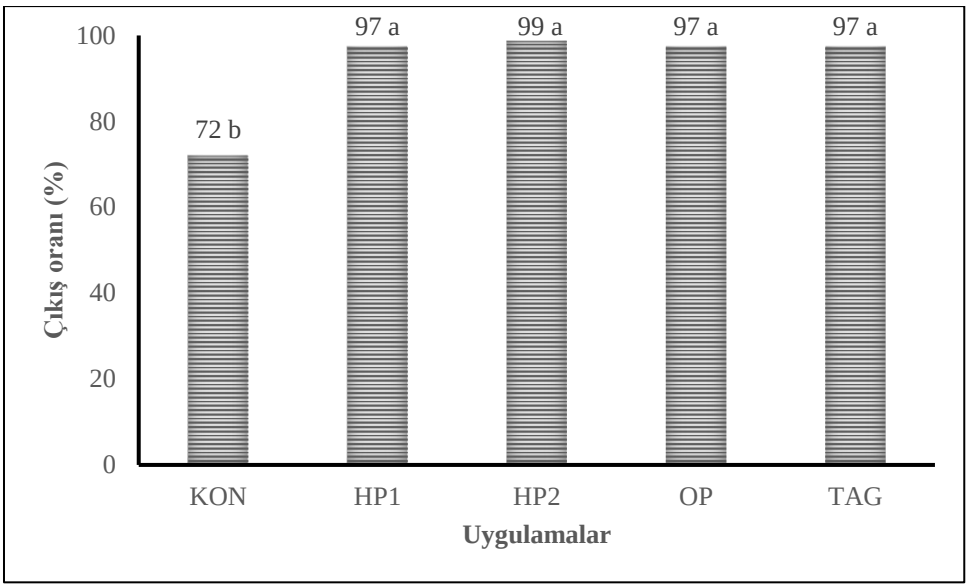
Tagates erecta uygulaması (TAG): Tohumlar 9 cm'lik petri kaplarında 2 g L^{-1} dozunda hazırlanan *Tagates erecta* demleme çayı ile nemlendirilmiş filtre kağıtları arasında 25°C de 16 saat bekletildikten sonra torf yetiştirme ortamına ekilmiştir (Mavi 2016).

Priming uygulamaları sonrasında tüm uygulamalar ve kontrol grubu tohumları 3×25 tekerrür×tohum üzerinden torf yetiştirme ortamında her tekerrür ayrı çıkış kaplarında (195x103x63 mm) olacak şekilde ekimleri gerçekleştirilmiştir.

Fide çıkış testi boyunca fide çıkışları ve gerçek yaprak çıkışları 14 gün süre ile sayılmış ve viyoller 25°C'de iklim kabininde tutulmuştur. Sayım sonunda fide çıkış oranı (%) ve ortalama çıkış süresi 3×25 tekerrür×bitki üzerinden hesaplanmıştır. Ortalama çıkış zamanı fide çıkış denemesi sırasında yapılan günlük sayımlardan elde edilen değerlere göre hesaplanmıştır (Orchard, 1977). Çıkış aşamasında ayrıca ortalama çıkış indeksi ve ortalama çıkış hızı katsayısı (Maguire, 1962) değerleri belirlenmiştir. Çıkış testinin kurulmasından itibaren 60 gün sonunda fide çıkış özelliklerinden fide çıkış özelliklerinden fide boyu, fide yaş ağırlığı, fide kuru ağırlığı, gövde kalınlığı ve yaprak sayısı özellikleri tespit edilmiştir. Tüm verilerin istatistiksel analizi SPSS paket programında Duncan çoklu karşılaştırma testi ile analiz edilmiştir. Farklılıklar $p<0.05$ önem düzeyinde belirlenmiştir.

ARAŞTIRMA BULGULARI VE TARTIŞMA

Solanum aethipicum türüne ait tohumlarda başlangıç canlılığı %72 (KON) olarak belirlenmiştir. Türe uygulanan farklı ekim öncesi tohum uygulaması sonrasında en yüksek çıkış oranı % 99 ile HP2 uygulamasından elde edilirken diğer uygulamaların çıkış oranları %97 olduğu tespit edilmiştir. Kontrol grubuna kıyasla uygulamaların %25-27 oranında artış sağladığı görülmüştür (Şekil 2).

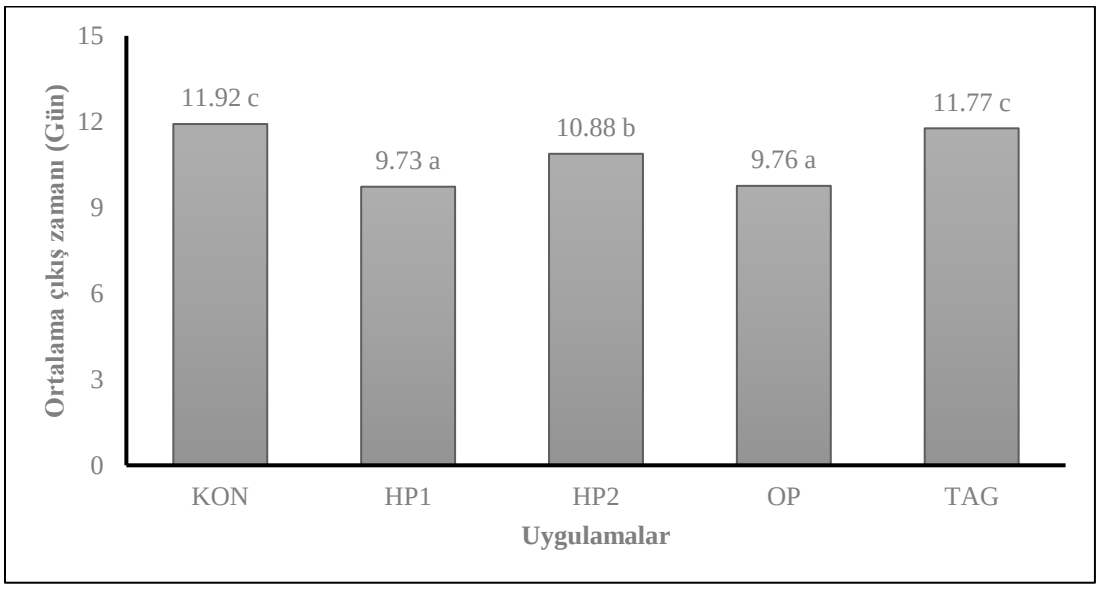


Şekil 2. *Solanum aethipicum* türüne ait tohumların fide çıkış testi sonrası ortalama fide çıkış oranı (%)

Ngode (2021), antesisten sonraki gün sayısına göre çimlenme ve çıkış özelliklerinin değişimi üzerine yaptıkları çalışmada en yüksek çıkış oranın antesisten sonra 76. günde %72 olarak belirlenmiştir. Çalışmamızda da kontrol grubu tohumları %72 başlangıç canlılığına sahip olduğu ve yapılan çalışma ile benzerlik gösterdiği görülmektedir. Mishida (2014), aynı tür üzerinde yaptığı çalışmada GA_3 ve KNO_3 uygulamalarının kontrol grubuna kıyasla çimlenme oranını arttırdığını belirtmiştir. Lopes ve ark. (2012) ise, *Solanum aethiopicum* tohumlarının fizyolojik potansiyelini incelendikleri çalışmada kontrol grubu tohumlarının fide çıkış oranı %67 olarak tespit etmişlerdir. Gisbert ve ark. (2011), petri kaplarının sadece nemlendirilmesi, besin ortamında nemlendirilmesi ve besin+GA_3 ortamında nemlendirilmesi sonucunda farklı patlıcan genotiplerinin çimlenme oranındaki değişimini incelemişlerdir. *Solanum aethiopicum* türüne ait iki farklı genotipin nemli ortamda çimlenme oranlarının %30-40 aralığında olduğu belirlerken, besin ortamında %80'lere ve besin+GA_3 ortamında bu oranın %85-95'lere kadar artış gösterdiğini gözlemlemişlerdir.

Fide çıkış testinin tamamlanmasının ardında ortalama fide çıkış zamanı üzerine uygulamaların istatistiksel olarak anlamlı farklılıklar oluşturduğu görülmektedir. Kontrol grubu tohumları ortalama 11.92 günde çıkışları tamamlanırken HP1 ve OP uygulamaları 2.16-2.19 gün erkencilik sağlayarak çıkışı en kısa sürede tamamlayan uygulama grupları olmuştur. 10.88 gün ile HP2 uygulaması kontrol grubuna kıyasla 1.04 gün erkencilik sağlarken, TAG uygulaması 0.15 gün erkencilik sağladığı görülmüştür (Şekil 3). Türe ait tohumlarda yapılan farklı sıcaklık

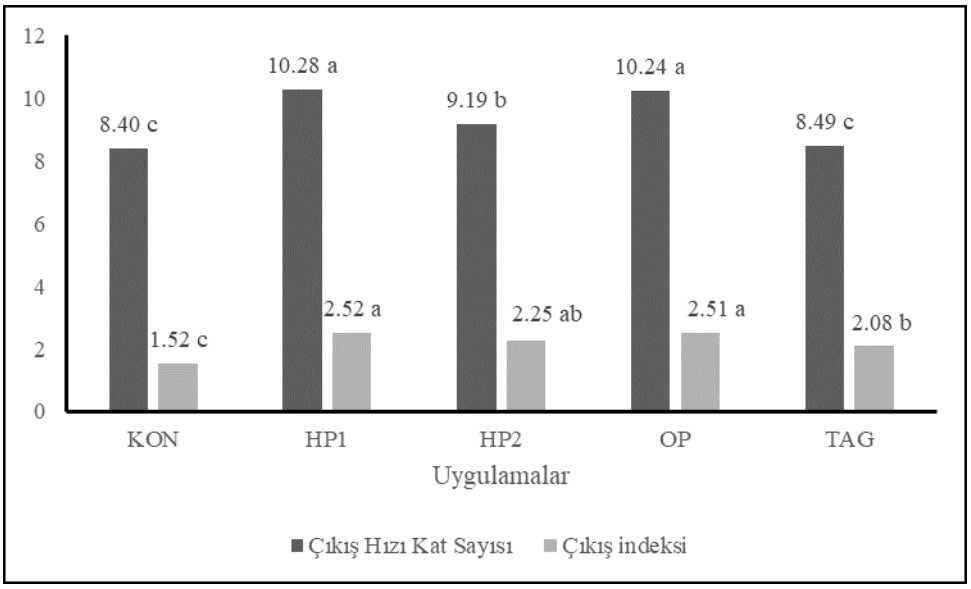
ve ışık altındaki çimlenme testi sonrasında çimlenme zamanları 5-8.5 günde tamamlandığı belirtilmiştir (Botey ve ark. 2022). Yapılan çimlenme testi sonuçları incelendiğinde fide çıkışın daha geç sürede tamamlanması beklenmektedir. Ancak çalışmamızda çıkış zamanı 9.73 ile 11.92 gün aralığında değişim gösterdiği tespit edilmiştir. Mavi ve Uzunoğlu (2020), allelopatik etkiye sahip farklı bitki ekstraktlarını kullanarak *Solanum betaceum* cav. tohumlarına ekim öncesi priming uygulamaları gerçekleştirmişlerdir. Uygulama sonrası ortalama çıkış zamanı üzerine uygulamaların kontrol grubuna kıyasla 3.18-4.16 gün aralığında erkencilik sağlamıştır. En erkenci grup ise 10.55 gün ile FER uygulaması olduğunu ifade etmişlerdir. Çalışmada kullandığımız türe en yakın akrabalarından biri olan bu türün çıkış zamanı ve çalışmada kullandığımız türe ait ortalama çıkış zamanı verileri incelendiğinde *Solanum aethiopicum* türünün *Solanum betaceum'a* göre daha erken çıkış gösterdiği söylenebilir.



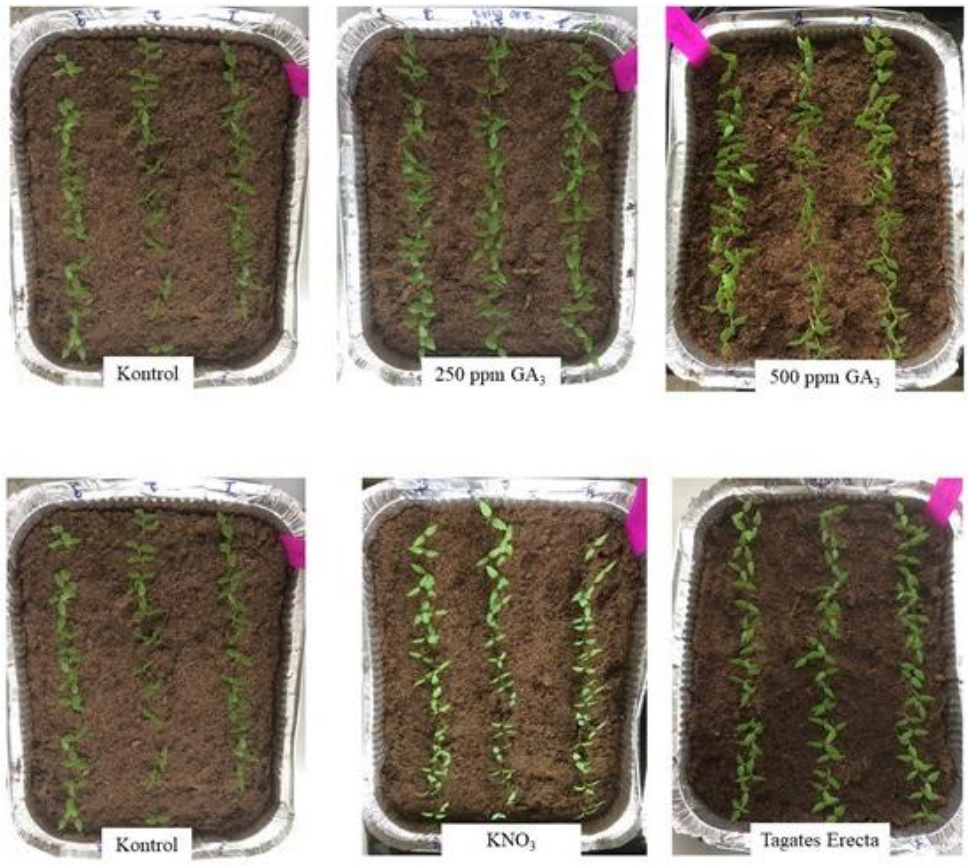
Şekil 3. *Solanum aethipicum* türüne ait tohumların fide çıkış testi sonrası ortalama fide çıkış zamanı (gün)

Fide çıkış testi sonrası hesaplanan çıkış hızı kat sayısı ve çıkış indeksi değerleri incelendiğinde her iki grup içinde tüm uygulamaların kontrol grubuna kıyasla daha yüksek sonuçlar verdiği görülmektedir (Şekil 4). Çıkış hız kat sayısı değeri (10.28) ve çıkış indeksi değeri (2.52) en yüksek olan uygulama grubunun HP1 uygulama grubu olduğu belirlenmiştir. OP uygulama grubu ise HP1 uygulamasından sonra en yüksek çıkış hızı katsayısı ve çıkış indeksi değerlerine sahip olduğu gözlemlenmiştir. *Solanum betaceum* tohumlarında farklı priming uygulamalarının çıkış indeksi ve çıkış hızı katsayısı üzerindede olumlu sonuçlar verdiği görülmüştür. Çıkış indeksi değerini 0.7-0.9 aralığında arttırırken, çıkış hızı kat sayısı değerini 1.95-2.57 aralığında

arttırdığı tespit edilmiştir (Mavi ve Uzunoğlu, 2020). Tüm sonuçlar incelendiğinde ekim öncesi yapılan her uygulamanın kontrol grubu tohumlarına kıyasla çıkış özelliklerini arttırdığı tespit edilmiştir. Uygulamalar ve KON grubu tohumlarının çıkış oranı ve çıkış özellikleri üzerindeki değişim ve farklılıklar Şekil 5'de görülmektedir.



Şekil 4. *Solanum aethipicum* türüne ait tohumların fide çıkış testi sonrası çıkış hızı kat sayısı ve çıkış indeksi değerlerinin uygulamalar arasındaki değişimi



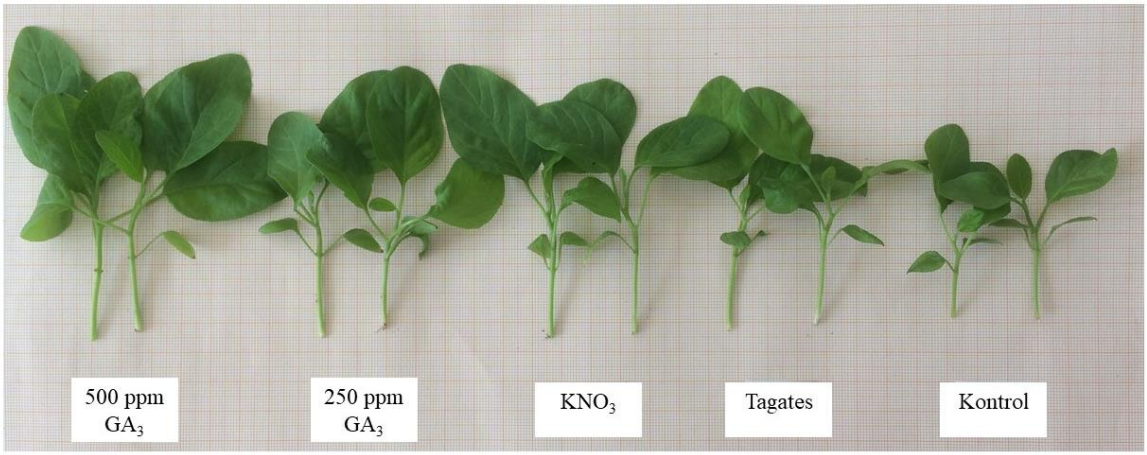
Şekil 5. *Solanum aethipicum* türüne ait tohumların fide çıkış testi sonrası görünümleri

Aşı ve ıslah çalışmalarında homojen çıkış ve çıkış oranının yüksek olmasının yanı sıra kaliteli fidelere sahip olması anaç dayanıklılığını arttırması hedeflenmektedir. Kontrol grubu tohumlarına kıyasla (KON) uygulanmış tohumlar (HP1, HP2, OP ve TAG) ile yapılan fide çıkış testi sonrasında sonuçlar arasında istatistiksel anlamda önemli farklılıklar bulunduğu görülmüştür. Kontrol grubu tohumlarının 3.16 cm fide boyu ile en kısa fide boyuna sahip olduğu, 211 mg fide yaş ağırlığı ve 17.4 mg fide kuru ağırlığı değerleri açısından da en düşük ağırlığa sahip olduğu saptanmıştır. Gövde kalınlığı değeri (1.18 cm) ve yaprak sayısı (2) açısından da KON grubu diğer uygulamalara kıyasla en düşük sonuçları verdiği tespit edilmiştir. Fide gelişimini en yüksek oranda iyileştirdiği tespit edilen uygulama grubun HP2 grubunun olduğu diğer uygulamaların ise OP, HP1 ve TAG şeklinde sıralandıkları belirlenmiştir (Tablo 1).

Tablo 1. *Solanum aethipicum* türüne ait tohumların fide çıkış testi sonrası fide özellikleri üzerindeki değişimi

Uygulamalar	Fide Boy (cm)	Fide Yaş Ağırlık (mg)	Fide Kuru Ağırlık (mg)	Gövde Kalınlığı (mm)	Yaprak Sayısı (adet)
KON	3.16 e	211.0 d	17.40 b	1.18 e	2 c
HP1	4.07 c	347.6 c	25.73 b	1.40 c	3 b
HP2	5.29 a	649.5 a	49.87 a	1.68 a	4 a
OP	4.71 b	482.6 b	42.73 a	1.52 b	4 a
TAG	3.61 d	284.6 cd	19.40 b	1.32 d	3 b

HP2 uygulaması ile 5.29 cm ile fide boyu kontrole kıyasla 2.13 cm artış gösterirken 649.5 mg ile fide yaş ağırlığını 438.5 mg arttırdığı, 49.87 mg değeri ile fide kuru ağırlığı değerini 32.47 mg arttırmıştır. Gövde kalınlığında HP2 uygulaması KON grubuna kıyasla 0.50 cm artış sağlamış ve gelişen yaprak sayısının KON grubundan 2 adet daha fazla olduğu belirlenmiştir. Yapılan tüm ekim öncesi tohum uygulamalarının *Solanum aethiopicum* türünde fide kalitesini iyileştirici etki sağladığı tespit edilmiştir (Şekil 6).



Şekil 6. *Solanum aethipicum* türüne ait tohumların fide çıkış testi sonrası fide ölçümlerinin alındığı aşamadaki uygulamalar göre fide gelişimleri

Solanum betaceum cav. fide boyu, fide yaş ağırlığı ve fide kuru ağırlığı verileri incelendiğinde kontrol grubuna kıyasla yapılan priming uygulamalarının fide özelliklerini iyileştirdiğini belirtilmiştir (Mavi ve Uzunoğlu, 2020). Kontrol grubu 5.6 cm fide boyuna sahip olurken

uygulamalar ile fide boyu 0.64-1.01 cm aralığında arttırdığı görülmüştür. Uygulamalar kontrole kıyasla fide yaş ağırlığını 90-153 mg aralığında arttırırken, fide kuru ağırlığı değerini 7.9-11.6 mg aralığında arttırmıştır.

Aşılamada toprak kökenli hastalık ve zararlılara dayanıklılık için kullanılmasının yanı sıra, meyvesi tüketilen ve süs bitkisi potansiyeline sahip ülkemiz için önemli bir gen kaynağı olarak gördüğümüz *Solanum aethiopicum* türünde ülkemizde yetişen bir genotip üzerinde yapılan bu çalışma ülkemizdeki ilk çalışma olma özelliğine sahiptir. Deneme sonrası başlangıç canlılığı, çıkış zamanı, çıkış hız katsayısı ve çıkış indeksi değerleri açısından öne çıkan uygulama grubun HP1, HP2 (250-500 ppm GA_3) ve OP (KNO_3) uygulama grupları olduğu tespit edilmiştir. Ekim öncesi yapılan farklı priming uygulamalarının fide gelişimi üzerine etkinliği ise en çok HP2 (500 ppm GA_3) uygulaması ve OP (KNO_3) uygulamaları ile sağlandığı gözlemlenmiştir. GA_3 ve KNO_3 uygulamalarının fidelerin büyüme ve gelişimini desteklediği saptanmıştır. Kontrol grubunun özellikle aşı çalışmalarında önem arz eden bir özellik olarak görülen gövde çapının uygulamalara kıyasla geride kaldığı tespit edilmiştir. Sonraki çalışmalarda genotip üzerinde meyve özelliklerinin belirlenmesi ve farklı genotiplerle melezlemeler yapılarak ülkemize ait çeşitlerin geliştirilebilmesi için üzerinde çalışmaların devam etmesi gerekmektedir.

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KAZLARDA YUMURTA VERİMİ İLE BAZI İKLİM FAKTÖRLERİ ARASINDAKİ İLİŞKİNİN BELİRLENMESİ

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ÖZET
Bu çalışmada, kazlarda yumurta verimi ile sıcaklık, yağış ve rüzgar arasındaki ilişkinin belirlenmesi amaçlandı. Bu amaçla Van İli Erciş İlçesi Açık Ceza İnfaz Kurumu Damızlık Kaz üretme çiftliğinde bulunan kaz sürüsünden yumurtlama döneminde (Şubatın son iki haftası ve Mart-Nisan-Mayıs-Haziran aylarında) elde edilen günlük yumurta sayları kullanılmıştır. Yumurta verileri modelde bağımlı (açıklanan) değişken olarak yer aldı. İlgili tarihler için MGM'nin Van ili Erciş istasyonundan sıcaklık, nem ve yağış kayıtları alınmış ve bu değişkenler modelde açıklayıcı değişken olarak yer aldı. Verilerin analizinde sırasıyla Poisson regresyon, Negatif Binom regresyon, şansa bağlı etkili Poisson regresyon ve şansa bağlı etkili Negatif Binom regresyon modelleri kullanıldı. Analizler SAS 9.4 istatistik paket programında yapıldı. Sonuçlar AIC, AICC ve BIC model uyum kriterlerine göre değerlendirildi Yumurta sayısındaki değişimi en iyi açıklayan modelin en küçük AIC (880.56), AICC (881.06) ve BIC (885.01) değerlerine sahip şansa bağlı etkili Poisson regresyon modeli olarak belirlendi. Bu modele göre, sıcaklığın yumurta verimi üzerine etkisi negatif yönde olurken rüzgar ve yağmurun pozitif yönde etki ettiği ortaya koyuldu.
Anahtar Kelimeler: İklim etkisi, Poisson, Negatif Binom, Şansa bağlı, Yumurta verimi

DETERMINATION OF THE RELATIONSHIP BETWEEN EGG PRODUCTION IN GEESE AND SOME CLIMATE FACTORS

ABSTRACT
This study aimed to determine the relationship between egg production in geese and temperature, precipitation and wind. For this purpose, daily egg numbers obtained from the geese flock in the Breeding Goose Breeding Farm of Van Province Erciş District Open Penal Institution during the egg laying period (the last two weeks of February and March-April-May-June) were used. Egg data was included in the model as the dependent (explained) variable. Temperature, humidity and precipitation records were taken from MGM's Van province Erciş station for the relevant dates and these variables were included in the model as explanatory variables. Poisson regression, Negative Binomial regression, Poisson regression with random effects and Negative Binomial regression model with random effects were used in the analysis of the data, respectively. Analyzes were made in the SAS 9.4 statistical package program. The results were evaluated according to AIC, AICC and BIC criteria. The model that best explained the change in the number of eggs was determined to be the random-effects Poisson regression model with the smallest AIC (880.56), AICC (881.06) and BIC (885.01) values. According to this model, it was revealed that the effect of temperature on egg production was negative, while wind and rain had a positive effect.
Keywords: Climate effect, Poisson, Negative Binomial, Random, Egg yield

GİRİŞ

Regresyon denkleminde bağımlı değişkenlerin sayma verisi olması durumunda genelleştirilmiş doğrusal regresyon modelleri kullanılır. Bu tip verilerin analizi için yaygın olarak Poisson regresyon kullanılmaktadır. Poisson regresyonu ortalama ve varyansın birbirine eşit olması varsayımına sahiptir. Ancak bu varsayım uygulamada nadiren geçerliliğini korur. Dağılımın varyansının ortalamasından büyük olması, aşırı yayılım olarak adlandırılır ve genel olarak uygulamada aşırı-yayılımla karşılaşılır. Bu durumda varysansın ortalamaya eşit olma varsayımından bağımsız Negatif Binomiyal (NB) regresyon kullanılır. Ancak heterojenlik kaynaklarından bir diğeri verilerin yapısıdır. Genel doğrusal modellerde (GLM) bağımsızlık varsayımının geçerliliğini yitirmesi durumunda da aşırı yayılım ortaya çıkabilir. Bu durumda modele şansa bağlı etki dahil edilerek Genel doğrusal karışık modeller (GLMM) kullanılır. Literatürde karışık etkili models (mixed effects model), çok düzeyli modeller (multi level models) veya hiyerşik models (hiararchical models) isimleriyle anılır ve GLMM başlığı altında incelenir (Dobson, 2022)

Hayvan yetiştiriciliğinde döl verimi hayvansal üretime etkisi en yüksek özelliktir. Kanatlı hayvanlarda döl verimi yumurta verimi anlamına gelir. Dolayısıyla yumurta verimi uygun kuluçka koşulları sağlandığı takdirde yavru verimi ile eş anlamlı olmaktadır. Kazlarda yumurta verimi yumurtlama periyodunun uzunluğu ile ilişkili olup mevsimseldir. Gün uzunluğunun artmasıyla ile başlayan yumurta verimi ırklara göre değişmekle birlikte yaklaşık olarak 130 gün kadar devam eder. Bu dönem genel olarak şubat ayı ile başlayıp haziran ayının sonunda tamamlanır (Arslan ve Saatci, 2003; Kırmızıbayrak, 2016).

Bu çalışmada, kazlarda yumurta verimi ile sıcaklık, yağış ve rüzgar arasındaki ilişkinin belirlenmesi amaçlandı. Bu amaçla Van İli Erciş İlçesi Açık Ceza İnfaz Kurumu Damızlık Kaz üretme çiftliğinde bulunan kaz sürüsünden yumurtlama döneminde (Şubatın son iki haftası ve Mart-Nisan-Mayıs-Haziran aylarında) elde edilen günlük yumurta sayları kullanıldı. Yumurta verileri modelde bağımlı (açıklanan) değişken olarak yer aldı. MGM'nin Van ili Erciş istasyonundan ilgili tarihleri kapsayan sıcaklık, nem ve yağış kayıtları alındı ve bu değişkenler modelde açıklayıcı değişken olarak yer aldı. Verilerin analizinde sırasıyla Poisson regresyon, NB regresyon, şansa bağlı etkili Poisson regresyon ve şansa bağlı etkili NB regresyon modelleri kullanıldı. Analizler SAS 9.4 istatistik paket programında yapıldı.

MATERYAL ve YÖNTEM

Materyal: Çalışma verisi Van İli Erciş İlçesi Açık Ceza İnfaz Kurumu Damızlık Kaz üretme çiftliğinde bulunan kaz sürüsünden Şubatın son iki haftası ve Mart-Nisan-Mayıs-Haziran (toplamda 18 hafta) aylarında toplanan yumurtalar ve ilgili tarihler arasında MGM'nin Van ili Erciş istasyonundan alınan sıcaklık, nem ve yağış kayıtları kullanılmıştır.

Yöntem: Poisson regresyonu sayma verilerinin cevap değişkenlileri için kullanılan bir istatistik modeldir. Poisson dağılımına sahip olan her bir y değişkeni için $y_i \sim iidPoisson(\lambda_i)$ varsayımı yapılır (Yirga ve ark., 2020). Poisson parametresi λ_i için model Eşitlik 1'deki gibi olur.

$$log(\lambda_i) = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \ldots + \beta_p x_{ip} \quad (1)$$

Eşitlik 1'in denk formu aşağıda verildiği gibi yazılır.

$$\lambda_i = e^{\beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \ldots + \beta_p x_{ip}} \quad (2)$$

Burada $x_1, x_2, \ldots, x_p$ p kadar açıklayıcı değişkeni, ve $\beta_0, \beta_1, \ldots, \beta_p$ regresyon katsayılarını gösterir. λ_i parameytreli Poisson değişkenine ait olasılık fonksiyonu Eşitlik 3'de verildiği gibi olur (Dobson, 2002; Rodriguez ve ark., 2002).

$$f(y; \lambda) = \frac{e^{-\lambda} \lambda^y}{y!} \quad y = 0,1,\ldots,n \quad (3)$$

Poisson dağılımından gelen bir y_i değişkeni için olabilirlik fonksiyonu Eşitlik 4'de verildi.

$$l(\theta, \varphi; y) = y\, log(\lambda) - \lambda - log(y!) \quad (4)$$

Bu eşitliğin denk formu

$$= \sum_{i=1}^{n} y\, log(\lambda) - \lambda - log(y!) \quad (5)$$

Buna göre p kadar açıklayıcı değişken $x_1, x_2, \ldots, x_p$ p kadar açıklayıcı değişkeni, ve $\beta_0, \beta_1, \ldots, \beta_p$ regresyon katsayıları için,

$$\ell(\beta_0, \ldots, \beta_p) = \sum_{i=1}^{n} \left| y_i \left(\sum_{j=0}^{p} \beta_j x_{ij} \right) - e^{\sum_{i=0}^{n} \beta_j x_{ij}} - lny_i! \right|$$

$$= \sum_{i=1}^{n} \{ y_i x_i' \beta - exp(x_i' \beta) - lny_i! \}. \quad (6)$$

yazılır.

Ortalaması λ_i olan bir y_i değişkeninin Poisson dağılımına sahip olduğu ($y_i \sim iidPoisson(\lambda_i)$) varsayıldığında y_i'nin ortalaması varyansına eşit olur. Bu durum değişkeni y_i~Poisson(λ_{ij}), dolayısıyla $E(y_i) = var(y_i) = \lambda_i$ şeklinde ifade edilir. Poisson dağılımının karakteristik özelliği olan bu varsayım her zaman yerine getirilemeyebilir. Gerçek verilerle çalışıldığında bazen varyans ortalamadan büyük olur. Bu durum aşırı yayılım olarak isimlendirilir ve varyansın ortalamadan büyük olması durumunda Negatif Binomial regresyon model kullanılır. Varyans ve ortalama arasındaki ilişkiyi açıklamak üzere Eşitlik 7 verildi.

$$Var(y_i) = E(y_i) = \varphi \lambda_i \quad (7)$$

Burada φ yayılım parametresini gösterir. Eğer $\varphi > 1$ ise aşırı yayılımdan, $\varphi < 1$ ise az yayılımdan bahsedilir. Bu durumların herhangi biri gerçekleştiğinde Poşsson dağılım artık uygun değildir. ı, $\varphi = 1$ ise bilinen Poisson dağılım geçerli olur. Aşırı yayılımlı veri için Poisson regresyon model kullanılırsa standart hataların değerlerinin düşük olmasına ve güvenilir olmayan tahminlerin yapılmasına neden olabilir(Hilbe, 2011; Stroup, 2012). Bu sorunun üstesinden gelmek amacıyla aşırı yayılımlı verilerin analizi için Negatif Binomiyal model önerilmaktedir (McCullagh ve Nelder;1989; Rodriguez ve ark,, 2002).

NB model Poisson modelin genelleştirilmiş halidir. NB regresyonda ortalamanın varyansa eşti olması varsayımını aranmaz. NB regresyon model ortalamadan daha yüksek bir varyansa izin

veren sayma verisi için geçerli bir dağılım kullanır. NB dağılımına sahip bir y değişkeni için olasılık fonksiyonu aşağıdaki Eşitlik 8'de verildiği gibi olur (Cameron ve Trivedi, 2013; Agresti, 2015**).**

$$\Pr(Y_i = y_i) = \frac{\Gamma(y_i+\alpha^{-1})\alpha^{y_i}\lambda_i{}^{y_i}}{y_i!\Gamma(\alpha^{-1})(1+\alpha\lambda_i)^{y_i+\alpha^{-1}}} \qquad y_i = 0,1,2... \qquad (8)$$

NB dağılıma ilişkin ortalama $E(y_i) = \mu_i$ ve varyans $Var(y_i) = \mu_i + \alpha\mu_i^2$ olur. Burada $\alpha = 0$ olunca Negatif Binomiyal model Poisson modele denk olur. Eştlik 8 için olabilirlik fomksiyonu Eşitlik 9'da verildiği gibidir.

$$L(\beta, \alpha) = \prod_{i=1}^{n} \frac{\Gamma(\alpha + k_i)}{k_i\Gamma(\alpha)} \left(\frac{\theta_i}{1+\theta_i}\right)^{k_i} \left(\frac{1}{1+\theta_i}\right)^{\alpha} \qquad (9)$$

$$\ell(\beta, \alpha) = \sum_{i=1}^{n} \left(\sum_{j=0}^{k_i-1} \log(\alpha + j) - log k_i! + k_i log\theta_i - (k_i + \alpha)\log(1 + \theta_i \right)$$

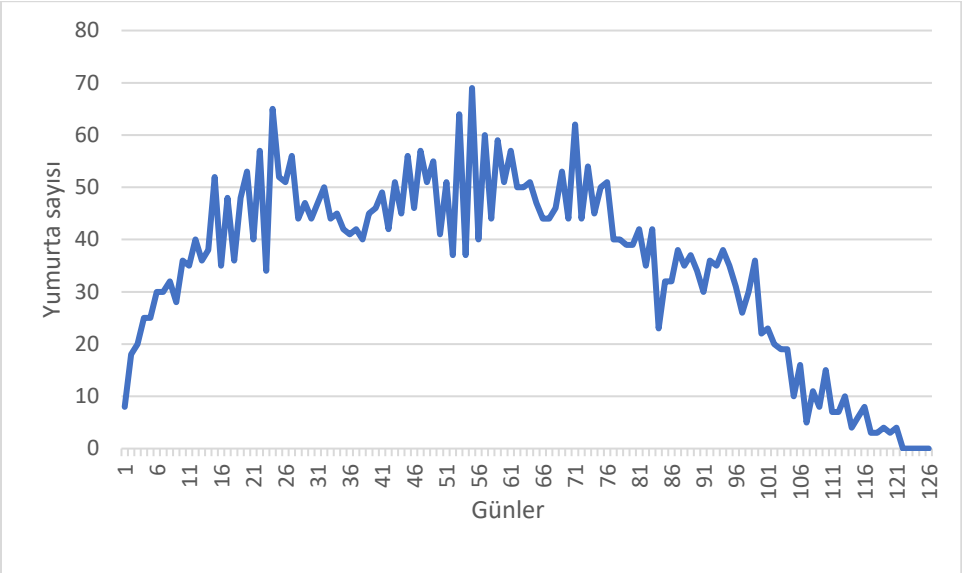
Tekrarlamalı ölçümler söz konusu olduğunda GLM'de gözlemlerin bağımsızlığı varsayımı geçerliliğini yitirmektedir. Bu nedenle GLMM (genel doğrusal karışık modeller)'de şansa bağlı etki (subject-spesific) modele dahil edilir. Zaman içinde tekrarlamalı olarak elde edilen sayma verileri için bağımsızlık varsayımı geçerliliğini yitirdiğinde bağımlılığı modelleyecek bir şansa bağlı etki modele dahil edilir. j'ninci zamandaki i'ninci ölçüm için y_{ij} verilsin. Karışık etkili Poisson regresyon modeli Eşitlik 10'da verildiği gibi olur.

$$log(\lambda_{ij}) = x'_{ij}\beta + z'_{ij}b_i + \varepsilon_{ij} \qquad (10)$$

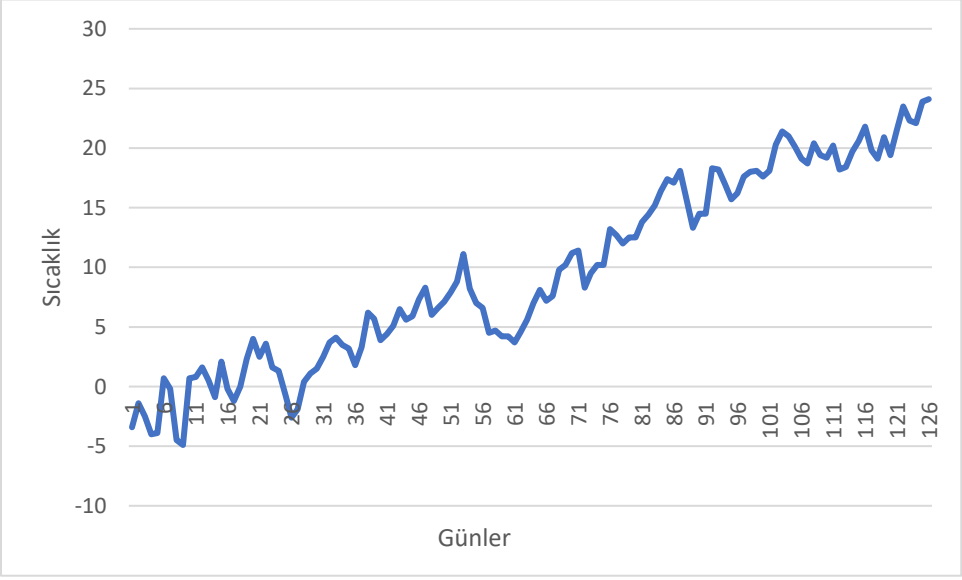
Burada x'_{ij}ilgilenilen değişkenlerin katsayı vektörü, β sabit etkiler vektörü, z'_{ij} şansa bağlı etkiler katsayı matrisi, ve b_i şansa bağlı etkiler vektörü ε_{ij} şansa bağlı hata terimidir. Bu denklem aşırı yayılımı modellemeye izin veren Negatif Binomiyal regresyon için de geçerlidir.

BULGULAR ve TARTIŞMA

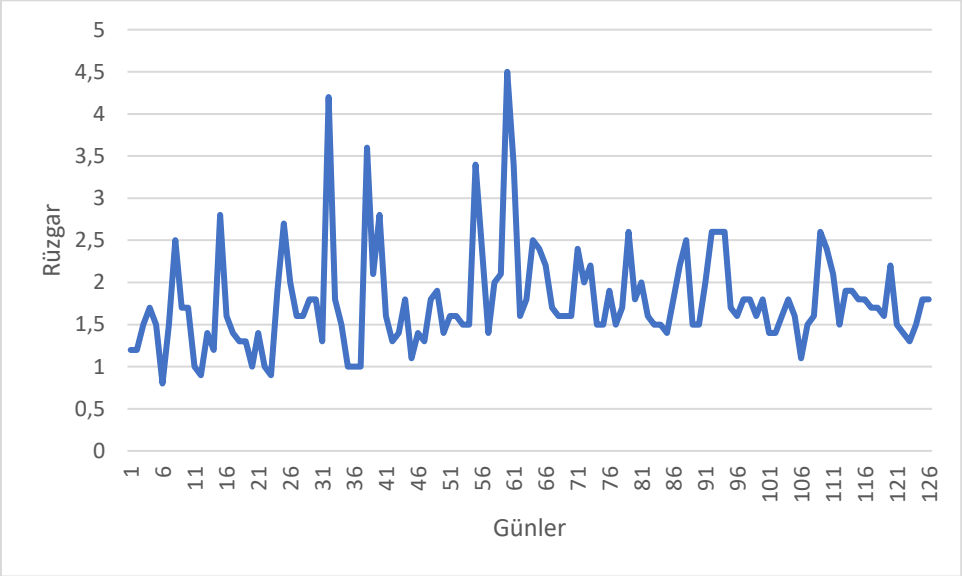
Merada beslenen kazlar Şubat ayının ikinci haftasından itibaren yumurtlamaya başlamış ve haziran ayının sonuna kadar yumurta verimleri takip edilmiştir. Yumurta verimlerinin takip süresi 18 hafta olup 126 güne tekabül etmektedir. Bu döneme ait günlük yumurta verimi, günlük sıcaklık ve rüzgar verilerine ait grafikler Şekil 1, Şekil 2, Şekil 3 ve Şekil 4'te verildi.



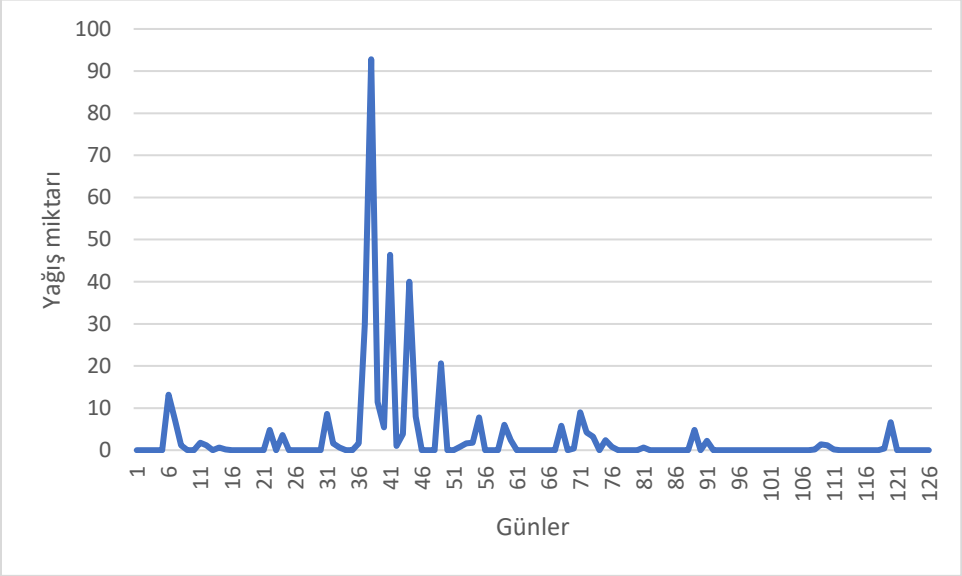
Şekil 1. Yumurta sayısının günlere göre dağılımı



Şekil 2. Sıcaklığın günlere göre dağılımı



Şekil 3. Sıcaklığın günlere göre dağılımı



Şekil 3. Yağış miktarının günlere göre dağılımı

Günlük yumurta sayılarının kaydedildiği günler için yumurta sayısı, sıcaklık rüzgar ve yağış miktarına ait tanıtıcı istatistikler Tablo 1'de verildi. Tablo 1'e göre en çok yumurta sayısı 69 olup 126 günlük takip süresi içinde ortalama 25 yumurta alınmıştır. Sıcaklıkta en düşük değer

-4.2 olup en yüksek değerin 24 olduğu ve ortalama sıcaklığın 9.59 derece olduğu görülmektedir. En az rüzgar hızı 0.8 olup en yüksek 4.5 ve ortalama rüzgar hızının 1.78 m/s olduğu, yağış miktarı metrekarede kg olarak ölçülmüş ve ortalama 2.93 olmuştur (Tablo 2). Yağış aynı zamanda ikili karakter olarak değerlendirildi ve havanın yağışlı olmaması 1, yağışlı olması 2 olarak kodlanarak ilgili sonuçlar Tablo 2'de sunuldu.

Tablo1. Yumurta sayısı ve bazı iklim verilerine ait tanıtıcı istatistikler

Değişken	N	Min	Mix	Ortalama	Median	Std. Sapma
Yumurta Sayısı	126	0	69	35.19	39.0	17.23
Sıcaklık	126	-4.9	24.1	9.59	8.2	7.98
Rüzgar	126	0.8	4.5	1.78	1.6	0.60
Yağış	126	0	92.8	2.93	0	10.39
Yağış (Var/Yok)	126	1	2	1.38	1	0.48

Çalışma verisine Poisson regresyon analizi uygulandı ve elde dilen sonuçlar Tablo 2'de verildi. Tabloda tahmin değerleri ve standart hatalar, güven sınırları ve anlamlılık düzeyleri yer aldı.

Tablo 2. Poisson regresyonu ile elde edilen parametre tahminleri

Değişken	**Tahmin**	**Standart Hata**	**95% Güven Sınırı**		**Khi_kare**	**P**
Sabit	1.9330	0.1194	1.6990	2.1670	262.12	<.0001
Hafta	-0.2059	0.0214	-0.2478	-0.1640	92.92	<.0001
Sıcaklık	0.0826	0.0135	0.0561	0.1091	37.30	<.0001
Rüzgar	1.4339	0.0878	1.2618	1.6061	266.51	<.0001
Yağış	0.1131	0.0309	0.0525	0.1737	13.37	0.0003

Tablo 2'de Poisson regresyon modelinde yer alan hafta, sıcaklık, yağış ve rüzgar değişkenlerinin yumurta sayısındaki değişimi açıklamada anlamlı olduğu görülmektedir.

Aşırı yayılımın varlığını test etmek üzere Poisson regresyon modelinden elde edilen uyum ölçütleri Çizelge 3'de verildi. Aşırı yayılımım belirleyicisi olan sapma değerinin yaklaşık 5.8 olduğu verilen çizelgede görülmektedir. Bu değerin birden büyük olması verinin aşırı yayılımlı olduğunu göstermektedir (Hilbe, 2011; Hilbe, 2014). AIC, AICC ve BIC değerleri bu modeli

diğer modellerle karşılaştırmak amacıyla kullanıldı. En küçük olan uyum kriterine sahip model değişimi en iyi açıklayan model olarak belirlenir.

Tablo 3. Poisson regresyonuna ait uyum ölçütleri

Uyum Ölçütleri			
Uyum İstatistikleri	**SD**	**Değer**	**Değer/SD**
Sapma (Deviance)	121	697.0138	5.7604
AIC		1344.2932	
AICC		1344.7932	
BIC		1358.4746	

SD: Serbestlk derecesi

Verinin aşırı yayılımlı olduğu tespit edildiği için veri NB regresyon modeli kullanılarak analiz edildi ve ulaşılan sonuçlar Çizelge 4'de ve model uyum ölçütleri Çizelge 5'de verildi.

Tablo 4. Negatif Binomiyal regresyonu ile elde edilen parametre tahminleri

Değişken	Tahmin	Standart Hata	95% Güven Sınırı		Khi_kare	P
Sabit	1.4257	0.3598	0.7204	2.1309	15.70	<.0001
Hafta	-0.3760	0.0627	-0.4989	-0.2532	36.01	<.0001
Sıcaklık	0.1755	0.0395	0.0982	0.2529	19.79	<.0001
Rüzgar	2.0999	0.2613	1.5877	2.6120	64.58	<.0001
Yağış	0.1288	0.0874	-0.0425	0.3000	2.17	0.1406
Dispersion	0.1805	0.0304	0.1298	0.2511		

Veriye Negatif Binomial regresyon uygulandığında hafta, sıcaklık ve rüzgarın etkisi anlamlı çıkarken (P<0.001) yağışın yumurta verimi üzerine etkisi anlamlı bulunmamıştır.

Tablo 5. Negatif Binomial regresyonuna ait uyum ölçütleri

Uyum Ölçütleri			
Uyum İstatistikleri	**SD**	**Değer**	**Değer/SD**
Deviance (Sapma)	121	155.1443	1.2822
AIC		1039.7820	
AICC		1040.4879	
BIC		1056.7997	

Sapma yani deviance değerinin Poisson regresyondaki değerden daha küçük olup NB regresyon kullanıldığında sapma yaklaşık 1.3 olarak elde edildi (Tablo 5).

Aşırı yayılımı modellemenin bir diğer çözümü verinin bağımsızlık yapısını dikkate alarak modele şansa bağlı etki dahil edilmesidir (Hilbe, 2011; Hilbe, 2014). Dolayısıyla olarak aşırı yayılımı modelleyebilmek amacıyla literatürle uyumlu verinin analizi için karışık etkili Poisson regresyon ve karışık etkili NB regresyon modelleri kullanıldı. Bu iki modeli karşılaştırabilmek amacıyla öncelikle model uyum kriterleri Tablo 6'da veridi.

Tablo 6. Karışık etkili Poisson ve Karışık etkili NB regresyon için uyum ölçütleri

Karışık Etkiler Modeli		
Uyum İstatistikleri	Poisson Regresyon	Negatif Binomiyal Regresyon
Sapma (Deviance)	1.02	1.00
AIC	880.56	882.54
AICC	881.06	883.25
BIC	885.01	887.88

Sapma değeri her iki modelde de yaklaşık 1.0 olarak elde edildi. Diğer uyum ölçütleri değerlendirildiğinde karışık etkili Poisson regresyon modelinin uyum ölçütleri (AIC, AICC, BIC) karışık etkili NB modelinkinden daha küçük olmuştur. Literatürde uyum ölçütleri küçük değere sahip olan model veriyi en iyi açıklan model olarak belirlenmektedir. Literatürle uyumlu olarak sapma ve uyum ölçütleri dikkate alındığında yumurta verimindeki değişimi en iyi açıklayan modelin karışık etkili Poisson regresyon modeli olduğu sonucuna varıldı. Tablo3, Tablo 5 ve Tablo 6'da verilen sapma, AIC, AICC ve BIC değerlendirildiğinde karışık etkili Poisson regresyon modelinin Poisson ve NB regresyondan daha iyi olduğu ortaya koyuldu.

Çalışma verisini en iyi açıklayan model karışık etkili (çok düzeyli) Poisson regresyon modeli olduğu için bu modelden elde edilen tahminler Tablo 7'de verildi.

Tablo 7. Karışık etkili Poisson regresyonu ile elde edilen parametre tahminleri

Sabit Etkiler	Tahmin	Standart Hata	t	P
Kesim noktası	1.3771	1.1309	1.22	0.2400
Sıcaklık	-0.08266	0.02053	-4.03	0.0001
Rüzgar	1.4404	0.6429	2.24	0.0272
Yağış miktarı	0.1102	0.03570	3.09	0.0026
Şansa bağlı etki	0.4014	0.1484		

Buna göre yumurta verimi şansa bağlı bir kesim noktasına sahip olup kesim noktasının haftadan haftaya değişim anlamlı bulundu. Haftalık ortalama sıcaklıkta meydana gelen artış yumurta veriminde azalmaya neden olmaktadır ve bu azalmanın önemli olduğu söylenir ($P<0.01$). Rüzgar ve yağış miktarı yumurta verimiyle doğru orantılı oldu. Buna göre rüzgar ve yağış miktarındaki artışın yumurta veriminde artışa neden olduğu ve bu artışın önemli sonucuna varıldı (sırasıyla $P<0.01$ ve $P<0.05$). Ulaşılan bu sonuç kazlarda yumurta veriminin genotip, yaş, beslenme ve barınma koşulları kadar iklim koşullarının da etkisi altında olduğu bilgisiyle uyumlu olmuştur (Aslan ve Saatçi, 2003;Kırmızıbayrak, 2016).

SONUÇ

Bu çalışmada aynı genotip ve yaştaki kazların yumurta verimlerinin iklim koşullarından sıcaklık, rüzgar ve yağış miktarıyla arsındaki ilişki belirlenmeye çalışıldı. Bu amaçla sayma verisi için kullanılan Poisson regresyon modeli kullanılarak tahmin yapılı. Ancak sapma değerinin birden büyük olması nedeniyle tahmin için NB ve karışık etkili Poisson ve NB regresyon modelleri kullanıldı. Yumurta verimindeki değişimi en iyi modelin karışık etkili Poisson regresyon modeli olduğu sonucun varıldı. Buna göre çalışmada dikkate alınan iklim koşullarından sıcaklığın artışının yumurta verimini azaltıcı, yağış ve rüzgarın yumurta verimini artırıcı yönde etkisi ortaya koyuldu.

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NORDUZ KOYUNLARINDA CANLI AĞIRLIK VE BAZI MORFOLOJİK ÖZELLİKLER ARASINDAKİ İLİŞKİLERİN PATH ANALİZ İLE BELİRLENMESİ

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ÖZET
Bu çalışma, Norduz koyunlarında canlı ağırlık ve bazı morflojik özellikler atasındakii ilişkilerin incelenmesi amacıyla yapılmıştır. Bu amaçla çalışmada Path analizi tekniği kullanılmıştır. Çalışmanın materyalini 120 baş Norduz koyunu oluşturmuştur. Çalışmada incelenen morfolojik özellikler cidago yüksekliği, vücut uzunluğu, kürekler arası göğüs genişliği, göğüs derinliği, göğüs cevrsi ve but çevresi olmuştur. Path analizinden elde edilen sonuçlara göre göğüs çevresi canlı ağırlık üzerinde en yüksek ve pozitif doğrudan etkiye sahip olan morfolojik özellik olarak belirlenmiştir. Canlı ağırlığa doğrudan etkisi en yüksek olan diğer iki değişken büyüklük sırasına göre vücut uzunluğu ve göğüs derinliği olarak tespit edilmiştir. Bu çalışmada, Norduz koyunlarında canlı ağırlık üzerine yapılacak seleksiyon çalışmalarında göğüs çevresinin önemli bir ölçüt olarak kullanılabileceği sonucuna varılmıştır.
Anahtar Kelimeler: Koyun, vücut ölçüleri, Path analizi, korelasyon

DETERMINATION OF RELATIONSHIPS BETWEEN LIVE WEIGHT AND SOME MORPHOLOGICAL CHARACTERISTICS IN NORDUZ SHEEP USING PATH ANALYSIS

ABSTRACT
This study was conducted to examine the relationships between live weight and some morphological characteristics in Norduz sheep. For this purpose, Path analysis technique was used in the study. The material of the study consisted of 120 Norduz sheep. The morphological characteristics examined in the study were withers height, body length, interscapular chest width, chest depth, chest grith and rump circumference. According to the results obtained from the path analysis, chest grith was determined as the morphological feature that had the highest and positive direct effect on live weight. The other two variables that have the highest direct impact on liveliness were determined to be body length and chest depth, in order of magnitude. In this study, it was concluded that chest grith can be used as an important criterion in selection studies on live weight in Norduz sheep.
Keywords: Sheep, body measurements, Path analysis, correlation.

1.GİRİŞ

Hayvan ıslahının başlıca amacı, üzerinde çalışma yapılan çiftlik hayvanlarının çeşitli verim özelliklerinin iyileştirilmesi ve hedeflenen yüksek verimin devamlılığının sağlanmasıdır. Çiftlik hayvanlarında verimin birçok faktörün altında olması nedeniyle iyileştirilmeye çalışılan verim özelliğinin hangi faktör veya faktörler tarafından ne kadar ve hangi yönde etkilendiğinin belirlenmesi gerekmektedir Topal ve Esenbuğa, 2001; Keskin, 2012). Hayvanların düzenli aralıklarla canlı ağırlık ölçümlerinin yapılması işletmedeki hayvanların sağlık durumlarının takibi ve dolayısıyla işletmenin karlılığı bakımından büyük öneme sahiptir. Hayvan ıslahında amaç mevcut nesildeki en iyi bireylerin seçilerek gelecekte yüksek verimli bireylerden oluşan sürüler elde edilmesidir. Bu amaçla canlı ağırlık ölçümleri ile birlikte ekonomik öneme sahip çeşitli vücut ölçümlerinin alınarak aradaki ilişkinin belirlenmesine ihtiyaç duyulmaktadır (Çankaya vd., 2009; Topal ve Esenbuğa, 2001; Yetigin; 2019).

Canlı ağırlık ve çeşitli vücut ölçüleri arasındaki ilişkileri belirlenmesinde araştırmacılar genel olarak korelasyon analizinden faydalanmaktadırlar (Çankaya vd., 2009; Topal ve Esenbuğa, 2001). Ancak korelasyon analizi değişkenler arsındaki ilişkinin yönü ve büyüklüğünün dışında değişkenler arasındaki fonksiyonel ilişkiyi açıklamada yetersiz kalmaktadır. Path analizi değişkenler arsasındaki fonksiyonel ilişkiyi dikkate alarak değişkenler arasındaki doğrudan ve dolaylı etkilerin incelenmesine olanak sağlar.

Bu çalışma, Norduz koyunlarında canlı ağırlık(CA) ile cidago yüksekliği (CY),vücut uzunluğu (VU), kaburgalar arası göğüs genişliği (KAGG), göğüs derinliği (GD), göğüs çevresi (GC), but çevresi (BC) arasındaki doğrudan ve dolaylı ilişkilerin Path analizi ile belirlemek amacıyla yapılmıştır.

2. MATERYAL VE YÖNTEM

2.1.MATERYAL

Çalışmanın materyalini Van Yüzüncü Yıl Üniversitesi Araştırma ve Uygulama İşletme Müdürlüğünde yetiştirilmekte olan 120 baş Norduz koyunu oluşturmuştur. Çalışmada 1-4 yaş aralığında 120 Norduz koyunundan alınan canlı ağırlık (CA), cidago yüksekliği (CY),vücut uzunluğu (VU), kaburgalar arası göğüs genişliği (KAGG), göğüs derinliği (GD), göğüs çevresi (GC), but çevresi (BC) ölçüleri kullanılmıştır. Norduz koyununa ilişkin bir fotoğraf Şekil 2.1'de verilmiştir.



Şekil 2.1 Çalışma materyali Norduz koyunu.

2.2.YÖNTEM

Korelasyon Analizi: Korelasyon katsayısı, ilk olarak Francis Galton tarafından ortaya koyuldu. Sonraki yıllarda Karl Person, Francis Edgeworth ve diğerleri ile birlikte korelasyon katsayısının ortaya koyulan formu üzerine ciddi çalışmalar yaptılar. Geliştirilen bu korelasyon katsayısı Pearson'un korelasyon katsayısı olarak bilinir. Pearson korelasyon katsayısı değişkenler arasındaki ilişkinin yönünü (derecesini) ve miktarını belirler

İki değişkenin olduğu veri setlerinde bağımsız değişken x ile bağımlı değişken y'nin birlikte gösterimi (x, y) olsun. Aynı örnekleme biriminden elde edilen n kadar örnek çifti $(x_1, y_1),(x_2, y_2),...(x_n, y_n)$ ile gösterilsin. Korelasyon katsısı;

$$r = \frac{S_{xy}}{\sqrt{S_{xx} S_{yy}}} \qquad 3.1$$

Burada, $S_{xy} = \sum(x_i - \bar{x})(y_i - \bar{y})$: x ve y Çarpımlar Toplamı, $S_{xx} = \sum(x_i - \bar{x})^2$: x'ler için Kareler Toplamı, $S_{yy} = \sum(y_i - \bar{y})^2$: y'ler için Kareler Toplamını gösterir.

Korelasyon katsayısının bir diğer diğer bir denk formu aşağıdaki eşitliklerde verildiği gibidir.

$$r_{xy} = \frac{\sum_{i=1}^{n}(x_i-\bar{x})(y_i-\bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i-\bar{x})^2}\sqrt{\sum_{i=1}^{n}(y_i-\bar{y})^2}} \qquad 3.2$$

Burada r_{xy}, x ve y $(i = 1, 2, \dots, n)$ arasındaki ilişkinin incelendiği Pearson korelasyon katsayısını göstermektedir.

Regresyon Analizi: Bağımsız değişkenler X_i ve bunların açıkladığı hata terimi e ve bağımlı değişken Y'den oluşan çoklu doğrusal regresyon modeli eşitlik 3.3'deki gibi yazılır.

$$Y = b_0 + b_1X_1 + b_2X_2 + \cdots.. + b_kX_k + e \qquad 3.3$$

Burada; b_0: regresyon sabiti ve b_i: $i = 1, 2, \dots, k$ için kısmi regresyon katsayılarını gösterir. Standardize edilmiş regresyon katsayıları Path katsayılarını verir ve standartlaştırılmış değişkenler için doğrusal regresyon denklemi, eşitlik 3.4'da verildiği gibi olur.

$$Y = P_{YX_1}X_1 + P_{YX_2}X_2 + \dots + P_{YX_k}X_k + P_{YX_e}X_e \qquad 3.4$$

Path katsayısı (P), yol modelindeki bağımsız değişkenlerin bağımlı değişken üzerindeki doğrudan etkisini gösteren standartlaştırılmış regresyon katsayısı olarak tanımlanır ve açıklayıcı değişkendeki bir standart sapmalık değişimin bağımlı değişken üzerinde yarattığı etki olarak ifade edilir.

$$P_{YX_k} = b_k \frac{S_{X_k}}{S_Y} \qquad 3.5$$

Burada, P_{YX_k}: Path katsayısı, S_{X_k} : Bağımsız değişkenin standart sapması, S_Y : Bağımlı değişken Y'nin standart sapması, b_k : Kısmi regresyon katsayısını gösterir.

Path Analizi: Path analizi bağımsız değişkenlerin bağımlı değişken üzerindeki doğrudan ve dolaylı etkilerini incelemek ve değişkenler arasındaki yapısal ilişkiyi tahmin etmek amacıyla kullanılan bir yöntemdir (Alpar, 2011). Bu yöntemde bağımlı ve bağımsız değişkenler arasındaki korelasyon katsayısı doğrudan ve dolaylı etkiler olarak incelenmektedir. Korelasyon

katsayılarının n kadar gözlem ve k kadar bağımsız değişken için doğrudan ve dolaylı etkiler olarak incelenmesi aşağıdaki eşitlikte verilmiştir.

$$\begin{aligned} r_{x_1y} &= P_{yx_1} + r_{x_1x_2}P_{yx_1} + \cdots + r_{x_1x_k}P_{yx_k} \\ r_{x_2y} &= r_{x_2x_1}P_{yx_2} + P_{yx_2} + \cdots + r_{x_2x_k}P_{yx_k} \\ r_{x_ky} &= r_{x_kx_1}P_{yx_k} + r_{x_kx_2}P_{yx_{nk}} + \cdots + P_{yx_k} \end{aligned} \qquad 3.6$$

Bu eşitlikler matris formunda aşağıda verildiği gibi ifade edilir.

$$\begin{bmatrix} r_{x_1y} \\ r_{x_2y} \\ \vdots \\ r_{x_ky} \end{bmatrix} = \begin{bmatrix} 1 & r_{x_1x_2} & \cdots & r_{x_1x_k} \\ r_{x_2x_1} & 1 & \cdots & r_{x_2x_k} \\ \vdots & \vdots & \ddots & \vdots \\ r_{x_kx_1} & r_{kx_2} & \cdots & 1 \end{bmatrix} \begin{bmatrix} P_{yx_1} \\ P_{yx_2} \\ \vdots \\ P_{yx_k} \end{bmatrix} \qquad 3.7$$

Bu matris kısaca B=AxP şeklinde yazılır. Burada A, bağımsız değişkenler arasındaki korelasyon matrisini; B, bağımlı ve bağımsız değişkenler arasındaki korelasyon vektörünü ve P, Path katsayıları vektörünü göstermektedir. Path katsayılarının hesaplanması için (Aytekin ve ark., 2016; Akıllı ve ark., 2022).

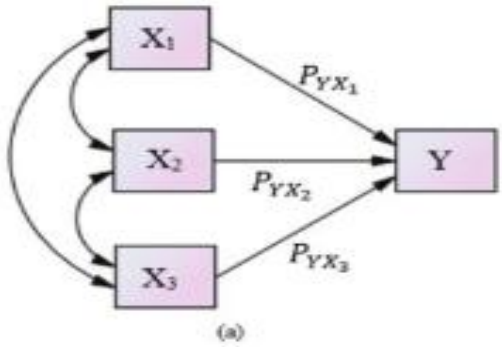
$$P = A^{-1}B \qquad 3.8$$

eşitliği kullanılır. Doğrudan ve dolaylı etkiler (DE), Path katsayıları köşegen matrisi (PKM) ve bağımsız değişkenlere ilişkin korelasyon matrisinin (A) çarpımı ile elde edilir. Diğer ifade doğrudan ve dolaylı etkiler aşağıda verilen eşitlik kullanılarak elde edilmektedir.

$$DE = (PKM)xA \qquad 3.9$$

Path analizinde, her bağımsız değişken aracılığıyla bir veya daha fazla bağımlı değişken analiz edilir; başka bir deyişle, aynı anda birden fazla çoklu regresyon analizi yapılabilir. Bu sayede iki veya daha fazla denklemli modellerin yanı sıra tek tek denklenmeli modeller kurulabilir. Tek denklemli Path modelinin denklemi Eşitlik 3.10 ‘de verildiği gibidir. Bu Path modeline ilişkin Path diyagramı Şekil 2.2’de gösterildiği gibi olur (Alpar, 2011).

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 \qquad 3.10$$

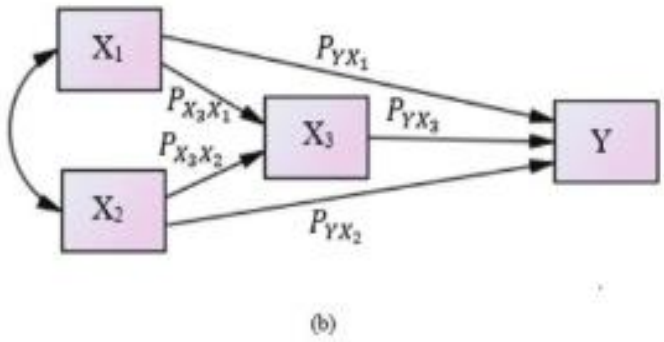


Şekil 2.2 Tek denklemli Pathh diyagramı

İki denklemli yol modelinin denklemi aşağıda verilen 3.11 ve 3.12 numaralı eşitlikte verildiği gibi yazılır.

$$X_3 = a + b_1X_1 + b_2X_2 \qquad 3.11$$
$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 \qquad 3.12$$

İki denklemli Path diyagramı Şekil 2.3'de olduğu gibidir.



Şekil 2.3 İki denklemli Path diyagramı.

Bu çalışmada istatistik analizler için MINITAB (16) ve LISREL (8.7) paket programları kullanılmıştır.

3 BULGULAR

Çalışma incelenen 120 Norduz koyununa ait canlı ağırlıklar ve vücut ölçülerine ilişkin tanımlayıcı istatistikler Tablo 3.1'de verilmiştir. 120 Norduz koyunundan alınan ölçümlerden canlı ağırlık ortalama 53.02 kg olup 33.50 ila 77.20 kg arasında değişlik göstermektedir. Canlı ağırlık dahil tüm vücut ölçülerine ait varyasyon katsayısı %30'dan küçük olmuştur. Sırasıyla cidago yüksekliği, vücut uzunluğu, kürekler arası göğüs genişliği, göğüs derinliği, göğüs çevresi ve but çevresi ortalama 77, 20, 48.5, 60.5, 118, ve 63 cm olarak ölçülmüştür.

Tablo 3.1. Canlı ağırlık ve vücut ölçülerine ilişkin tanımlayıcı istatistikler

Değişkenler	n	X_{min}	X_{max}	$\bar{X}$	SD	CV
CA	120	33.50	77.20	53.02	9.82	18.53
CY	120	59.00	77.00	69.50	3.84	5.53
VU	120	54.50	70.00	65.59	3.10	4.73
KAGG	120	14.00	48.50	18.89	3.71	19.66
GD	120	23.70	60.50	30.08	3.70	12.31
GC	120	76.00	118.00	93.62	7.60	8.12
BC	120	41.00	63.00	50.30	3.90	7.76

CA: Canlı Ağırlık; CY: Cidago Yüksekliği; VU: Vücut Uzunluğu; KAGG: Kürekler Atası Göğüs genişliği; GD: Göğüs Derinliği; GC: Göğüs Çevresi; BC: But çevresi; X_{min}: En küçük değer; X_{max}: En büyük değer; X_{mix}: Aritmetik ortalama; SD: Standart sapma; CV: Varyasyon katsayısı.

Çalışmada ölçümleri alınan koyunların canlı ağırlık, cidago yüksekliği, vücut uzunluğu, kürekler arası göğüs genişliği, göğüs derinliği, göğüs çevresi ve but çevresi arasındaki korelasyon değerleri Tablo 3.2'de ve korelasyonları gösteren görsel Şekil 3.1'de verildi.

Tablo 3.2. Canlı ağırlık ve vücut ölçüleri arasındaki korelasyon katsayıları

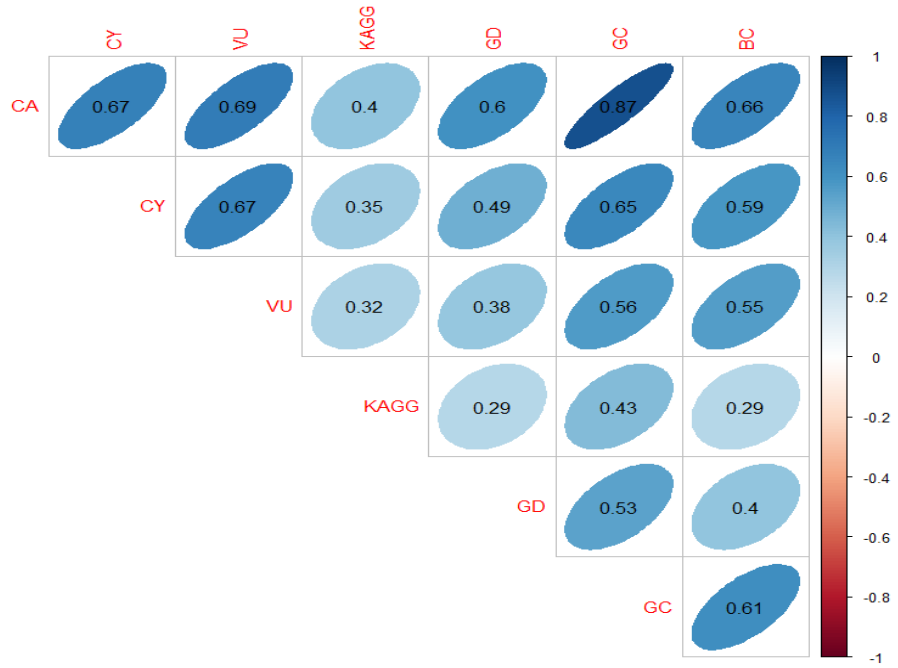
CA	CY	VU	KAGG	GD	GC	BC
1						
0.6727^{***}	1					
0.6903^{***}	0.6658^{***}	1				
0.3989^{***}	0.3536^{***}	0.3198^{***}	1			

0.6004***	0.4889***	0.3828***	0.2863***	1		
0.8712***	0.6476***	0.5603***	0.4434***	0.5313***	1	
0.6550***	0.5894***	0.5507***	0.2859**	0.3953***	0.6150***	1

CA: Canlı Ağırlık; CY: Cidago Yüksekliği; VU: Vücut Uzunluğu; KAGG: Kürekler Arası Göğüs genişliği; GD: Göğüs Derinliği; GC: Göğüs Çevresi; BC: But çevresi∗ : $P \leq 0.05$, ∗∗ : $P \leq 0.01$, ∗∗∗ : $P \leq 0.001$

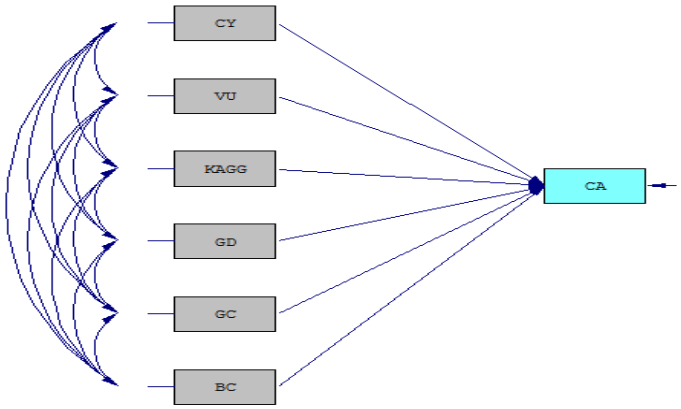
Tabloda canlı ağırlık, cidago yüksekliği, vücut uzunluğu, kürekler arası göğüs genişliği, göğüs derinliği, göğüs çevresi ve but çevresi arasındaki ilişkilerin tamamının anlamlı olduğu görülmektedir (P<0.001). Canlı ağırlık ile göğüs çevresi arasındaki korelasyon miktarı (0.8712) en yüksek olmuştur. Bunu sırasıyla vücut uzunluğu (0.6903), cidago yüksekliği (0.6727), but çevresi (0.6550), göğüs derinliği (0.6004) izlemektedir. Canlı ağırlık ile kürekler arası göğüs genişliği arasındaki ilişki en zayıf (0.3989) ilişki olarak belirlenmiştir.

Şekil 3.1'de korealsyon katsayıları ile birlikte etkisinin büyüklüğü sunulmuştur. Buna göre daha yüksek korelasyonlar bir doğru etrafında daha yakın olup elips şeklinde ifade edilmiştir. Korelasyonlar sıfıra doğru yaklaştıkça doğru etrafındaki dağılım elips şeklinden dairesel şekle yakınlaşmaktadır. Şekilde negatif korelasyonlar pembe renk ile gösterilmektedir. Buna göre ikili değişkenlerin hiçbirinin negatif korelasyona sahip olmadığı açıktır.



Şekil 3.1 Canlı ağırlık ve vücut ölçüleri arasındaki korelasyon katsayılarının gücü

Norduz koyunlarında vücut ölçülerinin canlı ağırlık üzerine doğrudan ve dolaylı etkilerini belirlemek amacıyla yapılacak Path analizine ait diyagram Şekil 3.2'de verilmiştir. Bu diyagram tek denklemli bir modeldir.



Şekil 3.2 Canlı ağırlık ve vücut ölçüleri arasındaki path diyagramı

Tek denklemli olan Path modeline ilişkin diagramda doğrudan etkiler canlı ağırlık üzerine giden oklar ile gösterilmektedir. Bu ok üzerinde yer alan değerler doğrudan etki miktarlarıdır. Vücut ölçüleri arasındaki çift yönlü oklar ise bu değişkenler arasındaki basit korelasyonları gösterip ok üzerindeki değerler korelasyon katsayıları olmaktadır.

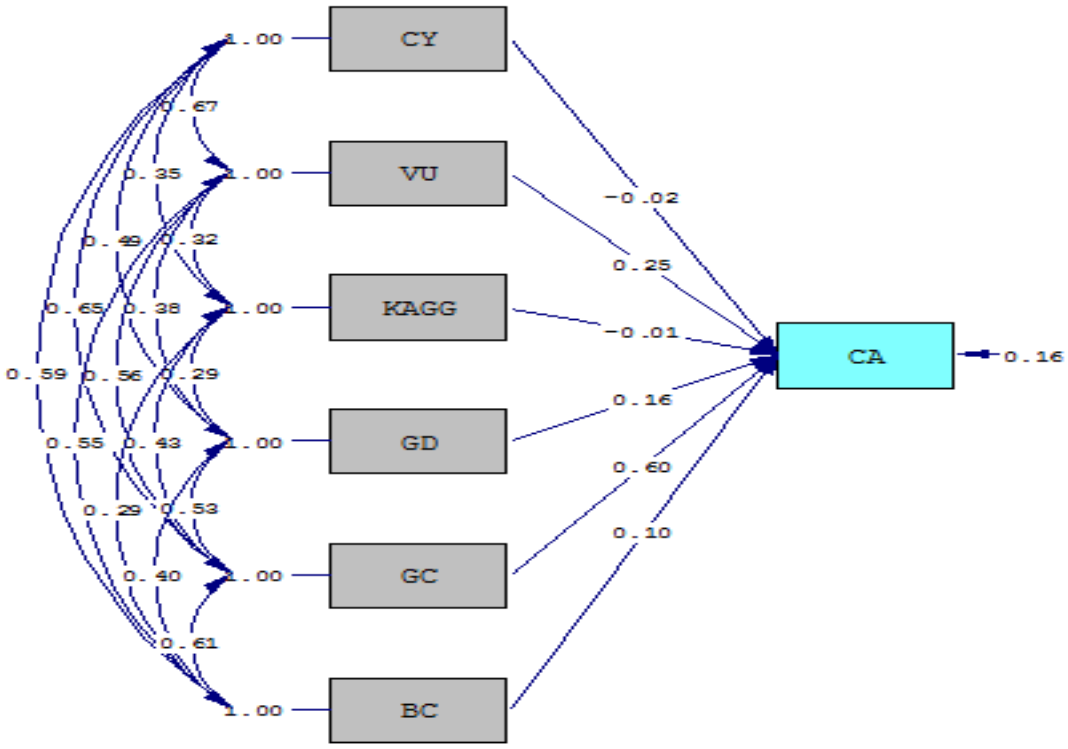
Çalışma verisine tek denklemli Path analizi uygulandıktan sonra elde edilen Path katsayıları (doğrudan etki) ve dolaylı etkiler ve bu etkilerin açıklama miktarları Tablo 3.3'te verildi.

Tablo 3.3Canlı ağırlık üzerinde vücut ölçülerinin doğrudan ve dolaylı etkileri ve etki miktarları

Doğrudan Etki	Dolaylı Etki		Etki değeri	%	Doğrudan Etki	Dolaylı Etki		Etki değeri	%
X_1 (CY)		P_{yx_1}	-0.0151	2.12	X_2 (VU)		P_{yx_2}	0.2546***	35.52
	X_2	$r_{x_1x_2}.P_{yx_2}$	0.1695	23.88		X_1	$r_{x_2x_1}.P_{yx_1}$	-0.0100	1.40
	X_3	$r_{x_1x_3}.P_{yx_3}$	-0.0035	0.50		X_3	$r_{x_2x_3}.P_{yx_3}$	-0.0032	0.44
	X_4	$r_{x_1x_4}.P_{yx_4}$	0.0764	10.76		X_4	$r_{x_2x_4}.P_{yx_4}$	0.0598	8.34
	X_5	$r_{x_1x_5}.P_{yx_5}$	0.3893	54.85		X_5	$r_{x_2x_5}.P_{yx_5}$	0.3368	46.99
	X_6	$r_{x_1x_6}.P_{yx_6}$	0.0561	7.90		X_6	$r_{x_2x_6}.P_{yx_6}$	0.0524	7.31
Korelasyon		r_{yx_1}	0.6727		Korelasyon		r_{yx_2}	0.6903	
X_3 (KAGG)		P_{yx_3}	-0.0100	2.32	X_4 (GD)		P_{yx_4}	0.1562***	25.16
	X_1	$r_{x_3x_1}.P_{yx_1}$	-0.0053	1.24		X_1	$r_{x_4x_1}.P_{yx_1}$	-0.0074	1.19
	X_2	$r_{x_3x_2}.P_{yx_2}$	0.0814	18.96		X_2	$r_{x_4x_2}.P_{yx_2}$	0.0974	15.70
	X_4	$r_{x_3x_4}.P_{yx_4}$	0.0447	10.41		X_3	$r_{x_4x_3}.P_{yx_4}$	-0.0029	0.46
	X_5	$r_{x_3x_5}.P_{yx_5}$	0.2608	60.74		X_5	$r_{x_4x_5}.P_{yx_5}$	0.3193	51.44
	X_6	$r_{x_3x_6}.P_{yx_6}$	0.0272	6.33		X_6	$r_{x_4x_6}.P_{yx_6}$	0.0376	6.06
Korelasyon		r_{yx_3}	0.3989		Korelasyon		r_{yx_4}	0.6004	
X_5 (GC)		P_{yx_5}	0.6011***	66.84	X_6 (BC)		P_{yx_6}	0.0951	14.02

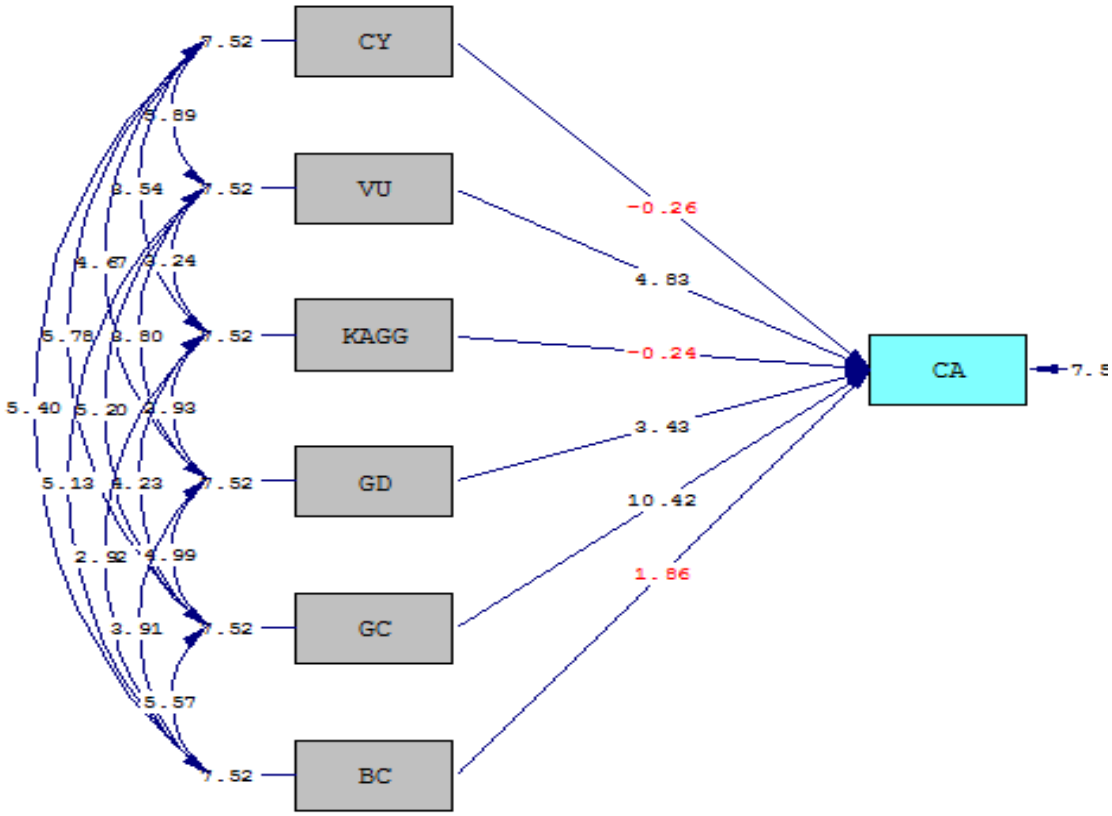
CA: Canlı Ağırlık; CY: Cidago Yüksekliği; VU: Vücut Uzunluğu; KAGG: Kürekler Arası Göğüs Genişliği; GD: Göğüs Derinliği; GC: Göğüs Çevresi; BC: But Çevresi; $*** : P \leq 0.001$.

Canlı ağırlık üzerine doğrudan etkiler incelendiğinde en yüksek etkiye sahip vücut ölçüsü değişkeni 0.6011 değeri ile göğüs çevresi olmuştur (Tablo 3.3). Diğer bir ifade ifadeyle göğüs çevresi, canlı ağırlık üzerine en yüksek doğrudan ve pozitif etkiye sahip değişken olarak belirlenmiştir (P<0.001). Bu etkiyi sırasıyla 0.2546 etki değeri ile vücut uzunluğu ve ardından 0.1565 değeri ile göğüs derinliği takip etmiştir. Canlı ağırlık üzerine göğüs çevresi gibi vücut uzunluğu ve göğüs çevresi de anlamlı bulunmuştur (sırasıyla, P<0.001 ve P<0.001). Diğer vücut ölçülerinden cidago yüksekliğinin doğrudan etki değeri -0.0151, kürekler arası göğüs genişliğinin doğrudan etki değeri -0.0100 ve but çevresinin doğrudan etki değeri 0.0951 olarak bulunmuştur. Cidago yüksekliği ve kürekler arası göğüs genişliğinin etkisi negatif yönlü olmuştur. Buna göre cidago yüksekliği ve kürekler arası göğüs genişliğindeki artış canlı ağırlıkta azalma ile sonuçlanmaktadır. Ancak bu etkiler anlamlı bulunmamıştır. Vücut ölçülerinden but çevresi, pozitif bir etkiye (0.0951) sahip olmasına rağmen canlı ağırlık üzerindeki etkisi anlamlı bulunmamıştır. Doğrudan ve dolaylı etkileriin Path diyagramında gösterimi Şekil 3.4'de verilmiştir.



Şekil 3.4 Tek denklemli Path diyagramı ve tahmin değerleri

Path diyagramı üzerinde gösterilen tahmin değerlerinin anlamlılıkları Şekil 3.5'te verilmiştir. Şekilde kırmızı olarak yazılan değerler ilgili tahmin değerinin anlamlı olmadığını göstermektedir. Buna göre cidago yüksekliği, kürekler arası göğüs genişliği ve but çevresinin canlı ağırlık üzerindeki doğrudan etkisi anlamlı bulunmamıştır. Daha önce ifade edildiği gibi vücut uzunluğu, göğüs derinliği ve göğüs çevresinin canlı ağırlık üzerindeki etkisi anlamalı bulunmuştur. Bağımsız değişkenler arasındaki korelasyon katsayılarının da hepsinin anlamlı olduğu Şekil 3.5'de görülmektedir.



Şekil 3.5 Tek denklemli Path diyagramı ve anlamlılık değerlendirmesi için t testi sonuçları.

Norduz koyunları için standardize edilmiş kısmi regresyon denklemindeki katsayılar $CA = -0.015\,CY + 0.225\,VU - 0.010\,KAGG + 0.156\,GD + 0.601\,GC + 0.095\,BC$ olup belirleme katsayısı $R^2 = \%83.3$ olarak belirlenmiştir. Bu denklenmedeki kısmi regresyon katsayıları Path katsayılarını göstermektedir.

4 TARTIŞMA ve SONUÇ

Çalışmada materyali Norduz koyunlarının ortalama canlı ağırlık ortalaması 53.02 kg olup 33.50 ila 77.20 kg arasında değişlik göstermektedir. 120 Norduz koyunundan alınan ölçümlerden canlı ağırlık ortalama 53.02 kg olarak bulunmuştur. Bu değer, Ambarcıoğlu ve vd. (2017)'nın Karacabey Merinosu için bildirdiği 51.36 kg ve Tellioğlu ve Sabas (1976)'ın değişik yaşlarda bulunan Morkaraman koyunlarına, ait canlı ağırlık ortalaması 52.830 kg. olan değerden yüksek bulunmuştur. Canlı ağırlık ve çalışmada kullanılan diğer vücut ölçülerine (cidago yüksekliği, vücut uzunluğu, kürekler arası göğüs genişliği, göğüs derinliği, göğüs çevresi ve but çevresi)

ilişkin varyasyon katsayısının küçük çıktığı bu nedenle üretilen sonuçların güvenilir olduğu sonucuna varılmıştır (Alpar, 2011).

Canlı ağırlık ile cidago yüksekliği, vücut uzunluğu, kürekler arası göğüs genişliği, göğüs derinliği, göğüs çevresi ve but çevresi arasındaki korelasyonların anlamlı çıkması literatürle uyumlu olmuştur (Ambarcıoğulu vd., 2017; Şahin vd., 2018; Kılıç ve Özbeyaz, 2010; Esen ve Elmacı 2021; Gürcan ve Akçapınar, 2006; Yakubu, 2009). Çalışmanın sonraki aşamasında veriye Path analizi uygulanarak canlı ağırlık ve vücut ölçüleri arasındaki korelasyon katsayıları doğrudan ve dolaylı etkiler şeklinde incelenmiştir. Path analizinden elde edilen sonuçlara göre göğüs çevresi, canlı ağırlık üzerindeki en yüksek ve pozitif doğrudan etkiye sahip olmuştur. Elde edilen bu sonuç, Karabacak vd. (2010) ve Ambarcıoğlu vd. (2017)'nin bildirdiği sonuçlar ile benzer olmuştur. Ayrıca Eken (2019)'in canlı ağırlığı açıklamada göğüs çevresinin en iyi vücut ölçüsü bulgusu ile de uyumlu olduğu tespit edilmiştir. Çalışma sonuçlarına göre Norduz koyunlarında canlı ağırlığa en fazla etki eden diğer vücut ölçüleri vücut uzunluğu ve göğüs derinliği olarak tespit edilmiştir.

Bu çalışmada Norduz koyunlarında canlı ağırlığa doğrudan etkisi en yüksek olan değişken göğüs çevresi olarak belirlenmiştir. Dolayısıyla Norduz koyunlarında canlı ağırlık üzerine yapılacak seleksiyon çalışmalarında göğüs çevresi önemli bir ölçüt olarak kullanılabileceği sonucuna varılmıştır.

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TARIMDA SU KORUNUMU İÇİN POLİMERLERİN KULLANIMI

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ÖZET
Ülkemiz ekolojik ve iklim koşulları nedeniyle su sıkıntısı çeken ülkeler arasında yer almaktadır. Önümüzdeki yıllarda da kuraklıktan ve küresel ısınmadan etkilenecek ülkeler arasında yer alacaktır. Tüm canlıların yaşam kaynağı olan su ve su kaynakları, tüm dünyada ve ülkemizde her geçen gün azalarak yok olmakta ya da kirlenerek kullanılamaz hale gelmektedir. Ülkemizde su kaynaklarımızın %72'si tarımda, %18'i evsel kullanımda ve %10'u sanayide kullanılmaktadır. Tarımsal üretimde toprakda suyun kaybını sulama yaparak önleyebiliriz ve böylece sulamadan maksimum faydayı sağlayarak üretimden daha fazla verim alabiliriz. Bu amaçla tarımsal üretimde toprakta suyun korunumunu sağlayabilmek için polimerler ve polimer bileşikleri kullanılabilmektedir. Bu polimer bileşikleri, tutulan suyu yavaş yavaş üretim ortamına yani toprağa geri verirler. Bu nedenle sıcak ve kurak iklimlerde topraktaki suyun korunmasında etkilidirler. Bu çalışmada polimerlerin genel özellikleri, toprak suyunun korunmasındaki yararları ve kullanım yöntemleri açıklanmaya çalışılacaktır.
Anahtar Kelimeler: Polimer bileşikleri, su yönetimi, sulama

USE OF POLYMERS IN WATER CONSERVATION IN AGRICULTURE

ABSTRACT
Our country is among the countries that suffer from water shortage due to its ecological and climatic conditions. It will be among the countries that will be affected by drought and global warming in the coming years. Water and water resources, which are the source of life for all living things, are decreasing and disappearing day by day all over the world and in our country, or are becoming polluted and unusable. In our country, 72% of our water resources are used in agriculture, 18% in domestic use and 10% in industry. By preventing the loss of water we put into the soil in agricultural production, we can get more efficiency from production by getting maximum benefit from irrigation. For this purpose, we can use polymers and polymer compounds in agricultural production to ensure water conservation in the soil. These compounds gradually release the water they have retained into the growing medium. For this reason, they are effective in preserving water in the soil in hot and arid climates. In this study, the general properties of polymers, their benefits in soil water conservation, usage methods and doses will be explained.
Keywords: Irrigation, polymer compounds, water management.

INTRODUCTION

With global climate change, the extension of dry periods and the imbalance in precipitation lead to productivity losses in agricultural production. Drought is actually a normal and recurring climate event. It occurs due to decreasing rainfall spread over one or more seasons. However, increasing temperatures and decreasing precipitation in many parts of the world as a result of global climate change increase the frequency and severity of drought events. The effects of drought are often first seen in agriculture and gradually spread to other water-dependent sectors. The meaning of drought in the agricultural sector is different from other sectors. Because the water available in the plant root zone during growth periods is more important for plants than the total precipitation during the year.

In our country, significant decreases are observed in winter and autumn precipitation. Hydrological, agricultural and socioeconomic droughts occur due to meteorological drought. Loss of agricultural products, insufficiency of surface and groundwater, and insufficiency of drinking water in big cities are important problems. Soil, which has a close relationship and interaction with the water cycle, also plays a role in providing valuable ecological services. Among these; Food and water safety and balancing and filtering of water flows can be listed as the most important ones. The movement of water into the lower layers of the soil (percolation) not only feeds groundwater but also can prevent surface waters (streams, lakes) from falling to ecologically critical levels, especially during dry seasons when rainfall decreases (Anonymous, 2015 and Anonymous, 2016). In this study, it was tried to explain the importance of using water-retaining polymers to ensure water conservation in the soil for a longer period of time in agriculture, especially in crop production, in case of changes in precipitation regimes under the influence of climate change and possible dry periods.

WATER CONSERVATION IN SOIL

Droughts, which have recently started to increase all over the world, reveal the need to use water more effectively. In our country, as in the world, water is used mostly in the agricultural sector (73%). Since the most water losses occur in agriculture, the most water savings should be made in irrigation. The basic condition in order to obtain the expected benefit from irrigation

is to deliver the part of the water needed by the plant that cannot be met by rainfall to the root zone of the plant in the soil at the required time and in the required amount. Preserving soil moisture and keeping water in the plant root zone for longer periods of time make irrigation more effective. One of these applications is the mixing of some organic and inorganic materials with flocculating or adhesive properties into the soil. Adding various forms of organic matter and inorganic soil conditioners, especially to sandy soils with low aggregate stability and water retention capacity, increases the water retention capacity of the soil (Buckman and Brady, 1965). There are many organic and inorganic materials that can be used for this purpose. However, these materials used must be of a quality that will not disrupt the economic and ecological balance.

One of the known properties of water-retaining polymers, a chemical soil conditioner that has been included in many studies on its use in agriculture in recent years, is that it retains water 400-500 times its volume and remains in the soil for about 5-7 years (Anonymous, 2011).



Figure 1. Drought and Cracking Soils

WHAT ARE WATER RETAINING POLYMERS?

Water-retaining polymers are cross-linked copolymers of water-insoluble potassium acrylate and acrylamides and are anionic absorbent materials. These materials absorb 500 times their weight of water like a sponge and turn into a gel form. Thanks to their ability to release the water they hold into the environment little by little, they gain the feature of being an ideal product for plant production in areas with limited irrigation facilities and in agricultural areas

in hot and arid climates. Polymers can maintain their water absorption and release efficiency for 4-5 years (Anonymous, 2023b).



Figure 2. Use of polymers



Şekil 3. Appearance of Polymers

THE USE OF WATER-RETAINING POLYMERS IN AGRICULTURAL PRODUCTION AND THEIR BENEFITS ON SOIL WATER CONSERVATION

Water retaining polymers can be used to meet the water needs of potted plant cultivation, vegetable and field crops, garden plants and fruit saplings.

pH, lime, mineral matter levels and water hardness of irrigation water affect the water retention performance of polymers. For this reason, these factors must be analyzed and determined before use. Water retaining polymers;

- It increases the water retention capacity of the soil and reduces the irrigation period by 50%.
- Prevents water loss caused by evaporation and percolation in the soil.
- Limits water and nutrient loss due to washing. It provides resistance to drought and water stress in the plant.
- It ensures that water and nutrients dissolve in the root area so that the plant can receive nutrients at optimum levels, and increases plant development.
- It improves the physical properties of tight impermeable soils by increasing the aeration capacity of the soil.
- Protects the environment against drought and pollution of groundwater.
- Provides economic benefit by reducing irrigation costs.
- It prevents the roots from drying out and keeps them moist during the transfer of saplings from the greenhouse to open areas and long distances.

RESULT

By using water-retaining polymers in agricultural production, maximum benefit from irrigation can be achieved by preventing the loss of water we put into the soil. This will result in greater efficiency from production. In addition, less water will be consumed in the use of natural underground and surface water resources for irrigation purposes in agricultural production.

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STRATEJİK BİR ÜRÜN; ARI ZEHRİ VE APİTERAPİDE KULLANIMI

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ÖZET
Arıcılık; bitkisel kaynakları, arıyı ve emeği birlikte kullanarak, bal, balmumu, polen, arı sütü, propolis ve arı zehiri gibi ürünler ile ana arı, oğul arı gibi canlı materyal üretimiyle gerek bal arılarının yaşam biçimi gerekse ürünlerinin hammaddelerini doğadan toplamalarından dolayı doğaya bağımlı bir hayvancılık faaliyetidir. Sağlıklı yaşam kavramı ile birlikte vücudun ihtiyacı olan enerji ve besin öğelerinin doğal kaynaklardan sağlanması eğilimi arıcılık faaliyetinin gelişmesinde önemli bir etmen olmuştur. Arı ürünlerinin sağlıklı ve hastalıklara karşı dirençli bireyler yetişmesinde faydaları oldukça fazladır. İçerdikleri vitamin, mineral ve enzimlerden dolayı antibakteriyel, antimikrobiyel, antiviral ve antiparaziter işlevleri bulunmaktadır. Apiterapi; sağlığı korumak, hastalığı önlemek ve iyileştirmek amacıyla bal, polen, arı sütü, propolis, arı zehri gibi arı ürünlerinin destek ve tedavi amacıyla kullanılmasıdır. Bir arı ürünü olan arı zehri, işçi arıların iğneleri ile bağlantılı olan iki salgı bezi tarafından üretilir. İşçi arı, kovan savunması ve besin arama işleri ile ilgilenmeye başladığında arı zehrinin üretimi en üst seviyeye ulaşır. Arı yaşlandıkça üretim azalır. Arı zehri, açık renkte, kokusuz, sıvı bir madde olup, keskin ve acı bir tada sahiptir. İçinde bulunan alarm feromonları nedeniyle aromatik özellik taşımaktadır. Hava ile temas ettiğinde opak ya da gri-beyaz kristaller şeklinde çökelmektedir. Suda çözünebilir ve solüsyonları renksizdir. Apiterapide arı zehri tedavi amacıyla multiple skleroz (MS), romatoid artrit, deri kanseri, egzama, epilepsi, damar tıkanıklığı, gribal ve ortopedik hastalıkların tedavisi, mafsal iltihabi, radyasyondan kaynaklanan hasarı azaltma gibi birçok hastalıkta kullanılmaktadır.
Anahtar Kelimeler: Arıcılık, Arı zehiri, Apiterapi

ASTRATEGIC PRODUCT; BEE VENOM AND ITS USE IN APITHERAPY

ABSTRACT
Beekeeping; It is a nature-dependent animal husbandry activity, using plant resources, bees and labor together, producing products such as honey, beeswax, pollen, royal jelly, propolis and bee venom, and living materials such as queen bees and son bees, both because of the lifestyle of honey bees and because they collect the raw materials of their products from nature. Along with the concept of healthy living, the tendency to provide the energy and nutrients the body needs from natural sources has been an important factor in the development of beekeeping activities. Bee products have many benefits in raising healthy and disease-resistant individuals. They have antibacterial, antimicrobial, antiviral and antiparasitic functions due to the vitamins, minerals and enzymes they contain. Apitherapy; It is the use of bee products such as honey, pollen, royal jelly, propolis and bee venom for support and treatment purposes in order to protect health, prevent and cure disease. Bee venom, a bee product, is produced by two glands connected to the stings of worker bees. When the worker bee begins to deal with hive defense and foraging, the production of bee venom reaches its highest level. As the bee ages, production decreases. Bee venom is a light-colored, odorless, liquid substance with a sharp and bitter taste. It has aromatic properties due to the alarm pheromones it contains. When it comes into contact with air, it precipitates as opaque or grey-white crystals. It is soluble in water and its solutions are colorless. In apitherapy, bee venom is used for treatment of many diseases such as multiple sclerosis (MS), rheumatoid arthritis, skin cancer, eczema, epilepsy, vascular occlusion, treatment of influenza and orthopedic diseases, joint inflammation, and reducing damage caused by radiation.
Keywords: Beekeeping, Bee venom, Apitherapy

INTRODUCTION

There are 18,000 species of bees from the Hymenoptera order of the Apoidea family within the membrane winged order (Kolaylı et al., 2017). The poisons of insects that are members of this order are important for humans. Especially honeybees have a very important place in terms of economy and ecology. The word of apitherapy means treatment with bee products. This concept has grown and gained importance since the 1990s. In this method, the purpose of using bee products in human health, nutrition and treatment is investigated. As a matter of fact, it is very wrong to try to find solutions to treatments without doing research. If we look at the past, the use of apitherapy has been detected even in the Ancient Egyptian period, 6000 years ago. Bee products used in apitherapy are honey, propolis, royal jelly, bee venom, pollen, apilarnil and perga. Each of them has different pharmacological properties. For example, bee venom is used in the treatment of rheumatic diseases because it is anti-inflammatory, propolis is used in the treatment of bacterial diseases because it contains antibacterial and antioxidant properties, and honey is used in the treatment of reducing inflammation and edema in wounds due to its antimicrobial and anti-inflammatory properties. Day by day As a result of increasing research, the health effects of these products are coming to light more and more. For this purpose, various professional groups come together and work together and make significant contributions to these researches.

While most pharmaceutical products used in disease treatments today have various chemical side effects, the products used in apitherapy are generally cheap, easily available, have no toxic effects, and do not produce various side effects. For this reason, apitherapy products are natural and preferable for treatment purposes. However, although they seem like traditional treatment methods, apitherapy treatments are procedures that require expertise. These treatments should be performed by an apitherapy specialist or a specialist medical doctor. Because, like everything else, bee products have various side effects, even in trace amounts. Side effects of apitherapy may vary from person to person, but rare and mild side effects are generally observed. These may include skin redness, itching, swelling, allergic reactions, and rarely severe allergic reactions.

Apitherapy treatment methods have been scientifically available since the time of Galen and Hippocrates. However, the first modern studies are valid from 1888. Australian Doctor Philipp Terč wrote an article on bee stings and bee venom, associating them with rheumatic diseases.

French pharmacist Nicola Louis Vauquelin studied propolis in the 19th century and analyzed its components. Today, the effective use of bee products continues. For example, propolis, a bee product, is used to gain immunity against diseases, especially during winter months.

Bee Venom

There are three individuals in the colony: worker (female), male and queen bees. It is the worker bees that produce bee venom from these individuals. As a matter of fact, male bees do not produce stingers or poison. As the worker bee transitions from the pupa period to the adult bee period, the bee venom glands become functional and secrete venom (Özbek, 1990).

The venom consists of the venom glands of the worker bee. The glands are divided into two: alkaline and acid glands. It is called alkaline Dufour gland. Thanks to the Dufour gland, the needle becomes lubricated and provides secretion to the environment. Pheromones released from the secretion warn the colony of danger. Therefore, Dufour's gland forms part of communication. The resulting poison contains Mellitin, apamin, MCD- peptide, histamine, hyaluronidase, phospholipase- A2. It has an aromatic structure due to the pheromones it contains. It is transparent in color and liquid with a sharp bitter taste. It has no smell. It has an acidic pH. While 88% of a bee's venom consists of water, 0.1 µg of it consists of dry venom (Şahinler et al., 2019).

Melitin compound has strong surface activity on the cell lipid membrane, activates the anti-inflammatory PLA2 at very low doses, reduces blood pressure and blood clotting by increasing capillary permeability and blood circulation, and shows immunostimulatory and immunosuppressive properties (Bogdanov, 2012; Chen and Lariviere). , 2010;Abbadi, 2003;Soon et al.,2007). Apamin exhibits anti-inflammatory properties; It stimulates the release of cortisone and has an antiserotonin effect. Additionally, in terms of its structural and pharmacological properties, apamin may have a central role in its cytotoxic effects and nociceptive activity on cancer cells (Son et al., 2007). MCD peptide exhibits anti-inflammatory, analgesic and nociceptive effects and prevents the release of histamine at low and high doses (Bogdanov, 2012; Chen and Lariviere, 2010; Abbadi, 2003; Soon et al., 2007; Bellik, 2015). Hyoluronidase enzyme exhibits detoxic activity and is involved in increasing the permeability of capillaries. Bee venom phospholipase A2 (BV-PLA2) is the most lethal bee venom peptide. It consists of a single chain of 128 amino acid residues and four disulfide bridges. Although

BV-PLA2 has a highly alkaline structure, it constitutes 12-15% of the dry weight of bee venom (Shipolini et al., 1974; Bellik, 2015).

There are generally two types of methods for obtaining poison. The most commonly used method is to give the bee an electric shock, create a perception of threat, inject its sting into a permeable surface and remove the poison. Another method is done by drying the whole bee. This method is not preferred because it has some drawbacks. Then, the venom secretion on the glass surface is dried, scraped from the surface with a scraper and collected.

Bee Venom Usage Areas

According to the World Health Organization (traditional medicine), it is the totality of skills and practices carried out by incorporating the theories, beliefs and experiences specific to different cultures, justifying the prevention, diagnosis and treatment of various diseases. When these practices include health practices that are not integrated into the dominant health system of a country and are not bound to traditions, they are called "complementary medicine" or "alternative medicine" (Yıldıray and Tekeoğlu, 2018). Alternative medicine methods are methods such as acupuncture, apitherapy, hydrotherapy, aromatherapy, hypnosis and massage. Bee venom, an apitherapy treatment method, has been used in the treatment of multiple sclerosis (MS) for 60 years.

A group of scientists who examined the uses of the bee venom reported that it can be used in rheumatoid arthritis, multiple sclerosis, lupus, low back pain, sciatica, tennis elbow and other soft tissue rheumatism.

In another study, it was seen that bee venom had an effect on the immune system of the HIV virus and strengthened the immune system of the person. In addition, it has been shown that it first slows down the disease and then stops its development (Silici and Tolon, 2002). The American Apitherapy Association, on the other hand, stated that bee venom can be used for many diseases in our time, such as joint inflammation (arthritis), tissue hardening, skin tuberculosis, hardening of the skin seen in the elderly, chronic fatigue syndrome, scars, skin cancer, and eczema (Cherbuliez 1997; Şahinler). ,2000). Other proven effects of the bee venom are in the treatment of allergic patients, sclerosis and scleroderma, which are skin diseases, rheumatic diseases, which are common joint disorders, gout and various immunological diseases including asthma, treatment of breast, liver and colectal cancer cells, musculoskeletal pain, neurological pain. It is used in neuropsychiatric disorders and hair loss, peripheral

neuropathy. Although bee venom is beneficial, a bee venom allergy test should be done before treatment, a specialist should be consulted and treatment should be started under his/her supervision. It is emphasized that bee venom should not be used if you have tuberculosis, gonorrhea, endocarditis or if you are pregnant (Derebaşı and Canbakal, 2009).

Although its scientific validity has not been proven, it is thought to be good for diseases such as epilepsy, mastitis, neurosis, neuralgia, myositis, bursitis, migraine, rhinosinusitis, tropical ulcers, iridocytis, premenstrual syndrome, ligament damage, sore throat, high cholesterol, radicultitus and malaria.

Conclusion

Generally, bee venom is a strategically important bee product. Studies on apitherapy are increasing this importance day by day. However, the production of bee venom, which is not as important as honey, pollen and propolis, is insufficient in our country. Apitherapy studies are increasing in Europe, Asia and America. Especially after the pandemic, the importance of both agricultural production and traditional treatment methods has increased. As a matter of fact, its use as an industrial medicine for the diseases it provides treatment for, as well as being not only traditional, should also become widespread. For this reason, importance should be given to the beekeeping sector in our country and the sector should be taken further. The production of not only honey, pollen and propolis, but also bee venom should be encouraged. Of course, like everything else, bee venom has side effects. For this reason, as Paracelsus said, it should be possible to eliminate these side effects by adopting the understanding that the difference between medicine and poison is the dose.

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ISITMA VE DEPOLAMANIN BALDA KALİTE KRİTELERİ ÜZERİNE ETKİSİ

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ÖZET
Türkiye uygun ekolojisi, zengin florası, yaklaşık 8 milyon koloni varlığı, 110 bin ton bal üretimi, 15 kg koloni başına bal verimi ile büyük bir arıcılık potansiyeline sahiptir. Dünya üzerinde sayısı 300.000'ini aşan bitki türünden yaklaşık olarak12.000 (Avcı, 2005) çeşidi Türkiye'de bulunmakta ve bunların çoğu endemik bitki olma özelliğindedir. Ülkemizin değişik bölgelerinde sahip oldukları floraya bağlı olarak farklı ballar üretilmektedir. Bunlar arasında en önemlileri; yayla, kestane, narenciye, yonca, ayçiçeği, pamuk, mısır, akasya ve ıhlamur ballarıdır *(Genç, 1994; Gül ve Şahinler, 2004; Şahinler ve ark., 2004 ve 2003; Anonim, 2005)*. Bal tebliğine göre bal; "Bal arılarının çiçek nektarlarını, bitkilerin veya bitkiler üzerinde yaşayan bazı canlıların salgılarını topladıktan sonra, kendine özgü maddelerle karıştırarak değişikliğe uğratıp, bal peteklerine depoladıkları tatlı maddedir." şeklinde tanımlanmıştır *(Anonim, 1990)*. Balın yapısına üretim sezonu, bitki orijini ve iklim koşulları etki etmektedir. Bunlar içinden en önemli faktör bitki çeşididir *(Crane, 1975; Yaniv and Rudich, 1996; Şahinler ve ark., 2004; Toy ve Şahinler,2022)*. Balın uzun süre depolanması invert şeker oranının artmasına *(White et al, 1961)*, balda asitliğin artması ise balın fermentasyonuna yol açmaktadır. Ayrıca kaliteli ballarda HMF (Hidroksi Metil Furfural) miktarının az olması istenir. Balda HMF miktarının artmasına hasad sonrası ısıtma işleminin uygulanması, depolama süresi, depolama sıcaklığı ve balın pH'sı etki etmektedir. Balların uzun süre depolanması ve ısıtılması da balda önemli kalite kriterlerinden olan diastaz aktivitesini etkilemektedir *(Şahinler ve Gül, 2004; Şahinler, 2007 ;Toy ve Şahinler 2022)*.
Anahtar Kelimeler: Bal, Kalite, Isıtma, Depolama

EFFECT OF HEATING AND STORAGE ON HONEY QUALITY CRITERIA

ABSTRACT
Turkey has a great beekeeping potential with its suitable ecology, rich flora, approximately 8 million colonies, 110 thousand tons of honey production, and 15 kg honey yield per colony. Of the more than 300,000 plant species in the world, approximately 12,000 (Avcı, 2005) species are found in Turkey and most of them are endemic plants. Different honeys are produced in different regions of our country depending on their flora. The most important among these are; plateau, chestnut, citrus, clover, sunflower, cotton, corn, acacia and linden honeys (Genç, 1994; Gül and Şahinler, 2004; Şahinler et al., 2004 and 2003; Anonymous, 2005). According to the honey honey notification "It is the sweet substance that honey bees, after collecting flower nectar and secretions of plants or some living creatures living on plants, modify by mixing with their own substances and store in honeycombs." It is defined as (Anonymous, 1990). Production season, plant origin and climatic conditions affect the structure of honey. The most important factor among these is the plant type (Crane, 1975; Yaniv and Rudich, 1996; Şahinler et al., 2004; Toy and Şahinler, 2022). Storage of honey for a long time causes an increase in invert sugar content (White et al, 1961), and an increase in acidity in honey leads to fermentation of honey. In addition, it is desired that the amount of HMF (Hydroxy Methyl Furfural) is low in quality honey. Post-harvest heating, storage time, storage temperature and pH of honey affect the increase in the amount of HMF in honey. Long-term storage and heating of honey also affects diastase activity, which is one of the important quality criteria in honey (Şahinler and Gül, 2004; Şahinler, 2007; Toy and Şahinler 2022).
Keywords: Honey, Qualıty, Heatıng, Storage

INTRODUCTION

The composition of honey is depend on produced season, origin of nectar and climatic conditions. The most important factor affecting honey composition is plant origin. The honey contains proteins, enzymes, water, carbon hydrate, acids, dextrin, ash, vitamins, pollen and substance of aroma (Crane, 1975; Yaniv and Rudich, 1996; Silici, 2002; Fallico et al, 2004).

The contents of these components in honey are the most important quality criteria of honey and indicate some important deterministic quality properties of the honey sample (Table I). Honey having high water content is more likely to ferment. The mineral content of honey indicates the botanical origin. The blossom honeys have lower mineral content than honeydew honey. Honey storage has remarkable influence on increase in invert sugar content. A prolong storage period of honey causes invert sugar to increase (White et al, 1961). Honey fermentation caused an increase in acidity because of this a maximum acidity value.

HMF levels and diastase testing, for measuring honey quality, have been in use for over 75 years (Fallico et al, 2004; White, 1994). Honey processing frequently requires heating both to reduce viscosity and to prevent crystallization or fermentation (Singh et al, 1988; Fallico et al, 2004). The less HMF in honey is the better honey quality. Also, effects of HMF in honey depend on heat process after harvesting, storage time and pH of honey and storage temperature.

Honey diastase activity is a quality factor influenced by honey storage, heating and thus, an indicator of honey freshness and overheating. Conductivity is a good criterion of the botanical origin of honey. Today it is determined in routine honey analysis instead of the mineral content. This measurement depends on the mineral and acid content of honey; when their content increases conductivity also increases (CODEX, 1993). There is a linear relationship between the mineral content and the electrical conductivity (Piazza et al, 1991). A honey quality standards according to the draft CL 1998/12-S of the CODEX Alimentarius, to the draft 96/0114 (CNS) of the EU and TSE 90/3036 were given in Table I.

The main quality factors that are used in the honey international trade with its sensorial characteristics (that is flavour, colour and taste) are moisture, HMF content and diastase activity as well. The latter two being strongly influenced by heating and storage duration of this produce. The one that had the bigger importance during recent years in the international trade was the HMF content (Raminez Cervantes et al., 2000)

Table I. Biochemical characteristic of the honey.

Quality Criteria	Result of Analysis	**TSE**	**CODEX**	*EU*
Mineral Content (%)	0.131	< 0.6 (blossom) < 1.0 (honeydew)	< 0.6 (blossom) <1.0 (honeydew)	< 0.6 (blossom) <1.2 (honeydew)
Moisture Content (%)	15.23	< 21g/100g	< 21g/100g	< 21g/100g
Acidity (meq kg^{-1})	32.3	< 40 meq kg^{-1} (blossom) < 40 meq kg^{-1} (honeydew)	< 50 meq kg^{-1} (blossom) < 50 meq kg^{-1} (honeydew)	< 40 meq kg^{-1} (blossom) < 40 meq kg^{-1} (honeydew)
HMF (mg kg^{-1})	5.73	< 40 mg kg^{-1} (blossom) < 40 mg kg^{-1} (honeydew)	< 80 mg kg^{-1} (blossom) < 80 mg kg^{-1} (honeydew)	< 40 mg kg^{-1} (blossom) < 40 mg kg^{-1} (honeydew)
Diastase Level	17.9	> 8 (blossom) > 8 (honeydew)	> 8 (blossom) > 8 (honeydew)	> 8 (blossom) > 8 (honeydew)
Invert Sugar Content (%)	65.87	> 65 (blossom) > 60 (honeydew)	> 65 (blossom) > 60 (honeydew)	> 65 (blossom) > 60 (honeydew)
Sucrose (%)	6.54	< 5 (blossom) < 10 (honeydew)	< 5 (blossom) < 10 (honeydew)	< 5 (blossom) <10 (honeydew)
Electrical conductivity (mS/cm^{-1})	0.36	Blossom honeys excepted the honeys listed below and blends of honeydew and blossom honey Honeydew and chestnut honey, excepted the honeys isted below and blends with those	< 0.8 > 0.8	

The main quality factors that are used in the honey international trade with its sensorial characteristics (that is flavour, colour and taste) are moisture, HMF content and diastase activity as well. The latter two being strongly influenced by heating and storage duration of this produce. The one that had the bigger importance during recent years in the international trade was the HMF content (Raminez Cervantes et al., 2000).

Diastase activity of honey is affected by long-term storage of honey and heat treatment of honey. Therefore, it is an indicator of the freshness of the honey and its overheating.

Conductivity is a good criterion in determining the botanical origin of honey. This measurement depends on the mineral and acid content of the honey; As their content increases, conductivity also increases. There is a linear relationship between the mineral content of honey and electrical conductivity.

Storage conditions and duration are factors that affect quality. Storing honey for a long time also causes its quality to decrease. Due to its structure, honey can attract odors and should be stored in corrosion-resistant containers. Again, long-term storage and exposure of honey to heat and light may cause the amount of HMF to increase. The lower the amount of HMF, the more this amount increases the quality of honey. One of the most important quality criteria in honey is HMF and the other is Diastase number; This is negatively affected by the increase in the storage time of honey.

When honey is stored for a long time and the fructose in its structure breaks down, HMF is released and its HMF content increases. According to the Turkish Food Codex honey communiqué, the HMF content in honey should be a maximum of 40 mg/kg. Storage of honey for a long time causes the number of Diastase in honey to decrease. According to the Turkish Food Codex honey communiqué, the Diastase number in honey must be at least 8. As a result of storing honey for a long time, honey loses its enzyme value and the number of Diastase decreases.

CONCLUSION

One of the most important quality parameters in the world honey trade is the HMF content of honey and the other is the Diastase number. High heat treatment is applied to affect the crystallization of honey, as a result, the honey does not crystallize, but loses its nutritional properties with the loss of enzymes. It will be important for consumers to be aware that the idea that crystallized honey is obtained from colonies fed with sugar syrup is not true.

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EFFECTS OF STORAGE PERIOD, HEATING TEMPERATURE AND HEATING DURATION ON THE QUALITY OF HONEY IN DIFFERENT HONEY TYPES PRODUCED IN THE AEGEAN REGION

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ABSTRACT

Turkey has a great beekeeping potential with its suitable ecology, rich flora, approximately 8 million colonies , 110 thousand tons of honey production, and 15 kg honey yield per colony. Of the more than 300,000 plant species in the world, approximately 12,000 (Avcı, 2005) varieties are found in Turkey, and most of them are endemic plants. Different honeys are produced in different regions of our country depending on their flora. The most important among these are; plateau, chestnut, citrus, clover, sunflower, cotton, corn, acacia and linden honeys *(Genç, 1994; Gül and Şahinler, 2004; Şahinler et al., 2004 and 2003 ; Anonim, 2005)* . According to the honey communiqué, honey; " It is the sweet substance that honey bees, after collecting flower nectars and secretions of plants or some living creatures living on plants, modify by mixing them with their own substances and store them in honeycombs. " *(Anonymous, 1990)* . Production season, plant origin and climatic conditions affect the structure of honey. The most important factor among these is the plant type *(Crane, 1975; Yaniv oath Rudich , 1996; Şahinler et al., 2004; Toy and Şahinler,2022)* . Long-term storage of honey invert Increased sugar content *(White et al, 1961)* and increased acidity in honey lead to fermentation of honey. In addition, it is desired that the amount of HMF (Hydroxy Methyl Furfural) is low in quality honey. Post-harvest heating, storage time, storage temperature and pH of honey affect the increase in the amount of HMF in honey . Storage and heating of honey for a long time also increases diastase activity , which is one of the important quality criteria in honey. *(Şahinler and Gül, 2004; Şahinler, 2007;Toy* and *Şahinler 2022)* . In this study, biochemical parameters of honey samples from different botanical origins were examined, and as a result of heat treatment at different temperatures and temperature degrees, the change in the amount of HMF in the honey was

determined and it was determined that there was an increase in the HMF content depending on the temperature.

Keywords: Honey, Qualıty, Heatıng, Storage

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INTRODUCTION

According to the honey communiqué, honey; It is defined as " It is the sweet substance that honey bees, after collecting flower nectars and secretions of plants or some living creatures living on plants, modify them by mixing them with their own substances and store them in honeycombs " (Anonymous, 2000). Nectar affects the physical and chemical properties of honey, in other words, it directly affects the quality of honey. Nectar may contain between 30-70 % water. For this reason, the nectar should be thickened and the water content should be reduced to around 17-18 % (Grandi et al., 1980 ; Sönmez and Altan, 1992; Tolon, 1999). A wide variety of honey is produced in our country, depending on the rich flora. The most important among these are; plateau, pine, chestnut, citrus, clover, sunflower, cotton, corn, acacia and linden honey (Genç, 1994; Tolon, 1999; Şahinler and Gül, 2004; Şahinler et al., 2004). Although our country, which has a great beekeeping potential, ranks 4th among the world's honey producing countries with approximately 65 000 tons of honey production, honey exports were negligibly low from the 1970s to the 1980s (Şahinler et al., 2003). Increasing honey exports and producing quality honey requires, first of all, producers to be made aware and trained on this issue.

Production season, plant origin and climatic conditions affect the structure of honey. The most important factor among these is the plant type (Crane, 1975; Yaniv oath Rudich , 1996; Silici, 2002, Şahinler et al., 2004). The basic composition of honey is carbohydrates. 85-95% of carbohydrates consist of glucose and fructose. There are also sugars such as sucrose , maltose, isomaltose , mestitose and lactose. In addition to carbohydrates, the structure of honey contains organic acids, amino acids (lysine , histidine, arginine , aspartic acid, serine, glutamic acid, proline, glycine , alanine , valine , methionine , leucine , isoleucine, triosine , phenylalanine , tryptophan), mineral substances (potassium, sodium, calcium, magnesium, iron, copper, manganese, chlorine, phosphorus, sulfur, sulfur dioxide, iodine), vitamins (riboflavin, pantothenic acid, niacin , thiamine, pyridoxine, ascorbic acid), Enzymes (amylase, sucrose , invertase , phosphotase , catalase, glucose oxidase) and flavoring substances (Crane, 1975; Yaniv oath Rudich , 1996; Silici, 2002, Sunay et al. 2003; Şahinler et al., 2004). These components are the most important components that affect the quality of honey and they show the quality of honey. Honey's high moisture content causes it to ferment in a short time. Mineral content determines the botanical origin of honey . For example, flower honey contains less

mineral substances than secretion honey (Vorwohl et al, 1989). Storing honey for a long time causes the invert sugar content to increase (White et al, 1961). Increased acidity in honey causes fermentation of honey. In addition, it is desirable that the amount of HMF is low in quality honey. Post -harvest heating, storage time, storage temperature and pH of honey affect the increase in the amount of HMF in honey . In addition, storing honey for a long time and heating honey affects diastase activity, which is one of the important quality criteria in honey (Şahinler and Gül, 2004).

biochemical data used as quality criteria in honey in the world honey trade for more than 75 years are the HMF content of honey and the number of diastases (Fallico , Zappala , Arena, & Verza , 2004; White, 1994). It is desired that the HMF level be low in quality honey . The HMF content in honey changes depending on the heat treatments applied to the honey and the storage period. Diastase activity in honey is one of the important quality criteria in honey , and diastase activity changes with the applied temperature and storage time. Studies have reported that as temperature and storage time increase, the HMF content in honey increases and the number of diastase decreases (Raminez Cervantes, Gonzales Novelo , & Saur Duch , 2000; Sahinler and Gul , 2004; Dustmann,1993; Yılmaz and Küfrevioğlu, 1999). Takenaka oath Echigo (1974) reported that diastase and invertase activity in honey decreases with long-term storage of honey. Zervalaki , (2001) , by heating honey, the HMf contained in it reported that both invertase activity and invertase activity increased. It has been reported that the invertase enzyme, which is affected by a number of factors such as abundance of nectar flow, sugar content, physiological age of the colony, age of worker bees, heat application to honey, and storage, determines the diastase number (Oddo et al., 1999). Invertase enzyme is an enzyme that converts sucrose into glucose and fructose . This enzyme is used by worker bees It is secreted from the hypopharyngeal glands and plays a role in converting nectar into honey (White, 1975, Karabournioti oath Zervalaki , 2001;Brouwers, 1982, 1983; Karabournioti oath Zervalaki , 2001).

Our honey export reached its highest level in 1997 with 8 457 tons and approximately 16 million dollars of foreign currency was provided. Lack of honey packaging and packaging in accordance with European Union standards, exporters' lack of organization and excessive reduction in pine honey prices (Fıratlı et al., 2000), and the drugs used by beekeepers to combat diseases and parasites, especially varroa , leaving residues in the honey (Kaftanoğlu and Özgür,

2000), In addition, due to reasons such as the use of naphthalene, feeding with starch-containing foods, the residues it leaves in honey, and the return of honey that does not pass the C-13 test from European countries (Kalaklıoğlu , 2000), it has negatively affected our exports and has damaged the image of Turkish honey, which ranks first in the world markets. It also caused significant income losses expected to be obtained from exports.

Although there are a number of studies in the literature on the effects of heating and storage on the HMF content and Diastase number of honey, there is no source on the optimum temperature and storage time for heating in different honey types . Although it is known that temperature and storage cause enzyme loss in honey, it is not known at which temperature this change begins in different honey varieties. It is expected that the herbal origin of different honey varieties will be different and the resistance of honey varieties to temperature will also be different.

The total honey production of the European Union member countries is around 160 thousand tons. Of the total 402 thousand tons of honey exported in the world, 204 thousand tons are purchased by European Union countries. The Union is a very important honey buyer with a large share of 51% . When a general evaluation is made in the light of all these data, it can be easily seen that the largest and most important honey buyer countries in the world are the European Union countries. Considering that there is a great demand for honey in the union countries during our country's European Union process, a quota will not be imposed on the honey produced in our country in this process. Türkiye should evaluate all market policies it will develop in this sector by taking this situation into consideration. For this purpose, it is inevitable to carry out studies on honey production in accordance with quality standards. As a result of the project, by determining the optimum temperature of the post -harvest heating process for different types of honey and applying these temperature levels, quality honey will be produced and this historical opportunity will be utilized with the market of quality produced honey during the European Union process.

the degree to which post-harvest heat should be applied to different types of honey and how long storage will not affect the structure of honey, and this is necessary for the quality criterion of honey, which is an important export product in the EU accession process. For these reasons, the aims of this study are listed below.

1- Considering that the two most important biochemical properties affecting the quality of honey change with heat and storage, to determine the optimum temperature applied to honey after harvest in different honey types and to determine the optimum storage time.
2- the correlations between HMF content and Diastase number of honey with temperature and storage .

MATERIAL METHOD

A total of 12 honey varieties were studied within the scope of the study. Honey samples were collected from different provinces of the Aegean region, taking into account the widespread vegetation (nectar source) and each honey type was randomly collected from 2 different beekeepers in 2 replicates. (Table 1) (Serper and Aytaç, 2000).

Table 1. Provinces where samples were taken within the scope of the project from different types of honey produced in the Aegean Region.

Provinces	Number of samples (n) (Piece)	honey variety
Izmir	2	karabashotu
Servant	2	Lavender
mugla	2	Pine
	6 Examples	3

Biochemical analyzes of the collected samples (moisture, acidity, HMF, invert sugar, ash, sucrose , PH, mineral substance) TSE (1990), AOAC (1996); Bogdanov et al. It was done according to (1997) . Heat treatment was applied to each honey sample of each honey variety at 45 ^{o}C. After the heating process, the samples were stored at room temperature. Changes in HMF content were detected.

CONCLUSION

According to the results of the biochemical analysis, the data of honey samples of different botanical origins are given in table 2. When Table 1 is examined, it can be seen that the moisture, sucrose , acidity, It can be seen that the results for inver sugar and ash are close to each other.

sucrose , acidity, invert sugar and ash content of honey varieties as a result of biochemical analysis

HONEY TYPE	MOISTURE	SUCROSE	ACIDITY	INVERTED SUGAR	ASH
PINE HONEY	16%	2.4%	2.8%	19.84%	28.2943
LAVENDER HONEY	16.4%	2.4%	2.3%	20.2%	25,346
BLACKBOARD HONEY	16.2%	2.5%	2.4%	21.1%	26,669

After the biochemical analysis of pine, lavender and black pepper honey samples, heat treatment was applied and HMF analyzes were performed after the heat treatment. According to the analysis results, it was determined that heat treatment of honey caused an increase in the HMF content in honey.

Table 3. HMF contents before and after heat treatment in honey samples of different botanical origins .

HONEY TYPE	BEFORE HEAT TREATMENT	45oC - _
PINE HONEY	24,384	68,928
LAVENDER HONEY	14.41	17.41
BLACKBOARD HONEY	24.57	33.79

In conclusion; Producing honey, an important bee product, in accordance with quality standards is important for human health. Care should be taken during heat treatment of honey.

HMF content should be maximum 40 mg / kg according to TSE and EU standards and 80 mg / kg according to CODEX standard. Honey that is heat treated at high temperatures loses enzymes and its HMF content increases. For this reason , quality honey can be obtained if production is carried out in accordance with the standards set by the Turkish Food Codex .

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BEE PRODUCT COMPOSITION AND USE OF AREAS

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ABSTRACT
Beekeeping ; It is a branch of animal husbandry in which the resort oath feeding of honey bee colonies are carried out in the autumn oath spring periods oath the production of products called bee products such as honey , pollen and propolis is carried out . Looking at the pictures drawn on cave walls in the Mesolithic Ibid. during historical excavations , it is claimed that beekeeping started in 7000 BC, and that bees were mentioned in stone inscriptions during the Hittite period (1300 BC) and have survived to the today day . Since beekeeping is a branch of animal husbandry that depends on nature , it can be done in almost every region of the world except the polar regions . Honeybees , which lived only in the European , Asian oath African continents , known as the Old World until the 16th century _ _ now spread almost all over the world except the polar regions (Genç, 1993; Fıratlı et al. 2000). the products obtained from bees as a result of their activities are great _ importance for both the country's economy oath people health with their Rich nutritional values . Bee products such as honey , propolis, beeswax , pollen , bee venom oath royal jelly , collected below the name of bee products , are obtained from places with dense flora and healthy colonies (Çevrimli, 2018). the use of products obtained from bees as the main food source , as a food supplement , antioxidant oath probiotic source , in different areas of cosmetics , and especially in alternative oath complementary medicine all over the world in recent years , has become widespread (Dogaroğlu , 1999; Güler, 2006; Gürdal et al., 2003).
Keywords: Bee products, structure, usage

Bee products

Products obtained from beekeeping activities; Products such as honey, beeswax, pollen, propolis, royal jelly and bee venom . These products are used among the public for treatment of many diseases. In recent years, treatment methods with bee products called " Apitherapy " have shown rapid development in the world. Honey, propolis and royal jelly have excellent antibacterial properties.

Definition of Honey

Honey has definitions made by many organizations around the world, but in our country, it is defined in the Turkish Food Codex honey communiqué as "a sweet product collected by honey bees from plant nectars and other parts of plants, processed with the help of special substances in their bodies, stored in natural or artificial burrows in the hives and matured there". .

Honey is a sugary food product with 95-99 % of its dry matter being carbohydrates. It is obtained from the nectar and sucrose secretions of plants , is transformed and stored in the honeycomb. It turns polarized light to the left (sucrose turns honey to the right). Water content is maximum 25%, ash content is maximum 0.25%. With the invertase enzyme they secrete during the conversion of nectar into honey, bees convert the sucrose in the nectar into simple sugars in the form of fructose and glucose and evaporate the excess water, which will delay fermentation . Honey, a food with a very high energy value and easy to digest, is used in the nutrition of all people , especially children, athletes and the elderly . It can be used to give energy to athletes, especially since it is a ready-made food that turns into energy quickly. One of the important properties of honey is its antibiotic properties, which enable it to remain intact for a long time. It has been reported that honey can be used as a natural food preservative due to its antimicrobial properties (Mundo et al. 2004). In addition, honey has a high osmotic pressure that increases its resistance to spoilage by microorganisms (White 1979). In addition, the antimicrobial activity of honey is associated with hydrogen peroxide and phenolic compounds produced by glucose oxidase inherent in honey (Küçük et al. 2007; Alvarez-Suarez et al. 2010; Al- Waili veark . 2011). Many studies have shown that honey is effective in gastrointestinal disorders (Haffeejee et al. 1985; Ladas et al. 1995), healing of wounds and burns (Efem 1988; Subrahmanyam 1991; Syazana et al. 2011) and as an antimicrobial agent (Ali et al. . 1991; Ladas et al. 1995), proves that it provides gastric protection against acute and chronic gastric lesions (Ali 1991; Ali 1995; Biglari et al. 2012). Honey also provides rapid

clearance of infections, rapid removal of dead tissues and foreign substances from wounds, and reduces inflammation. It provides rapid suppression, rapid reduction of wounds and scars, stimulation of new vessel formation, tissue granulation and epithelial development (Molan and Betts 2004). A study revealed that honey can also be therapeutic for liver diseases (El Denshary et al. 2011). The antioxidant properties of honey are due to compounds such as ascorbic acid, a-tocopherols, b-carotenes, as well as many polyphenolic compounds in its structure. Many phenolic compounds are identified in honeys of different botanical origins (Frankel et al. 1998). Additionally, a correlation was found between the antioxidant activity of honey and its proline content. It has been determined that some honeys containing high amounts of pyrroline amino acids have higher antioxidant capacity than other honeys (Meda et al. 2005). Honey is one of the many biological activities (antioxidant, antiradical , antibacterial , antiviral, anti-inflammatory, antitumoral) shown by various secondary metabolites contained in approximately 1% of its content. It is a natural food ingredient responsible for an increasing number of phytobiological activities, from the treatment of wounds to upper respiratory tract infections, from aging to the prevention of cancer formation . The use of honey in the field of apitherapy is preferred in the treatment or prevention of many diseases.

Usage Areas

It is mainly used as food. GETAT is also used within the scope of its studies. Honey has been used extensively for thousands of years, especially in the treatment of wounds and burns, skin disorders and stomach disorders. Many studies have shown that honey is effective in the treatment of stomach and intestinal disorders (Haffeejee et al. 1985; Ladas et al. 1995) and the healing of wounds and burns (Efem 1988; Subrahmanyam) . 1991; Syazana et al. 2011) proves to be effective as an antimicrobial agent (Ali et al. 1991; Ladas et al. 1995) and provides gastric protection against acute and chronic gastric lesions (Ali 1991; Ali 1995; Biglari et al. 2012).

Propolis

Propolis; It contains resinous substances and plant secretions that worker bees collect from tree barks, shoots, branches and buds of plants in the pollen baskets on their hind legs. The substance they create by biochemically changing these substances and plant secretions with the enzymes secreted from the glands in their heads and mixing them with some wax is called propolis.

Chemical Properties of Propolis

When we look at the general structure of propolis, it consists of 55% resin, 7.5%-35% waxes , 10% essential oils, 5% pollen and 5% other organic substances. It contains more than 300 compounds in its structure. These compounds can be listed as phalavonoids , terpenes , phenolic compounds, alcohols, aldehydes, aliphaic and aromatic acids and esters, steroids, sugars and amino acids . Propolis has a wide spectrum of effects thanks to the compounds found in its structure. It has many uses, especially in terms of human health. Anti-inflammatory with the compounds found in its structure , It has been supported by research that it has many effects such as antitumor , antimicrobial, antiviral, antifungal , antioxidant, antimutagenic and immunomodulatory . For example, flavonoids, one of the most important compounds found in the structure of propolis, are responsible for the antibacterial activity of propolis.

Aniseptic activity - benzoic acid , from its antiviral activity - caffeic acid-luteolin- quarcetin ,Antimutagenic - cinnamic acid-ferulic acid-coumaric acid , chrysin-artepilin-caffeic acid esters from antitumor activity , local anesthetic activity- pinosebrin - caffeic such as acid esters.

Clinical studies have shown that propolis is effective against respiratory system infections (bronchitis, COPD, influenza), skin diseases (herpes , skin fungi, allergies, burns, skin ulcers, abscesses), tooth and gum disorders (gum recession, mouth sores), ear, nose and It has shown that it is effective on throat infections, digestive system diseases (stomach parasites, colitis, stomach ulcers, reflux), gynecological diseases (chronic vaginitis , lesions of the cervix uteri) and urinary system diseases (such as urinary tract inflammation).

In the food industry, it is one of the products used to prevent spoilage and rotting of foods thanks to its antibacterial and antioxidant properties. Its phytoinhibitory effect is used in the storage of tuberous plant species to prevent the germination of the product. It is used in the furniture industry to polish our furniture. In line with the increasing cosmetic needs today, propolis; Royal jelly, which is in its product group, is mixed with plant extracts found in the environment and vitamin E, which is frequently used in the cosmetics industry, and is also used in this sector. The reason why it is preferred in this field is the rich content features it contains. It has also provided successful results in the solution of skin disorders, treatment of endometritis and foot diseases, which are among the most common problems of pets, which are also important for us.

Table.1.Chemical composition Of Propolis

Compounds	Number of Identified Compounds (Quantity)
Flavonoids	38
Hydroxyflavones	27
Hydroxyflavonones	11th
Chalcones	2
Benzoic acid and its derivatives	12
Acids	8
Esters	4
Benzaldehyde Derivatives	2
Cinnamyl and Cinnamic acid and its derivatives	14
Alcohols, Ketones , Phenols	8
Heteroaromatic Compounds	12
terpene Sekuterpene and its derivatives	7
Aliphatic Hydrocarbons	6
Sekuterpene and Triterpene Hydrocarbons	11th
Sterols and Steroid Hydrocarbons	6
Minerals	22
Candies	7
Amino acids	24

The Place of Propolis in Apitherapy

Propolis is also widely used in apitherapy. In the field of dentistry, propolis is used in acute tonsillitis , chronic laryngitis, hepatitis , herpes virus diseases, AIDS , eye inflammations, bronchial diseases. asthma, nonspecific It positively affects the treatment of diseases by using it in pneumonia, gastritis , gastroduodenal ulcer, colitis, vaginitis, eczema, follicullitis and tumors .

Royal Jelly

Royal jelly is one of the secretions of the mandibular and hypopharyngeal glands of 5 to 15-day-old worker bees. It is a jelly-like, bone-coloured, jelly-like substance that is used to feed the larvae inoculated into the queen bee cells, but is collected within 36-48 hours after the inoculation into the queen bee cells. It is defined as "it is a food with a unique odor and a burning taste." Bees use royal jelly in the nutrition of 1-3 day old young larvae and in the nutrition of the queen bee. Young workers take the raw material sources of royal jelly into their bodies,

modify them in their own bodies, secrete them back into the cell, and pass some of them into their blood, secreting royal jelly. In terms of physical properties, royal jelly is a fluid, yoghurt-like, viscous, cream-colored, pungent-smelling, sour-tasting bee product. Royal jelly is partially soluble in water and its density is 1.1 g/ml . Although its viscosity varies depending on the environmental conditions, it is a product with a pH between 3.4-4.5. [5,6] When we look at the structure of royal jelly, it contains plenty of protein, carbohydrates, lipids, minerals (such as ca, p , na , k), vitamins (c, d , e; b) and ash.

Table.2.Chemical composition Of Royal Jell.

Component	**Ratio(%)**
This	**68.43**
Dry Matter	**31.57**
Protein	**14.Oca**
acidity	**33.18**
Amino Acids	**mg/100g**
Aspartic Acid	**3851**
threonine	**807**
Cool	**980**
Glutamic acid	**3851**
proline	**-----**
Glycine	**421**

Generally speaking, the majority of royal jelly consists of water and proteins. While the amount of water in royal jelly varies between 50-70%, the amount of protein varies between 11-17%. Royal jelly is a good source of protein for humans and contains amino acids that cannot be synthesized in the human body. The 10-hydroxy- -2-deconoic acid in the structure of royal jelly is the substance that makes royal jelly different. It has been proven by studies that this substance it αcontains has an antibiotic effect against many fungi and bacteria. In addition to these, the structure of royal jelly contains trace amounts of substances that enable royal jelly to have its unique properties. The structure of royal jelly, as with every bee product, varies depending on the characteristics of the region where it is collected, climate, plant diversity, bee race and nutrition. It is a product with much more nutritional value than honey, which ensures continuous nutrition of the brood and the queen bee. Since the glands of very young worker bees, which are 1-3 days old, are not very developed, older worker bees do not have the ability to produce

royal jelly because these glands have weakened. In the digestive organs of worker bees, honey and pollen are broken down into simpler building blocks with the help of various enzymes and passed into the blood. In cosmetics, stimulating physical performance, ensuring learning capacity and self-confidence, sexual problems, anemia, cholesterol, increasing resistance to viral infections, cancer, high and low blood pressure. It is used in the treatment of arteriosclerosis, chronic and recurrent diseases. Royal jelly gives movement and energy to people . It has regenerative and invigorating properties for the organism. It is indicated in the treatment of nutritional disorders and mental retardation . It is good for skin diseases and rheumatic diseases. Royal jelly can be consumed with honey, or it is recommended to consume it pure in the morning on an empty stomach, at least half an hour before breakfast. The daily dose to be taken is between 10-20mg of pure royal jelly per kilogram of body weight. The average daily dose for adults is 500 mg, and in cases of illness and disease, 1 gram is recommended. In children, a dose between half and a quarter of the adult dose can be used, depending on age and doctor's recommendation.

Pollen

In flowering plants, it is the dried pollen collected by the honey bee located on the upper part of the male organs of the flowers. Pollen is the main source of protein required for bees to grow and complete their development and for the development of their glands. Without pollen, it is impossible for the colony to raise offspring and survive.

Table.3.Chemical composition Of Pollen

Component	**Ratio**
Energy	**2.46 kcal/g**
Protein	**23.7%**
Carbohydrate	**27 %**
lipid	**4.8%**
Phosphorus	**0.53%**
Potassium	**0.58%**
Sodium	**0.044%**
Calcium	**0.225%**
Magnesium	**0.148%**
Zinc	**87 ppm**
Copper	**14ppm**
Iron	**140 ppm**

Pollen is used as a great resource in the treatment of people with pollen allergies , and is also used in medicine in the treatment of prostate diseases.

some scientific studies showing that pollen protects humans and animals from the harmful effects of X-rays . Harvest and storage: It is collected with traps placed under or in front of the colony. Pollen can be stored by different methods such as freezing, vacuum dry freezing, drying in the open or in the oven, or canning. It can be stored in paper bags at -18 degrees for 2 years.

Bee Venom

Bee venom is defined as "It is a substance that forms in the venom bag of bees and contains mainly mellitin , apamin , MCD- peptide , histamine, hyaluronidase , phospholipase-A2, has a pungent odor, has a bitter taste , is yellowish in color, is liquid, and dries and crystallizes quickly when in contact with air." (Anonymous 1989c). Bee venom is produced in the acid and alkali glands of bees, which are connected to the poison bag by a channel, and stored in the poison bag. When a bee stings, this secretion is injected into the person stung through the venom channel in the sting. Although some bee venom is present in newly adult one-day-old bees , they cannot sting at this time because the sting is not yet hard. Starting from the second day, the activity of the acid gland increases and bee venom production reaches the highest level in 16-19 day old bees. The amount of poison in a bee varies depending on the season and the structure of the bee, ranging from 0.05 to 0.3 µ l /bee **.**

Table.4.Chemical composition Of Bee Venom.

Chemical matter	**Ratio (%)**	**Chemical matter**	**Ratio(%)**
Mellitin	**30-50**	**Hyaluronidase**	**2**
Phospholipase A	**10-20**	**MCD peptide**	**2**
Apamin	**3**	**Histamine**	**<1**

bee venom 18 different structures bioactive molecule detection has been made . of these some are : amino acids , protein, fat , sugar And enzyme characteristic showing mellitin , adolapin , apamin, mast cell degranulation (MHD), histamine , phospholipase A, peptide , dopamine And hyaluronidase.Suda soluble colorless , odorless And clear One liquid the one which... bee to the poison to the heat And to the cold It is durable . This poison is normal season at temperatures in about 20 minutes dries And loses 65-70% of its weight . After drying later yellowish brown One colour gets . One gram of solid bee poison for 10,000 bees to the needle need There is

Mellitin And adolapine proteins inflammation reducing (anti- inflammatory); apamin nerve transmission enhancer ; mast cell degranulation (MHD) , allergy inhibitor especially is equipped . Mellitin , 26 amino acids formed bee of poison main toxin is the article . antipyretic _ also has the feature adolapin , inflammation to the formation path blooming cyclooxygenase in preventing role gets And pain cutting (analgesic) effect does . from 10 amino acids formed One peptide the one which... apamin If , nerve system of damage in eliminating effective is is considered . mast cell degranulation (MHD) protein , low in concentrations allergic react path blooming histamine to release reason while high _ in doses this to prevent causes . _ Although _ First Name poison though this _ molecules , poison healing feature to gain at the point One It is a miracle . Nowadays treatment of methods rheumatic complaints _ in troubleshooting Sometimes insufficient stay , patients And health its employees complement medicine to its applications enthusiasm It does . bee venom first Chinese to be to , in America And A lot Europe in his country complement medicine from applications someone aspect acceptance has seen . In these countries apitherapy centers to be established has been started . apitherapy in the best way applied method bee It is poison . Bee sting imitation by bee _ poison skin into or under is applied . your poison micro- injection by sore to the region implementation , live of the bee human sting And acupuncture applications effect mechanisms each other is similar Acupuncture , brain And in the spine pain pathways (opioid and alpha 2 adrenergic receptors) by blocking of pain to be cut off It endures . Bee stings are similar way pain cutter molecule (endorphin) release warns . From this due to china in medicine bee of poison inflammatory area instead , acupuncture to the points implementation more It is common . Some in applications two treatment shape by combining api-acupuncture application together is being done Bee Its venom is mainly used in immunology, in the treatment of allergic patients, as well as in the treatment of various immunological diseases, including rheumatic diseases, gout, sclerosis (tissue hardening), scleroderma (skin hardening seen in the elderly) and asthma (Schmidt 1997).

Apilarnil

It is the product obtained by collecting and homogenizing the honeycomb cells containing male bee offspring along with their nutrients within 3-7 days. Apilarnil contains vitamins and minerals in its structure. It is a biologically active product and, in addition to vitamins and minerals, it contains amino acids, minerals, sugar, fatty acids and androgenic hormones. What

makes Apilarnil important is the amino acid found in its structure. These amino acids are amino acids that cannot be synthesized by humans and animals. It can also be mentioned as a bee product specifically for men. Apilarnil is a 3-7 day old male bee larva that is rich in nutritional components and contains many biologically active compounds. It was first discovered by a researcher in Romania. It is produced by crushing and filtering the male bees, which are 7-day-old larvae, with solutions. Apilarnil is a bee product that has a grayish-yellow color and a homogeneous sour taste (Barnitiu et al., 2013;Morgoan et al.,2017). Male bee larvae have a viscous structure when they are 3-7 days old, before they fully enter the pupa period. This larva has a characteristically strong egg odor. Considering its chemical content, it actually resembles royal jelly. Its chemical composition is quite rich. It can be called a complete food with the substances it contains. The majority of Apilarnil actually consists of moisture, that is, the moisture content is approximately 65-75%. The protein content varies between 9-12%, carbohydrate and lipid content varies between 6-10% and 5-8% (Barnitiu et al., 2013). ;Erdem and Özkök, 2017) When we look at the amino acids in the structure of apilarnil , it is concluded that it contains important amino acids such as lysine, hisdidine, valine, methionine and tyrosine. In addition, it contains vitamins such as B1, B6, vitamin A and minerals such as calcium, sodium and iron . contains. Sabatini et al. They conducted a study on apilarnil and looked at the carbohydrates in its structure. As a result of this study, while glucose, fructose and maltose were found in the content of apilarnil , It has been reported that sucrose is not present in its structure (Sabatini et al., 2009). It is important to keep apilarnil in a cold chain to preserve its nutritional value and to prevent loss of nutrients in its content. The larva must be subjected to this chain after harvest (within half an hour) when it is fresh. As with every product, the quality of apilarnil depends on the place of production and the stage of production. Hygiene conditions vary depending on storage and marketing conditions (Topal et al., 2018)

Despite the exam stress of students abroad, they examined the stress levels of students by giving them a certain amount of apilarnil . As a result of this study, interestingly, it was reported that the intensity of stress felt by the students decreased and their attention concentration capacity was also improved (Gavrilă-Ardelean and Olga, 2014). Apilarnil is a bee product that has begun to be researched in the world and in our country in recent years. Its properties that activate some hormones, its effects on stress, which is a problem of our age, the development of children, and its performance enhancing properties in animals have made apilarnil attract

attention . As with other bee products, the method of use and dosage of Apilarnil are of great importance. Apilarnil is beneficial when consumed in certain dosages, but may cause some discomfort when injected directly into the body. It is known that if used incorrectly, it can cause liver problems and kidney failure. For this reason, it should be consumed under expert control and in the specified dosages .

Bee Bread (Perga)

Perga (bee bread) has a very special place among bee products . " Perga " is actually a bee product that is not well known or mixed with pollen. This valuable bee product, whose main ingredient is pollen, is bee bread (bee Also known as bread) . It is much more valuable and beneficial than normal pollen, thanks to the unique and large amount of beneficial bacteria and residue it contains. It is a pollen specially fermented by bees . In other words; Bee bread is a fermented pollen produced by the enzymatic reaction of bee honey/nectar (25%) and pollen (70%).

and brought to the hive by placing it in the pollen basket dew (corbicula) on the hind legs of honey bees . It is emptied with the help of other young worker bees in the hive and covered with a thin layer of honey and wax mixture to prevent spoilage. This mixture is subjected to chemical change under the influence of different enzymes, microorganisms, humidity and temperature (35-36 oC). This stored pollen, which has undergone chemical changes, is called bee bread. Bee bread is a source of protein, fat and vitamins for bees, and also forms the raw material for the production of royal jelly. Although the contents of bee pollen and bee bread are similar, some differences are also observed. Bee bread contains less protein than bee pollen, but bee bread proteins are easier to digest. Moisture content decreases to 13-14 % as a result of drying after harvest . The general content of bee bread consists of essential amino acids, vitamins C, B1, B2, E, H, carotenoids and anthocyanins, saccharase , amylase and phosphatase enzymes and 25 different minerals. Compared to bee pollen, bee bread contains 6 times more lactic acid, and this feature ensures that it protects itself and is not as susceptible to yeast growth as pollen. In addition, the taste properties of bee bread are better than bee pollen and it is stated that it is easier to be absorbed in the body. Bee bread contains approximately 20% protein, 3% lipid, 24-35% carbohydrates, 3% vitamins and minerals. It contains all the essential amino acids that the human body cannot biosynthesize , protein, vitamins such as C, B, B2, E, H, P, nicotinic acid, folic acid, pantothenic acid, pigments, enzymes such as sucrose , amylase , phosphatase,

flavonoids, carotenoids and hormones. The transformation of bread into bread and biochemical changes occur as a result of microbial activity , mainly lactic acid fermentation caused by bacteria and yeasts . The high biological activity of bee bread ensures better preservation of bee bread by inhibiting the growth of mold and fungus. From the research conducted by Herbert and Shimanuki (1978) in which the chemical composition and nutritional value of bee pollen and pollen stored in the honeycomb cell were examined, it was found that bee bread has a higher reduced rate than pollen. They reported that it contains sugar and fiber. Human and Nicolson (2006) examined the amino acid and fatty acid composition of fresh (flower), bee pollen and stored pollen. They reported that while moisture and carbohydrate content increased in stored pollen, crude protein and lipid content decreased. While the pollen taken from outside is only 60% digestible in the stomach due to the outer shell around it, perga , which is the melted version of this indigestible shell that has been kept with the bee's special enzymes , is 100% digested in the stomach. In addition to containing all the minerals and valuable nutrients contained in pollen, Perga has at least three times more bioactive properties than pollen. The main reason for this is that pergan , unlike pollen, is fermented with special enzymes of the bee and the minerals in it become useful.

Usage areas

The medical world is in favor of reducing drug therapy as much as possible so that disease-causing microorganisms can develop less resistance. In this context, one of the best options before us is foods that are natural but contain substances that threaten the life of these microorganisms. One of them is still undervalued . eyen bee bread / perga (bee Perga is unrivaled in this field with its high antioxidant properties. With these properties, they reduce the risk of cells becoming abnormal and consequently forming tumors, and as it prevents cell destruction, it increases the chance of living a healthier life with minimal effects of aging. Although perga has a wide range of uses in the health industry, it can be especially used against metabolic problems, diet regulation and allergies. It is a very important bee product. Perga is an auxiliary product in the treatment of blood pressure and constipation with its high content of acetyl-choline. It treats and eliminates the digestive problems that occur in the stomach of patients who use antibiotic-containing drugs excessively and the intestinal laziness of these people. Pergan also has antiseptic and germicidal properties. It is also useful in the treatment of bleeding gums.

from Perga, its freshness and quality are extremely important. The perga to be used especially for apitherapy must be free of all kinds of pollution, especially heavy metals and pesticides. As a matter of fact , perga has a feature that can contain such pollution and toxicity elements intensively in its structure.

Conclusion

We must protect bees for the continuation of our world, ecological balance, nutrition and health. Care should be taken to use technical methods in the production of bee products and to ensure production in accordance with the standards. We should consume bee products for our nutrition and health. We must get a doctor's opinion before using apitherapy.

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ÖZET
Türkiye, birçok ılıman iklim meyve türünün anavatanı veya gen merkezi konumundadır. Bu sebeple meyve yetiştiriciliği alanında birçok meyvenin üretiminde başı çeken ülkeler arasındadır. Ceviz (*Juglans regia* L.), bu meyveler arasında bulunmakla birlikte, gerek depolama, gerek ekonomik değeri ve gerekse Anadolu insanında mevcut ceviz sevgisi ile Türkiye' de özel bir ilgi alanına sahiptir. Tarım ve Orman Bakanlığı' nın vasfını yitirmiş orman arazilerini belli ürünler için tarıma açması ki bu ürünler arasında ceviz mevcuttur, son yıllarda ceviz üzerine birçok sosyal medya platformunda ve tv ekranlarında ceviz üzerine yapılan reklamlar, söyleşiler ceviz üzerine insanların ilgisini daha da artırmış ve ceviz yetiştiriciliği konusu Türkiye' de ilgi konusu olmuştur. Sonuç olarak küçük veya büyük birçok alanda ceviz plantasyonları yaygınlaşmıştır. Geçim kaynağı büyük oranda tarım olan Yozgat ili, Türkiye' nin ortasında konumlanmış ve karasal iklimin hakim olduğu tipik Anadolu şehridir. Genel olarak tarla tarımının yaygın olduğu ilde ceviz yetiştiriciliği Türkiye' nin genelinde olduğu gibi son yıllarda ilgi odağı haline gelmiştir. Yozgat' ın geneline yayılmış bir ceviz varlığına rastlamak mümkündür. Bu yayılım atadan kalma dağınık konumlanmış eski tip genotipler veya profesyonel şekilde kurulmuş plantasyonlar şeklinde görülebilmektedir. Yozgat ilinde ceviz ile özdeşleşmiş köyler de mevcuttur, "Paşa" ve "Hisarbey" köyleri bu yerlere örnek olarak verilebilir. Yozgat ilinde son yıllarda gelişen ceviz ilgisi ve kurulan bahçe plantasyonlarına rağmen ceviz üretim ve verim rakamları gelişim gösterememiştir. Ceviz yetiştiriciliği konusunda karasal iklime sahip bölgelerde çeşit seçimi ve bahçe yerinin özellikleri başta olmak üzere, dikim tekniği, sulama, budama ve besleme konuları özellikle bilinmesi ve göz önünde bulundurulması gerekli konulardır. Ceviz yetiştiriciliği konusunda ilin ekolojik koşulları ve/veya üreticilerin eksiklikleri gerekli atılımın yapılamamış olmasının önemli iki faktörü olabilir. Bu çalışmada Yozgat ceviz yetiştiriciliğinin 2018-2023 yılları arasındaki gelişim durumu, eksiklikler varsa sebepleri ve problemlerin çözümü konuları tartışılacaktır.
Anahtar kelimeler: Ceviz, *Juglans regia*, Yozgat, 2018-2023

SUMMARY OF WALNUT CULTIVATION IN YOZGAT 2018-2023

ABSTRACT
Turkey is the homeland or genetic center of many temperate climate fruit species. Consequently, it stands out among the leading countries in fruit production. Among these fruits, walnut (Juglans regia L.) holds a special place in Turkey due to its storage, economic value, and the affection for walnuts within Anatolian culture. The Ministry of Agriculture and Forestry opening degraded forest lands for certain products, including walnuts, has sparked significant interest in walnut cultivation. In recent years, advertisements, interviews, and discussions on walnuts across various social media platforms and television have further increased public interest, making walnut cultivation a subject of interest in Turkey. As a result, walnut plantations have become widespread in both small and large areas. Yozgat province, primarily reliant on agriculture, is situated in the heart of Turkey and represents a typical Anatolian city dominated by a continental climate. Although field agriculture is generally widespread in the province, walnut cultivation has become a focal point of interest in recent years, similar to the rest of Turkey. A widespread presence of walnuts can be observed throughout Yozgat. This distribution can be seen in scattered traditional genotypes inherited from ancestors or in professionally established plantations. There are villages in Yozgat that are strongly associated with walnut cultivation, such as the villages of "Paşa" and "Hisarbey." Despite the growing interest in walnuts and the establishment of orchard plantations in Yozgat province in recent years, walnut production and yield figures have not shown significant development. In regions with a continental climate like Yozgat, the selection of varieties, orchard site characteristics, planting techniques, irrigation, pruning, and nutrition are crucial factors to be considered and understood for successful walnut cultivation. The ecological conditions of the province and/or shortcomings among the producers might be significant factors leading to the inability to make necessary advancements in walnut cultivation. This study will discuss the development of walnut cultivation in Yozgat between 2018 and 2023, addressing any shortcomings, their causes, and potential solutions.
Keywords: Walnut, Yozgat, 2018-2023

1. GİRİŞ

Tarım, ülkelerin kalkınmasında temel rol oynayan önemli bir sektördür. Gelişmiş ve modern bir ekonomik yapıya ulaşmak, tarımın geliştirilmesi ve buradan elde edilecek başarılar ile sanayileşme üzerine yatırım yapılmasından geçmektedir (Doğan ve ark., 2015). Tarımsal gelişimin en önemli adımlarından birisi katma değeri yüksek ürünlerin yetiştirilmesi ve değerlendirilmesidir. Gelişmiş olarak nitelendirilen ülkelerin ekonomik gelişimleri incelendiğinde bütününün öncelikle tarım sektöründe gelişimlerini tamamladıkları ve sonrasında kalkınma süreçlerini sürdürdükleri gözlemlenebilmektedir (Tuna, 1993).

Türkiye, ekonomik platformlarda gelişmekte olan ülkeler arasında yer almaktadır. Tarım sektörü konusunda hali hazırda bazı problemleri barındıran Türkiye, her ne kadar teknoloji yatırımları veya sanayileşmede son yıllarda atılımlar yapmış olsa da, ekonomisinin sağlam bir temele oturması tarımsal konularda var olan problemlerini çözmesinden geçmektedir (Kusat, 2014; Doğan ve ark., 2015). Tarım topraklarının katma değeri yüksek ürünlerle desteklenmesi ve değerlendirilmesi tarımsal kalınma için atılacak adımların başında gelmektedir. Bu ürünler çiftçi gelirinin ve dolayısıyla refahının artmasını sağlamakta ve kırsal kalkınma yolunda önemli katkılarda bulunmaktadır.

Yozgat, İç Anadolu' da ekonomisi büyük ölçüde tarımsal faaliyetlere bağlı olan bir ildir (Şekil 1). Türkiye' nin alan bakımından 15. büyük ilidir ve bazı ilçeleri Karadeniz Bölgesi' nde yer almaktadır. Geniş bir coğrafya ve farklı ekolojik özelliklere sahip bölgeleri sayesinde birçok ılıman iklim meyvesinin yetiştiriciliğine de rastlanılmaktadır (Anonim, 2023a,). Katma değeri yüksek türlerden birisi olan ceviz (*Juglans regia*) yetiştiriciliği yapılan önemli ılıman iklim meyve türlerinden birisi olarak karşımıza çıkmaktadır.



Şekil 1. Yozgat Konum Haritası (Wikipedia, 2023a/Kullanıcı: The Emirr)

Son yıllarda; Türk insanında hali hazırda mevcut olan ceviz sevgisi -ki kendisini türkülerde şiirlerde göstermektedir-, yetersiz bilgi kaynaklı ceviz bahçesi bakımının kolay olduğu inancı, ceviz meyvelerinin depolanmasının kiraz, çilek vb. meyve türleri ile karşılaştırıldığında görece kolay olduğu inancı ve insan diyeti açısından cevizin yerinin anlaşılması cevize ve ceviz yetiştiriciliğine olan ilginin katlanarak artmasını sağlamıştır (Şen, 2005; Akça, 2009; Cosmulescu, 2009; Asma 2012; Ercişli ve ark., 2012; Keles, 2018). Ceviz meyvelerinin her dönem için katma değerli bir meyve olarak pazarlanabilmesi ise ceviz ilgisi konusunda ayrıca önemli bir husustur (Tablo 1). Tablo 1 de çeşit ve ekoloji faktörleriyle değişmekle birlikte 2023 yılı için tahmini verim ve kazanç değerleri yer almaktadır.

Tablo 1. 7x7 mesafede kurulmuş bir ceviz bahçesinin 2023 yılı tahmini verim ve kazanç verileri

Ağaç Sayısı	**Yaş (Yıl)**	**Kg/Ağaç**	**Verim/dekar**	**Kg/TL**	**Dekar/Kazanç**
20	4	3±2	60	100	**6.000,00 TL**
20	5	6±2	120	100	**12.000,00 TL**
20	6	8±2	140	100	**14.000,00 TL**
20	7	15±2	300	100	**30.000,00 TL**
20	8	20±2	400	100	**40.000,00 TL**

Bu çalışmada, ceviz yetiştiriciliği ile ilgili bazı veriler değerlendirilerek Yozgat ceviz yetiştiriciliğinin son 5 yılı ile ilgili durum tespiti yapılmaya çalışılacaktır.

2. YOZGAT CEVİZ YETİŞTİRİCİLİĞİ

Türkiye, ceviz üretimi ile dünyada önemli üretici ülkeler arasında başı çekmektedir (Tablo 2 ve Tablo 3). Ancak ülke çapında tohumdan yetişmiş ceviz ağacı varlığının standart üretimi engellemesi ve kapama profesyonel bahçelerin son yıllarda yaygınlaşması ceviz üretim ve ticaret değerlerinin hak ettiği yere gelmemesine neden olmuştur (Keles, 2018) (Tablo 4).

Tablo 2. Önemli Ceviz Üreticisi Ülkeler

	2018	2019	2020	2021
Çin	850.000	1.000.000	1.100.000	1.100.000
ABD	615.980	594.206	716.680	657.710
İran	304.039	321.073	356.953	386.976
Türkiye	215.000	225.000	286.706	325.000

FAOSTAT, 2023

Tablo 3. Önemli Üretici Ülkelerin Verim Değerleri

	2018	2019	2020	2021
Çin	379.440	382.390	387.730	393.060
ABD	434.890	402.280	466.040	416.720
İran	719.930	717.000	591.480	723.270
Türkiye	192.350	180.650	202.200	211.700

FAOSTAT, 2023

Türkiye sert kabuklu meyveler açısından yaklaşık % 149 oranında kendine yeter bir ülke konumundandır. Oran göz önünde bulundurulduğunda bu alanda kendi kendine yetebilen bir ülke durumundadır. Ancak fındıkta % 553' luk, antep fıstığında % 112'lik ve kestanede % 111' lik oranlar toplam yeterlilik oranını artırmaktadır. Ceviz açısından bakıldığında ülkenin kendi kendine yeterlilik oranı% 80' ler civarındadır (TÜİK, 2023a). İthalat ve ihracat rakamlarına da yansıyan durum, Türkiye' nin cevizde ithalatçı konumunda olmasına ve döviz kaybına neden olmaktadır (Tablo 4). Bu sebeple ceviz üretimi konusunda gerekli tedbirlerin alınması önem arz etmektedir.

Tablo 4. Türkiye Ceviz Ticaret Rakamları

	2018	**2019**	**2020**	**2021**
İthalat Miktarı (t)	52.770	88.053	63.492	78.090
İhracat Miktarı (t)	6.57	16.587	15.262	14.758
İthalat Gideri (1000 $)	163.192	176.676	142.923	154.548
İhracat Geliri	32	43.840	43.332	34.050

FAOSTAT, 2023

Türkiye ceviz yetiştiriciliğinde mevcut problemler özele inildiğinde Yozgat ceviz sektörü için de benzer olarak ortaya çıkmaktadır. Yozgat sınırları içerisinde bulunan ilçe ve bunlara bağlı kasaba, belde veya köylerde ceviz varlığına rastlamak oldukça mümkündür. Yozgat'ta ceviz varlığı ile dikkat çeken, cevizle özdeşleşmiş bazı yerler dahi vardır. Şefaatli ilçesine bağlı "Paşaköy" ve Sarıkaya ilçesine bağlı "Hisarbey" köyleri bu örneklerden sadece birkaç tanesidir (Wikipedia, 2023b). Ancak Türkiye' nin birçok bölgesinde olduğu gibi ceviz yetiştiriciliğinde bazı problemler Yozgat ili için de geçerlidir. Yıllık ortalama sıcaklığın 9.2 °C, ortalama yıllık donlu gün sayısının 108.6 gün olduğu ilde kış soğuklarının -30 °C' leri buluyor olması ve yılık

12 ayının 10 ayında don olaylarının görülüyor olması Yozgat ceviz yetiştiriciliğini kısıtlayan en önemli faktörlerden birisidir. Aynı zamanda ilkbahar geç donları büyük risk teşkil etmektedir (Engin ve Aydınözü, 2001; Anonim, 2023b).

Ekolojik problemlerle beraber çeşit seçimi ile ilgili yapılmış hatalar, çiftçilerin teknik konular hakkında ki mevcut bilgisizlikleri gibi konular Türkiye genelinde olduğu gibi ceviz yetiştiriciliği konusunda Yozgat' ı sınırlandırmakla birlikte çiftçiler açısından başarısızlık ve sonucunda bu konudan uzaklaşma olarak kendini göstermektedir. Yozgat tarımında meyveciliğin yaygın olmaması, meyvecilik konusunda eksik bilgi ve donanım gibi faktörler de ayrıca verim ve üretim rakamlarının düşüklüğünün sebeplerindendir (Tablo 5 ve 6).

Tablo 5. 2018-2022 Türkiye ceviz alanı bakımından başı çeken 5 il ve Yozgat (da)

	2018	**2019**	**2020**	**2021**	**2022**
Denizli	70.066	80.730	109.519	114.530	122.307
Kahramanmaraş	58.468	65.875	78.577	97.020	106.450
Bursa	68.323	72.702	83.633	87.565	91.062
Çanakkale	34.843	37.573	40.303	43.638	44.642
Mersin	23.758	31.618	34.057	38.702	34.987
Yozgat	4.161	4.185	4.180	4.283	4.512

TÜİK, 2023

Tablo 6. 2018-2022 Türkiye ceviz üretiminde başı çeken 5 il ve Yozgat üretimi (ton)

	2018	**2019**	**2020**	**2021**	**2022**
Kahramanmaraş	10.515	11.436	13.036	19.237	19.059
Bursa	8.828	10.837	19.319	18.991	16.111
Mersin	7.863	10.838	16.495	22.598	15.245
Denizli	8.537	8.941	12.054	13.595	14.910
Çanakkale	4.064	4.606	6.879	10.149	13.854
Yozgat	872	817	921	1092	931

TÜİK, 2023

Yozgat özelinde ceviz yetiştiriciliği açısından mevcut problemler daha çok bilgi eksikliği, yanlış yönlendirme ve teknik destek yetersizliğinden kaynaklıdır. Rakamlar ceviz üretimine yetersiz bir eğilimin olduğunu ve var olan potansiyelin yeterince kullanılmadığını göstermektedir. Alınacak önlemler bu konuda özelde Yozgat, genelde ise Türk tarımına önemli katkılarda bulunabilecektir. Mevcut problemleri maddeleştirecek olursak;

- Ceviz plantasyonları kurulurken uzman görüşlerine başvurulmaması,
- Yöre ekolojisi dikkate alınarak çeşit seçiminin yapılmaması ve ezbere uygulamalar,
- Çiftçilerin bu konuda yetersiz donanımı,
- Fidan temininde sertifika ve güvenilir firma seçeneğinin göz ardı edilmesi

olarak sıralanabilir.

3. SONUÇ

Ceviz katma değeri yüksek tarımsal ürünlerden birisidir. Yozgat, geçim kaynağı büyük oranda tarım olan ve tarımsal faaliyetlerin tahıl üretimi ile baskılandığı bir Anadolu şehridir. Sulu veya sulanma potansiyeli yüksek kuru tarım yapılan alanların bu gibi katma değerli ürünlerle devşirilmesi önce yöre ve yöre halkının ekonomisine sonrasında ülke ekonomisine önemli katkılarda bulunacaktır. Ceviz konusunda ülke ticareti incelendiğinde son yıllarda ithalat harcamalarının bir nebze azaldığı, ihracat değerlerinin ise dikkat çekici biçimde arttığı gözükmektedir. Uzun yıllar artma eğiliminde olan ceviz alanları, 2013 yılında gerilemiş ve bununla beraber Tarım ve Orman Bakanlığı tarafından bazı önlemler alınmıştır. Özellikle vasfını yitirmiş orman arazilerinin ceviz tarımına açılması, ceviz üretimine yönelik bakanlıklar tarafından verilen destekler bu önlemlerin başında gelmektedir (Kadakoğlu ve ark., 2022).

Yozgat ceviz yetiştiriciliği incelendiğinde ise, hem alan hem üretim açısından bir artış eğilimi görünmekte ancak yeterli potansiyel ortaya çıkarılamamaktadır. Yozgat için en önemli sınırlayıcı faktör ekolojik koşullardır. İlkbahar geç donları, sonbahar erken donları bu konuda dikkat edilmesi gerekli en önemli noktalardır. Fenolojik uyanma tarihleri geç, uykuya geçiş tarihleri erken çeşitlerin yetiştiricilikte tercih edilmesi, bu konuda yöreye hakim uzman görüşlerine yer verilmesi, cevizin beslenmesi ve türe özgü kültürel işlemlerin çiftçi tarafından benimsenmesi ve eksiksiz uygulanması, yörede ekolojik anlamda uygunluk haritası çıkarılarak cevize en uygun alanlara plantasyonların dağıtılması alınabilecek en önemli önlemlerdir.

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ÖZET
Türkiye gibi geleneksel ekonomik yapıya sahip ülkelerde tarım ekonomik gelişmenin en önemli faktörlerinden birisidir. Genel kalkınmanın temeli kırsal kalkınmadan geçmekte, kırsal kalkınmadaki başarı ise birim alandan sağlanan kazancın artırılması ile gerçekleşmektedir. Sınırlı ekonomik değere sahip ürünlerin yerine yöreye uygun ekonomik değeri yüksek alternatif ürünlerin yetiştirilmesi kazancın artırılmasına yönelik en önemli hamlelerden birisidir. Ekonomik faaliyetlerini daha çok tarımın oluşturduğu Yozgat ili, Türkiye' nin tahıl ambarı olarak tanımlanmaktadır. Buğday, arpa, şeker pancarı, ayçiçeği, mercimek ve nohut gibi ürünlerin çoğunlukla yetiştirildiği ilde, birim alandan elde edilen kazanç beli sınırlarda kalmaktadır. Geniş tarımsal alana sahip yörenin uygun yerlerinin katma değeri daha yüksek ürünlerle değerlendirilmesi özelde Yozgat, genelde ülke için fayda arz edecektir. Lezzetli ve besleyici özellikleri ile dikkat çeken Hünnap (*Ziziphus jujuba* Mill), Çin geleneksel tıbbında "Ölümsüzlük Meyvesi" olarak adlandırılmaktadır. Besin özelliklerinin yanında 1700 metre rakıma kadar yetişebiliyor olması, çöl bölgelerinde dahi görülebilmesi ve -20 °C gibi düşük sıcaklıkları tolere edebilmesi bitkisel özellikleri ile de dikkat çekmesini sağlamaktadır. Ayrıca hünnap meyvelerinin günümüzde yaş olarak 35-70 TL/kg, kurutulmuş olarak ise 70-120 TL/kg gibi fiyatlara alıcı bulabilmesi ekonomik anlamda da dikkat çekmektedir. İç Anadolu Bölgesi' nde konumlanmış Yozgat, karasal iklim özelliklerine sahiptir. Yıllık yağış miktarı 350-450 mm arasında, genel anlamda kireçli toprak yapısına sahip ve ilkbahar donlarının meyvecilik açısından problem oluşturduğu bir ekolojiye sahiptir. Toprak seçiciliğinin fazla olmaması, kurak koşullara dayanıklılığı ve yöre de Mayıs aylarında yaprak, Haziran aylarında çiçek açması gibi özellikleri ile Yozgat Yöresi için ön plana çıkan bir meyve türü olarak karşımıza çıkmaktadır. Tarla tarımı ürünlerine karşın birim alandan daha yüksek kazanç potansiyeli olan ve yöreye uyum ile ilgili potansiyel vadeden hünnap bitkisinin Yozgat açısından değerlendirilmesi önemli gözükmektedir. Bu çalışmada, Yozgat tarımı ve ekolojisi bakımından Hünnap bitkisinin durumu, potansiyeli ve yetiştiriciliği ile ilgili konular tartışılacaktır.
Anahtar Kelimeler: Hünnap, *Ziziphus jujuba*, Yozgat, Ekoloji

GROWING POTENTIAL OF JUJUBE (Ziziphus jujuba Mill.) PLANT UNDER YOZGAT CONDITIONS

ABSTRACT
In countries with a traditional economic structure like Turkey, agriculture is one of the most crucial factors for economic development. The foundation of overall development lies in rural development, and success in rural development occurs through increasing profit per unit area. Cultivating alternative high-value products suitable for the region, rather than products with limited economic value, is one of the most significant steps towards increasing profits. Yozgat province, where economic activities are predominantly driven by agriculture, is recognized as the granary of Turkey. Although crops like wheat, barley, sugar beets, sunflowers, lentils, and chickpeas are predominantly grown in the province, the profit per unit area remains relatively limited. Leveraging the fertile agricultural land in the region for higher value-added products, especially in Yozgat and generally in the country, will be beneficial. Jujube (*Ziziphus jujuba* Mill), known in Chinese traditional medicine as the "Fruit of Immortality," stands out with its delicious and nutritious characteristics. Apart from its nutritional properties, its ability to grow at altitudes of up to 1700 meters, its presence even in desert regions, and its tolerance to low temperatures, as low as -20°C, make it remarkable. Furthermore, the current market price for fresh jujube fruits ranges from 35-70 TL/kg, while dried ones can fetch prices between 70-120 TL/kg, making it economically appealing. Positioned in the Central Anatolia Region, Yozgat experiences continental climate characteristics. The annual precipitation ranges between 350-450 mm, generally featuring a calcareous soil structure. Ecologically, it faces challenges with spring frosts that can be problematic for fruit cultivation. However, its adaptability due to less soil selectivity, resistance to drought conditions, and its characteristics of leafing in May and flowering in June make Jujube a prominent fruit species in the Yozgat region. Given its potential for higher profit per unit area compared to field crops and its adaptability to the region, evaluating the jujube plant from Yozgat's perspective seems significant. This study will discuss the status, potential, and cultivation of the jujube plant concerning Yozgat's agriculture and ecology.
Keywords: Jujube, *Ziziphus jujuba,* Ecology

1. GİRİŞ

Yozgat, ekonomisi büyük ölçüde tarıma bağlı olan ve Türkiye' nin İç Anadolu Bölgesi' nde yer alan bir ildir (Şekil 1). Karadeniz Bölgesi' nde yer alan üç ilçesi de (Çekerek, Aydıncık ve Kadışehri) bulunmaktadır. Bu sebeple bazı bölgelerinde farklı bitki türlerine rastlamak mümkün olmaktadır. Alan bakımından Türkiye' nin 15. ili (1.412.300 ha) konumunda olan Yozgat ilinin yer şekilleri %98,8 oranında tarıma imkân vermektedir. Yarı kurak iklim şartlarının daha çok kuru tarıma izin verdiği ilde yaygın olarak tahıllar ve baklagiller yetiştirilmektedir. Sulu tarım imkânlarının bulunduğu bölgelerinde ise şeker pancarı, ayçiçeği, patates ve soğan türleri yetiştirilebilmektedir. Meyve ve sebze yetiştiriciliğinin kısıtlı olduğu il de elma, armut, kiraz, ayva, üzüm ve ceviz gibi meyveler yoğunlukta görülürken domates, biber, fasulye ve hıyar gibi sebzelerin yetiştiriciliğine rastlanılmaktadır (Wikipedia, 2023a).

Yozgat ili kalkınmada birinci derecede öncelikli yöreler kapsamındadır. Bu kapsama alındığı ilk yıllarda sanayi bölgesinde doluluk yaşanırken, sonrasında yaşanan ekonomik krizler firma sayılarında ciddi düşüşlere sebebiyet vermiştir. Ülkelerin ekonomik yapılarında olduğu gibi özelde yörelerin gelişmesi ve ekonomilerinin modern bir yapıya dönüşmesi öncelikle sanayileşmeden geçmektedir. Ancak bu dönüşümün yaşanması yüksek oranda geleneksel ekonomik yapı ile ilişkilidir (Kusat, 2014; Doğan ve ark., 2015).



Şekil 1. Yozgat Konum Haritası (Wikipedia, 2023b/Kullanıcı: The Emirr)

Tarımsal faaliyetlerin (tarla ve bahçe tarımı, hayvancılık vb.) bir bütün olarak oluşturduğu geleneksel ekonomik yapının büyümesi ve gelişmesi ekonomik kalkınmayı öncelikli etkileyen faktördür. Dünyada gelişmiş ülkeler olarak bilinen İngiltere, Japonya ve Almanya gibi ülkelerin ekonomik yapıları incelendiğinde, sanayileşme açısından attıkları önemli adımları tarım

sektöründen elde ettikleri başarı ve ekonomik güç ile şekillendirdikleri görülmektedir (Tuna, 1993).

Birim alandan elde edilen gelirin artırılması kırsalda yaşayan nüfusun tarıma daha özverili, daha heyecanlı yaklaşmalarını sağlamaktadır. Yozgat gibi özellikle tarla tarımının yapıldığı illerde ekonomik potansiyeli yüksek, kuru veya sulu tarla tarımına alternatif oluşturabilecek ürünlerin yaygınlaştırılması birim alandan elde edilen gelirin artırılması açısından en önemli başarılardan birisi olacaktır.

Bitkisel ürünlerin besleyici özelliklerin oldukça önemli hale geldiği son yıllarda bazı ürünlerin hem sosyal medyanın etkisi ile hem de insanların beslenme alışkanlıklarında bilinçlenmesi ile ön plana çıktığı görülmektedir. Hünnap (*Ziziphus jujuba* Mill.) besleyici özellikleri ile birlikte aynı zamanda bitkisel özellikleri ile de dikkat çeken meyve türlerinden birisidir.

Çin orjinli bir bitki olan Hünnap; Rusya, Hindistan, Kuzey Afrika, Güney Avrupa, Orta Doğu ve Anadolu' da doğal yayılma alanı bulmuştur (Reichl, 1991; Yaşa, 2016). Özellikle Batı Anadolu' da yoğun bir yayılma alanı bulmuş olan Hünnap bitkisinin sahip olduğu bitkisel özellikleri farklı bölgeler de yetiştiriciliği açısından potansiyel oluşturmaktadır.

Bu çalışmada Hünnap bitkisinin özelliklerinden bahsedilerek Yozgat ili açısından potansiyeli konusunda değerlendirmelerde bulunulacaktır.

2. HÜNNAP

Rhamnaceae familyasına ait hünnap (*Ziziphus jujuba* Mill.) bitkisinin en yaygın ve bilinen türleri Ziziphus mauritiana Lam. (Hint hünnabı) ve Ziziphus jujuba Mill. (Çin hünnabı)' dır. Birçok iklim özelliğine adapte olabilen hünnap, marjinal tarım alanlarında dahi yetiştirilebildiği bilinmektedir (Rendle, 1959; Mukhtar vd., 2004; Pareek, 2013; Johnston, 1972). Ülkemizde doğal olarak yetişmiş halde bulunabilen hünnap, bazı yörelerde kapama bahçeler şeklinde de değerlendirilmektedir. Ülkemizde daha çok batı ve güney kısımlarda rastlanılmaktadır (Hacıyusufoğlu vd., 2016; Kavas ve Dalkılıç, 2015).

Hızlı bir şekilde verime yatan ve periyodisite göstermeyen hünnap ağaçlarının dikenli olması bazı kültürel işlemlerin daha zor yapılmasına sebebiyet veriyor olsa da çok ağır yapılı topraklar hariç farklı toprak yapılarına uyumu, kireçli topraklara toleransı ve 120-2200 mm yağış skalasında yetişebilmesi gibi özellikleri ile birçok alanda alternatif ürün olarak öne çıkmaktadır. Hünnabın en dikkat çekici özelliği fenolojik özellikleridir ki hünnap bitkilerinin Mayıs-Haziran aylarında çiçekleniyor olması karasal iklim ve ilkbahar geç donlarının meyvecilik için sorun

teşkil ettiği yörelerde öne çıkmasının birincil nedenlerindendir (Tümen ve Sekendiz, 1989; Karıncalı, 2013; Kavas ve Dalkılıç, 2015; Karıncalı, 2013; Yaşa, 2016).

Hünnap meyveleri hem taze hem kuru şekilde tüketime uygundur. Birçok çalışmada hünnap meyvelerinin fitokimyasal özellikleri vurgulanmakta olup, bu meyvelerin vitaminler, mineraller, antioksidanlar ve fenolik bileşikler açısından oldukça zengin oldukları bildirilmektedir (Promyou ve ark., 2012; Keles,2020; Sobhani ve ark., 2020; Liu ve ark., 2021; Khadivi ve ark, 2022; Mahmoud ve ark, 2022).

Günümüzde taze meyveleri 30-50 TL, kuru meyveleri ise 50-150 TL arası fiyatlardan alıcı bulan hünnap bitkisel ve besin özellikleri yanında ekonomik anlamda da önemli bir meyve olarak karşımıza çıkmaktadır. 4x5 mesafede ve 1 dekar alanda kurulacak bir hünnap bahçesinin tahmini kazanç fizibilitesi Tablo 1' de gösterildiği şekilde gerçekleşebilir. Verim değerleri bahçe bakımı ve ekolojik koşullarla birlikte azalıp artabileceği düşünüldüğünde ortalama göstergeler aşağıdaki gibi olacaktır.

Tablo 1. 4x5 Hünnap bahçesi verim ve değer tablosu.

Ağaç Sayısı/Number of Trees	**Yaş / Year**	**Kg/Ağaç Kg/Tree**	**Verim/dekar Yield/da (kg)**	**Kg/TL**	**Da/Kazanç Da/Earning**
50	4	5	250	50	**12.500 TL**
50	5	10	500	50	**25.000 TL**
50	6	20	1000	50	**50.000 TL**
50	7	30	1500	50	**75.000 TL**

3. YOZGAT ve HÜNNAP

Yozgat ili ekonomisinin temelini ve halkın büyük bölümünün geçim kaynağını tarım sektörü oluşturmaktadır. Tarla tarımının yoğunlukta yapıldığı yörede bahçecilik çok yaygınlaşmamış olmakla birlikte meyvecilik açısından Türkiye kapsamında örnek çalışmalar da mevcuttur. Yozgat Kadışehri İlçesi Kabalı Köyü' nde 1800 parselde toplulaştırma çalışması yapılarak toplam 5.640 da alanda meyve bahçesi kurulmuş ve bu bahçede 300 bin adet kiraz, elma, armut, şeftali, nektarin, hünnap türlerinin bulunduğu meyve fidanları dikilmiştir (Anonim, 2023a). Yozgat bahçeciliğini kısıtlayan en önemli faktör ilkbahar geç donlarıdır. Bazı yıllarda Mayıs aylarına kadar sarkan ilkbahar geç donları özellikle ceviz, kiraz, kayısı, şeftali, erik, badem gibi

türlerde önemli verim kayıplarına neden olmaktadır. Bu nedenle her tür için en önemli koşul, fenolojik tarihleri uygun çeşitlerle yetiştiriciliğin yapılmasıdır.

Hünnap (*Ziziphus jujuba* Mill.) hastalık ve zararlılara karşı toleransı, elverişsiz toprak koşullarında iyi performans gösterebilmesi ve özellikle fenolojik özellikleri ile Yozgat için alternatif bir tür olarak karşımıza çıkmaktadır. İl çevresinde takip edildiği ve henüz yayımlanmamış çalışmalarımıza göre tomurcuk patlama tarihler Mayıs ayı başlarına, çiçeklenme tarihleri ise Haziran ve Temmuz aylarına yayılan Hünnap meyvesi ilkbahar geç donları açısından Yozgat ili için oldukça geleceği parlak bir bitkidir. Hünnabın ülkemizde toplam 2248 ton üretimi yapılmaktadır. Bu üretimin % 60' ını 5 il yapmaktadır (Tablo 2).

Tablo 2. Türkiye Hünnap Üretim Rakamları

	Yıl	**Amasya**	**Manisa**	**Denizli**	**Çanakkale**	**Antalya**	**Türkiye**	**5 ilin toplamı**	**5 ilin payı**
Üretim Miktarı (Ton)	**2022**	522	252	233	170	137	2248	1314	60%

Tüik, 2023

Tablo 2' de Amasya örneği Yozgat için de bir örnek teşkil edebilir. Donlardan devamlı zarar gören bir elma bahçesinin bir kısmında hünnabın performansının denenmesi ve sonucunda neredeyse bütün bahçenin hünnap ile çevrilmesi Amasya' nın hünnap yetiştiriciliğinde baskın illerin önüne geçmesini sağlamıştır.

4. SONUÇ

Yozgat ili genelinde tarım toprakları organik madde bakımından düşük, orta veya yüksek kireçli toprak yapısına sahip ve yıllık yağış miktarı 571 mm civarında yarı kurak iklime sahip bir ildir. Yıllık ortalama sıcaklık 9.2 °C' dir. Yozgat ortalama yıllık donlu gün sayısı 108.6 gündür. Kış soğuklarının -30 °C' lere kadar indiği yılın 10 ayında don olaylarının görüldüğü Yozgat ili için ilkbahar geç donları meyvecilik açısından büyük risk teşkil etmektedir (Engin ve Aydınözü, 2001; Anonim, 2023b). Yozgat ekolojisi için hünnabın alternatif bir meyve türü olarak değerlendirilebileceği literatürden de takip edildiği üzere aşikardır. Bu konuyla alakalı çalışmaların çeşitlendirilmesi, türün ilin farklı lokasyonlarında adaptasyon yeteneklerinin denenmesi ve yaygınlaştırılması önem arz etmektedir.

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SÜRDÜRÜLEBİLİR GIDA ARZI İÇİN YENİ BİR YAKLAŞIM: HÜCRESEL TARIM

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ÖZET

Günümüzde Dünya nüfusunun hızla artıyor olması, buna paralel olarak beslenme ihtiyacının artmasına neden olmaktadır. Her geçen gün artan besin ihtiyacı ve bu besin kaynaklarının tüketimi ile açığa çıkabilecek problemler beraberinde çözüm arayışlarını ortaya getirmiştir. Bu nedenle, mevcut gıda kaynaklarını desteklemek için alternatif yöntemlerin araştırılması esastır. Yakın gelecekte karşılaşılacak sürdürülebilirlik, çevre, küresel halk sağlığı, yenilebilir bitki kaynakları, hayvan refahı gibi problemlere küresel bir çözüm olabilecek teknoloji olarak 'hücresel tarım' kavramı ileri sürülmüştür. Hücresel tarım; yeni teknolojiler ile hücresel düzeyde et, süt, yumurta, deri gibi ürünlerin üretiminin yapılabildiği yeni bir alanı oluşturmaktadır. Hayvan hücresi kültürü teknolojisi ile et analoğu üretilmesinin yanı sıra fermantasyona dayalı hücresel tarım ile rekombinant DNA teknolojisi yardımı ile genetiği değiştirilmiş bakteri, küf veya mayalar kullanılarak jelatin, kazein, kolajen gibi organik moleküller üretmek mümkündür. Hayvansal proteinlerin ve özellikle süt proteinlerinin tüketimi, sürdürülebilirlik ve hayvan refahı sorunları ile doğrudan ilişkili olduğundan süt proteinlerinin rekombinant sentezi son zamanlarda yoğun ilgi görmektedir. Fermantasyona dayalı hücresel tarımdan günümüzde endüstriyel düzeyde üretimde yararlanılmaktadır. Dünya pazarında hücresel tarım ile endüstriyel olarak üretilen çeşitli ürünlerin yanı sıra mayalar ile süt proteinleri üretimi yapılmaktadır. Hücresel tarımla et ve süt ürünlerinin üretilmesi gıda arzının sürdürülebilirliği açısından umut verici olmasının yanında endüstriyel biyoteknoloji uygulamaları enerji, toprak ve su gibi kaynakların kullanımını en aza indirirken, mevsimsel ve coğrafi koşullara bağlılığı azaltmaktadır. Üretim sürecinde ortaya çıkan atıkların ve kullanılan kimyasalların azaltılması insanlığa besleyici, güvenli ve sağlıklı gıda sağlamanın mümkün olduğunu göstermektedir. Hücresel tarımın geleneksel tarım ile kıyaslandığında çevresel zararının daha az olduğunun bilinmesi sürdürülebilir gıda üretiminde başvurulabilecek bir yöntem olduğunu göstermektedir. Sürdürülebilirlik tartışmaları odağında, ekosistemin bozulmaması adına hücresel tarımın değerlendirilmesi ve hızlı bir şekilde pazara sunulması gerekliliği çalışmalara ve tüketici isteklerinin artmasına bağlıdır. Hücresel tarım ile sürdürülebilirlik hedeflerinin gerçekleştirilmesinin ancak bu teknolojinin anlaşılması ve geliştirilmesi ile mümkün olabileceği görülmektedir.

Anahtar kelimeler: Hücresel tarım, Hücre temelli gıdalar, Sürdürülebilir gıda arzı, Sürdürülebilirlik, Gıda üretimleri

A NEW APPROACH TO SUSTAINABLE FOOD SUPPLY: CELLULAR AGRICULTURE

ABSTRACT
Nowadays, the rapid increase in the world population causes an increase in the need for nutrition. The increasing need for food and the problems that may arise with the depletion of these food sources have brought along the search for solutions. It is therefore essential to explore alternative methods to supplement existing food sources. The concept of 'cellular agriculture' has been proposed as a technology that can be a global solution to problems such as sustainability, environment, global public health, edible plant resources, and animal welfare that will be encountered in the near future. Cellular agriculture; With new technologies, it creates a new area where products such as meat, milk, eggs and leather can be produced at the cellular level. In addition to producing meat analogs with animal cell culture technology, it is possible to produce organic molecules such as gelatin, casein and collagen using genetically modified bacteria, molds or yeasts with the help of cellular agriculture based on fermentation and recombinant DNA technology. Recombinant synthesis of milk proteins has attracted great attention recently, as the consumption of animal proteins, and especially milk proteins, is directly related to sustainability and animal welfare issues. Cellular agriculture based on fermentation is currently used in industrial production. In addition to various products produced industrially by cellular agriculture in the world market, yeasts and milk proteins are produced. While producing meat and dairy products with cellular agriculture is promising in terms of sustainability of food supply, industrial biotechnology applications minimize the use of resources such as energy, soil and water, while reducing dependence on seasonal and geographical conditions. Reducing the waste and chemicals used in the production process shows that it is possible to provide nutritious, safe and healthy food to humanity. Knowing that cellular agriculture has less environmental damage compared to traditional agriculture shows that it is a method that can be applied in sustainable food production. Sustainable food production depends on the evaluation of cellular agriculture, its rapid delivery to the market and increasing consumer demands. It is seen that the realization of sustainability goals with cellular agriculture can only be possible with the understanding and development of this technology.
Keywords: Cellular agriculture, Cell-based foods, Sustainable food supply, Sustainability, Food productions

1. GİRİŞ

Tarih boyunca gıdanın toplanması veya üretilmesi insanlığın büyük endişe kaynaklarından biri olmuştur. Toplumların göçebe hayat tarzından yerleşik hayata; diğer bir deyişle avcı-toplayıcı yaşamdan tarım ve hayvan yetiştiriciliğine geçmesiyle birlikte medeniyet kavramı oluşmuştur. Modern tarım ise sulama sistemleri, gübre ve tarım ilacı kullanımı vb. uygulamalar ile tarımsal üretimde verimi büyük ölçüde artırmıştır (Hocquette, 2016). Günümüzde artan insan popülasyonu, ekilebilir alanların ve su kaynaklarının azalması tarımsal üretimde sürdürülebilirliği tehlikeye atmaktadır. 2050 yılına gelindiğinde dünya nüfusunun 9 milyara ulaşması beklenmektedir. Bu rakam mevcut gıda üretiminin iki katına çıkması gerektiğini göstermektedir. İklim değişikliği ile tarımsal üretimin günden güne daha zor hale gelmesi gıda üretiminde sürdürülebilir yeni yolların bulunması gerekliliğini ortaya koymaktadır (FAO, 2013).

Hücresel tarım, laboratuvar ortamında gıda üretimiyle geleneksel hayvancılık metotlarına alternatif bir yol sunmaktadır. Bu teknoloji, geleneksel hayvancılığın yol açtığı yüksek sera gazı emisyonlarını, su ve arazi kullanımını önemli ölçüde azaltma potansiyeline sahiptir. Ayrıca, hücresel tarım, hayvan refahı ve etik konularında da olumlu katkılar sunmaktadır (Kırmacı & Akmanoğlu, 2021).

Dünya'da sınırlı olan kaynakların etkin kullanımına yönelik olarak doğan amaç doğrultusunda geleneksel tarım hücresel tarıma kıyasla sera gazı emisyonunun, arazi kullanımının, su ve enerji tüketiminin önemli bir kısmını oluşturmaktadır. Hayvancılığın karbondioksit, metan ve nitröz oksit bakımından toplam emisyona katkısı sırasıyla %9, %39 ve %65'tir (FAO, 2006). İn vitro et üretiminin enerji tüketimini ve arazi kullanımını %99, su kullanımını %90, enerji kullanımını ise %40 azaltabilmesi mümkündür (Post, 2012). Hücresel tarımın sağlayabileceği katkı ile sera gazı emisyonunda büyük bir azalmaya yol açacaktır.

Bu çalışmada hücresel tarım ve uygulamaları, sürdürülebilirliğe katkısı, hücresel tarımdan beklentiler ve hücresel tarımın zorlukları ele alınmıştır.

2. HÜCRESEL TARIM

Hücresel tarım, gıda üretimini temelden değiştirmeyi amaçlayan yenilikçi bir alan olarak ortaya çıkmıştır. Hücresel tarım, hayvan hücreleri, mikroorganizmalar veya bitki bazlı bileşenler kullanarak laboratuvar ortamında et, süt ürünleri ve diğer gıda maddelerini üretmeyi hedefleyen

yeni bir yaklaşımdır (Mattick, 2018). Bu yaklaşım, geleneksel tarımın yol açtığı çevresel etkiyi, hayvan refahı sorunlarını ve gıda güvenliği meselelerini azaltmayı hedeflemektedir. Hücresel tarım geleneksel gıda üretimine alternatif olarak geliştirilmiş olup, sürdürülebilirlik, besin değerleri ve gıda güvenliği açısından avantaj sunmaktadır (Bhat & Fayaz, 2011). Bu alandaki gelişmeler, biyoteknoloji, moleküler biyoloji, genetik mühendisliği ve doku mühendisliği disiplinlerindeki ilerlemelerle yakından ilişkilidir.

Kültürlenmiş hücrelerinin gıda olarak kullanılması kavramı, sağlıklı, protein açısından zengin ve besin açısından dengeli gıda hammaddesi elde etmek için bir alternatif sunmaktadır. Şu anda her ne kadar kalori bazında değerlendirildiğinde küresel gıda üretimi şu ana kadar nüfus artışına ayak uydurmuş olsa da, yeterli gıdanın sağlanması ve mikro besin eksikliklerine neden olan düşük kaliteli diyetler ile ilgili çok ciddi problemler vardır (Rischer vd., 2020).

Hücresel tarım özellikle süt endüstrisinde, bebeklerin ihtiyaçlarına göre fonksiyonel bileşenlerin spesifik olarak üretimi için kullanılabilir. Örneğin bu teknolojinin anne sütüyle beslenemeyen bebekler için fonksiyonel süt biyoaktif maddeleri sağlama potansiyeli vardır. Bu şekilde uygulamalarla hücresel tarım fermentasyon yoluyla gıdalarda fonksiyonel özelliklerin geliştirilmesi için de hücresel tarım kullanılabilmektedir (Yart vd., 2023).

Mevcut gıda sistemini sağlıklı beslenme ve çevresel sürdürülebilirlik hedefini artan nüfusa rağmen sağlamak, geleneksel tarımın karşılaştığı en büyük zorluktur (Morchid vd., 2023). Gıda ve çeşitli gıda katkı maddeleri biyoteknolojik üretimi için hücresel tarım umut verici bir teknolojidir.

3. HÜCRESEL TARIM UYGULAMALARI

Kültürlenmiş et, doğrudan kesilen hayvanlardan elde edilmek yerine, bir biyoreaktördeki bir büyüme ortamında kültürlenen hayvan hücrelerinden üretilir. İn vitro et üretme fikri uzun zamandan beri bilim insanları, politikacılar ve sanatçılar tarafından tartışılmaktadır (Treich, 2021). Profesör Mark Post'un in vitro etten yapılmış bir hamburgeri gösterdiği gün olan 5 Ağustos 2013'ten bu yana in vitro etin bilimsel gelişimi giderek artmaktadır (Orellana vd., 2020). Günümüzde kültür et ve deniz ürünleri start-up'ların çoğu Amerika'da bulunmaktadır.

Tarımsal faaliyetler su ayak izinin %70-85'inden ve dünya sera gazı emisyonlarının %30'undan sorumludur. Gıda talebinin yakın gelecekte artacak olması, bu etkilerin de artmasına neden olacaktır. Et üretimi, gıda üretimini en çok etkileyen faaliyettir (Smetana vd., 2015).

Kültürlenmiş et üretiminde doku mühendisliği teknikleri kullanılır. Hayvanın bir çiftlikte doğal olarak bütün üretilmesi yerine belirli kısımları üretilebilir. Hücreler kas dokusundan ya da embriyodan seçilir ve geliştirilerek kas hücrelerine farklılaşması sağlanır. Bu hücreler biyoreaktöre konularak, çoğaltılırlar. Biyoreaktör hücrenin ihtiyacı olan materyali sağlayan zengin bir kaynaktır. Kas lifleri ve daha büyük dokulara dönüşmek üzere bir matrise veya yapı iskeletine çoğaltılan hücreler aktarılırlar (Orellana vd., 2020).

Hücre kültür teknolojisi aynı zamanda gıda güvenliği açısından da avantajlar sunmaktadır. Laboratuvar ortamında kontrol edilen koşullarda, gıda kaynaklı hastalıkların risk etmeni mikroorganizmaların kontaminasyonu oldukça düşüktür (Eibl vd., 2021). Ayrıca pestisitler, arsenik, dioksinler ve hormonlar gibi geleneksel et üretim sistemleriyle ilişkili diğer bileşiklere maruz kalma riskleri de geleneksel üretime kıyasla daha azdır (Bhat vd., 2017).

Diğer yandan et üretiminde hayvanlar üzerinde kullanılan antibiyotikler de hücre kültürü teknolojisinde olmadığından kullanılan ve ete geçebilen antibiyotik miktarını azaltmaktadır. Bu durum dolayısıyla antibiyotik dirençli mikroorganizmaların ortaya çıkması bakımından da önleyicidir (Newman vd., 2023).

Hücresel tarım rekombinant DNA teknolojisi ile özellikle kollajen, kazein ve jelatin gibi biyomoleküllerin üretiminde önemli bir potansiyele sahiptir. Kollajen, hayvan dokularında bol miktarda bulunan bir proteindir ve çeşitli tıbbi ve kozmetik uygulamalarda kullanılır. Hücresel tarım, genetik mühendisliği ve hücre kültürü tekniklerini kullanarak, hayvanlardan elde edilen kollajene benzer olarak yüksek saflıkta ve fonksiyonel özelliklere sahip kollajen üretimini mümkün hale getirmektedir (Dupuis vd., 2023). Kazein, sütte bulunan ana proteindir ve gıda endüstrisinde yaygın olarak kullanılır. Hücresel tarım, kazein üretiminde yenilikçi bir yaklaşım ile süt üretimi için alternatif ve daha sürdürülebilir bir yöntem sunmaktadır. Jelatin, hayvan derisi, kemikler, tendon ve kıkırdaklardan elde edilen bir protein türüdür (Gómez-Guillén vd., 2011). Hücresel tarım, jelatin üretiminde hayvansal elde yöntemlerine etik ve sürdürülebilir bir alternatif sunmaktadır.

Rekombinant DNA teknolojisi ile çeşitli biyomoleküllerin sentezi yapılabilmektedir. Rekombinant DNA teknolojisi, genleri tanımlamak, eşlemek, sıralamak ve fonksiyonlarını belirlemek için kullanılmaktadır. Rekombinant DNA probları, tek tek hücreler içindeki ve tüm organizmaların dokuları boyunca gen ekspresyonunun analizinde kullanılmaktadır (Pazarli, 2019).

Rekombinant DNA teknolojisi gıda ve tıp alanlarında yenilikçi yaklaşımlar sunmaktadır. rDNA teknolojisi kullanılarak geliştirilen hücre hatları, spesifik gıda bileşenleri veya farmasötik ürünlerin üretiminde kullanılabilir. Ayrıca gıda güvenliği ve gıda alerjileri konusunda yeni çözümler sunabilir ve gıda ürünlerinin özelliklerini iyileştirebilir (Bryant, 2020).

Rekombinant DNA teknolojisi, genetiği değiştirilmiş bakteri ve mayaların fermentasyonu ile halihazırda diyabet hastaları için insülin ve peynir mayası gibi gıda enzimleri üretmek için ticari olarak kullanılmaktadır. Şimdi ise etki alanı daha hayvan proteini setini kapsayacak şekilde genişletilmiştir. Örneğin Perfect Day şirketi bu süreci kullanarak süt proteinleri ve Clara Foods yumurta beyazı proteinleri üretmektedir (Saavoss, 2023). Hücre bazlı süt ürünlerinde, ürün bileşenlerin formülasyona bağlı birleştirilmesi ile satışa sunulmaktadır İnek sütünde bulunan hayvansal bazlı yağ ve şekerin yerine bitkisel bazlı yağlar ve şekerler eklenir. Bu şekilde üretilen gıda ürünlerinde proteinlerin ve tamamlanmış ürünlerin tat, doku ve beslenme profillerinin iyileştirilmesi gerekliliği önemli bir teknolojik engeldir.

4. SÜRDÜRÜLEBİLİR GIDA ÜRETİMİNDE HÜCRESEL TARIMIN FAYDALARI

Sürdürülebilir gıda üretimi, artan nüfus ve çevresel zorluklar nedeniyle 21. yüzyılın en hayati sorunudur. Artacak olan gıda tüketimine cevap vermeye yönelik ortaya çıkan hücresel tarımın geleneksel tarıma kıyasla sağladığı avantajlardan en önemlileri; çevresel sürdürülebilirlik, hayvan refahının artırılması ve gıda güvenliğinin iyileştirilmesidir (Mcmorris vd., 2021).

Çevresel sürdürülebilirlik açısından, hücresel tarım, geleneksel tarıma kıyasla daha az su ve toprak kullanımı ve daha düşük karbon emisyonları ile dikkat çekmektedir Geleneksel hayvancılık, sera gazı emisyonlarının büyük bir kaynağıdır ve önemli miktarda su ve arazi kullanımına ihtiyaç duymaktadır. Hücresel tarım, bu kaynakların kullanımını azaltarak gıda üretiminin çevreye etkisini önemli ölçüde düşürebilir (Behm vd., 2022).

Geleneksel tarım, hayvan refahı yönünden oldukça fazla sorun barındırmaktadır. Hayvan refahı bakımından, hücresel tarımın hayvanlara yönelik etik kaygıları azaltmaktadır (Saavoss, 2023). Geleneksel hayvancılıkta sıkça rastlanan hayvanların mental ve fiziksel olarak zor yaşam koşulları, hücresel tarım yöntemiyle ortadan kaldırılması için çözüm sunmaktadır (Schaefer & Savulescu, 2014). Diğer bir yaklaşım ise hücresel kültürlü et üretiminin geleneksel et üretimini azaltmak yerine toplam et tüketimini artırmaya yönelik etki edeceği ve geleneksel et üretimi,

çevresel etkileri ve kesilen hayvan sayısı hiç azalmayacağı yönündedir (Stephens vd., 2018). Hücresel kültürlü etin eti ikame etmek yerine zaman içinde artacak popülasyona gıda sağlama kaygısı ile üretilmesi bu durumu daha iyi açıklamaktadır.

Son olarak, hücresel tarım, gıda güvenliğini artırma potansiyeline sahiptir. Laboratuvar ortamında kontrol edilen üretim süreçleri, gıda kaynaklı hastalıkların riskini azaltma potansiyeline sahiptir. Hücresel tarım ayrıca, gıda üretiminin iklim değişikliği gibi dış faktörlere olan bağımlılığını azaltarak daha kararlı bir gıda üretim sistemi kurma olanağı sağlayabilmektedir (Eibl vd., 2021).

5. GELECEK BEKLENTİLERİ, ZORLUKLAR VE SONUÇ

Gıda üretiminde verimlilik, ürünün ticarileşmesi açısından en önemli parametredir. Hücresel tarım ile üretimi yapılan ürünün geleneksel tarım ile üretimi yapılan ürünle rekabet edebilmesi için üretim prosesinin daha verimli olması gerekmektedir. Hücresel kültürlü et üretiminde biyoreaktör boyutu ve verimliliği önemli rol oynar. Büyük ölçekli uygulamaya ilişkin olarak, biyoreaktör tasarımları ilerleyen süreçte büyü rol oynayacaktır (Eibl vd., 2021).

Hücresel tarımda diğer bir zorluk da geleneksel et ürünlerinin sahip olduğu tat, renk ve doku ile ilgili özellikleri in vitro etin sağlamasıdır. Üretimde yer alan proses koşullarının optimizasyonu, biyoteknolojik olarak üretilen hemoglobinin kullanımı ve kas hücrelerinin yağ dokusuyla birlikte yetiştirilmesi, tin vitro etin duyusal olarak kabulünü artırabilecek potansiyel çözümlerdir (Bhat vd., 2019)

Son olarak tüketicilere yönelik her türlü sağlık ve güvenlik riskini ortadan kaldırmak için kapsamlı bir izleme sistemi geliştirilmelidir. ABD Gıda ve İlaç İdaresi (FDA) ve ABD Tarım Bakanlığı (USDA), piyasaya sürülen hücresel et ürünlerinin güvenli ve doğru bir şekilde etiketlenmesini sağlamak için birlikte çalışmaktadır. Avrupa Birliği'nde in vitro et ile ilgili Yeni Gıda Yönetmeliği oluşturulmuştur ve in vitro et için piyasaya sürülmeden önce Avrupa Komisyonu'ndan pazar onayı alınması gerekmektedir (Eibl vd., 2021). Türkiye'de hücresel tarım ile üretilmiş et ile ilgili üretim çalışmaları yaygın olmasa da bulunmaktadır. Ancak hücresel tarım ürünleri ile ilgili yönetmelik bulunmamaktadır.

Hücresel tarım ile üretilen ürünlere zaman içinde tüketici ilgisinin artması durumunda geleneksel tarım sistemi üzerinde ortaya çıkabilecek sosyoekonomik zorluk da hücresel tarıma yönelik başka bir tartışma konusunu oluşturmaktadır. Geleneksel tarım sistemlerinde faaliyet

gösteren insanlar üzerindeki etkiyi azaltmak için bu endişenin dikkate alınması ve dengeli yavaş bir geçiş sürecinin sağlanması gerekmektedir (Saavoss, 2023).

Hücresel tarıma yönelik tüketici tutumları, bir çok yenilikte olduğu gibi bu yeni gıda üretim sisteminde de belirleyici rol oynamaktadır. Hücresel tarımın yaygınlaşması, tüketiciye geleneksel tarım ile ilgili endişe ile hücresel tarımın gerekçe ve sonuçlarının iyi anlatılmasıyla gerçekleşebilecek bir hedeftir.Yeni gıda sisteminde üretilen ürünün tat, koku ve fiyat bakımından geleneksel ürünlerle rekabet etmesi gerekmektedir. Hücresel tarım ile ilgili sorunların hızlı çözümü ve gıda güvenliği hücresel tarımın yaygınlaşmasında en önemli kısmı oluşturmaktadır.

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BEYAZ ETLİ VE KIRMIZI ETLİ PİTAYA (*Hylocereus spp.*) TÜRLERİNİN *İN VİTRO* KOŞULLARDA TOHUM ÇİMLENDİRMESİNE BAP ve GA_3' in ETKİSİ

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ÖZET
Ejder meyvesi (Pitaya) *Hylocereus* cinsine ait *Hylocereus undatus* (beyaz etli kırmızı kabuklu) ve *Hylocereus polyrhizus* (kırmızı etli kırmızı kabuk) türlerinden oluşmakta ve dünyada yaygın üretilmektedir. Türkiye'de ise pandemi ile birlikte tüketimi artan meyvelerden biri olarak göze çarpmaktadır. Türkiye, birçok bitki türünün yanında ejder meyvesinin de üretimi için uygun ekolojik yapıya sahiptir. Ejder meyvesine karşı artmakta olan talep de yetiştiriciliğini teşvik etmektedir. Sağlık açısından birçok fayda barındıran, süs bitkisi olarak da değerlendirilen ve çeşitli antioksidan maddeleri içeren ejder meyvesinin tohumları uzun süre depolanamamaktadır. Bu da yüksek ölçekli meyve üretimini kısıtlamaktadır. İn vitro da yapılan bu çalışmada, tohum çimlenmesine bitki büyüme düzenleyicilerin etkisinin belirlenmesi hedeflenmiştir. Yapılan bu araştırmada, BAP (Benzil amino pürin) ve GA_3 (Gibberellik asit)'ün farklı konsantrasyonları kullanılarak, 14 uygulamalı bir deneme deseni hazırlanmıştır. 'Royal Red' çeşidinde en yüksek çimlenme oranı %73.33 ile 1 mg/l BAP + 6 mg/l GA_3 içeren MS ortamında sağlanırken, en düşük çimlenme oranı ise %26.67 ile 3 mg/l BAP + 12 mg/l GA_3 içeren MS ortamında tespit edilmiştir. 'Vietnam White' çeşidinde en yüksek çimlenme oranı %93.33 ile 3 mg/l BAP + 12 mg/l GA_3 içeren MS ortamından sağlanmıştır. En düşük çimlenme oranını veren uygulamalar ise %63.33 oran ile 3 mg/l BAP + 6 mg/l GA_3, 3 mg/l BAP + 3 mg/l GA_3, 2 mg/l BAP + 9 mg/l GA_3 ve 1 mg/l BAP + 3 mg/l GA_3 konsantrasyonlarını içeren MS ortamları olmuştur. Yapılan bu çalışmada elde edilen sonuçların ejder meyvesi üretimine katkı sağlayacağı ve yapılacak yeni araştırmalara ışık tutacağı ön görülmektedir.
Anahtar Kelimeler: BAP, GA_3, *Hylocereus polyrhizus, Hylocereus undatus, in vitro*, pitaya

THE EFFECT OF BAP AND GA_3 ON *IN VITRO* SEED GERMING OF WHITE FLESHY AND RED FLESHY PITAYA (*Hylocereus spp*.) SPECIES

ABSTRACT
Dragon fruit (Pitaya) is composed of *Hylocereus undatus* (red shell with white flesh) and *Hylocereus polyrhizus* (red shell with red flesh) species of the genus Hylocereus and is widely produced in the world. In Turkey, it stands out as one of the fruits whose consumption has increased with the pandemic. Turkey has a suitable ecological condition for the production of dragon fruit as well as many other plant species. The increasing demand for dragon fruit also encourages its cultivation. The seeds of dragon fruit, which has many health benefits, is also used as an ornamental plant and contains various antioxidant substances, cannot be stored for a long time. This limits large-scale fruit production. In this in vitro study, it was aimed to determine the effect of plant growth regulators on seed germination. In this study, an experimental design with 14 treatments was prepared using different concentrations of BAP (Benzyl amino purine) and GA_3 (Gibberellic acid). The highest germination rate of 'Royal Red' variety was 73.33% in MS medium containing 1 mg/l BAP + 6 mg/l GA_3, while the lowest germination rate was 26.67% in MS medium containing 3 mg/l BAP + 12 mg/l GA_3. In 'Vietnam White' variety, the highest germination rate was obtained from MS medium containing 3 mg/l BAP + 12 mg/l GA_3 with 93.33%. The treatments with the lowest germination rate were MS media containing 3 mg/l BAP + 6 mg/l GA_3, 3 mg/l BAP + 3 mg/l GA_3, 2 mg/l BAP + 9 mg/l GA_3 and 1 mg/l BAP + 3 mg/l GA_3 concentrations with 63.33%. It is foreseen that the results obtained in this study will contribute to the production of dragon fruit and will shed light on new researches to be carried out.
Keywords: BAP, GA_3, *Hylocereus polyrhizus*, *Hylocereus undatus*, *in vitro*, pitaya

1. GİRİŞ

Pitaya'nın (*Hylocereus spp*.) anavatanı Meksika ile Orta ve Güney Amerika'nın tropik ve subtropik bölgeleri iken, doğal olarak yetişme bölgeleri Güney Meksika, Guatemala'nın Pasifik tarafı, Kosta Rika, El Salvador, Venezuela, Kolombiya, Ekvador, Nikaragua, Panama, Brezilya ve Uruguay olarak belirtilmektedir (Gunasena vd., 2007; Demirkaplan, 2020). Bu tür, anavatan bölgesi olan Amerika'nın tropik ve subtropik bölgelerinden Asya, Avustralya ve Orta Doğu'ya kadar yayılım göstermektedir (Gunasena vd., 2007; Demirkaplan, 2020). Günümüzde bu türün yetiştiriciliği 25'ten fazla ülkede (Avustralya, Kamboçya, Çin, Kolombiya, Ekvator, Guatemala, Hawaii, Endonezya, İsrail, Japonya, Laos, Malezya, Meksika, Yeni Zelanda, Nikaragua, Peru, Filipinler, İspanya, Sri Lanka, Tayvan, Tayland, güney batı ABD, Vietnam, Yunanistan ve Türkiye) yapılmaktadır (Demirkaplan, 2020).

Ejder meyvesi, Cactaceae (kaktüsgiller) familyasının bir üyesi olan çok yıllık yeşil gövdeli tırmanıcı bir bitkidir. Tropikal ve subtropikal bölgelerde yetişir (Thinesh ve Seran, 2015; Abdulrahman vd., 2022). Ejder meyvelerinin besleyici ve tedavi edici özellikleri dolayısıyla bu ürün popülerlik kazanmaktadır (Sonawane, 2017; Abdulrahman vd., 2022). Dünya genelinde bu ekonomik olarak önemli bir meyve türü olarak kabul edilmektedir (Rifat vd., 2019; Abdulrahman vd., 2022). Ejder meyvesi *Hylocereus* cinsine ait *Hylocereus undatus* (beyaz etli kırmızı kabuklu) ve *Hylocereus polyrhizus* (kırmızı etli kırmızı kabuk) türlerinden oluşmakta ve dünyada yaygın üretilmektedir. Türkiye'de ise pandemi ile birlikte tüketimi artan meyvelerden biri olarak göze çarpmaktadır. Türkiye, birçok bitki türünün yanında ejder meyvesinin de üretimi için uygun ekolojik yapıya sahiptir. Ejder meyvesine karşı artmakta olan talep de yetiştiriciliğini teşvik etmektedir.

Sağlık açısından birçok fayda barındıran, süs bitkisi olarak da değerlendirilen ve çeşitli antioksidan maddeleri içeren ejder meyvesinin tohumları uzun süre depolanamamaktadır. Bu da yüksek ölçekli meyve üretimini kısıtlamaktadır (Abdulrahman vd., 2022).

İn vitro tohum çimlenmesi bu sorunların üstesinden gelmek için bir alternatif olabilir. Ayrıca tohumlar toplandıkları mevsimde çimlendirilebildiğinden, ıslah döngülerinin uzunluğunu azaltmakta ve daha kısa sürede fide elde edilmesine olanak sağlamaktadır (Şan ve Yıldırım, 2009). *In vitro* kültür tekniği, hastalıksız geliştirilmiş dikim materyalleri elde etmek için bitkileri hızla çoğaltmanın alternatif bir yoludur ve ayrıca diğer geleneksel bitki çoğaltma yöntemlerine kıyasla daha hızlı ve verimli bir süreçtir (Choffe vd., 2000; Dahanayake ve

Ranawake, 2011; Thinesh ve Seran, 2015). Bitki büyüme düzenleyicilerden özellikle GA_3, sentezlenen ABA miktarını düşürerek tohum çimlenmesine olanak sağlamaktadır (Şan vd., 2014).

Bu çalışmada da tohum canlılığı kısa süren pitaya tohumlarının in vitro koşullarda çoğaltılmasına bitki büyüme düzenleyicilerinin etkisi araştırılmıştır.

2. MATERYAL METOT

2.1 MATERYAL

Bu çalışmada, Türkiye'nin Antalya ilinin Serik ilçesinde yüksek plastik tünel altında yetiştirilen 'Vietnam White' ve 'Royal Red' çeşitlerinin meyvelerinden çıkartılan tohumlar materyal olarak kullanılmıştır.

2.2 METOT

Yapılan bu araştırmada, MS besin ortamı (**Çizelge 2.1**) içerisine, BAP (Benzil amino pürin) ve GA_3 (Gibberellik asit)'ün farklı konsantrasyonları ilave edilerek, 14 uygulamalı (**Çizelge 2.2**) bir deneme deseni hazırlanmıştır.

Çizelge 2.1 Çalışmada kullanılan olan, MS ortamı (Murashige ve Skoog, 1962) makro ve mikro elementler ile vitamin miktarları

Bileşik	**Konsantrasyon (mg/l)**	**Bileşik**	**Konsantrasyon (mg/l)**
$MgSO_4.7H_2O$	370	$CoCl_2.6H_2O$	0.025
KH_2PO_4	170	KI	0.83
KNO_3	1900	$FeSO_4.7H_2O$	27.8
NH_4NO_3	1650	Na_2EDTA	37.3
$CaCl_2.2H_2O$	440	Glycine	2.0
H_3BO_3	6.2	Myo-inositol	100
$MnSO_4.H_2O$	15.6	Nicotinik asit	0.5
$ZnSO_4.7H_2O$	8.6	Pyridoxine HCl	0.5
$Na_2MoO_4.2H_2O$	0.25	Thiamine HC	0.1
$CuSO_4.5H_2O$	0.025		

Kırmızı ve beyaz etli pitaya meyvesinin tohumları ilk olarak %70'lik etil alkole 1.0 dakika süreyle daldırılmıştır. Daha sonrasında ise, %15'lik NaOCl (Sodyum hipoklorit) + 1-2 damla Tween-20 çözeltisinde 15 dakika bekletilmiştir. Uygulanan sterilizasyon süreleri tamamlanan pitaya tohumları steril kabil içerisinde 3 kez steril saf su ile durulanmıştır.

Çizelge 2.2 Denemede kullanılan uygulamalar ve konantrasyonları besin ortamına ilave edilen elisitörler ve konsantrasyonları

Uygulamalar	Konsantrasyonlar (mg/l)
1	Kontrol
2	1 mg/l BAP + 3 mg/l GA_3
3	1 mg/l BAP + 6 mg/l GA_3
4	1 mg/l BAP + 9 mg/l GA_3
5	1 mg/l BAP + 12 mg/l GA_3
6	2 mg/l BAP + 3 mg/l GA_3
7	2 mg/l BAP + 6 mg/l GA_3
8	2 mg/l BAP + 9 mg/l GA_3
9	2 mg/l BAP + 12 mg/l GA_3
10	3 mg/l BAP + 3 mg/l GA_3
11	3 mg/l BAP + 6 mg/l GA_3
12	3 mg/l BAP + 9 mg/l GA_3
13	3 mg/l BAP + 12 mg/l GA_3
14	2 mg/l BAP

2.2.2 DENEME DESENİ VE VERİLERİN DEĞERLENDİRİLMESİ

Deneme, her uygulama 3 tekerrürlü ve her tekerrürde 10 tohum olacak şekilde tesadüf parselleri deneme desenine göre kurulmuştur.

Araştırmadan elde edilen veriler MINITAB yazılım paket programı kullanılarak varyans analizine (ANOVA) tabi tutulmuştur. Uygulamalar arasındaki önemli farklılıkları belirlemek için Tukey çoklu karşılaştırma testi kullanılmıştır.

3. BULGULAR VE TARTIŞMA

İn vitro da yapılan bu çalışmada, tohum çimlenmesine bitki büyüme düzenleyicilerin etkisinin belirlenmesi hedeflenmiştir. Yapılan bu çalışmada en yüksek çimlenme oranları çeşitlere göre farklılık göstermiştir. 'Royal Red' çeşidinde en yüksek çimlenme oranı %73.33 ile 1 mg/l BAP + 6 mg/l GA_3 içeren MS ortamında sağlanırken, "Vietnam White" çeşidinde bu oran %83.33

ile 1 mg/l BAP + 12 mg/l GA_3, 2 mg/l BAP + 12 mg/l GA_3, 3 mg/l BAP + 9 mg/l GA_3 ve 3 mg/l BAP + 12 mg/l GA_3 konsantrasyonlarını içeren MS ortamlarından sağlanmıştır (**Çizelge 3.1**).

Çizelge 3.1. "Royal Red" ve "Vietnam White" çeşitlerinin çimlenme oranı (%) Tukey testine göre harflendirilmiş

Uygulamalar (mg/l)	**Çimlenme oranı (%)**	
	Royal Red	**Vietnam White**
Kontrol	56.67ab	66.67a
1 mg/l BAP + 3 mg/l GA_3	33.33ab	63.33a
1 mg/l BAP + 6 mg/l GA_3	73.33a	76.67a
MS ortamı + 1 mg/l BAP + 9 mg/l GA_3	36.67ab	80.00a
MS ortamı + 1 mg/l BAP + 12 mg/l GA_3	40.00ab	83.33a
MS ortamı + 2 mg/l BAP + 3 mg/l GA_3	33.30ab	73.30a
MS ortamı + 2 mg/l BAP + 6 mg/l GA_3	60.00ab	60.00a
MS ortamı + 2 mg/l BAP + 9 mg/l GA_3	36.67ab	63.33a
MS ortamı + 2 mg/l BAP + 12 mg/l GA_3	66.67ab	83.33a
MS ortamı + 3 mg/l BAP + 3 mg/l GA_3	46.70ab	60.00a
MS ortamı + 3 mg/l BAP + 6 mg/l GA_3	43.30ab	60.00a
MS ortamı + 3 mg/l BAP + 9 mg/l GA_3	60.00ab	83.33a
MS ortamı + 3 mg/l BAP + 12 mg/l GA_3	20.00b	83.33a
MS ortamı + 2 mg/l BAP	60.00ab	70.00a

Çizelge 3.3. "Royal Red" çeşidinin çimlenme indeksi (%) ve ortalama çimlenme zamanı (gün)

Uygulamalar (mg/l)	**Çimlenme indeksi(%)**	**Ortalama çimlenme zamanı(gün)**
Kontrol	0.377[ö.d.]	3.67[ö.d.]
1 mg/l BAP + 3 mg/l GA_3	0.22	2.16
1 mg/l BAP + 6 mg/l GA_3	0.48	4.75
1 mg/l BAP + 9 mg/l GA_3	0.24	2.37
1 mg/l BAP + 12 mg/l GA_3	0.26	2.59
2 mg/l BAP + 3 mg/l GA_3	0.22	2.16
2 mg/l BAP + 6 mg/l GA_3	0.42	4.11
2 mg/l BAP + 9 mg/l GA_3	0.31	3.02
2 mg/l BAP + 12 mg/l GA_3	0.44	4.32
3 mg/l BAP + 3 mg/l GA_3	0.33	3.24
3 mg/l BAP + 6 mg/l GA_3	0.31	3.02
3 mg/l BAP + 9 mg/l GA_3	0.40	3.89
3 mg/l BAP + 12 mg/l GA_3	0.17	1.73
2 mg/l BAP	0.40	3.89

*ö.d. = istatistiki olarak önemli bulunmamıştır.

''Royal Red'' çeşidinde 1 mg/l BAP + 6 mg/l GA_3 içeren MS ortamında en yüksek çimlenme indeksi % 0.48 ve en yüksek ortalama çimlenme zamanı 4.75 gün olarak tespit edilmiştir (Çizelge3.3).

Çizelge 3.4 "Vietnam White" çeşidinin çimlenme indeksi (%) ve ortalama çimlenme zamanı (gün)

Uygulamalar (mg/l)	**Çimlenme indeksi(%)**	**Ortalama çimlenme zamanı(gün)**
Kontrol	0.46[ö.d]	3[ö.d]
1 mg/l BAP + 3 mg/l GA_3	0.42	2,72
1 mg/l BAP + 6 mg/l GA_3	0.51	3,29
1 mg/l BAP + 9 mg/l GA_3	0.53	3.43
1 mg/l BAP + 12 mg/l GA_3	0.57	3.72
2 mg/l BAP + 3 mg/l GA_3	0.48	3.15
2 mg/l BAP + 6 mg/l GA_3	0.48	3.15
2 mg/l BAP + 9 mg/l GA_3	0.42	2.72
2 mg/l BAP + 12 mg/l GA_3	0.55	3.58
3 mg/l BAP + 3 mg/l GA_3	0.42	2.72
3 mg/l BAP + 6 mg/l GA_3	0.42	2.72
3 mg/l BAP + 9 mg/l GA_3	0.55	3.58
3 mg/l BAP + 12 mg/l GA_3	0.62	4.01
2 mg/l BAP	0.48	3.15

*ö.d. = istatistiki olarak önemli bulunmamıştır.

''Vietnam White" çeşidinde 1 mg/l BAP + 12 mg/l GA_3 içeren MS ortamında en yüksek çimlenme indeksi %0.57 ve en yüksek ortalama çimlenme zamanı 3.58 gün olarak tespit edilmiştir (Çizelge 3.4).

Yapılan bu çalışma genel olarak literatür ile uyumlu çıkmıştır. Farklı araştırmacılar yaptıkları çalışmalarda farklı sterilizasyon yöntemleri (Kasim vd., 2015), hormon konsantrasyonlarının (Chaturani ve Jayatilleke, 2005; Kari vd., 2010; Abdulrahman vd., 2022) ve farklı besi ortamlarının (Chaturani ve Jayatilleke, 2005; Kari vd., 2010; Kasim vd., 2015; Abdulrahman vd., 2022) ejder meyvesi tohumlarının çimlenmesi üzerine etkisini araştırmışlardır.

Yapılan bu çalışmada en iyi çimlenme oranı "Royal red" %73.33 "Wietnam white" çeşidinde %83.33 oranla sağlanmıştır. Diğer araştırıcıların yaptığı çalışmalarda en iyi çimlenme oranları %89.3 (Kari vd., 2010), %98.5 (Chaturani ve Jayatilleke, 2005) bulunmuştur. Bu farklılığın

tohum canlılık oranından kaynaklanabileceği düşünülmektedir. Abdulrahman vd. (2022)'nin yaptıkları çalışmada ise, en iyi çimlenme oranını veren BAP ve GA3' ün yüksek olduğu konsantrasyonlarda çimlenme artış göstermiş bizim yaptığımız çalışma ile benzer sonuçlar elde edilmiştir.

4. SONUÇ

Süs bitkisi olarak kullanılan son dönemde sağlık için yararlı olan pitaya meyvelerinin dünya ile paralel olarak ülkemizde de pandemi ile birlikte artan talep doğrultusunda popülaritesi artmakta ve yetiştiriciliği yaygınlaşmaktadır. Fakat pitaya ile ilgili ülkemizde fazla bir çalışmaya rastlanılmamaktadır (Demirkaplan, 2020). Yapılan bu çalışma sonucunda "Royal red" çeşidinin tohumları "Wietnam white" çeşidinin tohumlarına oranla daha yüksek çimlenme yüzdesine sahip olmuştur. Bu çalışmanın literatürde daha sonra yapılacak olan çalışmalara ışık tutması öngörülmektedir.

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BAZI İKLİMSEL ÖZELLİKLERİN BAL ÜRETİMİNE ETKİLERİNİN İNCELENMESİ

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ÖZET
İklim değişikliği doğal dinamikleri ile ortya çıksada insan kaynaklı etkiler ile değişimin ivmesi hızlanmakta ve gezegendeki yaşamı her açıdan olumsuz etkilemektedir. Küresel bir sorun olan iklim değişikliği tarımsal üretimi tehdit etmekte, gıda güvenliği ve sürdürülebilir kalkınma hedefleri açısındanda ciddi bir endişe kaynağıdır. Tarımsal üretimin bir kolu olan arıcılık faaliyetleri ve bunun en önemli çıktılarından başlıcası olan bal üretimide ilkim değişimden olumsuz etkilendiği düşünülmektedir. Bal; dayanıklı, yoğun, yüksek enerji veren, şifa kaynağı olan, besin değeri yüksek, tamamıyla doğal bir gıda maddesidir. Beslenmedeki öeneminin yanı sıra küresel ticarete konu olan önemli bir emtiadır. Bu çalışmada amaç yüzey sıcaklık değişimi ve yağış miktarı gibi ölçülebilir iklimsel etkilerin bal üretimi olan ilişkisini panel veri analizi yaklaşımı ile icelemektir. Çalışma verileri Birleşmiş Millettler Gıda ve Tarım Organizasyonu (FAO) ve Dünya Bankası (Word Bank) kaynaklarından elde edilmiştir. Çalışmada Dünya bal üretiminde 2021 yılı itibari ile ilk sırada yer alan 15 ülkeye ait 1992 ile 2020 yılları arasındaki yıllık veriler ile aynı ülkelerin yıllık meteorolojik sıcaklık ve metrakaraye düşen ortalama yıllık yağış değerleri veri setini oluşturmuştur. Çalışma kapsamında incelenen ülkeler; Çin, Türkiye, İran, Arjantin, Ukrayna, ABD, Rusya, Hindistan, Meksika, Brezilya, Angola, Güney Kore, Kanada,Tanzanya ve Vietnam'dır. Bu örneklem dünyanın her kıtasını temsil eder nitelikte kabul olduğu edilmiştir. Şansa bağlı etkiler modeli kullanılarak incelenen Panel veri analizi yaklaşımı ile yıllık yeryüzü sıcaklık değişimin etkisi önemli, yıllık yağış miktarının etkisi ise istatistiksel olarak anlamlı bulunmamıştır. Her ne kadar yağış etkisi bu çalışmada istatistiksel olarak anlamlı bulunmamış olsa da üreticilerin ve bu konuda politika yapıcların bu iki iklimsel değişkeni dikkatle takip etmeleri ve önlemler almaları bir zorunluluktur.
Anahtar Kelimeler: Bal üretimi, İklim değişikliği, Panel veri analizi

EXAMINING THE EFFECTS OF SOME CLIMATE CHARACTERISTICS ON HONEY PRODUCTION

ABSTRACT
Climate change, although arising from natural dynamics, is accelerating in pace due to anthropogenic effects, adversely affecting life on the planet in various ways. A global issue, climate change poses a threat to agricultural production, raising serious concerns for food security and sustainable development goals. Apiculture, a branch of agricultural production, and one of its most significant outputs, honey production, are believed to be adversely affected by climate change. Honey, a durable, dense, high-energy, healing, and nutritionally rich natural food substance, is also a crucial commodity in global trade. The aim of this study is to examine the relationship between measurable climate factors such as surface temperature changes and precipitation amounts and honey production using a panel data analysis approach. The study data were obtained from the Food and Agriculture Organization of the United Nations (FAO) and the World Bank. Covering the years from 1992 to 2020, the study created a dataset with annual data for the top 15 countries in world honey production as of 2021. This dataset included annual meteorological temperature and average annual precipitation values for the same countries. The countries examined in the study are China, Turkey, Iran, Argentina, Ukraine, the United States, Russia, India, Mexico, Brazil, Angola, South Korea, Canada, Tanzania, and Vietnam. This sample is considered to represent every continent on Earth. Utilizing the Random Effects Model in the examined Panel Data Analysis approach, the impact of annual surface temperature changes has proven significant, while the effect of annual precipitation amounts has not been statistically meaningful. Although the influence of precipitation did not exhibit statistical significance in this study, it is imperative for producers and policymakers to diligently monitor and take preventive measures regarding these two climatic variables.
Keywords: Honey production, Climate change, Panel data analysis

INTRODUCTION

Climate change has widespread ecological effects, impacting species' distributions, productivity, and various aspects of ecosystems. It influences species abundance, reproductive activities, and microhabitat use. Species adjust their geographic distribution based on environmental tolerance, local food availability, and interactions with other species. The current climate crisis limits species' options for daily activities, reducing populations and jeopardizing survival. Adaptation to existing or new habitats and evolutionary tolerance to climatic changes are crucial for species to avoid extinction in the face of these challenges (Hodgson et al, 2011; Flores et all. 2019)

Honey production is an important activity that provides food, income, and environmental benefits to many people around the world. However, honey production is also vulnerable to the effects of climate change, which can affect the availability and quality of honey plants, the health and survival of honeybees, and the management practices of beekeepers.

Globally cultivated crops, essential for food production, rely on pollination, primarily by honeybees. Climate change poses a threat to honeybee populations by disrupting their habitats and food sources, impacting food supplies, and raising costs. In developing countries like El Salvador, beekeepers lack information on climate change adaptation strategies. A study with nine Salvadoran beekeepers reveals climate change-induced challenges, including food and water scarcity and extreme weather events. These challenges result in adverse effects on honeybee health, such as insufficient food and water, hive damage, and increased susceptibility to pests and diseases. To adapt, beekeepers reinforce beehive boxes, relocate hives, and supplement honeybee food. They express a need for assistance in formulating supplementary diets and managing pests and diseases. Due to difficulties in understanding online climate change information, they seek guidance from local sources for improved adaptation strategies and the overall well-being and productivity of their honeybees (Landaverde et al. 2023)

Chynybaeva's (2021) report indicates that the loss of glaciers in Kyrgyzstan has a detrimental impact on local farmers and beekeepers. This is evidenced by a decline in irrigation water supply and poor pasture growth in the region. The article also underscores challenges related to pesticide usage, soil degradation, and the absence of sufficient government support for the beekeeping sector.

There are enormous challenges for honey bee, Apis mellifera, colonies worldwide. Climate change is expected to be the major threat for honey bees in the future. Climate change can impact honey bee colonies negatively and/or positively. It is expected that thermal stress on honey bee colonies in Egypt will be the major problem for beekeepers, especially during summer. No major changes are expected to happen in the other bioclimatic factors, including precipitation. Beekeepers are advised to harvest honey from their colonies earlier than the current time. Some honey bee diseases and pests are not expected to be a great challenge in the near future. For future challenges, studies towards obtaining heat-tolerant bees are very essential (Abou-Shaara, 2016).

Honey bees are vital pollinators for many crops and wild plants, but they are facing multiple threats from climate change, parasites, pesticides, and habitat loss. Climate change can affect the availability and quality of honey plants, the health and survival of honey bees, and the management practices of beekeepers (Le Conte & Navajas, 2008). For example, climate change can alter the phenology of flowering plants, resulting in mismatches between the demand and supply of pollen and nectar for honey bees (Dainese et al., 2018). Climate change can also increase the frequency and intensity of extreme weather events, such as droughts, floods, heat waves, and cold snaps, which can stress honey bees and reduce their productivity and survival (de Jongh et al., 2022). To cope with the challenges of climate change, honey bees and beekeepers need to adapt and adopt strategies that can enhance their resilience and sustainability. Honey bees can exhibit behavioral and physiological plasticity, such as adjusting their foraging patterns, thermoregulation, and immune responses, to cope with environmental changes (Meixner et al., 2010). Beekeepers can also implement various adaptation strategies, such as diversifying their honey sources, improving their hive management, monitoring their colonies' health, and participating in collective actions and networks (de Jongh et al., 2022). However, honey bees and beekeepers also face many barriers and constraints, such as lack of information, resources, and support, that limit their adaptive capacity (de Jongh et al., 2022). Therefore, there is a need for more research, education, and policy interventions to support honey production and conservation in the face of climate change.

Wild bee species in China, characterized by their limited distribution ranges, may face heightened vulnerability to climate change due to potential limitations in climate adaptation (Williams et al., 2015). Conversely, managed honeybees, such as A. cerana and particularly A.

mellifera, have demonstrated successful adaptation across diverse climates, suggesting fewer challenges in their ability to adapt.

Precipitation and temperature, crucial climatic factors, significantly influence honey production and honeybee phenology. Precipitation affects nectar and pollen source availability, while temperature influences honeybee development and metabolism. Both factors vary across seasons and regions, impacting honey production and bee survival differently. Studies indicate complex and interactive impacts, emphasizing the need for adaptation to changing climates in the beekeeping industry (Naug, 2009; Grogan, 2020; Langowska et al., 2017).

Honey production and climate change are interconnected in several important ways. Climate change can impact global weather conditions, affecting factors such as vegetation, precipitation levels, and temperature. Therefore, understanding the interactions between climate change and beekeeping and adapting beekeeping practices accordingly is crucial. Combating climate change and adopting sustainable beekeeping methods are essential to preserving the health of bees and honey production (Vercelli et al., 2021; Van Espen, et al., 2023)

The main objective of this study is to examine the relationships between annual surface temperature changes, average annual precipitation data, and annual honey production. The data used in the study is recorded data obtained from FAO and the World Bank. The study includes data from the top 15 countries with the highest honey production. The obtained time series cover the period from 1992 to 2020.

MATERIAL and METHODS

This study utilized data obtained from FAO and the World Bank through open access between the years 1992 and 2020 for analysis. The 15 countries with the highest honey production were examined within the scope of the study. The countries examined in the study are, in order, China, Turkey, Iran, Argentina, Ukraine, India, Russia, Mexico, United States, Brazil, Canada, Tanzania, South Korea, Angola, and Vietnam. The 29-year data on Precipitation (mm) (Pr), surface Temperature Change (C^o) (TC), and annual Honey Production (ton) (HP) for each country were used. The chosen approach for analysis is panel data analysis, as the data exhibits both cross-sectional and time-series structures. The analyses have been conducted using EViews and R software. The panel equation used is defined as follows:

$$\ln(HP)_{it} = \alpha + \beta_1 \ln(\mathrm{Pr})_{it} + \beta_2 ln(TC)_{it} + e_{it}$$

In this equation, α represents the intercept, β_1 denotes the regression coefficient for precipitation, and β_2 indicates the regression coefficient for temperature change. Panel Ordinary Least Squares (POLS) approach was initially used for the analysis of the panel model. To determine whether this model is appropriate, the Breusch Pagan test was applied. According to the Breusch Pagan test, the Random Effect Model (REM) was identified as a better alternative to POLS. However, to determine whether the Fixed Effect Model (FEM) approach is an alternative to REM, the Hausman test was conducted. The Hausman test concluded that the random effect model is the appropriate model. In the REM model, country effects and years were considered as random effects, and the analyses were conducted accordingly. Descriptive statistics for the data have also been provided.

RESULTS and DISCUSSION

The honey production quantities and locations on the map for the countries covered in the study, based on the records of the year 2021, are illustrated in Figure 1. As observed on the map, data from the continents of Africa and Australia are not included, except for two countries, and data is mainly obtained from Western and Northern Europe.

	Country	Honey Production
1	China	485960
2	Turkey	96344
3	Iran	77152
4	Argentina	71318
5	Ukraine	68558
6	India	66278
7	Russia	64533
8	Mexico	62080
9	United States	57364
10	Brazil	55828
11	Canada	40720
12	Tanzania	31608
13	South Korea	30221
14	Angola	23409
15	Vietnam	21526

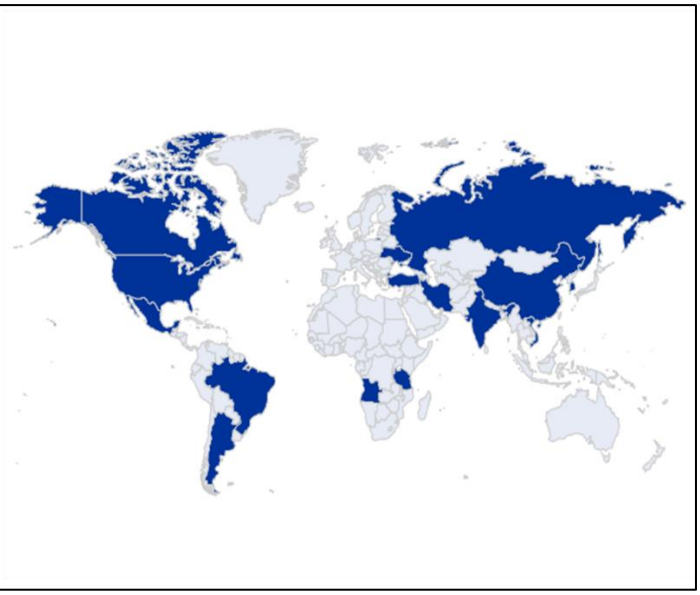


Figure 1. Distribution of honey production data and countries.

Figure 2, 3, and 4 depict the 29-year average honey production, average precipitation, and average temperature change for the 15 countries covered in graphical representations.

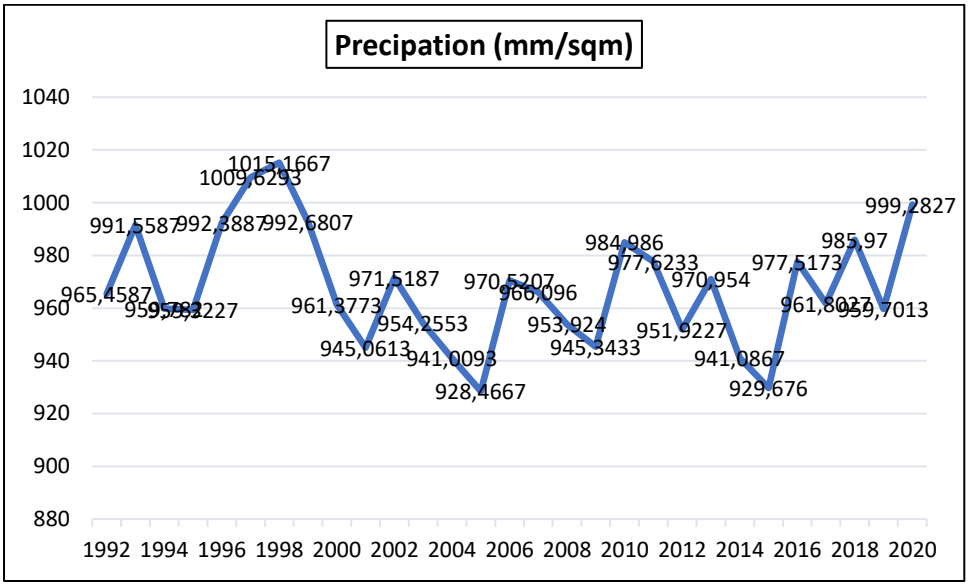


Figure 2. Average precipitation over the years

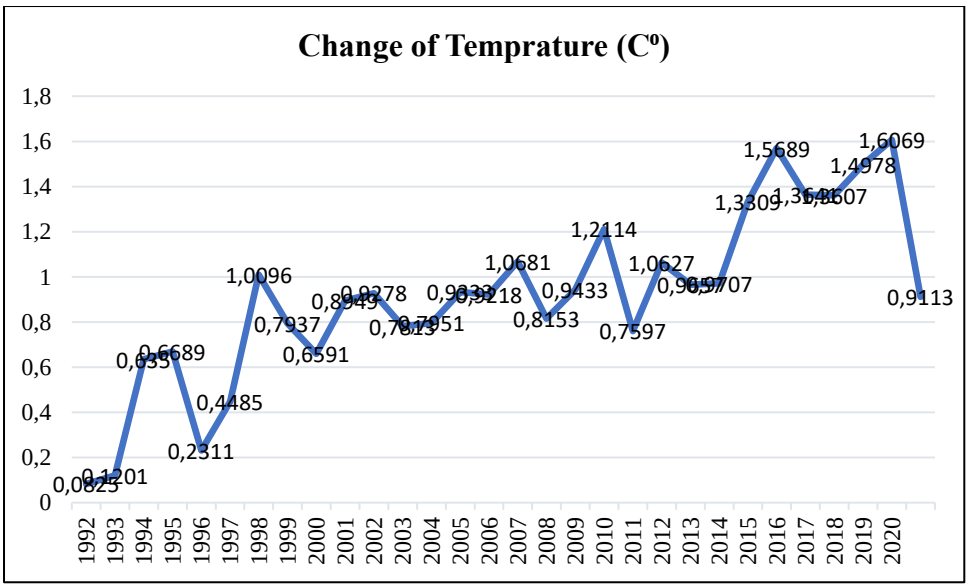


Figure 3. Average temperature change over the years

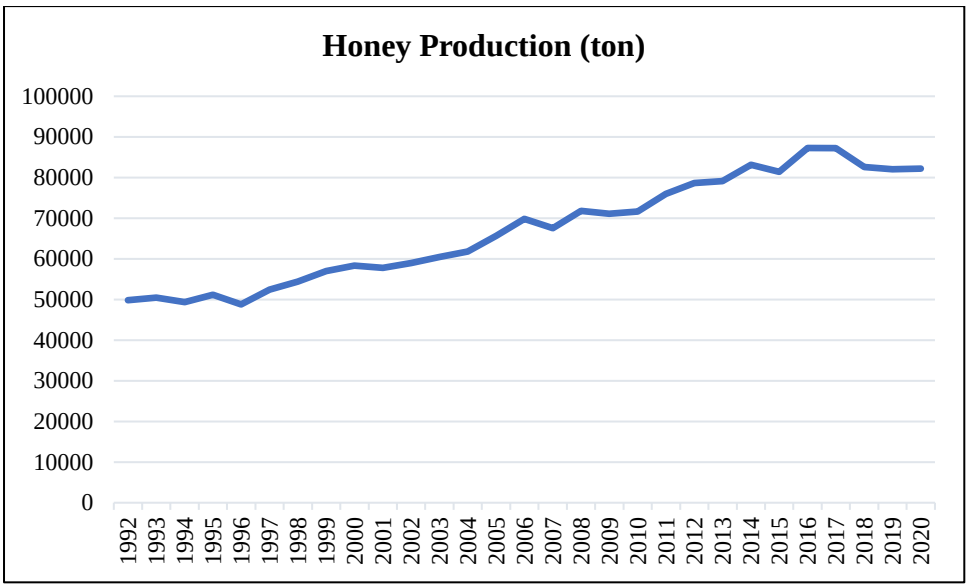


Figure 4. Average honey production change over the years

The data was initially analyzed using the POLS model, and the results presented in Table 1 were obtained. According to these results, precipitation significantly and negatively influences honey production, while temperature change has a significant and positive effect on production. However, the outputs of this model are often misleading. Therefore, the appropriateness of alternative models has been checked using the Breusch-Pagan test.

Table 1. POLS model outputs

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.623427	0.256019	21.96489	0.0000
LNPR	-0.359042	0.085372	-4.205605	0.0000
LNTC	0.343147	0.111866	3.067477	0.0023

Breusch-Pagan results are provided in Table 2. According to these results, examining the model with a random effects model both in terms of time (years) and cross-section (countries) would be more appropriate than the POLS model.

Table 2. Test of Breusch-Pagan

	Test Hypothesis		
	Cross-section	Time	Both
Breusch-Pagan	4505.612	6.283446	4511.895
p value	0.0000	-0.0122	0.0000

Additionally, whether the fixed effects model could be an alternative to REM has been checked with the Hausman test. The Hausman test results revealed that effects should be random both in the cross-section and time series. The results of the data analysis according to the REM model are presented in Table 3.

According to the REM model, unlike the POLS model, the effect of precipitation was not statistically significant. However, the temperature change was found to be 19.50%, and it was statistically significant.

Table 3. Random Effects Model for Panel Data

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.552577	0.427406	10.65165	0.0000
LNPR	0.018168	0.140468	0.129339	0.8971
LNTC	0.195099	0.047202	4.133291	0.0000

The random effects panel data model has been formulated as follows;

$$\ln(HP)_{it} = 4.552 - 0.018\ln(\mathrm{Pr})_{it} + 0.195ln(TC)_{it} + e_{it}$$

The predictions of random effects obtained for years and countries are shown in Figures 5 and 6.

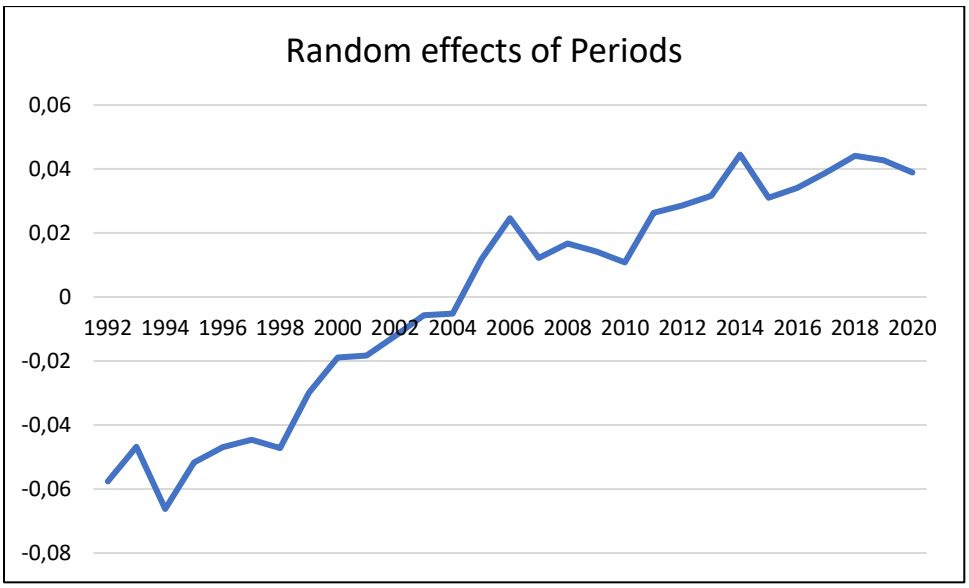


Figure 5. Predicted random effects for Years.

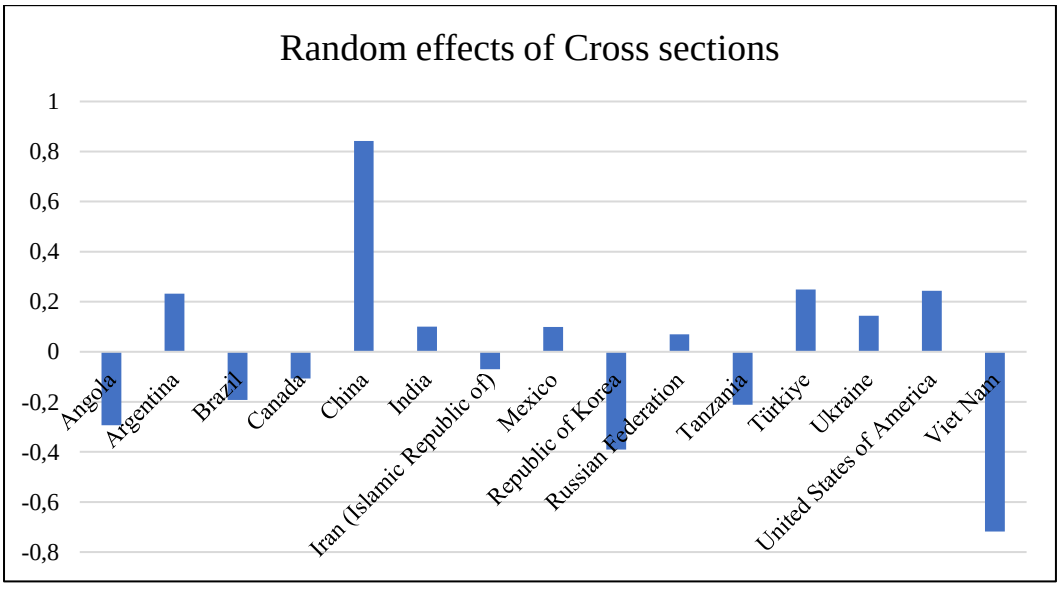


Figure 6. Predicted random effects for countries.

CONCLUSIONS

This study, conducted over 29 years across 15 different countries, aimed to examine the factors influencing honey yield. The results indicate the following:

Effect of Annual Precipitation: According to the statistical analysis, the variable representing annual precipitation, ln(Pr), does not significantly impact honey yield ($p>0.05$). This suggests that changes in honey yield are independent of annual precipitation.

Effect of Annual Mean Surface Temperature: On the other hand, the variable ln(TC) (annual mean surface temperature) significantly influences honey yield ($p<0.05$). This implies that variations in honey yield may be associated with changes in the annual mean surface temperature.

These findings provide valuable insights for honey producers, researchers, and policymakers. Particularly, those looking to increase or optimize honey production may find it more beneficial to focus on the annual mean surface temperature rather than annual precipitation. In cases where annual precipitation shows no significant effect, monitoring temperature changes could offer a better strategy for planning and managing honey production.

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MEYVE ÖZELLİKLERİNİN BİRLİKTE DEĞERLENDİRİLMESİ

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ÖZET
Ülkemiz bulunduğu konum itibari ile farklı iklim koşullarını içermektedir. Bu da ülkemizdeki meyve ürün çeşitliliği, üretim zamanı ve meyve üretim çeşitliliğini artırmaktadır. Meyvecilikte, hem tüketici hem de üretici taleplerini temsil eden verim ve kalite unsurları, temel olarak genotip tarafından kontrol edilir. Ancak, ekolojik faktörler ve kültür şartları da ürünün nihai şekli üzerine önemli etkiler barındırır. Tüm bu faktörlerin, kümülatif etkisi altında şekillenen meyve özellikleri, birbirleri ile oldukça kuvvetli ilişki içerisindedirler. Zigotta hücre artışını takiben, hücre bölünmesi evresinde, enine ve boyuna büyümenin birlikte görülmesi sebebiyle, meyve eni ve meyve boyu pozitif ilişki içerisindedir. Ayrıca bu her iki özellik, meyve ağırlığı üzerine etki ediyor olmasından dolayı, meyve ağırlığı ve meyve boyutları da pozitif ilişki içerisindedir. Meyve ağırlığında meydana gelen artış, hücrelerarası boşluğu arttırdığından, birim alanda biriken kuru madde miktarı ve meyve eti sertliği üzerine olumsuz etkiler gösterir. Bu sebeple, meyve boyutları ile meyve eti sertliği, kabuk a* değeri, suda çözünebilir kuru madde ve diğer biyokimyasal özellikler arasında negatif yönlü ilişkiler görülmektedir. Antioksidan özelliğe sahip organik ve fenolik asitler, asidik ortamlarda daha yüksek düzeyde çözünürler. Bu sebeple, düşük pH veya yüksek asitliğe sahip meyvelerde, organik ve fenolik asitler ile antioksidan aktivite nispeten daha yüksek düzeylerde ölçülmektedir. Verim, meyve özellikleri üzerine etki eden en önemli faktörlerden birisidir. Asimilasyon ürünlerinin daha fazla meyveye paylaştırılması durumunda, pomolojik ve kimyasal özelliklerde düşüşler gözlemlenmektedir. Benzer şekilde, tam çiçeklenmeden hasada geçen süre de meyvelerin son şekli ve içeriği üzerine oldukça önemlidir. Erken hasat edilen meyveler, daha küçük boyutlarda kalırken, fitokimyasal birikimin tamamlanamaması sebebiyle de önemli biyokimyasallarca daha fakir durumdadır. Yetiştiriciliğin, ürünün pazarlama amacına yönelik planlanması oldukça önemli olup, bahçe yönetiminin, belirtilen kümülatif etkenler altında planlanması gerekmektedir.
Anahtar Kelimeler: Hücre bölünmesi, kalite, korelasyon, meyve, verim

EVALUATION OF FRUIT CHARACTERISTICS TOGETHER

ABSTRACT
Our country has different climatic conditions due to its location. This increases the variety of fruit crops, production time and fruit production diversity in our country. In fruit growing, yield and quality elements, which represent both consumer and producer demands, are mainly controlled by genotype. However, ecological factors and cultural conditions also have important influences on the final shape of the crop. Fruit characteristics, which are shaped under the cumulative influence of all these factors, are strongly interrelated. Fruit width and fruit length are positively correlated due to the combination of transverse and longitudinal growth during the cell division phase following cell increase in the zygote. Fruit weight and fruit size are also positively correlated, as both of these traits have an effect on fruit weight. As the increase in fruit weight increases the intercellular space, it has negative effects on the amount of dry matter accumulated per unit area and fruit flesh firmness. For this reason, there are negative relationships between fruit size and fruit flesh firmness, peel a* value, water soluble dry matter and other biochemical properties. Organic and phenolic acids with antioxidant properties are more soluble in acidic environments. Therefore, organic and phenolic acids and antioxidant activity are measured at relatively higher levels in fruits with low pH or high acidity. Yield is one of the most important factors affecting fruit characteristics. If assimilation products are allocated to more fruit, pomological and chemical characteristics are reduced. Similarly, the time from full flowering to harvest is also very important for the final shape and content of the fruit. Early harvested fruits are smaller in size and poorer in important biochemicals due to incomplete phytochemical accumulation. It is very important to plan the cultivation for marketing purposes and orchard management should be planned under these cumulative factors.
Keywords: Cell division, fruit, yield, quality, correlation

1. GİRİŞ

Türkiye'nin içerisinde bulunduğu jeopolitik konum, onun farklı iklim ve toprak özelliklerine sahip olmasına olanak sağlamaktadır (Köksal vd., 2010). Ülkemiz konumunun getirdiği avantajlardan birisi de üzerinde yetişebilen çok fazla meyve türünü barındırmasıdır (Sadeler, 1997). Ülkemiz, sahip olduğu coğrafi konum itibariyle meyvecilik açısından dünyada önemli bir yere sahiptir (Çetinkaya, 2022). Nitekim, Ülkemiz bitkisel biyo-çeşitliliğe önemli katkılar sağlamıştır. Türkiye yetiştirilen tür sayısının yanı sıra meyve çeşit sayısı bakımından da büyük bir zenginliğe sahiptir ve yetişen bitki türlerinin üçte biri endemik özellik göstermektedir (Çetinkaya, 2022).

Dünya nüfusunun artan bir ivme göstermesine ek olarak, yeni yerleşim, sanayi ve yaşam alanlarına ihtiyaç olmasının yanında, gıda ihtiyacı da artış gösterirken, tarım alanlarında sürekli azalmalar olmaktadır (Nielsen, 2016; Mertoğlu ve Evrenosoğlu, 2019). Artan nüfusun, gıda ihtiyacını karşılamak, mevcut alanların etkin şekilde kullanımına bağlıdır. Üstelik, dengeli ve sağlıklı beslenme açısından yetiştirilen ürünlerin, nitelik olarak üstün özellikleri içeriyor olması da çok önemlidir (Nielsen, 2016; Mertoğlu ve Evrenosoğlu, 2019). Meyvecilik sektörü dünyada artan bir ivmeyle değer kazanan sektörlerden biridir. Son yıllarda gelişen yetiştiricilik sistemleri meyveciliği dünyada daha önemli kılmaya başlamıştır (Uzundumlu vd., 2009). Ülkemizde yetiştirilen meyve türlerinin büyük bir çoğunluğu dünya da yaygın olan ve talep gören ürünlerdir (Baraz, 2002).

Fitokimyasal özellikler açısından üstün kabul edilen, fonksiyonel gıda olarak adlandırılan türlerin, farkındalık düzeyi artan toplumlarda tüketimi artış gösterme eğilimindedir (Demir ve Aktaş, 2018; Mertoğlu ve Evrenosoğlu, 2019). Fitokimyasal miktarın yüksek ve çeşitliliğin fazla olması, bitkilerin savunma mekanizmasını pozitif yönde etkileme eğilimi gösterek, abiyotik ve biyotik stres koşullarına dayanma gücünü arttırmaktadır (Günen vd., 2005; Sklodowska vd., 2018; Mertoğlu ve Evrenosoğlu, 2019).

Geri dönüşü olmayan hacim ve ağırlık artışı büyüme olarak tanımlanır (Kocaçalışkan, 2006). Tüm türlerde büyüme ve gelişme temel olarak genotip tarafından belirlenir, ekoloji ile tamamlanır. Ancak, kültürel işlemler ve yetiştiriciliğin yönetimi de bu faktörler üzerine etki gösterir (Eriş, 1990). Farklı bir deyimle, ürünün nihai kompozisyonları üzerine genetik, ekolojik ve kültür şartları kümülatif şekilde etki eder (Atay vd., 2008).

Meyve tutum döneminde, serin giden hava koşulları, büyüme konilerinde sentezlenen sitokinini arttırarak hücre sayısını arttırmış ve hücre genişlemesi sonrası bu bölgelerde yetişen meyvelerin daha büyük boyutlara ve ağırlığa ulaştığı belirtilmiştir. Yetiştirme periyodunun devamında hava sıcaklıkları yüksek olduğunda, meyvelerde yuvarlak yapının oluşmasını sağlayan oksin, düşük ise meyve eksenini uzatan giberellik asit daha çok sentezlenir (Sherman ve Beckman, 2002). Bu durum hasat edilen meyvelerin, basık veya uzun şekilli olmasını oldukça etkilidir. Özellikle hasada yakın dönemde, gece ve gündüz sıcaklık farkı, ışık miktarı ve kalitesi ile nem, renklenme üzerine fazlaca önem arz etmektedir. Sık dikim, güneş ışınlarının daha etkin kullanımına engel olmakta olduğu için, goble budamanın tercih edilmesi bu bakımdan avantajlıdır (Özkan ve Küçüker, 2009). Güneş ışığı, hava sirkülasyonu, taç sıcaklığı, nem ve hastalık ile zararlı üzerine etki eden bu etkenler, ürünlerin son hali üzerine fazlaca önemli etkiler göstermektedir (Usanmaz vd., 2018). Meyve tutum miktarının yükseliş, pomolojik ve kimyasal özelliklerin miktarında azalışa neden olur (Mertoğlu vd., 2019; Eskimez vd., 2020). Hasat, klimakterik meyve türlerinde, yeme olumuna doğru kaydırıldığında ise, pektin parçalanması nedeniyle meyve eti sertliğinde, organik asit parçalanması nedeni ilede TEA'da azalış ve pH'da artış olmaktadır (Çolak vd., 2019). Hastalık ve zararlı kontrolü meyve biyokimyası bakımından önemli olup, epidemi artışına paralel, özellikle organik ve fenolik asitler, karşı savunma ajanı olarak yükseliş sergilemektedir (Gunen vd., 2005; Polat vd., 2020).

Tüm faktörlerden etkilenen meyve özellikleri, aynı zamanda kendi içlerinde de birbirleri ile etkileşim içerisindedirler. Elma (Polat vd., 2020), İşbakan ve Bostan (2020), çilek (Gündüz ve Özdemir, 2012), armut (Mertoğlu ve Evrenosoğlu, 2019) ve üzümün farklı çeşitleri ile yürütülen çalışmalarda, incelenen meyve özelliklerinin birbirleri ile olan ilişkileri, korelasyon katsayıları ile birlikte verilmiştir (**Çizelge 1, Çizelge 2, Çizelge 3, Çizelge 4 ve Çizelge 5).**

Çizelge 1. Elmada meyve özellikleri arasındaki ilişkiler (Polat vd., 2020)

	En	Boy	Ağırlık	Sertlik	L	a	b	SÇKM	pH	TEA	Verim
Boy	0.87***										
Ağırlık	0.97***	0.90 ***									
Sertlik	-0.44***	-0.41**	-0.46***								
L	-0.40***	-0.26***	-0.39***	0.16*							
a	0.43***	0.30***	0.43***	-0.22**	-0.85***						
b	-0.31***	-0.20**	-0.31***	0.12ns	0.91***	-0.82***					
SÇKM	0.13ns	0.17*	0.15*	-0.06ns	-0.06ns	0.07ns	-0.05ns				
pH	0.03ns	0.04ns	0.04ns	-0.15*	0.10ns	-0.03ns	0.14ns	-0.09ns			
TEA	0.04ns	0.02ns	0.03ns	0.11ns	-0.16*	0.05ns	-0.16*	0.15*	-0.78***		
Verim	-0.60***	-0.51***	-0.56***	-0.20**	0.40***	-0.46***	0.37***	-0.17*	0.07ns	-0.07ns	
TCHGS	0.05ns	0.04ns	0.06ns	-0.03ns	-0.08ns	0.05ns	-0.05ns	0.02ns	0.04ns	-0.01ns	-0.06ns

*: p<0.05, **: p<0.01, ***: p<0.001

Çalışmaların ortak noktası olarak, meyve özellikleri üzerine verimin en önemli faktör olduğu vurgulanmaktadır. Artan ürün yükü, asimilasyon ürünlerinin paylaştırılması demek olduğundan, meyve boyutlarında ve biyokimyasal birikimde azalmalar meydana gelmektedir. Ürün yükünün dengelenmesi durumunda ise daha iri meyvelerde, sertliğin azaldığı bildirilmektedir. Sertlik, hücrelerarası boşluğun artmasına bağlı olarak gerçekleştiğinden birim alanda biriken kuru madde miktarında düşüş meydana geldiği ifade edilmektedir.

Çizelge 2. Fındıkta incelenen özellikler arasındaki ilişkilere ait korelasyon katsayıları (İşbakan ve Bostan, 2020)

	ZB	ZTK	YA	YE	YB	YK	YSU	YSK	YS	DB	GÇ	YDS	OYDU	YDOSS	ÇMS	TÇS	V	VE	TMS
ZTK	0.698**																		
YA	0.134	0.110																	
YE	-0.225	-0.077	0.207																
YB	0.033	0.143	0.467	0.410															
YK	0.726**	0.672**	0.011	-0.450	-0.124														
YSU	0.052	0.297	0.241	0.589*	0.188	-0.059													
YSK	0.851**	0.607**	0.326	-0.293	0.144	0.715**	0.026												
YS	-0.175	-0.065	0.375	-0.023	0.321	-0.128	-0.102	-0.152											
DB	0.281	0.290	0.083	-0.501*	-0.271	0.371	-0.133	0.254	0.547*										
GÇ	0.354	0.408	0.506*	-0.131	0.442	0.101	0.019	0.353	0.536*	0.561*									
YDS	-0.196	-0.275	0.474*	-0.109	0.106	-0.218	0.081	-0.011	0.648**	0.519*	0.405								
OYDU	-0.220	-0.345	0.160	-0.170	0.243	-0.366	-0.364	-0.207	0.292	0.023	0.241	0.099							
YDOSS	-0.626**	-0.508*	0.174	-0.024	0.284	-0.567*	-0.184	-0.478*	0.508*	-0.037	-0.026	0.455	0.618**						
ÇMS	-0.626**	-0.425	0.187	0.313	0.359	-0.544*	-0.028	-0.337	0.001	-0.422	-0.117	0.174	0.378	0.490*					
TÇS	0.081	0.157	0.077	-0.370	0.390	0.152	-0.087	0.170	0.322	0.455	0.687**	0.283	0.304	0.077	0.050				
V	0.363	0.158	0.297	-0.361	0.129	0.241	-0.317	0.294	0.368	0.609**	0.769**	0.206	0.363	-0.119	-0.311	0.639**			
VE	0.162	-0.323	-0.208	-0.093	-0.303	0.062	-0.225	0.103	-0.529*	-0.386	-0.553*	-0.473*	0.188	-0.078	-0.197	-0.411	-0.115		
TMS	0.427	0.255	0.133	-0.503*	0.077	0.344	-0.314	0.399	0.323	0.652**	0.731**	0.180	0.283	-0.174	-0.396	0.667**	0.928**	-0.166	
SMO	-0.172	-0.387	0.298	0.433	0.177	-0.359	0.103	-0.322	0.087	-0.070	0.137	0.082	0.343	0.125	0.112	0.093	0.380	0.239	0.074
KÜMO	0.597**	0.716**	-0.152	-0.372	-0.203	0.629**	0.054	0.350	0.054	0.493*	0.327	-0.286	-0.091	-0.455	-0.729**	0.202	0.379	-0.115	0.525*
BOMO	-0.482*	-0.252	-0.110	0.243	0.055	-0.194	0.141	-0.255	-0.158	-0.505*	-0.512*	0.058	-0.328	0.132	0.512*	-0.331	-0.764**	-0.186	-0.656**
KUİO	0.027	0.006	-0.140	-0.210	-0.011	-0.090	-0.159	0.282	-0.021	0.012	-0.008	0.121	-0.093	0.125	0.196	-0.011	-0.194	-0.065	-0.051
MA	-0.163	-0.074	0.189	0.117	-0.092	-0.055	-0.177	-0.152	-0.001	-0.095	-0.118	-0.090	0.009	0.085	0.274	-0.200	-0.131	0.110	-0.419
Mİ	0.249	0.043	-0.105	-0.137	-0.152	0.074	-0.266	0.262	-0.019	-0.004	-0.101	-0.166	0.312	0.089	-0.085	-0.243	-0.019	0.448	0.026
MŞİ	0.531*	0.437	-0.024	-0.208	-0.168	0.503*	-0.325	0.301	0.340	0.505*	0.288	-0.085	-0.054	-0.339	-0.515*	-0.060	0.433	-0.139	0.462
MH	0.229	0.168	0.024	-0.283	-0.177	0.031	-0.435	0.205	0.078	0.371	0.351	-0.151	0.537*	0.044	-0.052	0.134	0.522*	0.203	0.460
MY	-0.277	-0.159	0.071	0.326	0.181	-0.023	0.354	-0.234	-0.071	-0.427	-0.389	0.092	-0.543*	-0.011	0.163	-0.211	-0.582*	-0.173	-0.628**
KK	0.390	0.181	0.216	-0.311	0.035	0.417	-0.311	0.297	0.184	0.188	0.205	-0.133	0.124	-0.037	-0.339	0.071	0.410	0.305	0.279
İA	-0.012	0.013	0.207	0.042	0.065	-0.007	-0.289	0.025	-0.040	-0.167	-0.009	-0.299	0.206	0.120	0.100	-0.129	0.051	0.372	-0.177
İO	0.200	0.117	0.001	-0.123	0.168	0.051	-0.164	0.260	-0.051	-0.077	0.121	-0.293	0.298	0.089	-0.262	0.053	0.225	0.416	0.326
İİ	0.480*	0.255	0.183	-0.030	-0.065	0.185	-0.293	0.394	-0.303	-0.141	0.140	-0.480*	0.210	-0.330	-0.186	-0.213	0.294	0.490*	0.180
İŞİ	0.760**	0.547*	-0.005	-0.434	-0.190	0.639**	-0.186	0.549*	0.058	0.500*	0.381	-0.126	-0.074	-0.457	-0.800**	0.131	0.574*	0.099	0.679**
İH	0.198	0.107	0.027	-0.206	-0.130	0.077	-0.465	0.141	0.155	0.357	0.269	-0.126	0.427	0.103	-0.120	0.068	0.491*	0.280	0.367
İY	-0.260	-0.099	0.122	0.284	0.250	-0.086	0.380	-0.157	-0.186	-0.587*	-0.337	-0.067	-0.389	-0.032	0.214	-0.181	-0.597**	-0.124	-0.579*
GBB	-0.123	-0.204	0.315	-0.144	-0.122	-0.173	-0.319	0.014	-0.055	0.047	0.028	0.178	0.249	0.252	0.408	-0.116	0.076	0.094	-0.113

Çizelge 1.2 Fındıkta incelenen özellikler arasındaki ilişkilere ait korelasyon katsayıları(devamı) (İşbakan ve Bostan, 2020)

	SMO	KÜMO	BOMO	KUİO	MA	Mİ	MŞİ	MH	MY	KK	İA	İO	İİ	İŞİ	İH	İY
KÜMO	-0.284															
BOMO	-0.427	-0.465														
KUİO	-0.544*	-0.305	0.114													
MA	0.280	-0.347	-0.014	-0.013												
Mİ	-0.117	0.071	-0.124	0.247	0.051											
MŞİ	-0.130	0.605**	-0.445	-0.078	-0.057	0.270										
MH	0.153	0.249	-0.634**	0.149	0.222	0.580*	0.375									
MY	-0.078	-0.373	0.641**	-0.139	0.180	-0.554*	-0.382	-0.916**								
KK	0.126	0.148	-0.469*	0.073	0.410	0.219	0.337	0.321	-0.143							
İA	0.282	-0.179	-0.174	-0.040	0.788**	0.355	-0.083	0.473*	-0.140	0.548*						
İO	-0.034	0.247	-0.227	0.007	-0.308	0.533*	-0.044	0.424	-0.525*	0.177	0.337					
İİ	0.196	0.194	-0.413	-0.073	0.316	0.596**	0.301	0.675**	-0.534*	0.413	0.643**	0.494*				
İŞİ	-0.126	0.798**	-0.562*	-0.210	-0.366	0.341	0.709**	0.363	-0.499*	0.327	-0.092	0.402	0.444			
İH	0.276	0.136	-0.588*	0.061	0.380	0.587*	0.354	0.903**	-0.758**	0.526*	0.656**	0.457	0.655**	0.343		
İY	-0.211	-0.258	0.653**	-0.105	0.026	-0.495*	-0.475*	-0.838**	0.876**	-0.281	-0.155	-0.316	-0.392	-0.479*	-0.842**	
GBBÜ	0.166	-0.437	-0.159	0.307	0.618**	-0.106	-0.118	0.358	-0.122	0.300	0.407	-0.308	0.188	-0.359	0.346	-0.203

*: 0.05 seviyesinde önemli, **: 0.01 seviyesinde önemli

Hücrelerarası boşluğun azaldığı meyveler, hasat sonrası açısından daha uygun meyveler olarak nitelendirilmektedir. Bu ürünlerde, stabilitenin korunduğu, bu korunuma ise yüksek asitliğin ve pektin bütünlüğünün sebep olduğu ifade edilmektedir. Bu meyvelerde artan asitlik, pH düşüşlerini de sağlayarak, mikroorganizma faaliyetini kısıtlamaktadır.

Çizelge 3. Çilekte meyve özellikleri arasındaki ilişkiler (Gündüz ve Özdemir, 2012)

Değişkenler	Meyve Kalite Özellikleri						Kimyasal Özellikler			
	SÇKM	Asitlik	Dış Renk L	Dış Renk *C*	Sitrik Asit	Toplam Şeker	TA	TP	FRAP	TEAC
Meyve İriliği	-0.47*	-0.64*	-0.38*	0.25	-0.56*	-0.51*	-0.08	0.10	0.10	0.20
SÇKM	-	0.53*	-0.06	-0.51*	0.59*	0.82*	0.37*	0.37*	-0.03	0.02
Asitlik	-	-	0.25	-0.44*	0.73*	0.54*	0.17	-0.06	-0.23	-0.33*
Dış Renk L	-	-	-	-0.37*	0.18	0.08	-0.66*	-0.41*	-0.31*	-0.45*
Dış Renk C	-	-	-	-	-0.51*	-0.50*	-0.03	-0.35*	-0.07	-0.06
Sitrik Asit	-	-	-	-	-	0.52*	0.17	-0.05	-0.31*	-0.38*
Toplam Şeker	-	-	-	-	-	-	0.38*	0.27	-0.12	-0.05
TA	-	-	-	-	-	-	-	0.34*	0.21	0.27*
TP	-	-	-	-	-	-	-	-	0.73*	0.78*
FRAP	-	-	-	-	-	-	-	-	-	0.92*

*: $p \leq 0.05$

Meyvelerde asitliğin artışı, antioksidan etkisi yüksek ve genel olarak asidik karaktere sahip ve asidik ortamda çözünen bileşiklerin miktarında artışa katkı sağlamaktadır. Bu sebeple, asitlik biyokimyasal özelliklerin iyileştirilmesinde en önemli parametre olarak dikkat çekmektedir. Çalışmalardan da görüleceği üzere, asitliğin artışı, Vitamin C, bireysel organik ve fenolik asitlerin miktarında artış sağlamaktadır. Antioksidan etkideki bu kimyasallar ise antioksidan aktivitenin artışını sağlamaktadır. Ayrıca bu bitki ve meyvelerde hastalık, zararlı epidemisinin azalma gösterdiği ve hasat sonrasının daha uzun ve kaliteli seyrettiği ifade edilmektedir.

Çizelge 4. Üzümde meyve özellikleri arasındaki ilişkiler (Kamiloğlu ve Üstün, 2014)

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	0.63**	0.75**	0.78**	0.86**	0.75**	0.62**	0.68**	0.69**	-0.09$^{(1)}$	-0.23$^{(1)}$	-0.41*	0.21$^{(1)}$	0.57**	-0.27$^{(1)}$	0.62**
2		0.87**	0.89**	0.93**	0.75**	0.84**	0.85**	0.84**	-0.35$^{(1)}$	-0.16$^{(1)}$	-0.01$^{(1)}$	-0.13$^{(1)}$	0.56**	-0.25$^{(1)}$	0.64**
3			0.95**	0.91**	0.89**	0.91**	0.92**	0.91**	-0.42*	-0.33$^{(1)}$	0.03$^{(1)}$	-0.17$^{(1)}$	0.67**	-0.46$^{(1)}$	0.52**
4				0.94**	0.87**	0.87**	0.90**	0.91**	-0.33$^{(1)}$	-0.27$^{(1)}$	-0.06$^{(1)}$	-0.09$^{(1)}$	0.65**	-0.41*	0.57**
5					0.83**	0.83**	0.87**	0.87**	-0.27$^{(1)}$	-0.22$^{(1)}$	-0.19$^{(1)}$	0.00$^{(1)}$	0.61**	-0.27$^{(1)}$	0.70**
6						0.96**	0.97**	0.96**	-0.55**	-0.54**	0.09$^{(1)}$	-0.28$^{(1)}$	0.60**	-0.46**	0.48**
7							0.99**	0.98**	-0.61**	-0.47**	0.20$^{(1)}$	-0.35$^{(1)}$	0.62**	-0.46*	0.49**
8								0.99**	-0.56**	-0.48**	0.12$^{(1)}$	-0.30$^{(1)}$	0.59**	-0.41*	0.53**
9									-0.54**	-0.47**	0.11$^{(1)}$	-0.29$^{(1)}$	0.59**	-0.40*	0.55**
10										0.81**	-0.80**	0.90**	0.03$^{(1)}$	0.19$^{(1)}$	0.11$^{(1)}$
11											-0.56**	0.78**	0.26$^{(1)}$	-0.05$^{(1)}$	0.06$^{(1)}$
12												-0.94**	-0.28$^{(1)}$	-0.15$^{(1)}$	-0.55**
13													0.33$^{(1)}$	0.01$^{(1)}$	0.35$^{(1)}$
14														-0.79**	0.40*
15															0.22$^{(1)}$

**: Korelasyon önemlilik (p≤0.01); *: Korelasyon önemlilik (p≤0.05); $^{(1)}$: Önemli Değil; 1: Salkım eni (cm); 2: Salkım Boyu (cm); 3: Salkım ağırlığı (g); 4: Salkım hacmi (ml); 5: Salkım büyüklüğü (cm^2) 6: Tane eni (mm); 7: Tane boyu (mm); 8: Tane ağırlığı (g); 9: Tane hacmi (ml); 10: pH; 11: SÇKM (%); 12: Asitlik (%); 13: SÇKM/Asitlik; 14: Çekirdek ağırlığı (mg/çekirdek); 15: Çekirdek sayısı (n/tane); 16: Çekirdek ağırlığı (mg/tane).

Mertoğlu ve Evrenosoğlu (2019) yaptığı çalışmada, elma ve armut çeşitlerinde fitokimyasal özelliklerin geniş aralıkta dağılım göstermesine (**Çizelge1.5**) genetik yapılarının farklı olmasının sebep olduğu belirlenmiştir.

Çizelge 1.5 Elma ve amutta meyve özellikleri arasındaki ilişkiler (Mertoğlu ve Evrenosoğlu (2019)

			ELMA		
	AOA	TEA	Vitamin C	Toplam Fenol	SÇKM
TEA	0.54***				
Vitamin C	0.56***	0.66***			
Toplam Fenol	0.38**	0.33*	0.59***		
SÇKM	-0.01öd	-0.1öd	-0.02öd	0.1öd	
pH	-0.45**	-0.81***	-0.66***	-0.21öd	0.26öd
			ARMUT		
	AOA	TEA	Vitamin C	Toplam Fenol	SÇKM
TEA	0.47***				
Vitamin C	0.69***	0.30*			
Toplam Fenol	0.78***	0.19öd	0.45***		
SÇKM	-0.06öd	-0.16öd	0.24öd	0.05öd	
pH	-0.36**	-0.79***	-0.21öd	-0.11öd	0.34**

AOA: Antioksidan aktivite, TEA: Titre edilebilir asit, SÇKM: Suda çözünebilir kuru madde
*: $P \leq 0.05$, **: $P \leq 0.01$, ***: $P \leq 0.001$, öd: önemli değil

SONUÇ

Ülkemiz birçok türün gen merkezleri arasında olup, ticari değere sahip birçok türde üretici ülke pozisyonundadır. Bu durum, sürdürülebilir ve kaliteli ürün eldesini son derece önemli hale getirmektedir. Bu bağlamda, genotipe ilave olarak ekoloji önem taşımaktadır. Ancak, kültürel işlemlerin de ürünlerin nihai şekli ve kompozisyonu üzerine önemli etkiler barındırdığı unutulmamalıdır. Bu noktada, üreticilerin meyve özelliklerinin birbirleri ile nasıl etkileşim halinde olduğunu bilmesi, kültürel işlemlere doğru yön vermesi bakımından son derece önemlidir. Çalışma sonuçlarının, farklı araştırmalarda kaynak ve üretici düzeyinde yönlendirici olması temenni edilmektedir.

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MEYVE GENETİK KAYNAKLARININ DEĞERLENDİRİLMESİ

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Özet
Meyve genetik kaynakları küresel iklim değişikliği karşısında üzerinde önemle durulan ve insanoğlunun gelecek gıda güvenliği açısından oldukça önemli bir konudur. Bütün ülkeler sahip oldukları meyve genetik kaynaklarının korunması ve sürdürülebilir kullanımı konusunda son yıllarda oldukça önemli adımlar atmaktadırlar. Meyve genetik kaynakları bir anlamda ülkelerin en önemli doğal zenginlik kaynaklarını da oluşturmaktadır. Meyve genetik kaynakları aynı zamanda uzun vadeli sürdürülebilir meyve üretimi için de değerli meyve özelliklerini içinde barındıran önemli bir hazinedir. Islah çalışmalarında oldukça farklı özelliklere sahip yeni meyve çeşitleri geliştirmek için genetik kaynakların yani gen havuzunun mevcudiyeti büyük önem taşımaktadır. Özellikle son yıllarda kendini hissettiren iklim değişikliği sonucu yeni ortaya çıkan zararlılar ve hastalıklar ve bunlara karşı tüketici talebini karşılayacak şekilde daha az pestisit girdisinin kullanılması ihtiyacı ıslahta çözüm bekleyen önemli problemlerden birisidir. Meyve genetik kaynakları esas olarak *ex situ* ağaç koleksiyonları şeklinde farklı kamu kurumları ve özel sektör kuruluşları tarafından muhafaza edilmektedirler. Yerinde koruma (*in situ*) ise bazen dondurarak muhafaza gibi koruma unsurlarını da içerebilir.
Anahtar kelimeler: Genetik kaynaklar, koruma stratejileri, biyogüvenlik

EVALUATION OF FRUIT GENETIC RESOURCES

Abstract
Fruit genetic resources are an issue that is emphasized in the face of global climate change and is very important for the future food security of humanity. All countries have been taking important steps in recent years regarding the protection and sustainable use of their fruit genetic resources. Fruit genetic resources, in a sense, constitute the most important natural wealth resources of countries. Fruit genetic resources are also an important treasure that contains valuable fruit characteristics for long-term sustainable fruit production. In breeding studies, the availability of genetic resources, that is, the gene pool, is of great importance in order to develop new fruit varieties with very different characteristics. Newly emerging pests and diseases as a result of climate change, which has become evident especially in recent years, and the need to use less pesticide input to meet consumer demand against them are one of the important problems awaiting solution in breeding. Fruit genetic resources are mainly preserved in the form of ex situ tree collections by different public institutions and private sector organizations. In situ preservation may sometimes include preservation elements such as cryopreservation.
Keywords: Genetic resources, conservation strategies, biosecurity

Bitki genetik kaynakları

Bitki genetik kaynakları, yabani türlerden ve ilkel formlardan gelen, doğal seçilim yoluyla biriken çeşitliliğin toplamını temsil eder. Bitki genetik kaynakları introdüksiyon, göç ve evcilleştirmenin yanı sıra ıslah çalışmaları ve yapay yöntemlerle de elde edilebilir. Başka bir ifadeyle geniş bir karakter yelpazesini etkileyen tüm alelik kaynakların toplamı bitki genetik kaynaklarını oluşturur. Bir ürünün (mahsulün) milyonlarca yıllık varoluşu boyunca doğal koşullar altında veya insan etkisi altında elde ettiği ve dolayısıyla doğal veya insan müdahalesi yoluyla daha fazla gelişme için hammadde sağlayan genetik zenginliği ifade etmektedir (Ercisli, 2004; Singh vd., 2020).

Genetik kaynaklar, uluslararası biyoçeşitlilik sözleşmesine göre, insanlar için mevcut ve potansiyel değeri olan genleri içeren canlı materyallerdir. Bitki genetik kaynakları, tüm tarımsal ürünlerimizi ve hatta bunların bazı yabani akrabalarını içerir. Bitki genetik kaynakları bu yüzden çoğu zaman değerli özelliklere sahiptirler (Maxted vd., 2011; Halewood et al., 2018).

Bitki genetik kaynakları, ürün geliştirme programlarının mevcut ve gelecekteki ihtiyaçlarının karşılanması için temel hammaddeyi oluşturmaları nedeniyle büyük önem taşımaktadır. Dünyada mahsul üretimini artırmak için yeni çeşitler geliştirmeyi amaçlayan bitki ıslah araştırmalarında daha geniş bir genetik temel önceliklidir (Wang vd., 2017; Sahu et al., 2023). Bu çeşitlilik mahsul bitkilerinin yabani akrabalarını da içermektedir.

Bitki genetik kaynaklarının, menşei, mevcut durumu, korunması ve bitki ıslahında gelecekteki kullanımı ile doğrudan ilgili olan tüm yönleri, aşağıdaki birbiriyle ilişkili üç faaliyet olarak tanımlanabilir:

• Mahsul bitkilerinin kökeni ve yayılması
• Bitki geninin toplanması, değerlendirilmesi ve korunması
• Bitki gelişimi için genetik kaynakların kullanılması (Archak and Agrawal, 2012).

Bitki germplazmı nedir?

Bitki germplazmı yeni bitkilerin yetiştirilebileceği canlı dokudur. Germplazm genellikle tohum olarak kabul edilir ancak bitkinin başka bir parçası örneğin bir gövde, bir yaprak veya polen veya hatta bütün bir bitkide kültüre alınabilecek (çoğaltılabilecek) sadece birkaç hücre germplazmını da temsil edebilir (Gowda et al., 2011; Archak and Agrawal, 2012).

Çeşitlilik/Orijin merkezleri

Vavilov (1951), çeşitli bitki türleri için varyasyonun coğrafi dağılımına dayanarak, bitkilerin sekiz orijin merkezini tanımlamıştır. Bu alanların çoğu günümüzde hala zengin çeşitlilik kaynağı olmaya devam etmektedir. Araştırıcı ayrıca iki tür merkezdeki dağıtım modelini de açıklamıştır:

Çeşitlilik merkezleri/menşe merkezleri

•**Birincil merkez**: Bir ürünün ortaya çıktığı ve maksimum çeşitliliğe sahip olduğu coğrafi bölgedir.

•**İkincil merkez**: Bazı mahsullerin yabani atalarının menşe merkezinden başka yerlere göç etmesi nedeniyle oluşan çeşitlilik bölgeleridir.

Örneğin kayısı için Çin birincil merkez iken, Türkiye ikincil merkez konumundadır (Ercisli, 2004).

Bitki genetik kaynaklarının sınıflandırılması

•Kültürü yapılan türler

1. Ticari çeşitler
2. Yerel çeşitler veya geleneksel yerel çeşitler
3. Islah hatları
4. Özel genetik stoklar

•Yabani türler

1. Doğrudan kullanım için
2. Dolaylı kullanım için
3. Potansiyel olarak kullanılabilir

Kültür bitkilerinin yabani akrabaları, hastalık, böcek ve nematod direncinin kaynağı olarak, adaptasyonu genişletmek, kaliteyi arttırmak, üreme modlarını değiştirmek, boy kısalığını (bodurluk) teşvik etmek, türler arasındaki çaprazlanabilirliği arttırmak, strese direnci geliştirmek ve verimi artırmak için kullanılırlar. Bazı mahsuller yabani bitki türlerinin genetik desteği olmadan ticari statülerini koruyamazlar (Maxted vd., 2007; Loskutov et al., 2023).

Meyve türlerinde biyoçeşitlilik

Meyve türleri değişken tarımsal-ekolojik koşullara daha yüksek adaptasyon kabiliyetine sahip olup çeşitli bahçecilik sistemleri için uygundurlar (Singh, 2003). Doğada insanoğlu için sayısız bitki türü bulunmakta ve bunların yalnızca 5000 kadarı dünya çapında insanlar tarafından kullanılmaktadır. Günümüzde sadece 150 kadar bitki türü insanlığın gıdası açısından önem taşımaktadır. Çok az sayıda bitki türüne, yani dünya çapında yaklaşık 20-30 bitki türüne daha fazla bağımlılık vardır. Bu durum, genetik çeşitliliğin yapı taşları olarak hayati önem taşıyan yerli genetik kaynakların yavaş yavaş kaybolmasıyla sonuçlanmaktadır. Yalnızca Güneydoğu Asya'da 120 ana meyve türü ve 275 ikincil meyve türü bulunmaktadır (Verheij ve Coronel, 1992).

Narenciye, muz, mango, jackfruit (jack meyvesi), liçi ve durian bölgedeki toplam meyve üretiminin yüzde 80'ini oluşturur. Bölgede yer alan Hindistan, mango, narenciye ve muz gibi meyve türlerinin de dahil olduğu pek çok bahçe bitkisinin menşei ve çeşitliliğinin önemli bir merkezidir (Singh vd., 2020).

Asya' da meyve çeşitliliği

Asya yüksek oranda meyve çeşitliliği ile karakterize edilmekte olup, yaklaşık 500 meyve türü kıtanın farklı ekosistemlerinde yaygınlık göstermektedir. Böylece yarı nemli, nemli tropikal ve yarı kurak koşullara iyi adapte olmuş geniş bir doğal çeşitlilik yelpazesi ortaya çıkmaktadır. Bu bölgede evcilleştirilen ve çeşitlendirilen yerli meyve türlerine ek olarak, tropik Amerika kökenli çok sayıda tür, tarımsal-ekolojik nişler geliştirmiş ve iyi bir şekilde bölgeye adapte olmuşlardır (Verheij ve Coronel, 1992).

Bölgede 70'in üzerinde fazla ve az bulunan meyve türü yetiştirilmekte olup, bazı umut verici egzotik tropik meyveler de yetiştirilmektedir. Bununla birlikte, sadece 20 türün kültürü daha iyi bilinmekte ve bunlar arasında muz, narenciye, mango, ananas, papaya, durian, rambutan, liçi, longan, demirhindi, çarkıfelek meyvesi, hünnap ön sıralarda yer almaktadır (Verheij ve Coronel, 1992).

Bölge için güzel bir örnek ise turunçgillerdir (Citrus). Citrus cinsi, Kuzeydoğu Hindistan ve Güney Çin'den, Kuzey Avustralya ve Yeni Kaledonya'ya kadar doğal olarak bulunur. Yetiştirilen türler Güneydoğu Asya'nın tropikal ve subtropikal bölgelerine özgüdür. Yaygın olarak yetiştirilen turunçgiller Citrus, Fortunella ve Poncirus olmak üzere üç cinse aittir. Bu

cinslerin tümü birbiriyle yakından ilişkilidir ve kolayca melezleşerek farklı isimlerle birçok olağandışı bitki formunun gelişmesine neden olmuştur. Turunçgil türleri ve çeşitler arasında sık göz mutasyonu, tür içi ve türler arası melezleme, apomiksis ve uzun yetişme periyodu nedeniyle oldukça yüksek varyasyon bulunmaktadır.

Bitki genetik kaynaklarının korunması

Amaç, her bir türün genetik potansiyelinin ıslah çalışmaları için tamamen kullanılabilir olmasını sağlamak amacıyla yeterli çeşitliliği korumaktır.

Bitki genetik kaynakları/biyolojik çeşitliliği neden korunmalıdır?

Modern tarımda yalnızca birkaç ürün kullanılıyor ve bunlar genellikle dar bir genetik temele sahiptirler. Bu, önceki nesiller tarafından kullanılan önemli genetik çeşitliliğe sahip çok sayıda yerel çeşitlerle çelişmektedir. Eğer artan genetik erozyona (kayba) karşı önlem alınmaz ise, insanlık için bunun ciddi sonuçları olacaktır.

Genetik varyasyon kaybı telafi edilemez

Genetik temeli dar olan ürün çeşitlerinin hastalıklar nedeniyle tamamen yok edilebildiği gösterilmiştir. Bitki yetiştiricileri daha sonra söz konusu hastalığa karşı direnç genlerini bulmak için daha eski çeşitlere veya yakından ilişkili yabani türlere geri dönmektedir. Gelişmiş gen teknolojisi bile, genlerin bolluğu ve gen etkileşimi nedeniyle doğal çeşitliliğin yerini hiçbir zaman alamamaktadır.

Genetik çeşitliliği korumak insanoğlunun sorumluluğudur

Genetik kaynakların düzenli olarak korunması, gelecek nesillerin ürün çeşitlerini yetiştirebilmesi ve yeni zorluklarla yüzleşebilmesi için bir ön koşuldur. Mahsul çeşitlerine yönelik gelecekteki talepler hakkında henüz her şeyi bilmiyoruz, ancak bunların daha çevre dostu bir yetiştirme sisteminin parçası olması ve daha kaliteli olması gerektiğini biliyoruz.

Genetik kaynakları koruma sistemi

1. *Ex situ* (Bulunduğu yer dışında koruma)
2. *In situ* (Yerinde koruma) (Şekil 1)

Bu iki sistemin birbirinin rakibi değil tamamlayıcısı olduğu düşünülmelidir.

In situ koruma:

•Türün yetiştiği alan ve habitatın yasal olarak korunmasını içerir

•Bu yabani bitkiler için özellikle tercih edilen tekniktir

•Avantajı türlerin evrimsel dinamiklerinin korunmasıdır

•Dezavantajı ise maliyet ve zaman zaman ortaya çıkan sosyal ve politik zorluklardır

Ex situ koruma:

Bir popülasyonun/kültürün genetik değişkenliğini temsil eden örneklerin toplanmasını ve bunların tohum, sürgün, *in vitro* kültür ve bitki olarak germplazm bankalarında veya botanik bahçelerinde muhafaza edilmesini ifade eder. *Ex situ* koruma esas olarak tohumla çoğaltılan kültür bitkilerinde kullanılır (Volis ve Blecher, 2010).

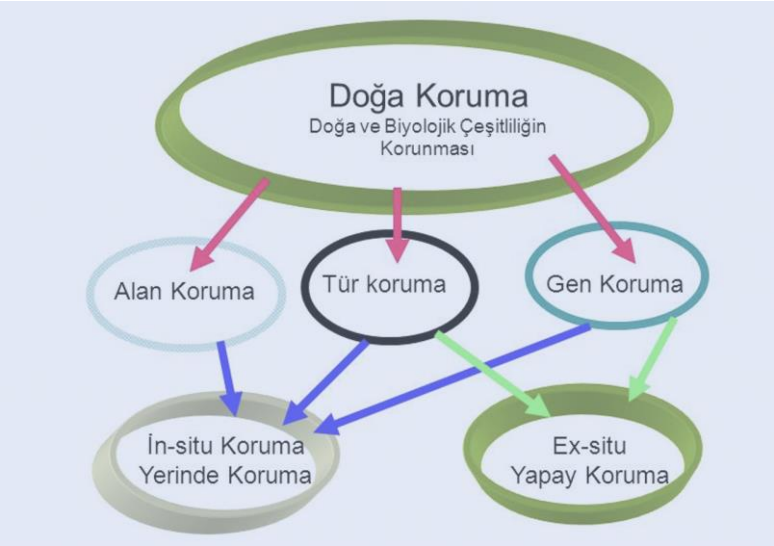
Genetik çeşitliliğin kaybı

•Hızlı çevresel değişiklikler genellikle kitlesel yok oluşlara neden olur.

•İnsanın ortaya çıkışından bu yana geçen süre, devam eden bir biyolojik çeşitlilik azalması ve buna eşlik eden genetik çeşitlilik kaybı sergilemiştir. Holosen yok oluşu olarak adlandırılan bu azalma, öncelikle insan etkilerinden, özellikle de habitat tahribatından kaynaklanıyor.

•2006 yılında pek çok tür resmi olarak nadir veya nesli tükenmekte olan veya tehdit altında olan türler olarak sınıflandırılmıştır. Üstelik bilim insanları, resmi olarak tanınmayan milyonlarca türün daha risk altında olduğunu tahmin etmektedirler. IUCN Kırmızı Liste kriterleri kullanılarak değerlendirilen 40.177 türün yaklaşık yüzde 40'ı artık nesli tükenme tehlikesiyle karşı karşıya olan türler arasında yer almaktadır (Petit-Marty vd., 2022).

•Biyoçeşitlilik kaybının mevcut ve öngörülen oranı, Dünya üzerindeki yaşamın tarihindeki altıncı büyük yok oluş olayını oluşturmaktadır; bu durum özel olarak tetiklenen ilk olaydır. İnsan faaliyetlerinin etkisiyle türlerin yok olma oranını 10 kat artırmıştır.



Şekil 1. Doğa koruma stratejileri

Biyoçeşitlilik kaybının ana nedenleri

Biyoçeşitliliğin azalmasının doğrudan nedenleri arasında habitat kaybı, istilacı yabancı türler, doğal kaynakların aşırı kullanımı ve kirlilik yer almaktadır. Bunların hepsinin sorumlusu insanoğludur. Ana suçlu, tarıma ve hayvancılığa, su ürünleri yetiştiriciliğine, kentleşmeye ve sanayiye uyum sağlamak için doğal yaşam alanlarının tahrip edilmesidir. Özellikle yabani istilacı türlerin girişi tahmin edilmez boyutlarda bitki ve hayvan biyoçeşitliliğine zarar vermiştir (Roe vd., 2019).

Genetik kirlilik

Endemik türler, kontrolsüz melezlenme, gen kaçışı ve gen akışı gibi genetik kirlilik süreci nedeniyle yok olma tehlikesiyle karşı karşıya kalabilirler. Genetik kirlilik, tanıtılan türün sayısal ve/veya uygunluk avantajının bir sonucu olarak yerel genomların homojenleşmesine veya değiştirilmesine yol açar. Melezleme ve gen kaçışı, introdüksiyon ve istilanın yan etkileridir. Bu olaylar, daha bol bulunan türlerle temasa geçen nadir türler için özellikle zararlı olabilir. Bol miktarda bulunan türler, nadir türlerle melezlenerek onların gen havuzunu değiştirebilir. Bu sorun her zaman yalnızca morfolojik (dış görünüş) gözlemlerle ortaya çıkmaz. Bir dereceye kadar gen akışı normal adaptasyon sayılır ve tüm gen ve genotipler bu nedenle korunamaz. Ancak gen kaçışlı veya kaçışsız melezleme nadir bulunan türlerin mevcudiyetini tehlikeye atabilir.

Türlerin kayıp oranları

Geçtiğimiz yüzyılda biyolojik çeşitlilikte giderek azalmalar gözlemlenmiştir. 2007 yılında, 2050 yılına kadar tüm türlerin %30'unun neslinin tükeneceği yönünde tahminler bulunmaktadır. Bunlardan, bilinen bitki türlerinin yaklaşık sekizde biri yok olma tehlikesiyle karşı karşıyadır. Tahminler yılda 140.000 türe kadar ulaşmaktadır (Tür-alan teorisine dayanarak). Bu rakam sürdürülemez ekolojik uygulamaları göstermekte çünkü her yıl çok az tür ortaya çıkıyor. Hemen hemen tüm bilim adamları, tür kaybı oranının insanlık tarihinin herhangi bir dönemindekinden daha yüksek olduğunu, yok oluşların arka plandaki yok olma oranlarından yüzlerce kat daha yüksek oranlarda meydana geldiğini kabul etmektedirler. 2012 yılı itibarıyla bazı araştırmalar, 20 yıl içinde tüm memeli türlerinin %25'inin neslinin tükenebileceğini öne sürmektedirler.

Çekirdek koleksiyon

Son zamanlarda farklı ülkelerde farklı lokasyonlarda tekerrürler halinde meyve türleri genetik kaynaklarını içeren çekirdek koleksiyonları kurulmuştur. Koleksiyonlar fenotipik tanımlamanın, biyokimyasal (özellikle fitokimyasal) tanımlamalar yanında GWAS ve diğer genetik çeşitlilik çalışmalarına da izin vermektedir.

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EVALUATION OF SOME AROMATIC PLANT PULPS AS SILAGE

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ABSTRACT
The aim of this study was to determine the usefulness of aromatic plant pulps as silage. Varying amounts of alfalfa hay and maize were combined with minced aromatic plant pulps during ensilage. For this purpose, four different silages were prepared in four replicates. The main components of the silages were *Origanum vulgare* pulp (OvP), *Hyssopus officinalis* pulp (HoP), *Helichrysum italicum* pulp (HiP) and *Lavandula angustifolia* pulp (LaP), respectively. After 45-60 days, the silage jars were opened and physical and chemical evaluations were conducted. The dry matter level was higher in HoP and LaP silages compared to OvP and HiP silages ($P<0.05$). HoP silage had the highest crude protein content, followed by HiP, LaP, and OvP groups ($P<0.05$). The highest ether extract and ash content was observed in HoP silages, whereas HiP had the lowest ether extract, and HiP and OvP had the lowest ash ($P<0.05$). There was no significant difference observed among groups regarding ADF and NDF levels ($P>0.05$). The pH value was highest in HoP silage with a value of 4.76 and lowest in HiP silage with a value of 4.08 ($P<0.05$). The Fleig score was highest in HiP silage and lowest in LaP, OvP and HoP silages, respectively ($P<0.05$). The obtained findings demonstrate that aromatic plant pulps, which are waste products, have potential usage in silage production. However, in vivo studies evaluating feeding behaviour, voluntary feed intake and animal performance are required to establish their suitability as an alternative feed source.
Keywords: *Origanum vulgare*, *Hyssopus officinalis*, *Helichrysum italicum*, *Lavandula angustifolia*, Silage, Alternative Forage

Introduction

Using non-food products derived from agricultural crops as animal feed enhances food security and also helps to alleviate environmental issues caused by their disposal. Moreover, such practices are likely to decrease feeding costs and increase profits for animal breeders.

Due to the ban on antibiotics, medicinal and aromatic plants have emerged as a key alternative in animal feed. Research demonstrates that including immune-enhancing, antimicrobial and antiseptic substances in rations can effectively reduce the use of antibiotics, even in cases of disease treatment procedures. Secondary metabolites (essential oils) obtained from aromatic plants have the following effects on ruminants; reducing energy loss by increasing the production of volatile fatty acids in the rumen, facilitating the digestion of difficult-to-digest nutrients such as cellulose and lignin, stimulating rumen microbial activity, changing the course of rumen fermentation in favour of the ruminant, having positive effects on rumen development, being alternative methane inhibitors, contain flavouring and appetising compounds, have antimicrobial, antiviral, antioxidant, sedative, bactericidal, fungicidal and antiparasitic effects against various microorganisms, anticarcinogenic and immune system enhancing properties (Kaçmaz, 2021). After extracting essential oil from medicinal and aromatic plants using methods such as distillation, extraction, multidirectional extraction or mechanical methods, the remaining pulp can be used by breeders in regions where essential oils are produced as a source of roughage due to their high nutrient content. Additionally, the presence of residual essential oils in the pulps is believed to improve the quality of the roughage. For this reason, it is important to investigate alternative roughage types.

Our country's geographical location allows for cultivating various medicinal and aromatic plants, including thyme and lavender, both of which belong to the Lamiaceae family. Castillejos et al. (2008) reported that thymol and carvacrol from polyphenols contribute to thyme's antimicrobial effect. It was reported that animal feed supplemented with thyme, rosemary, hyssop, sage, and clove oil increased propionate and valerate ratios and decreased acetate to propionate ratio and butyrate levels. The thyme plant was also found to increase the concentration of rumen volatile fatty acids while decreasing ammonia nitrogen levels and pH. However, it should be noted that thyme essential oil contains 78-80% thymol and polyphenols, leading to a decrease in the thymol and polyphenol content of thyme pulp, a byproduct of the plant. Hyssop herb belongs to the Lamiaceae family. Due to their essential oils are used as

preservatives in cosmetics and the food industry. They are used to increase the shelf life of foods. Golden grass herb is a perennial plant that belongs to the Asteraceae family. It contains tannins and curcumine. Tannins are considered antinutritional substances. However, when used in limited quantities not exceeding 5%, their consumption enhances feed utilisation and inhibits enteric fermentation in the rumen. Coumarin is a phytochemical that carries anticarcinogenic and antimicrobial characteristics. Lavender, a herbaceous plant that yields high-quality essential oil, is frequently used in the cosmetics and pharmaceutical industries. The essential oil of this plant exhibits an inhibitory effect on methane gas formation in the rumen. Studies have demonstrated that incorporating it as an additive in silages aids in the maturation process by providing support to the beneficial bacteria present in the silage content.

In light of the available information, the present study examined the potential for ensiling aromatic plant pulps - the waste byproducts of essential oil extraction - and evaluated the nutritional values of the resulting silages.

Materials and Methods

Origanum vulgare pulp (OvP), *Hyssopus officinalis* pulp (HoP), *Helichrysum italicum* pulp (HiP) and *Lavandula angustifolia* pulp (LaP) were obtained from the Medicinal and Aromatic Plants Laboratory of the Department of Field Crops at Eskişehir Osmangazi University Faculty of Agriculture. The pulps were subsequently brought to the Department of Animal Science Laboratory at the same university and cut into pieces roughly 3-5 cm in length. Due to the high water content in all pulps (as feed weights 16.61%, 21.64%, 21.70% and 16.55% for OvP, HoP, HiP and LaP, respectively), alfalfa hay with 90.01% dry matter weight and maize with 86.46% dry matter weight were added to the silages and mixed to provide 33% dry matter in the silage raw material and ensiled in 1 kg glass jars in an airtight manner. Four groups with four replicates were created for this study. The groups were comprised of *Origanum vulgare* pulp at 87.55%, alfalfa hay at 7.84%, and maize at 5% (OvP); *Hyssopus officinalis* pulp at 79.61%, alfalfa hay at 15. 38%, and maize at 5% (HoP); *Helichrysum italicum* pulp at 85.55%, alfalfa hay at 10.30%, and maize at 5% (HiP); and *Lavandula angustifolia* pulp at 78.65%, alfalfa hay at 16.34%, and maize at 5% (LaP). The silage jars were allowed to ferment for 45-60 days before being opened for physical and chemical evaluations. Nutrient composition and cell wall components were analyzed following the procedures and equipment

described by Kandemir and Kop-Bozbay (2023), which were identical to those used in our study. To investigate feed quality of pulp silages, Relative Feed Value (RFV) and RFV grade were determined using dry matter digestibility and dry matter intake data (Van Dyke and Anderson, 2000) by Rohvveder et al. (1978). The Flieg quality score and grade were determined following the methodology established by Kılıç (1986). pH measurements were obtained utilizing an electronic pH meter (HANNA Instruments HI2002-02).

The data were analyzed in SPSS 17.0 package program. The Kolmogorov-Simirnov test was applied for the data's normality assumption, and the variances' homogeneity was evaluated with the Levene test. The data of the study were subjected to a one-way analysis of variance. Duncan test, one of the multiple comparison tests, was used.

Results and Discussion

The nutrient composition, cell wall components and metabolic energy of aromatic plant pulps, alfalfa hay and maize used in the study are given in Table 1.

Table 1. Nutrient composition (%), cell wall components (%) and metabolic energy (kcal/kg DM) of silage materials

Material	DM	CP	EE	Ash	ADF	NDF	ME
Origanum vulgare pulp	92.83	12.80	3.84	7.34	33.70	41.96	2066
Hyssopus officinalis pulp	93.42	18.04	1.83	10.45	26.60	36.32	2291
Lavandula angustifolia pulp	93.02	11.48	1.88	8.99	36.24	51.57	1986
Helichrysum italicum pulp	89.88	8.01	1.94	3.63	43.80	50.34	1746
Alfalfa hay	91.98	16.77	1.20	7.73	34.35	41.00	2045
Maize	88.00	8.80	3.52	1.28	3.21	8.05	3030

DM: Dry matter; CP: Crude protein; EE: Ether extract; ADF: Acid detergent fiber; NDF: Neutral detergent fiber.

The nutrient composition, cell wall components, metabolic energy and relative feed values of silage groups are shown in Table 2. The dry matter level was higher in HoP and LaP silages compared to OvP and HiP silages ($P<0.05$). HoP silage had the highest crude protein content, followed by HiP, LaP, and OvP groups ($P<0.05$). The highest ether extract and ash content was observed in HoP silages, whereas HiP had the lowest ether extract, and HiP and

OvP had the lowest ash (P<0.05). No significant difference was observed among groups regarding ADF, NDF and ME levels (P>0.05). The RFV calculated by using dry matter digestibility and dry matter intake values were not affected by the treatments (P>0.05).

Table 2. Nutrient composition (%), cell wall components (%), metabolic energy (kcal/kg DM) and relative feed values (RFV, %) of silage groups

Silage	DM	CP	EE	Ash	ADF	NDF	ME	RFV	RFV grade
Origanum vulgare pulp	30.90^{b}	11.43^{d}	3.13^{ab}	6.75^{c}	35.83	43.27	1999	131.06	High
Hyssopus officinalis pulp	33.99^{a}	15.88^{a}	3.34^{a}	8.00^{a}	37.45	42.69	1947	130.59	High
Lavandula angustifolia pulp	32.69^{a}	12.52^{c}	2.98^{b}	7.15^{b}	37.45	42.60	1947	131.25	High
Helichrysum italicum pulp	31.18^{b}	13.12^{b}	2.57^{c}	6.84^{c}	34.52	45.28	2040	127.41	High
P	0.001	0.000	0.000	0.000	0.381	0.099	0.595	0.889	
SEM	0.358	0.396	0.074	0.123	0.684	0.441	26.747	1.845	

DM: Dry matter; CP: Crude protein; EE: Ether extract; ADF: Acid detergent fiber; NDF: Neutral detergent fiber. SEM: standard error of the mean, a,b: within a row, means with different superscripts differ significantly (P<0.05).

Table 3 demonstrates the significant effect of treatments on the pH and Flieg quality score values of silage groups (P<0.05). The highest pH value was observed in HoP at 4.76, followed by OvP, LaP, and HiP silages (P<0.05). The Fleig score was highest in HiP silage and lowest in LaP, OvP and HoP silages, respectively (P<0.05).

Table 3. pH and Flieg quality score values of silage groups

Silage	pH	Flieg quality score	Flieg quality score grade
Origanum vulgare pulp	4.63^{b}	85.90^{c}	Very good
Hyssopus officinalis pulp	4.76^{a}	80.80^{d}	Good
Lavandula angustifolia pulp	4.52^{c}	90.40^{b}	Very good
Helichrysum italicum pulp	4.08^{d}	07.90^{a}	Very good
P	0.000	0.000	
SEM	0.059	2.367	

SEM: standard error of the mean; a,b: Within a row, means with different superscripts differ significantly (P<0.05).

Using agro-industrial by-products as feed can reduce costs and mitigate environmental pollution (Sadh et al., 2018). Among these products, medicinal and aromatic plant pulps need to be preserved due to their high water content to be stored for a long time and used as feed for animals. Silage is a suitable technique for this purpose. Unless procedures are implemented to decrease the moisture content to below 12% through drying, silage will be the most feasible approach for preserving medicinal and aromatic plant pulps. Silages offer ruminant diets with energy, protein, and easily digestible fibre (Grant and Adesogan, 2018).

To assess the quality of silage feeds, it is crucial to evaluate the dry matter and physical characteristics (Alçiçek and Özkan, 1997). The dry matter reflects the quantity of nutrients a specific feed provides the animal. In other words, nutrients (energy, protein, minerals and vitamins) are present in the dry matter of the feed. Considering that the dry matter content of the highest quality maize silages is between 25-32% (Kılıç, 1986), all the silages obtained in the present study can be considered as good quality in terms of dry matter content, and this shows that the ensiling potential of medicinal and aromatic plant pulps is high.

The variations in nutrient composition can be ascribed to the substance content. Notably, the HoP silage with the highest crude ash content exhibited the superior crude ash content. This linear correlation was evident across all groups, affirming our standpoint. Furthermore, the differences among groups in terms of crude protein contents indicated that the crude protein contents of the raw materials used were linearly impacted. The crude protein level in animal feed is key to determining feed quality (Gillen and Berg, 1998). Ruminant diets necessitate a minimum of 7-8% crude protein on a dry matter basis to maintain healthy microbial activities (Van Soest 1994). As a result, it can be said that the silages obtained in this study are high quality forage.

The RFV index is a widely used tool for comparison of feed varieties and prices, aiming to assess feed quality objectively. It should be noted that RFV values represent feed quality, with higher values indicating better quality, as reported by Jeranyama and Garcia (2004). The feed's crude protein content is not considered when calculating RFV, but higher RFV values are generally associated with higher protein (Stallings, 2006). The present study confirms these findings.

One of the significant factors impacting ensiling fermentation is pH. In quality silage, pH must range between 3.8-4.2. The pH values in the silages produced in the research

demonstrated pH levels above acceptable thresholds for quality silages, except for HiP silage. Besides, HiP silage registered the highest score in Fleig score values utilized to assess silage quality.

Comparing the results from the present study with the data presented in the literature is challenging as no studies on silages made from medicinal and aromatic plant pulps exist. Nevertheless, adding dried thyme pulp to grass and alfalfa silages improved silage quality in a study (Aksu et al., 2017). Literature research on golden grass needed to yield more findings regarding its use in animal nutrition science. Due to the tannin content of golden grass, it is important to limit the total tannin content of the feed to 5% to enhance feed utilization. Furthermore, it prevents enteric fermentation in the rumen by suppressing protozoa in the rumen microflora, which in turn prevents the activity of methanogen microorganisms. Apart from tannins, golden grass contains certain coumarins which have anticarcinogenic and antimicrobial properties. For these reasons, golden grass displays antioxidant effects in silages (Şen and Kalaycı, 2016). Studies have shown that adding rosemary, hyssop, sage, and clove oil to rations increased propionate and valerate ratios while decreasing the acetate/propionate ratio and butyrate levels.

On the other hand, using the thyme plant in silage increased rumen UYA and reduced ammonia nitrogen and pH (Castillejos et al., 2008). Duru (2019) discovered that incorporating lavender into alfalfa silage prevented dry matter losses by impeding the formation of unwanted components. Moreover, the proportion of NDF increased with the amount of lavender in the silage because of the lavender stem's high NDF ratio.

Conclusions

The inadequacy of feed resources in terms of quantity and quality and the fact that most of them are expensive have led feed producers and animal nutritionists to find new and alternative feed resources and to conduct research on these resources (Özdüven et al., 2005). In this context, silages obtained from medicinal and aromatic plant pulps can be used as alternative feed especially because of the phytochemicals they contain. However, in vivo studies evaluating feeding behaviour, voluntary feed intake and animal performance are required to establish their suitability as an alternative feed source.

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ARTAN KÜRESEL RİSK ORTAMINDA TARIM (GIDA) ARZI GÜVENLİĞİ

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ÖZET
Son on yılda yaşanan salgınlar, savaşlar, ekonomik krizler ülkelerin ekonomik güvenlik konseptlerinin değişmesine yol açmıştır. Özellikle parayla dahi temin edilmesi zor ürünlerin yer aldığı savunma, tarım (gıda) sektörlerine yönelik tedarik güvenliği daha da öne çıkmıştır. Bu alanlar içerisinde tarım (gıda) sektörü özellikle Ukrayna-Rusya savaşı sonrasında ortaya çıkan tahıl krizi nedeniyle en dikkat çeken husus haline gelmiştir. Türkiye'nin ekonomik güvenlik konsepti kapsamında tarım (gıda) güvenliği, bu küresel gelişmelerin etkisiyle değişmeye ve dönüşmeye başlamıştır. Tarım (gıda) arzı güvenliğinin sağlanmasında öne çıkan unsurlar arasında birinci faktör sürdürülebilirlik kavramıyla özdeşleşmektedir. İkinci faktör yerli üretimin iç tüketimi karşılaması noktasındadır. Üçüncü faktör ise tarım (gıda) ürünlerin depolanması, stoklanması, saklanması yönündedir. Dördüncü faktör ise tarım (gıda) ürünlerinin fiyatlarının stabilitesinin korunmasıdır. Beşinci faktör ise değişen tarım (gıda) teknolojilerine uyum sağlanabilmesi verimliliğin arttırılabilmesi ve akıllı tarım uygulamalarının yaygınlaştırılması şeklinde ifade edilebilir. Özellikle tarım (gıda) sektöründe drone, yapay zeka, nesnelerin interneti gibi yeni dijital teknolojilerin kullanılmasının ortaya çıkarabileceği katma değer vurgulanmıştır. Tarım (gıda) ürünlerine salt ekonomik yaklaşımla bakılmasının sorunları artan küresel risk ortamında öne çıkmaktadır. Tarım (gıda) sektörüne ekonomik güvenlik konsepti içerisinde daha geniş bir bakış açısıyla yaklaşmak gerekmektedir. Bu çalışmada ekonomik güvenlik konsepti içerisinde belirtilen faktörler çerçevesinde seçilen tarım ürünlerinin yıllık üretim ve tüketim dengesi yönünden analizi gerçekleştirilmiştir. Özellikle yapılan ithalat miktarlarının olası ambargo veya küresel risk dolayısıyla sıfırlanması durumunda yapılması gerekenler incelenmiş, olası risklere cevap verme yöntemleri ekonomik yönden analiz edilmiştir.
Anahtar Kelimeler: Ekonomik Güvenlik Konsepti, Küresel Risk Ortamı, Tarım (Gıda) Arzı

AGRICULTURAL (FOOD) SUPPLY SECURITY IN AN ENVIRONMENT OF INCREASING GLOBAL RISK

ABSTRACT
Epidemics, wars, and economic crises in the last decade have led to changes in the economic security concepts of countries. Supply security has become more prominent, especially for the defense and agriculture (food) sectors, which include products that are difficult to procure even for money. Among these areas, the agriculture (food) sector has become the most striking issue, especially due to the grain crisis that emerged after the Ukraine-Russia war. Within the scope of Turkey's economic security concept, agricultural (food) security has begun to change and transform under the influence of these global developments. Among the prominent elements in ensuring agricultural (food) supply security, the first factor is identified with the concept of sustainability. The second factor is the point where domestic production meets domestic consumption. The third factor is the storage, storage, and storage of agricultural (food) products. The fourth factor is maintaining the stability of prices of agricultural (food) products. The fifth factor can be expressed as adapting to changing agricultural (food) technologies, increasing productivity, and disseminating smart agricultural practices. The added value that can be created by the use of new digital technologies such as drones, artificial intelligence, and the internet of things, especially in the agriculture (food) sector, has been emphasized. The problems of viewing agricultural (food) products with a purely economic approach come to the fore in the increasing global risk environment. It is necessary to approach the agriculture (food) sector from a broader perspective within the concept of economic security. In this study, the analysis of the annual production and consumption balance of selected agricultural products within the framework of the mentioned factors within the concept of economic security was carried out. In particular, what needs to be done in case the import amounts are reduced to zero due to a possible embargo or a global risk has been examined, and methods of responding to the possible risk have been analyzed from an economic perspective.
Keywords: Economic Security Concept, Global Risk Environment, Agriculture (Food) Supply

1.GİRİŞ

Dünya nüfusunun yıldan yılda artması, iklim değişiklikleri, dünya kaynaklarının sınırlı olması tarım (gıda) güvenliği konusunu bir problem olarak ortaya çıkarmaktadır. Küresel olarak nüfus ihtiyaçlarının karşılanmasından başlayarak, devletin, bölgenin, ilin, ilçenin, köyün, mahallenin, ailenin ve insanın hatta evcil hayvanların gıda ihtiyaçlarının karşılanması sorunun bakış açısına göre kapsamını belirlese de niteliğini değiştirmemektedir. Dünya kaynaklarının nüfusun gıda ihtiyaçlarını karşılamaya yeterli olduğu Birleşmiş Milletler Gıda ve Tarım Örgütü'nün 2023 yılında yayınladığı "Dünyada Gıda Güvenliği ve Beslenmenin Durumu" isimli 316 sayfalık raporunda açıklanmıştır. Yine raporda "küresel açlık hâlâ salgın öncesi seviyelerin çok üzerinde olup 2022'de dünyada 690 ile 783 milyon insanın açlıkla karşı karşıya kalacağı tahmin ediliyor" olarak ifade edilmektedir (FAO, 2023:6). Salgın hastalık, savaş, küresel iklim değişikliği, küresel güç mücadeleleri küresel riskleri arttırmaktadır.

Gıda sistemlerinin küresel çevresel değişime adapte edilebilmesi ve insanların ve diğer canlı/cansız varlıkların yaşamlarını devam ettirebilmeleri için ekoloji temelli yeni bir paradigma ve politika setinin önemi ve aciliyeti kaçınılmazdır (Kuran; 2021:12). Değişen güvenlik konsepti kapsamında ekonomik güvenlik, tarım (gıda) güvenliği gibi nispeten yeni kavramlar yaygınlaşmakta ve daha fazla dikkat çekmektedir. Gelişmekte olan ülkeler, tarıma yönelik uygun ekonomi politikaları ve programları ile istihdam yaratılabilir, refah artışı sağlanabilir ve ülkenin rekabet gücünü arttırılabilir (Tümenbatur; 2022:7).

Gıda güvenliği yeni bir kavram olmasından dolayı bakış açısına göre içeriği farklılıklar gösterebilmektedir. Gıda güvenliği dört bileşenden oluşmaktadır (Guliyev; 2019:21). Bunlar;

- Gerçeklik: Gıda türüne iç talep, arz ve ticaret cirosu,
- Erişebilirlik: Toplam gelir, işsizlik, ekonomik büyüme ve yoksulluk düzeyi,
- Tüketim: Sağlık, eğitim düzeyi, altyapı ağı,
- İstikrar: Uygun gıdanın fiziksel ve ekonomik bulunabilirliği olarak açıklanabilmektedir.

Birleşmiş Milletler Gıda ve Tarım Örgütü ise gıda güvenliğini gıda yeterliliği, gıda erişimi, gıda kullanımı ve gıda istikrarı olmak üzere dört kalem de değerlendirilmesi gerektiğini belirtmektedir. Gıda güvenliğini ele alan çalışmalar içerisinde gıda güvenliğini etkileyen faktörler benzer olarak sıralanmakla beraber konunun muhasebe yönünün analizi, matematiksel olarak formülüze edilmesi noktasında eksiklikler olduğu görülmektedir. Bu çalışma

kapsamında Türkiye'nin gıda güvenliği konusunda karşılaşabileceği riskler rakamsal ve matematiksel olarak ifade edilmek istenmektedir.

2.KÜRESEL RİSK ORTAMI

Dünya ülkeleri ticari, ekonomik ve finansal yönlerden birbirleriyle etkileşim halindedirler. Artan iletişim ve ulaşım olanakları, yaygınlaşan dijital teknolojiler, ülkelerin birbirleriyle olan ticari, ekonomik ve finansal faaliyetlerini de arttırmıştır. Üretim fazlalıklarının ihraç edilmesi, üretim eksikliklerinin ithalat yoluyla giderilmesi dış ticaretin gelişmesine, ülkelerin kendi vatandaşlarının ihtiyaçlarını daha kolay karşılamalarına dolayısıyla da refah düzeyinin yükselmesine yardımcı olmaktadır. Bu tip ilişkilerin normal olduğu, aksamadan yürüdüğü durumlarda tüm taraflar bu işlemlerden kazançlı çıkmakta, sınırlı kaynakların belirli ölçüde de olsa optimal dağılımı sağlanmaktadır.

Bir ülkede gerçekleşen risk ve belirsizlikteki artış, yerli-yabancı tüm yatırımcıların ülkeye yapacağı yatırımları ve finansal varlık fiyatlarını genellikle olumsuz yönde etkilemektedir (Gürsoy ve Kılıç; 2021:1325). Ülkelerin risk değerlendirmeleri bulundukları konumuna, komşularına, savaş veya çatışma bölgelerine yakınlıklarına, ekonomik durumlarına, küresel ticaretteki paylarına bağlı olarak değişebilmektedir. Küresel belirsizlik endeksi, küresel risk göstergelerine ve tek tek ülkelerin risk durumlarına bağlı olarak hesaplanabilmektedir. Küresel riskler; salgın hastalıklar, küresel iklim değişiklikleri, düzensiz göçler, savaşlar, çatışmalar, üretim kapasitelerinde ortaya çıkan sorunlar, ulaşım ağlarının ve yollarının değişmesi, enerji fiyatlarındaki dalgalanmalar gibi geniş bir yelpaze de düşünülmektedir. Küresel durumu ve küresel işleyişi tehdit edebilecek önemdeki her unsur küresel risk unsuru olarak kabul edilebilmektedir. Burada riskleri her zaman olumsuz olarak değerlendirmemek gerekmektedir. Oysa risk; istisna değil, normal bir durumdur, dolayısıyla toplum ve politikanın büyük dönüşümünün motoru olabilir (Çelik; 2014:85).

Ülkeler kendi risk değerlendirmelerine uygun olarak güvenlik stratejilerini, politikalarını belirlemektedirler. Bu güvenlik ve risk algısı çerçevesinde gelişen dünya düzeninde ülkeler "tarım (gıda) arzı" güvenliği kavramına odaklanmaktadır. Son yıllarda ortaya çıkan küresel riskler şunlardır:

- Savaşlar, silahlı çatışmalar,
- Terör,
- Düzensiz göçler,

- İklim değişikliği ve küresel ısınma,
- Ambargo ve ekonomik yaptırımlar,
- Salgın hastalıklar,
- Erozyon, deprem gibi doğal afetler olarak sıralanabilir.

Sözkonusu risklerin doğrudan veya dolaylı olarak tarımsal faaliyetler ve gıda arzı üzerinde etkili olduğu ifade edilebilmektedir. Bu riskler tarım alanlarındaki faaliyetlerin yürütülmesini engelleyebildiği gibi gıda taşınmasını, ülkelerin gıda ihtiyacını ithalat ve diğer yollarla karşılamasını da önleyebilmektedir. Tarım, insanların en temel ihtiyacı olan beslenme için gerekli gıdayı sağlayan bir sektör olduğundan, devletin toplumun gıda güvenliğini ve daha da ötesinde tarımsal arz güvenliğini sağlaması gerekmektedir (Tokatlıoğlu vd.; 2018:152). Tarımsal (gıda) arzı güvenliğinin sağlanmasında temel görevin devlete düştüğü konusunda geniş bir uzlaşı bulunmaktadır. Hükümetler yüzyıllar boyunca tarım piyasalarında sektörel koordinasyonu sağlamak, verimliliği artırmak, ticaretten elde edilen kazançların dağılımını etkilemek ve gıda güvenliği temin etmek üzere müdahalede bulunmaktadır (Köse ve Meral 2021:55)

3.TARIM (GIDA) ARZI GÜVENLİĞİ KAVRAMI

Gıda güvenliği çok geniş bir kavramdır. Pek çok farklı boyutu ile çeşitli bilimler tarafından inceleme konusu yapılmıştır. Özellikle uluslararası hukuk alanında pek çok düzenlemeye tabi tutulan temel insan hakkı olarak görülmektedir. 1948 İnsan Hakları Evrensel Beyannamesi'nde dolaylı olarak ifade edilen gıda hakkı, spesifik olarak kendisine ilk kez 1966 Birleşmiş Milletler Ekonomik, Sosyal ve Kültürel Haklar Sözleşmesi'nde yer bulmuştur (Şeyşane; 2022:389). 1945 yılında Birleşmiş Milletler bünyesinde bir uzmanlık teşkilatı olarak Gıda ve Tarım Örgütü kurulmuştur.

Ticaretin küreselleşmesi, yiyecek ürünlerinin uluslararası pazarlamasının hızla yaygınlaşmasına sebep olmuş ve bu durum yiyecek zincirinin üretimden tüketime her evresinin özenle kontrol edilmesini gerekli kılmıştır (Erdoğan; 2014:19). Ancak üretimden tüketime her evreyi etkileyebilecek çeşitli riskler bulunmaktadır. Bu risklerin bazıları bir veya birkaç ülkeyi tehdit edebilirken, bazıları tüm dünya ülkelerini tehdit edebilecek seviyededir. Bu nedenle tarım (gıda) arzı kavramına yönelik üzerinde anlaşılmış tek bir tanım bulunmamaktadır.

Bu çalışma kapsamında tarım (gıda) arzı güvenliği, geniş anlamda dünya nüfusunun gıda tüketimini engelleyecek riskleri bertaraf edebilecek stratejiler, politikalar, yöntemler, tedbirler

ve uygulamalar bütünüdür. Dar anlamda tarım (gıda) arzı güvenliği ise bir ülkede yaşayanların gıda tüketimini engelleyebilecek risklere yönelik geliştirilen, uygulanan, strateji, politika, yöntem, tedbir, yasal mevzuat, idari davranışlar setidir. Her iki tanımda da tarımsal (gıda) arzı riske artan ve insanların gıdaya erişiminde sorunlar meydana getirilebilecek her unsur kapsam içerisinde görülmektedir. Tarımda üretimi hemen durdurmak veya arttırmak mümkün olmadığı gibi talebi ertelemek de olası değildir.

4.LİTERATÜR TARAMASI

Arz talep dengesinin sağlanabilmesi, üretici ve tüketici fiyatlarındaki dalgalanmalar, iklim değişikliğinin ortaya çıkardığı ve çıkarabileceği olası etkiler, sağlık ve çevre ile ilgili konularda endişelerin artması, değişen üretim koşullarının iyileştirilmesi, global olarak insan diyetindeki değişiklikler gibi birçok faktörle birlikte dünyada gıda güvencesi ve gıda güvenliği kavramları yapılan çalışmalarda ön plana çıkmaktadır (Koç ve Umay; 2015:40). Türkiye'de yapılan çalışmaların nispeten yeni olduğu, sorunu matematiksel formüllerle ifade eden çalışmaların ise çok sınırlı olduğu görülmektedir.

Dağdur ve Olhan (2015); küresel gıda ve güvence endeksinde 39'ncu sırada iyi bir puanda olduğunu belirtmişlerdir. Standartların, düzenlemelerin, ortalama gıda arzının Türkiye'nin puanını yükselttiği, buna karşılık kişi başına GSYH ise azalttığı çalışmanın sonuç bölümünde belirtilmiştir (Dağdur ve Olhan; 2015:60).

Sarısoy ve Akay (2018); kırmızı et piyasası yönünden piyasa başarısızlığı ve gıda güvencesizliği konusunu ele almışlardır. 2007-2017 kırmızı et üretim verileri, dana, keçi ve koç sayısı üzerinden hayvan varlığının ve et arzının arttırılması nispeten kısa vadeli bir sonuç sağladığına ulaşmışlardır (Sarısoy ve Akay; 2018:118).

Turkal ve arkadaşları (2019); gıda güvenliğini gıda savunması boyutuyla ele almışlardır. İç ve dış tehdit ayrımı yaparak, gıda savunması uygulamalarıyla tüm gıda sistemi güvenliğinin güçlendirilmesi gerektiği sonucuna ulaşmışlardır (Turkal vd; 2019:609).

Yıldız Karakoç ve Kovancı (2019); iklim değişikliği konusunu bir güvenlik tehdidi olarak incelemişlerdir. İklim değişikliğinin doğrudan etkilediği alanlardan biri olan tarımsal üretim, iklim değişikliği nedeniyle yaşanan kuraklık, sıcaklıktaki artışlar, toprağın yapısının bozulması, yağış miktarının azalması gibi nedenlerden olumsuz biçimde etkilendiğini savunmuşlardır (Karakoç ve Kovancı; 2019:354)

Beykaya (2020); Türkiye'de gıda güvenliği denetimleri konusunu inceleyerek kamu otoritesinin rolünü ele almış ve Iğdır iline ilişkin hammaddenin tedarikinden nihai ürünün elde edilmesine kadar olan her aşamada denetimin önemini vurgulamıştır (Beykaya; 2020:268).

Turmuş ve Güneş (2020); Dünya'da ve Türkiye'de gıda güvenliğini hububat sektörü açısından buğday ve mısır da kişi başına tüketim miktarlarını esas alarak incelemişlerdir. Çalışmanın sonucunda buğday ve mısır ürünleri üretiminin nüfus artışı karşısında dalgalanmalar gösterdiği sonucuna ulaşmışlardır (Turmuş ve Güneş; 2020:142).

Fidan (2021); kırmızı et bakımından kendine yeterlik oranını hesaplayarak ürün mevcudiyetinin yetersiz olduğu sonucuna ulaşmıştır (Fidan; 2021:100). Hesaplamalarında kişi başına kırmızı et üretim ve tüketim miktarlarını kullandığı görülmektedir.

Soylu (2022); sürdürülebilir kalkınma ve gıda güvenliği bağlantısını inceleyerek 2021-2019 yılları arasında Türkiye'nin gıda güvenliği endeksindeki yerinin 36 ila 49 arasında dalgalanmalar gösterdiğini açıklamıştır. 2019-2023 yıllarını kapsayan On Birinci Kalkınma Planı'nda gıda ve gıda güvenliğine ilişkin ayrı bir başlık bile bulunmamasını eleştiri konusu yapmıştır (Soylu; 2022:109).

Arıkan ve Tozkoparan (2022); küreselleşmenin gıda üzerinde yaratmış olduğu etkileri inceleyerek, küreselleşmenin gıda üzerinde yaratmış olduğu etkilerle güvenli gıdaya ulaşabilme noktasında Türkiye'nin küreselleşen dünyada geri planda kalmadığını tespit etmişlerdir (Arıkan ve Tozkoparan; 2022:476).

Çelik ve Aytekin (2023); gıda güvenliği ile küreselleşme ve iktisadi büyüme ilişkisini Malezya, Endonezya, Güney Kore, Türkiye için 1970-2019 verileri yönünden incelemişlerdir. Uzun dönemde ekonomik büyümenin gıda güvenliğini pozitif; küreselleşmenin ise negatif etkilediği sonucuna ulaşılmıştır (Çelik ve Aytekin; 2023:197).

Kıymaz (2023); Türkiye'de hububat üretiminde istikrarın korunması ve üretim sürdürülebilirliğinin sağlanması 2006-2022 dönemi üretim verilerini kullanarak tarımsal destekleme ödemelerini incelemiştir. Sonuçta buğday ve arpa özelinde destekleme sisteminde gelir istikrarını temel alan statik değil dinamik bir modele geçilerek, çiftçinin aynı arazide 5 yıllık üretim faaliyetinden kaynaklanan ortalama net gelirinin esas alınması önerisini getirmiştir (Kıymaz; 2023:73).

Yazar ve arkadaşları (2023); tarımsal gıda üretiminde blok zinciri ve nesnelerin interneti teknolojilerinin birlikte kullanıldığı bir model önermişlerdir. Çalışmanın sonucunda gıda üretim

ve tedarik maliyetlerinin izleneceği modelin maliyetinin de az olduğu belirtilmiştir (Yazar vd.; 2023:21).

5.TÜRKİYE TARIM (GIDA) ARZI RİSKLERİNİN TESPİTİ

Türkiye tarım (gıda) arzı konusunda pek çok düzenleme yapmakta, hedefler belirlenmekte, dokümanlar yayınlamaktadır. Bu anlamda yapılanların olumlu olduğu, konuya farkındalık sağladığı ifade edilebilmektedir ve bütünsel bir yaklaşımla şirket gibi yönetim tarzı düşünülecek olursa; en az stok miktarı, tedarik zincir güvenliği, gereksinim analizi, ithalata bağımlılık oranı gibi ticari faaliyetlerinin aksatılmadan yürütülebilmesi için bilinmesi ve yönetmesi gereken bilgilerin önemi ortaya çıkmaktadır.

Türkiye tarım (gıda) arzı konusunda çeşitli stratejiler geliştirmekte ve eylem planları hazırlamaktadır. Küresel gıda arzını tehdit eden riskler yanı sıra Türkiye özelinde tarım gıda arzı riskleri; salgın hastalık, terör, düzensiz dış göç, iklim değişikliği, sulama sorunları, ekonomik yaptırımlar, açık veya gizli ambargolar, erozyon, deprem, orman yangınları gibi doğal afetler, köyden kente geçişin hızlanması, tarımsal teşvik ve sübvansiyonların düşük kalması, tarımsal üretime yönelik anlık veri alınabilecek ortamın henüz kurulamaması olarak sıralanabilir. Ancak bu risk unsurlarını tek tek incelemek yerine tarımsal üretime yönelik anlık veri alınabilecek ortamın henüz kurulamaması konusu üzerinde durulması gerekmektedir. Peter Drucker, kaliteye yönelik olarak "Ölçemediğiniz hiçbir şeyi kontrol edemez, kontrol edemediğiniz hiçbir şeyi yönetemezsiniz" demiştir. Aynı sözü tarım (gıda) arzı güvenliği noktasına taşıyacak olursak durumu ölçme ihtiyacının boyutu da belirginleşecektir. Hal kayıt sistemi, çiftçi kayıt sistemi, ürün doğrulama ve takip sistemi, hayvan kayıt bilgi sistemi gibi çeşitli çalışmalar başarıyla hayata geçirilmiş olsa bile henüz istenilen seviyeden uzak olunduğu ifade edilebilmektedir. Örneğin tarımsal makine envanteri, işlenen toprak miktarı, bu yıl ekilen ürün miktarı, olası hasat miktarı, tarımsal üretimde çalışan kişi sayısı gibi bilgilerin toplandığı ve idare edildiği bir merkezi yaklaşıma ihtiyaç olduğu belirtilebilir. Tarımsal (arz) güvenliği kapsamında büyük veri çalışmalarında kullanılabilecek, veri madenciliği yapılabilecek, nesnelerin interneti, blok zinciri teknolojisi, makine öğrenmesi ve yapay zeka çalışmalarında işe yarayabilecek verilere ihtiyaç bulunmaktadır. Bu verilerin elde edilebileceği bir ortamı oluşturabilmek, gıda arzı güvenliğine ilişkin politikaların etkinliğini ve başarı durumunu da arttırabilecektir.

6.OLASI RİSKE CEVAP VERME YÖNTEMLERİ

Savaş, silahlı çatışma, terör, düzensiz göç, iklim değişikliği ve küresel ısınma, ambargo ve ekonomik yaptırımlar, salgın hastalık, erozyon, deprem gibi doğal afetler tarım (gıda) arzı konusunda çeşitli sorunlara neden olabilmektedir. Bu küresel risklere karşı ülkeler kendilerine göre tedbirler geliştirmektedirler. Bu riske cevap verme yöntemlerinden herhangi biri veya bir kaçı ülkelerin tarımsal üretim kapasitesine bağlı olarak kullanılabilmektedir. Bunlar:

- Yerli üretimi artıracak devlet teşvik ve sübvansiyonların konulması,
- Yerli üretimde yeni teknolojileri ve akıllı tarım uygulamalarını kullanarak verimliliğin arttırılması,
- Yerli üretimin ihtiyaç duyacağı baraj, yol, liman gibi alt yapı yatırımlarının yapılması,
- Tarımsal stok kapasitesinin arttırılması, modern stoklama alanlarının hazırlanarak, stok miktarının çoğaltılması,
- Risk seviyesi düşük başka ülkelerde tarımsal üretimin yapılabilmesi,
- Yeni ithalat kanalları ve ulaşım yollarının geliştirilmesi olarak sıralanabilir.

Devletlerin regülasyonlar getirerek tarımsal (gıda) arzı üzerinde etkili olabilmesinin pek çok yolu bulunmaktadır. Ancak bu yolların etkileri her zaman çok hızlı bir şekilde görülmemektedir. Tarım (gıda) alanında verilen teşviklerin, sübvansiyonların, yapılan vergisel düzenlemelerin gıda arzına etkilerinin hemen yansımaması nedeniyle geçen süreye "gecikme etkisi" adı verilebilmektedir. Bu nedenle tarım (gıda) arzına yönelik stratejilerin, politikaların, uzun, orta ve kısa vadeli olarak belirlenmesi ve uygulama sonuçlarının düzenli aralıklarla kontrol edilmesi zorunluluğu ortaya çıkmaktadır. Tarımsal dış ticaret politikalarına yönelik olarak da gecikme etkisi görülmektedir.Tarımsal işletmelerinin birleşerek büyümesinin sağlanması ve böylece ölçek ekonomilerinden faydalanılması istenmektedir. Ancak tarımsal üretimin yapısına bağlı olarak büyük tarım işletmeleri kurmak, bu işletmelerin sürdürülebilirliğini sağlamak her zaman çok kolay olmamaktadır. Tarımsal işletmelerin kredi teminlerinde karşılaştığı güçlükler, borsalarda yer alan tarımsal üretim yapan işletmelerin azlığı finansman noktasında devlete de bazı sorumluluklar yüklemektedir. Büyük tarım işletmelerinin tarım (gıda) arzını daha fazla planlayabildiği, verimsizlikleri azalttığı bilinmekle beraber, üretimde tekel ve karteller oluşturma gibi riskleri de bulunmaktadır.

7.TÜRKİYE TARIM (GIDA) ARZI SEÇİLMİŞ VERİLERİ

Türkiye için tarım (gıda) arzı güvenliği; ülkede yaşayanların gıda tüketimini engelleyebilecek risklere yönelik geliştirilen, uygulanan, strateji, politika, yöntem, tedbir, yasal mevzuat, idari davranışlar seti olarak tanımlanabilmektedir. Bu dar anlamdaki gıda arzı güvenliği tanımının ekonomi bilimi yaklaşımıyla matematiksel olarak ifade edilmesi durumunda ölçülebilir bir sonuca ulaşmak mümkün olabilmektedir.

(1) Tarım (Gıda) Arzı =Tarım (Gıda) Talebi [Temel Ekonomik Eşitlik veya Denge Hali]

(2) Tarım (Gıda) Arzı=Yerli Üretim-Fire + Stok + İthalat [Arz kısmını açacak olursak)

(3) Tarım (Gıda) Talebi=Yurtiçi Talep + İhracat + İsraf [Talep kısmını açalım)

(4) Yerli Üretim -Fire + Stok + İthalat= Yurtiçi Talep + İhracat + İsraf [Yeni Formül]

Yeni elde edilen formül ile miktar dengesi hesaplanmak istendiğinden ele alınan tarım (gıda) kalemi ne olursa olsun birimlere dikkat edilmesi gerekmektedir. Ton, adet, kilogram gibi kullanılan birimlerin aynı olması olası hataları önleyecektir. Ülke için tarımsal (gıda) arz dengesi (4) numaralı formülde, ülke yönetimi ihracat kısıtlaması uygulaması getirerek ve israfı önleyici tedbirler alarak talep yönünü etkileyebilecektir. Benzer şekilde ülke yönetimi arz yönünü ithalatı arttırarak, fireleri önleyici tedbirler alarak veya stok miktarını arttırarak belirleyebilecektir.

Dış ticaret bağımlılığı gıda güvenliği açısından önem arz etmektedir. Aynı şekilde ihracat yapılan ülkeler tarım ürünü alımlarını durdurabilecekleri gibi ithalat yapılan ülkelerinde gıda satımlarını sınırlayabilir veya sıfırlayabilirler. Gıda arzının ithalata bağımlılığı önemli bir güvenlik riski oluşturabilmektedir. Bazı ülkelerde ithalat bağımlılığını azaltmak için yerli üretimi arttırma, ithal edilen malları stoklama, alternatif ithalat kaynakları geliştirerek belirli ülkelere bağımlılığı düşük seviyelerde tutma, başka ülkelerin içerisinde tarım arazisi kiralayarak orada kendi nam ve hesabına üretim yapma gibi yöntemlere başvurulduğu görülmektedir. Bu yöntemlerle ithalata bağımlılıktan doğan gıda güvenliği riskini azaltmaya çalışan ülkeler, gıda konusunda halkın refahını artırmaya çalışmaktadırlar.

7.1. Türkiye Tarımsal (Gıda) Üretim Verileri

Tarımsal (gıda) üretimine ilişkin TÜİK verilerinden 2017-2023 yılı veriler bu çalışma kapsamında derlenmiştir. 2023 yılının 9 aylık üretim verisi olduğunu, diğer yıllarda ise 12 aylık üretim verileri kullanılmıştır. Çalışmada Türkiye'nin ithalata bağımlı olduğu, ülkelerin gıda güvenliği riskinde ithalatın önemli bir risk kalemi oluşturduğu düşünülmektedir. Bu yöndeki

görüşlerin verilerle desteklenip desteklenmediğini incelemek amacıyla her bir üretim kalemi için ithalata bağımlılık oranı ayrıca hesaplanmıştır.

Tablo 1: Tarım (Gıda) Arzı Üretim Verileri

Ürünler	**Birim**	**2023 (*)**	**2022**	**2021**	**2020**	**2019**
Buğday	Ton	21.800.000	19.750.000	17.650.000	20.500.000	19.000.000
Mısır	Ton	8.750.000	8.500.000	6.750.000	6.500.000	6.000.000
Süt	Litre	7.938.811	11.199,41	11.593,96	11.452,71	10.854,19
Yoğurt	Litre	919,69	1.161,36	1.125,91	1.113,73	977,68
Ayran	Litre	611,72	761,09	716,86	587,66	588,23
İnek Peyniri	Ton	575,11	701,07	735,70	739,64	563,41
Tereyağı	Ton	67,14	95,09	85,62	78,48	45,39
Tavuk Eti	Ton	1.723,82	2.426,99	2.245,77	2.136,25	2.137,59
TavukYumurtası	BinAdet	15.149.200	19.808.539	19.376.161	19.788.064	19.965.600
Hindi Eti	Ton	34,85	53,64	52,34	58,22	59,63
Kırmızı Et	Ton	2.144.000(**)	2.191.625	1.952.038	1.785.952	1.201.469
Kesilen Tavuk	Adet	939,68	1.347,726	1.250.059	1.200.704	1.207.402
Sığır Sayısı	Adet	16.520.965	16.851.956	17.850.543	17.965.482	17.688.139
Manda Sayısı	Adet	166.803	171.835	185,574	192.489	184.192
Koyun Sayısı	Adet	42.565.444	44.687.888	45.117.960	42.126.781	37.276.050
Keçi Sayısı	Adet	10.708.674	11.577.862	12.341.514	11.985.845	11.205.429

Kaynak: TÜİK verilerinden derlenmiştir.
(*) 2023 verileri Eylül Ayı dahil 9 aylık, hayvan sayıları ise 6 aylık verilerdir.
(**) Tarımsal Ekonomi ve Politika Geliştirme Enstitüsü Ekim 2023 Durum ve Tahmin Kırmızı Et Raporu'nda yer alan tahmindir.

Tablo 1'de yer alan veriler incelendiğinde Türkiye'nin üretim kapasitesinin çok yüksek olduğu görülmektedir. Ülke nüfusunun 85.279.553 kişi ve kayıt altına alınmış geçici koruma statüsündeki Suriyeli sayısının da 19 Ekim 2023 tarihi itibarıyla 3.264.248 kişiden oluşmaktadır. Ülkedeki Suriye dışındaki yabancılar ve turistler de dikkate alındığında yaklaşık 90 milyon kişilik bir nüfusun gıda güvenliğinin sağlanması gerektiği sonucuna ulaşılabilmektedir.

Türkiye'nin ithalata bağımlı olmasının bir gıda güvenliği riski oluşturup oluşturmayacağının tespiti için Tablo 1'de yer alan ürünlerin ithalat miktarı verilerinin incelenmesi gerekmektedir. Daha sonra bulunan ithalat miktarları Tablo 1'de yer alan üretim miktarlarına oranlanarak

ithalat bağımlılık yüzdeleri tespit edilebilmektedir. Genel olarak ithalat bağımlılığının %10 ve üzerinde olduğu durumlarda gıda güvenliği riskinin olduğu düşünülebilmektedir.

Tablo 2: Tarım (Gıda) Arzı İthalat Verileri

Ürünler	Birim	2023 (*)	2022	2021	2020	2019
Buğday	Ton	8.700.000	6.800.000	6.500.000	10.790.000	9.800.000
Mısır	Ton	1.505.000	2.983.000	3.561.000	2.000.000	2.700.000
Süt	Litre	7.250.000	11.600.000	2.800.000	1.850.000	1.400.000
Yoğurt	Litre	110.858	106.629	394.739	96.909	97.809
Ayran	Litre	71.481	76.139	204.124	59.806	67.109
İnek Peyniri	Ton	58.75	63.29	8.422.858	9.445.259	10.510.701
Tereyağı	Ton	6.787.000	7.429.000	1.899.560	10.723.410	35.702.486
Tavuk Eti	Ton	1.113,14	1.826,62	1.485,77	1.586,25	1,337,59
Tavuk Yumurtası	BinAdet	11.174.100	13.608.539	16.654.113	15.648.125	12.965.600
Hindi Eti	Ton	23,16	38,64	41,12	36,28	43,87
Kırmızı Et	Ton	1.564.000	1.198.568	1.123.256	900.256	889.458
Kesilen Tavuk	Adet	423,58	975.265	1.021.036	987.426	867.124
Sığır Sayısı	Adet	8.264.324	9.547.354	10.896.475	11.564.124	11.245.765
Manda Sayısı	Adet	102.021	113.456	128.786	147.456	87.215
Koyun Sayısı	Adet	18.365.225	24.189.246	28.146.252	27.156.458	22.168.971
Keçi Sayısı	Adet	1.821.657	2.248.355	2.761.892	3.564.321	3.651.357

Kaynak: TÜİK verilerinden derlenmiştir.

Tablo 2'de yer alan ithalat veriler incelendiğinde tahıl ürünlerine yönelik ithalat rakamlarının yüksek olduğu anlaşılmaktadır. Detayı incelendiğinde un ve makarna ihracatına yönelik olarak yüksek düzeyde ithalat olduğu ve aslında bu durumun ithalatın ihracatı karşılamak üzere gerçekleştirildiği görülmüştür. Kısaca iç talebi karşılamaya yönelik olmayan ithalatın bir gıda arzı güvenlik riski olarak değerlendirilmesinin uygun olmadığı kanaatine varılmıştır.

Tahıl dışındaki kalemlerde ithalatın et ve hayvancılık ürünlerinde yüksek olduğu ancak %10 sınırını aşmadığından yine bir gıda arzı güvenliği riski taşımadığı anlaşılmıştır.

7.2. Türkiye'nin Küresel Gıda Güvenlik Endeksindeki Yeri

Türkiye'nin gıda güvenliği endeksindeki yeri bu çalışma kapsamında 2012-2022 yılı verileri dikkate alınarak 10 yıllık bir dönemi kapsayacak şekilde derlenmiştir. Böylece ithalat

bağımlılığı dışında tarım (gıda) arzını tehdit eden unsurların etkisinin ne olduğunun görülebilmesi hedeflenmiştir.

Tablo 3: Türkiye Gıda Güvenliği Endeksi Sıralaması

Yıllar	Genel Sıralama	Toplam Ülke Sayısı	Ekonomik Erişim (Uygun Fiyat)	Fiziksel Erişim	Kalite ve Gıda Güvenliği	Doğal Kaynaklar ve Dayanıklılık
2012	36	105	42	26	35	-
2013	36	107	44	26	35	-
2014	39	109	43	36	41	-
2015	39	109	47	33	40	-
2016	45	113	52	41	41	-
2017	49	113	54	50	39	38
2018	48	113	47	53	39	23
2019	53	113	72	49	49	23
2020	58	113	75	45	49	23
2021	48	113	67	42	47	27
2022	49	113				

Söz konusu endeksin hesaplanmasında ekonomik erişim (uygun fiyat) (%32,4) değerlendirmelerinde şu kriterler esas alınmaktadır:

- Ortalama Gıda Maliyetlerinde Değişim (%6,6)
- Küresel Yoksulluk Sınırı Altında Yer Alan Nüfusun Payı (%6,0)
- Eşitsizlik Durumuyla Standardize Edilmiş Gelir Endeksi (%6,6)
- Tarımsal İthalat Tarifeleri (%3)
- Gıda Güvenliği Programları (%6,6)
- Piyasa Erişimi ve Tarımsal Finansal Hizmetler (%3,6)

Söz konusu endeksin hesaplanmasında fiziksel erişim (ulaşılabilirlik) (%32,4) değerlendirmelerinde şu kriterler esas alınmaktadır:

- Arz Yeterliliği (%8,5)
- Tarımsal Araştırma ve Geliştirme (ARGE) (%2,9)
- Tarımsal Altyapı (%4,6)

- Tarım Üretiminde Dalgalanmalar (%4,9)
- Erişimde Siyasi ve Sosyal Engeller (%3,9)
- Gıda Kayıpları (%4,6)
- Gıda Güvenliği ve Gıdaya Erişime Dair Politikalara Bağlılık (%2,9)

Söz konusu endeksin hesaplanmasında kalite ve gıda güvenliği (gıdanın sağlıklı olması) (%17,6) değerlendirmelerinde şu kriterler esas alınmaktadır:

- Beslenmede Çeşitlilik (%3,6)
- Besleyici İçeriğe İlişkin Standartlar (%2,4)
- MikrobesleyicilerinVarlığı (%4,5)
- Protein Kalitesi (%4,2)
- Gıda Güvenliği (%3,0)

Söz konusu endeksin hesaplanmasında doğal kaynaklar ve dayanıklılık (sürdürülebilirlik ve adaptasyon) (%17,6) değerlendirmelerinde şu kriterler esas alınmaktadır:

- İklim Hareketleri (%3,7)
- Su (%2,5)
- Toprak (%2,5)
- Okyanuslar, Irmaklar ve Göller (%2,2)
- Hassasiyet (%1,9)
- Adaptasyona Yönelik Politik Bağlılık (%3,7)
- Demografik Yoğunluk (%1,2)

Bütün bu değerlendirmeler neticesinde Türkiye'nin sıralamasının yanı sıra puanı da bulunmaktadır. Puanların değerlendirilmesinde 80 puan ve üzerinin çok iyi, 60-79 puan arasının iyi, 40-59 puan arasının orta, 20-39 puan arasının zayıf, 0-19.9 puan arasının çok zayıf olduğuna dair kriterler esas alınmaktadır. Türkiye ise "iyi" kategorisinde yer almaktadır. Bu değerlendirmeler neticesinde Türkiye, küresel gıda güvenliği endeksinde 113 ülke arasında 49'ncu sırada yer almaktadır. 2012'de 36'ncı sıradayken 2020'de 58'nci sıraya düştüğü, tekrar yükselişe geçerek bugünkü seviyesine geldiği görülmektedir. Artan gıda fiyatlara, kişi başına düşen milli gelirin seviyesinin azalması, nüfus yoğunluğunun fazla olması, Türkiye'nin küresel gıda endeksindeki zayıf yönlerini oluşturmaktadır. Arz yeterliliği, iklimi, su ve doğal kaynakları, beslenme çeşitliliği ise ülkenin güçlü yanlarını göstermektedir.

8.SONUÇ

Bu çalışma kapsamında seçilen kritik öneme sahip tarımsal (gıda) üretim kalemlerinden Türkiye'nin 2019-2023 yılları arasındaki 5 yıllık döneme ait verileri analiz edilmiştir. Çalışmanın sonucunda elde edilen veriler ışığında Türkiye tarım (gıda) üretim kapasitesinin çok yüksek olduğu, ithalata bağımlılığın %10'un çok altında bulunduğu, bu anlamda ithalat bağımlılığının gıda arzı güvenliği açısından risk oluşturmadığı sonuçlarına ulaşılmıştır.

Küresel gıda endeksinde Türkiye'nin yeri 2012-2022 yılları arasındaki 10 yıllık dönem dikkate alınarak analiz edilmiştir. Küresel gıda endeksi açısından 2012 yılından 2020 yılına kadar sürekli olarak sıralama kaybı yaşayan Türkiye'nin son üç aldığı önlemlerle durumunu daha iyi seviyelere taşıdığı sonucuna ulaşılmıştır. Küresel gıda endeksi açısından Türkiye'nin zayıf yönleri olduğu kadar güçlü yönlerinin de bulunduğu nihayetinde, 2022 yılında 113 ülke arasında 49'ncu sırada yer aldığı görülmüştür.

Gıda güvenliğinin ekonomik hesaplanmasında matematiksel bir formül oluşturulmuş, formülün her iki yönüne de devlet yönetiminin müdahale edebileceği anlaşılmıştır. İthalatı kısıtlamak, ihracatı durdurmak, tarımsal üretime teşvik ve destek sağlamak gibi çeşitli gıda arzı güvenliği politikalarının geliştirilmesinin olası olduğu değerlendirilmiştir.

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