3rd International Paris Congress on Agriculture & Animal Husbandry

1-3 JULY 2024

PARIS, FRANCE

PROCEEDINGS BOOK

EDITORS

Assoc. Prof. Dr. Mateo SPAHO

Burak ŞAHİN

ISBN: 978-625-367-766-4

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& ANIMAL HUSBANDRY

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Issued: 17.07.2024

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CONGRESS ID

CONGRESS TITLE

3rd INTERNATIONAL PARIS CONGRESS ON AGRICULTURE & ANIMAL HUSBANDRY

DATE AND PLACE

July 1-3, 2024 / Paris, FRANCE

ORGANIZATION

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ISBN: 978-625-367-766-4

3rd INTERNATIONAL PARIS CONGRESS ON AGRICULTURE AND ANIMAL HUSBANDRY

July 1-3, 2024 / Paris

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REF: Akademik Teşvik

İlgili makama;

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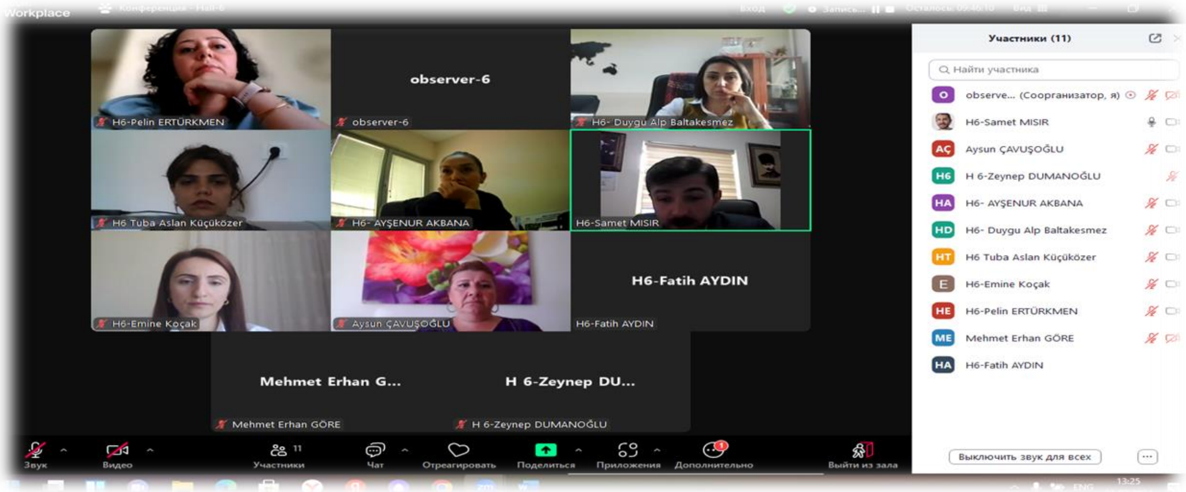

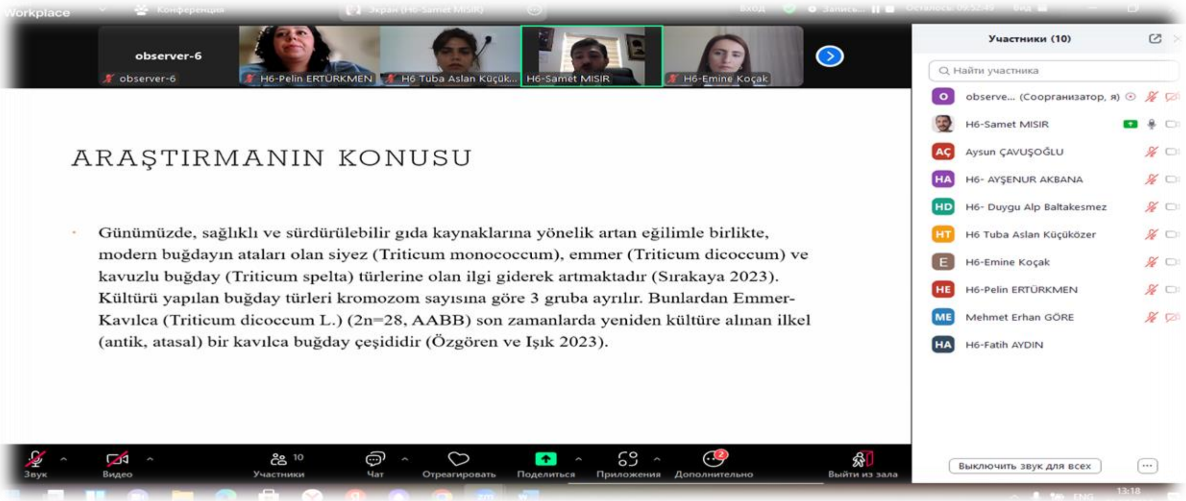

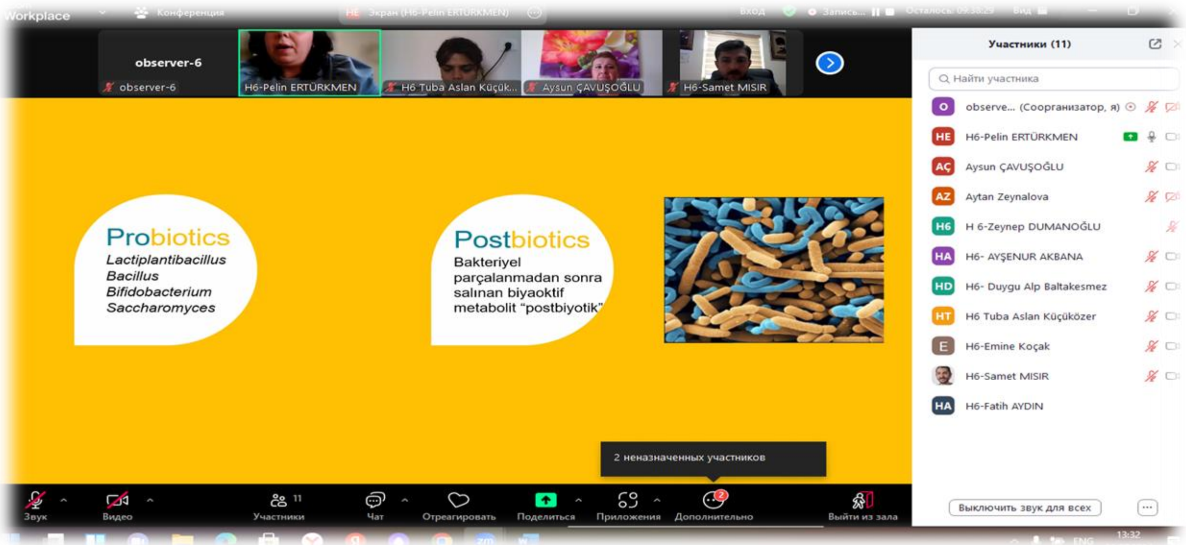

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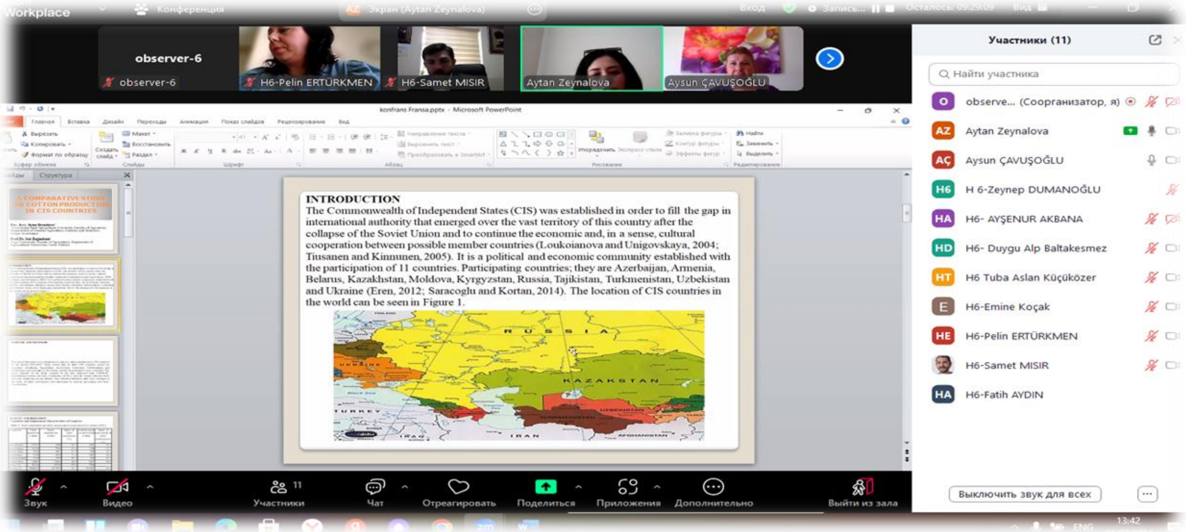

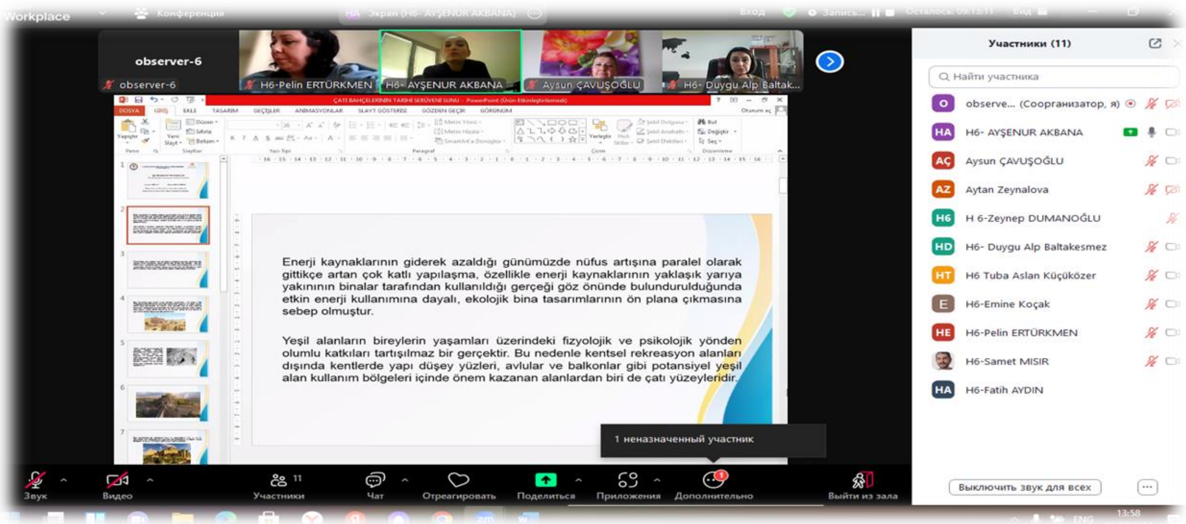

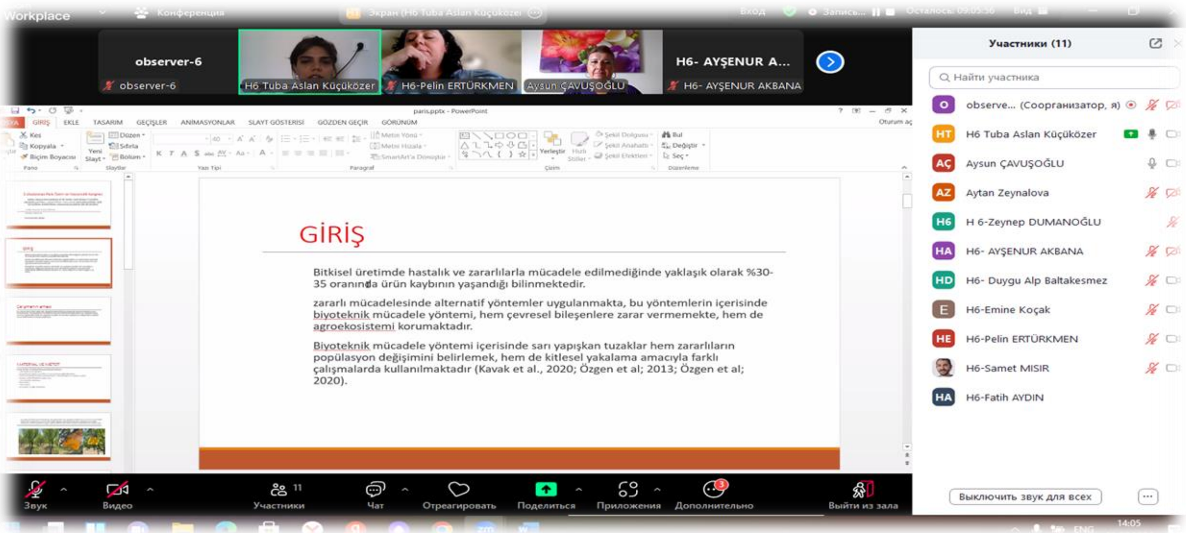

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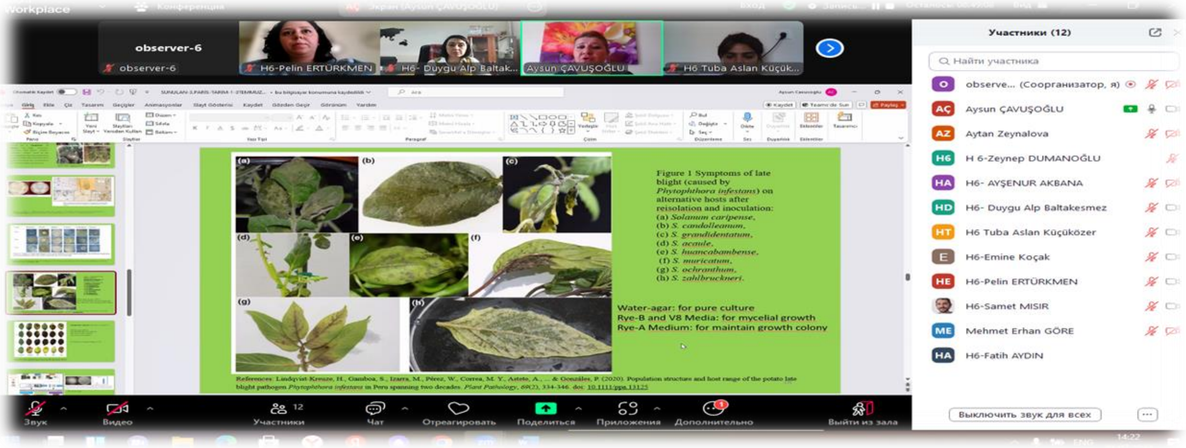

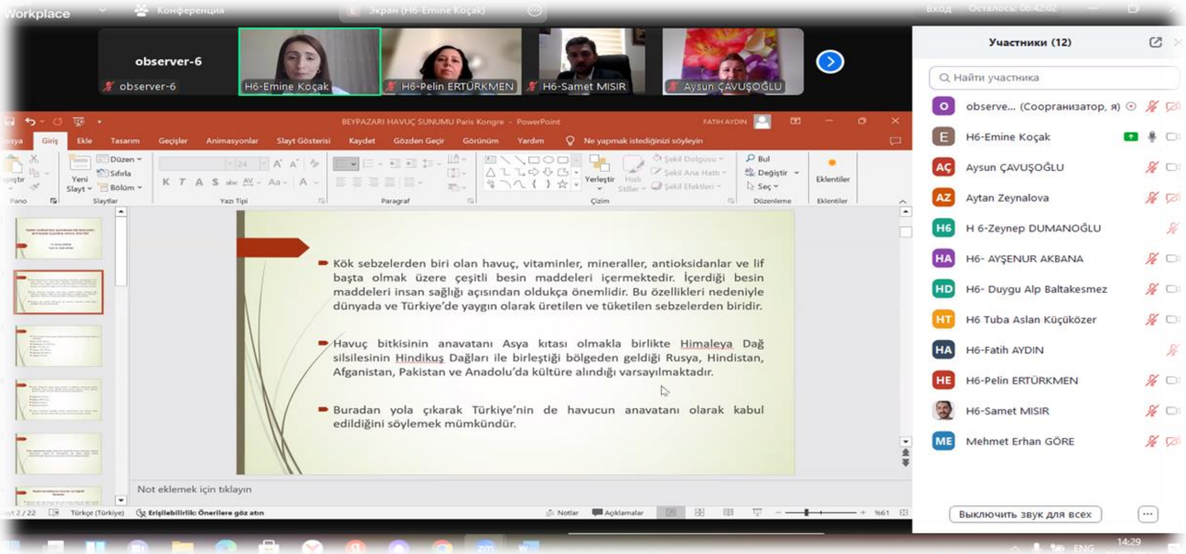

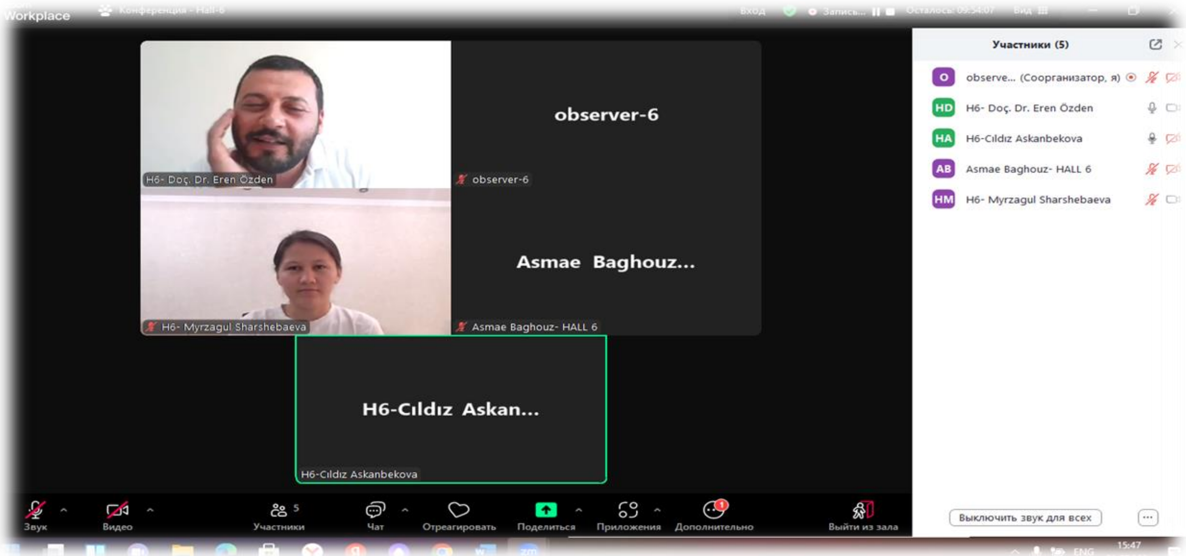

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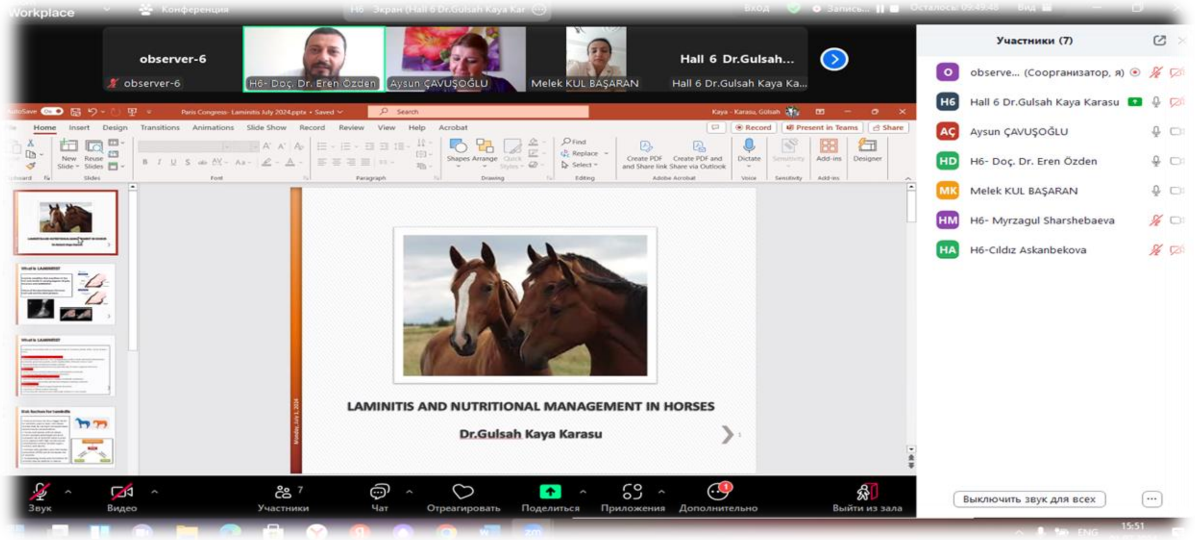

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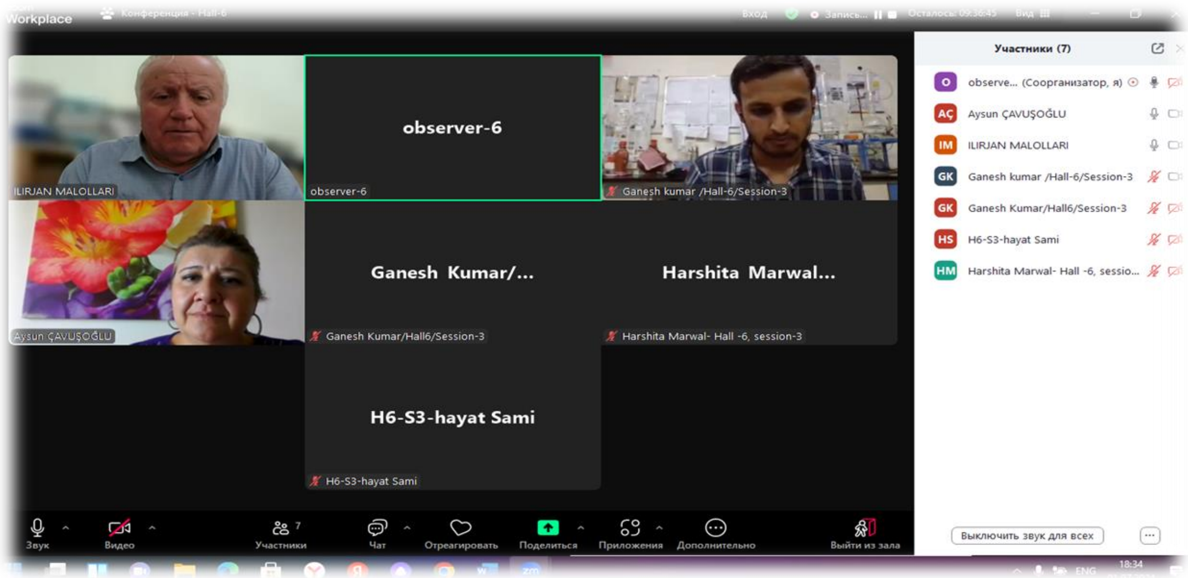

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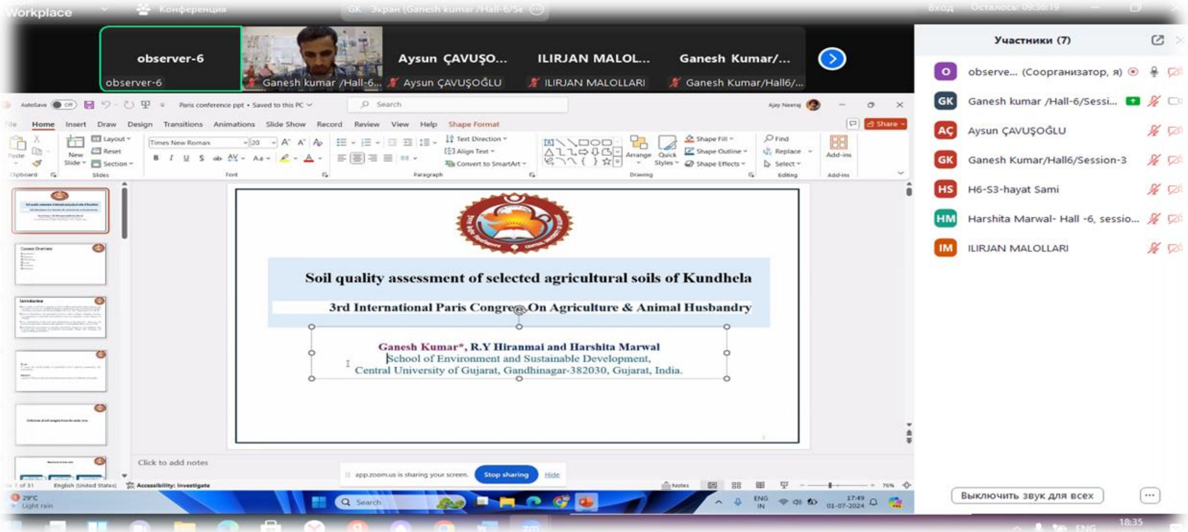

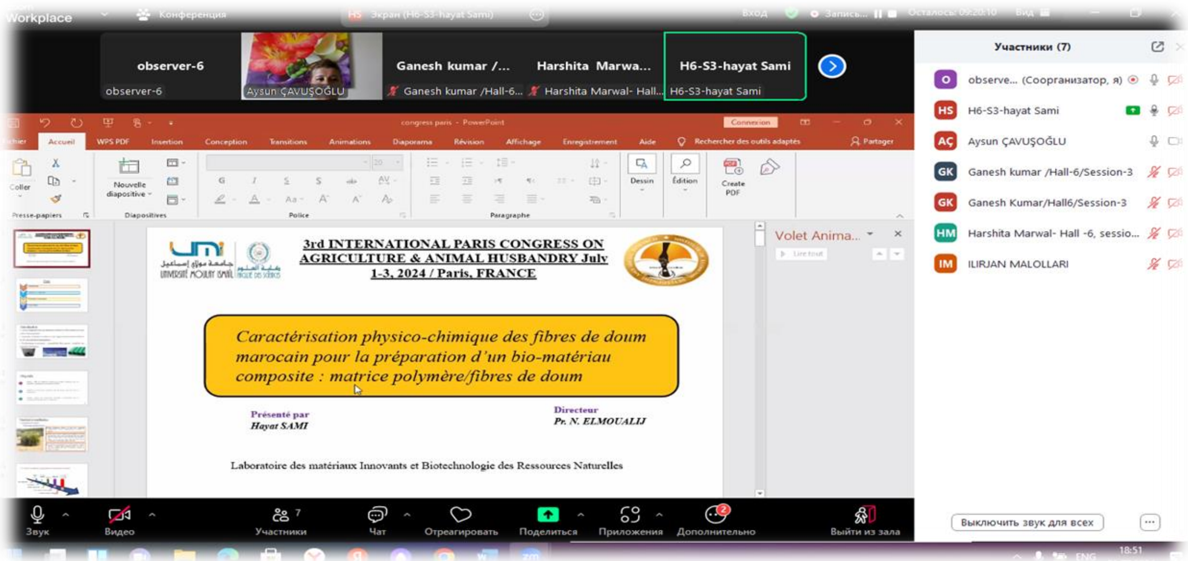

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ONLINE PRESENTATIONS

01.07.2024 / HALL-6 / SESSION-1

PARIS LOCAL TIME	ANKARA LOCAL TIME
09 00 : 11 00	10 00 : 12 00

HEAD OF SESSION: Lect. Dr. Pelin ERTÜRKMEN

Authors	Affiliation	Presentation title
Lect. Samet MISIR **Duygu ALP BALTAKESMEZ**	Ardahan University TÜRKİYE	DETERMINATION OF THE TEXTURAL AND SENSORY PROPERTIES OF THE NOODLES PRODUCED BY USING DIFFERENT RATIOS OF KAVILCA (Triticum dicoccum L.) FLOUR
Lect. Dr. Pelin ERTÜRKMEN	Burdur Mehmet Akif Ersoy University TÜRKİYE	POSTBIOTICS: TRENDS IN NUTRITION AND FOOD TECHNOLOGICAL APPLICATIONS
Aytan Zeynalova **Prof. Dr. Sait ENGİNDENİZ**	Azerbaijan State Agricultural University AZERBAIJAN Ege University TÜRKİYE	A COMPARATIVE STUDY ON COTTON PRODUCTION IN CIS COUNTRIES
Assist. Prof. Dr. Ayşenur AKBANA **Assoc. Prof. Dr. Zeynep DUMANOGLU**	Bingöl University TÜRKİYE	HISTORICAL ADVENTURE OF ROOF GARDENS
Tuba ASLAN KÜÇÜKÖZER **İnanç ÖZGEN**	Fırat University TÜRKİYE	DETERMINATION OF STATISTICAL DIFFERENCES OF DATA SETS OBTAINED IN THE CONTROL OF CACOPSYLLA PYRI L. (HEMIPTERA: PSYLLIDAE) WITH TWO DIFFERENT STICKY YELLOW COLORED TRAPS AT DIFFERENT WAVELENGTHS
Assoc. Prof. Dr. Aysun ÇAVUŞOĞLU **Prof. Dr. Mehmet Erhan GÖRE**	Kocaeli University TÜRKİYE Bolu Abant İzzet Baysal University TÜRKİYE	THE MEDIA USED FOR PHYTOPHTHORA INFESTANS ISOLATION IN SEVERAL STUDIES
Dr. Emine KOÇAK **Prof. Dr. Fatih AYDIN**	Karabük University TÜRKİYE	A STUDY IN TERMS OF AGRICULTURAL GEOGRAPHY: CARROT PRODUCTION IN BEYPAZARI DISTRICT

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ONLINE PRESENTATIONS

01.07.2024 / HALL-6 / SESSION-2

PARIS LOCAL TIME	ANKARA LOCAL TIME
11 30 : 13 30	12 30 : 14 30

HEAD OF SESSION: Assoc. Prof. Dr. Eren ÖZDEN

Authors	Affiliation	Presentation title
Dilbar SATINBEKOVA Melek KUL BAŞARAN Assoc. Prof. Dr. Eren ÖZDEN	Kyrgyz-Turkish Manas University KYRGYZ REPUBLIC Iğdır University TÜRKİYE	EDIBLE PLANTS USED AS VEGETABLES IN KYRGYZSTAN
Mırzagül ŞARŞEBAEVA Assoc. Prof. Dr. Eren ÖZDEN	Kyrgyz-Turkish Manas University KYRGYZ REPUBLIC Iğdır University TÜRKİYE	THE CURRENT STATE OF GREENHOUSE AGRICULTURE IN KYRGYZSTAN
Cıldız ASKANBEKOVA Assoc. Prof. Dr. Eren ÖZDEN	Kyrgyz-Turkish Manas University KYRGYZ REPUBLIC Iğdır University TÜRKİYE	THE CURRENT STATE OF VEGETABLE GROWING IN KYRGYZSTAN
Samir Mehdiyev Shahin	Azerbaijan Academy of Labor and Social Relations AZERBAIJAN	THE ROLE OF MODERN AGRICULTURAL TECHNIQUES IN THE SUSTAINABLE DEVELOPMENT OF AGRICULTURE
Prof. Assoc. Dr. Mateo SPAHO	Barleti University ALBANIA	CLIMATE FINANCE: THE IMPACT OF CLIMATE CHANGE TO BEHAVIORAL FINANCE
Dr. Gulsah KAYA KARASU	Van Hall Larenstein University of Applied Sciences NETHERLANDS	LAMINITIS AND NUTRITIONAL MANAGEMENT IN HORSES
Ayşe BARAN	Mardin Artuklu University TÜRKİYE	SYNTHESIS, CHARACTERIZATION, AND EVALUATION OF ANTIBACTERIAL AND ANTIFUNGAL ACTIVITIES OF BIOLOGICALLY DERIVED SELENIUM NAOPARTICLES FROM GREEN LEAVES OF NIGELLA SATIVA L.

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ONLINE PRESENTATIONS

01.07.2024 / HALL-6 / SESSION-3

PARIS LOCAL TIME

14 00 : 16 00

ANKARA LOCAL TIME

15 00 : 17 00

HEAD OF SESSION: Dr. Sazada Siddiqui

Authors	Affiliation	Presentation title
Ilirjan Malollari Violeta Lajqi (Makolli) Terkida Prifti	Tirana University ALBANIA High Education Institute, UBT KOSOVO	SUSTAINABLE TECHNOLOGIES OF FOOD WASTE PROCESSING FOR ENERGY, ENVIRONMENTAL AND ECONOMIC ASPECTS
Ahmed A. ELKADY Taha NM Mandour AA Lebda, MA Ghareeb, DA Gerish EKH Aref N-EM	Misrata University LIBYA Alexandria University EGYPT The Higher Institute of Agricultural Technology LIBYA Assiut University EGYPT	SERUM PARAOXONASE (PON-1) ACTIVITY AND LIPID PROFILE IN MASTITIC DAIRY COWS
Dr. Sazada Siddiqui	King Khalid University SAUDI ARABIA	GENOTOXICITY ASSESSMENT IN CICER PLANT GROWN ON SOIL POLLUTED WITH HEAVY METALS
Ganesh Kumar R.Y Hiranmai Harshita Marwal	Central University INDIA	SOIL QUALITY ASSESSMENT OF SELECTED AGRICULTURAL SOILS OF KUNDHELA
Harshita Marwal Ganesh Kumar R.Y Hiranmai	Central University INDIA	INVESTIGATING SOIL QUALITY FOR URBAN FARMING IN NARODA, GUJARAT, INDIA
Hayat Sami Oumayma Oulidi Ibtissam Elaaraj Afaf Chakir Mohammed Alami Noureddine El Moualij	Moulay Ismail University MOROCCO	PHYSICO-CHEMICAL CHARACTERIZATION OF MOROCCAN DOUM PLANT FIBERS FOR THE PREPARATION OF A BIO-COMPOSITE MATERIAL: POLYMER MATRIX/DOUM FIBER
Asmae Baghouz Rajae El Brahimi Raja Guemmouh	Sidi Mohamed Ben Abdellah University MOROCCO	USE OF SOME BOTANICAL POWDERS TO PROTECT COWPEA SEEDS AGAINST CALLOSOBRUCHUS MACULATUS PEST DAMAGE
Retem CHAHIRA Fertas DOUNIA AMANI Bairi ABD EL MADJID	Badji Mokhtar University ALGERIA 8 May University ALGERIA Badji Mokhtar University ALGERIA	DETERMINATION OF GSH QUANTITY AND GST ACTIVITY INDUCED BY RESTRAINT STRESS IN WISTAR RATS

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CONTENTS

INVESTIGATING SOIL QUALITY FOR URBAN FARMING IN NARODA, GUJARAT, INDIA

Harshita Marwal

School of Environment and Sustainable Development, Central University of Gujarat
Gandhinagar, India (382030)

Ganesh Kumar

School of Environment and Sustainable Development, Central University of Gujarat
Gandhinagar, India (382030)

R.Y Hiranmai

School of Environment and Sustainable Development, Central University of Gujarat
Gandhinagar, India (382030)

Abstract

Urban farming has emerged as a pivotal strategy in addressing food security, fostering environmental sustainability, and enhancing community resilience within rapidly urbanising areas. In the current era of changing climate and reducing land there is need to explore the possibilities of utilising available soil and space in urban areas. This study presents a comprehensive comparative analysis of soil quality across urban, peri-urban and industrial zones of Naroda, Ahmedabad, with a particular focus on its implication for urban farming. Soil samples were meticulously collected from various sites within each zone and subjected to rigorous analysis, including pH levels, organic matter content, heavy metal concentrations and nutrient levels. The findings highlight the transformation role that urban agriculture can play in revitalising urban spaces, promoting local food production and fostering community engagement. Moreover, the study emphasizes the importance of ongoing soil health monitoring and adoption of sustainable agriculture practices to ensure the long-term viability of urban farming ventures. Integrating urban farming into urban planning frameworks and policy agendas can further support its growth and sustainability, paving the way towards more resilient and self-sufficient urban communities in Naroda, Ahmedabad.

Keywords: Soil quality, Urban farming, Sustainable development.

SUSTAINABLE TECHNOLOGIES OF FOOD WASTE PROCESSING FOR ENERGY, ENVIRONMENTAL AND ECONOMIC ASPECTS

Ilirjan Malollari

Chemical Process Engineering Group, Faculty of Natural Science, University of Tirana, Albania

Violeta Lajqi (Makolli)

High Education Institute, UBT, Prishtina, Kosove

Terkida Prifti

Chemical Process Engineering Group, Faculty of Natural Science, University of Tirana, Albania

Abstract

Food waste is a significant global environmental and economic concern, with substantial amounts generated daily. The efficient conversion of food waste into energy can mitigate these issues. This paper presents a comprehensive review of sustainable technologies for food waste processing, focusing on both environmental and economic aspects.

We have considered and examined various methods, including anaerobic digestion, gasification, and pyrolysis, highlighting their advantages and limitations. The environmental benefits of these technologies, such as reduced greenhouse gas emissions and landfill waste, are discussed alongside their economic viability. However, the real game-changer is the potential for policy and regulatory frameworks to support the adoption of these technologies. This research provides valuable insights for policymakers, industry stakeholders, and researchers seeking sustainable solutions for food waste management and energy production, potentially reshaping how we approach these issues.

In Albania, various types of food waste are being converted into energy. Here are some examples: Olive Oil Waste: Albanian farmers are transforming olive oil waste into energy through a project that aims to bring the latest technology for organic waste-to-energy conversion to 15 farms across the country. Biomass Energy: Albania has significant biomass resources, including forest waste and agricultural residues.

These biomass sources are being used to produce energy through various methods, such as direct combustion, anaerobic digestion, and gasification. Food Waste from Agriculture: Agricultural by-products and processed residues are also used to generate energy. For example, energy crops like grasses and short-rotation trees are used for biofuels, and agricultural residues are converted into biogas.

These examples demonstrate Albania's diverse range of food waste being converted into energy, contributing to a more sustainable waste management system and reducing the country's reliance on fossil fuels.

Keywords: food waste, energy production, sustainable technologies, environmental protection

INTRODUCTION

The sustainable technologies for converting food waste into energy have significant economic benefits. These technologies can help reduce waste disposal costs and generate revenue by selling biofuels. Here are some key points highlighting the financial viability of these technologies: Cost Savings: Food waste conversion to energy can significantly reduce waste disposal costs by diverting organic waste from landfills and incinerators. This approach reduces the need for traditional waste management methods, which are often expensive and environmentally harmful [1-5].

Revenue Generation: Anaerobic digestion facilities can generate income by selling biofuels from food waste. This revenue stream can help offset the costs of implementing these technologies, making them more economically viable [6-7].

Reduced Energy Costs: By producing energy from food waste, businesses can reduce their reliance on traditional energy sources, leading to lower energy costs. This can be particularly beneficial for industries with high energy consumption, such as food processing and manufacturing [8-10].

Job Creation and Local Economic Growth: Implementing food waste-to-energy systems can create new job opportunities in the waste management and energy sectors, contributing to local economic growth and development [11].

Government Incentives and Policies: Governments can support adopting these technologies through policies and incentives, such as tax credits, grants, or subsidies for businesses that invest in food waste-to-energy infrastructure 12-14]. These incentives can offset the initial implementation costs and make the technology more economically viable [15]. The search results do not provide a complete breakdown of food industry waste destinations in Albania for the year 2024 specifically. However, some relevant information can be inferred:

- *58.1%* of municipal waste produced in Albania in 2022 was organic waste, which likely includes a significant portion of food waste.
- Albania is working to implement a circular economy and reduce food waste through measures like food donations to help achieve food waste reduction in the food industry.
- *Around 89%* of the Albanian population was served by waste collection services in 2022, mainly in urban areas, well short of the EU average of 98%.
- *10-18.5%* of municipal waste is estimated to be collected for recycling in Albania, mainly by the informal sector.
- Albania is building two new incinerators with high processing capacities through public-private partnerships:
    - The Fier incinerator will have a capacity of around 180-200 tonnes per day.
    - The Tirana incinerator will have a capacity of around 550-800 tonnes per day.
- The already operational Elbasan incinerator has a processing capacity of around 120-140 tonnes per day.

So, while precise 2024 data is not available, it appears that in 2022, the majority of food industry waste in Albania likely ended up in landfills or was mismanaged, with only 10-18.5% collected for recycling. Going forward, Albania is working to reduce food waste through donations and increase incineration capacity, but more data would be needed to quantify the exact 2024 destinations 16-18].

In Albania, there are following figures showing the proporcions of wastes destinations : *Food Waste to Energy: Driving Sustainability and Renewable Power - HomeBiogas. https://www.homebiogas.com/blog/food-waste-to-energy/).*

Technologies that Turn Food Waste into Energy [19-21].

- *Food waste fermentation* for producing energy-rich biofuels like bioethanol and biopolymers for various applications
- *Waste-to-liquid conversion* for turning food waste into biofuels that can replace conventional natural gas
- *Thermal conversion***.** It includes pyrolysis and gasification, through which food waste becomes syngas and biochar.

MATERIALS AND METHODS

Anaerobic Digestion: A Sustainable Waste-to-Energy Solution

Bioconversion of food waste to energy uses renewable resources and solves two major issues: it keeps organic waste from decomposing in landfills and generating methane gas; it uses renewable energy to lower the demand for fossil fuels. It addresses a symptom and fixes the root cause of methane emissions. The technologies involved are continuously upgraded to minimize consumption and maximize energy recovery.

Home Biogas systems offer a sustainable solution to the pressing issues of food waste right where it's the easiest to control: at the source.

The results are significant: a lower carbon footprint, fewer greenhouse gas emissions, less money spent on energy bills, and a self-sufficient and sustainable lifestyle. The journey towards a more sustainable future can start right in our kitchen. Something as simple as separating our trash can support waste-to-energy initiatives to create electricity from renewable resources. Innovative solutions can help convert food waste to energy at home. We can compost or generate heat from biogas for a self-sufficient, sustainable lifestyle. It's a small change with a significant potential impact [21].

RESULTS OF SEARCH

Here is successful case studies in food waste processing for energy in Albania:

BioteCH4's Food Waste Management Campaigns: BioteCH4 has worked on several successful food waste management campaigns in Albania, including projects that convert food waste into energy through anaerobic digestion. This project focused on reducing organics in the waste system, reducing costs, and meeting clinical guidelines. The program involved solid interpersonal relationships, staff involvement, and collaboration with a commercial operator and a food rescue organization. The results included recycling food waste, creating livestock feed for farmers, and preventing CO2 emissions. This case study demonstrates the positive impact of food waste processing for energy on waste reduction, cost savings, and environmental sustainability.

Albania faces several specific challenges in implementing waste-to-fuel technology:

Downturn Economy: The country's economy has been experiencing a downturn, making it difficult to develop reliable and profitable hydrocarbon-bearing zones. This affects the implementation of waste-to-fuel technology, which relies on a stable economic environment.

Environmental Challenges: Albania has significant environmental challenges, including waste management, water and air pollution, land degradation, and biodiversity loss. These issues hinder the effective implementation of waste-to-fuel technology.

Infrastructure and Logistics: The country's infrastructure and logistics are not well-suited for efficient waste collection, transportation, and processing. This creates significant barriers to implementing waste-to-fuel technology [21].

Public Awareness and Education: There is a need for increased public awareness and education about the importance of waste management and the benefits of waste-to-fuel technology. This can help raise support for the implementation of such projects.

Policy and Regulatory Framework: Albania lacks a comprehensive policy and regulatory framework to support the development and implementation of waste-to-fuel technology. This creates uncertainty and hinders investment in the sector.

Technical and Financial Constraints: Implementing waste-to-fuel technology requires significant technical and financial resources. Albania's limited budget and lack of expertise in the field can make it difficult to overcome these challenges.

Integration with Existing Infrastructure: Waste-to-fuel technology must be integrated with existing infrastructure, such as power plants and transportation networks. This process can be complex and costly, especially in a country with limited resources [21].

These challenges highlight the need for a comprehensive approach to addressing Albania's economic, environmental, and social aspects of waste management. The fact that there are ongoing projects in Albania focused on converting food waste into energy is to be mentioned. Here are some examples:

Waste-to-Energy Plants: Albania is investing in constructing three waste-to-energy plants with a total capacity of 1,300 tons per day. Two plants have been constructed, and one is currently in operation. These plants aim to shift the quantities of municipal solid waste from landfilling to energy recovery, reducing greenhouse gas emissions. Data-Driven Strategies for Optimizing Renewable Energy: The country focuses on waste reduction, recycling, and promoting renewable energy sources to achieve Sustainable Development. This includes optimizing renewable energy utilization from urban waste through data-driven strategies. Municipal Waste Management: Albania has started the development of new waste management practices, including converting waste to energy. These projects demonstrate Albania's commitment to reducing waste and increasing the use of renewable energy sources, including waste-to-energy conversion [15-21].

DISCUSSIONS

The environmental impacts of disposing of food industry waste in Albania are significant and multifaceted, primarily due to current waste management practices and the composition of waste generated. Here are the key impacts:

Greenhouse Gas Emissions

- *Methane Generation*: Approximately **50%** of disposed waste in Albania is organic, which includes food waste. When organic waste decomposes anaerobically in landfills, it generates methane, a potent greenhouse gas that contributes to climate change. This process significantly increases the carbon footprint associated with waste disposal in the country.

Soil and Water Pollution

- *Landfill Leachate*: The disposal of food waste in landfills can lead to leachate, a toxic liquid that can contaminate soil and groundwater. This poses risks to agricultural productivity and drinking water supplies, endangering both human health and the environment.

Resource Wastage

- *Inefficient Resource Use:* Food waste represents a loss of resources, including water, energy, and labor, that were used in food production, processing, and distribution. This inefficiency exacerbates resource scarcity and environmental degradation, particularly in a country where agricultural practices are already under pressure from climate change and urbanization.

Biodiversity Loss

- *Deforestation and Habitat Destruction:* The environmental impact of food waste also extends to biodiversity. The need for agricultural expansion to compensate for food waste can lead to deforestation, loss of habitats, and increased soil erosion. This is particularly concerning as Albania's natural landscapes are already vulnerable.

Economic Implications

- *Economic Costs*: The mismanagement of food waste not only has environmental repercussions but also economic ones. The costs associated with waste disposal and the lost economic value of wasted food can strain local economies and contribute to food insecurity.

Current Initiatives

Albania is making efforts to modernize its waste management systems, aiming to align with EU standards. Initiatives include promoting recycling and composting, raising public awareness about waste reduction, and implementing a circular economy approach to minimize waste generation. However, the effectiveness of these measures in mitigating environmental impacts remains to be fully realized. In summary, the disposal of food industry waste in Albania has profound environmental impacts, including greenhouse gas emissions, pollution of soil and water, resource wastage, and threats to biodiversity. Addressing these issues is crucial for sustainable development and environmental protection in the country.

Albania's waste-to-energy plants have several benefits:

- *Reduced Greenhouse Gas Emissions*: The plants will shift municipal solid waste from landfilling to energy recovery, reducing greenhouse gas emissions. This aligns with Albania's Nationally Determined Contribution (NDC) to mitigate climate change.
- *Increased Energy Production*: The waste-to-energy plants will generate energy from waste, reducing the country's reliance on traditional energy sources and increasing its overall energy production capacity.
- *Improved Waste Management*: By converting waste into energy, the plants will help reduce waste sent to landfills, a significant contributor to methane emissions in Albania. This will also improve the country's overall waste management system.
- *Economic Benefits*: The plants will create jobs and stimulate local economies by generating revenue from the sale of energy produced from waste.
- *Enhanced Sustainability*: Albania's waste-to-energy plants will contribute to a more sustainable waste management system, aligning with the country's goals for a circular economy and reducing its environmental impact.

These benefits highlight the importance of implementing waste-to-energy technologies in Albania, which can help the country achieve its environmental and economic goals.

In Albania, various types of food waste are being converted into energy. Here are some examples:

- *Olive Oil Waste*: A pioneering project in Albania is harnessing the potential of olive oil waste, transforming it into energy. This initiative, set to introduce cutting-edge technology for organic waste-to-energy conversion to 15 farms nationwide, promises significant environmental and economic benefits.
- *Urban Waste*: Albania's dedication to sustainable energy and waste management is evident in its investment in three large-scale waste-to-energy plants. With a combined capacity of 1,300 tons per day, these plants will be crucial in converting urban waste into energy, thereby reducing greenhouse gas emissions and enhancing waste management practices.
- *Biomass Energy*: Albania's significant biomass resources, including forest waste and agricultural residues, are being harnessed for energy production. These resources are utilized through various methods, such as direct combustion, anaerobic digestion, and gasification, demonstrating the diversity and potential of biomass energy.
- *Food Waste from Agriculture*: Agricultural by-products and processed residues are also used to generate energy. For example, energy crops like grasses and short-rotation trees are used for biofuels, and agricultural residues are converted into biogas.

These examples demonstrate Albania's diverse range of food waste being converted into energy, contributing to a more sustainable waste management system and reducing the country's reliance on fossil fuels. Albania's biomass energy production significantly impacts reducing its carbon footprint. Here are some key points: Renewable Energy Source: Biomass energy is a renewable energy source, which means it does not contribute to the increase of $CO2$ in the atmosphere like fossil fuels do. This reduces Albania's carbon footprint by providing an alternative energy source that is more environmentally friendly. Carbon Emissions Reduction: Biomass energy production helps reduce carbon emissions by replacing traditional energy sources. For example, using biomass for heating and electricity generation reduces the need for fossil fuels, which significantly contribute to greenhouse gas emissions. Energy Independence: Albania's biomass energy production also contributes to energy independence by reducing reliance on imported fuels. This reduces the country's carbon footprint by minimizing the transportation-related emissions associated with importing energy sources. Sustainable Forestry Practices: Albania's biomass energy production is linked to sustainable forestry practices. These practices ensure that forests are managed to maintain their ecological integrity while providing a sustainable source of energy. This approach helps reduce the carbon footprint by preserving forests, which are significant carbon sinks. Waste Management: Biomass energy production also helps manage waste effectively. For example, using agricultural residues and urban waste for energy production reduces the waste sent to landfills, significantly contributing to methane emissions. Energy Efficiency: Albania's biomass energy production also focuses on improving energy efficiency. This includes using modern heating systems and promoting highly efficient radiators for local systems. This approach helps reduce energy losses and minimize the carbon footprint. Overall, Albania's biomass energy production plays a crucial role in reducing the country's carbon footprint by providing a renewable energy source, reducing carbon emissions, promoting energy independence, supporting sustainable forestry practices, managing waste effectively, and improving energy efficiency.

CONCLUSIONS

Based on the provided search results, here are some conclusions and recommendations for the Albanian case study on sustainable technologies of food waste processing for energy, focusing on environmental and economic aspects:

- *Significant Potential for Biomass Utilization:* Albania has considerable biomass resources, including agricultural residues, forest waste, and urban organic waste, which can be effectively converted into energy through various technologies such as anaerobic digestion and gasification. This presents a viable opportunity for energy production and waste management.
- *Alignment with EU Directives*: Albania's efforts to improve waste management practices increasingly align with EU directives, which is crucial for the country's aspirations for EU membership. This alignment can facilitate access to funding and technical assistance for implementing sustainable waste-to-energy technologies.
- *Environmental Benefits:* The conversion of food waste into energy can significantly reduce greenhouse gas emissions and improve waste management practices. By diverting organic waste from landfills, Albania can mitigate methane emissions and enhance its environmental sustainability.
- *Economic Opportunities*: Implementing waste-to-energy technologies can create jobs, stimulate local economies, and reduce waste disposal costs. Additionally, producing energy from waste can contribute to energy independence and reduce reliance on imported fossil fuels.
- *Challenges in Implementation*: Despite the potential benefits, Albania faces challenges such as inadequate waste segregation, low recycling rates, and limited public awareness regarding waste management practices. Addressing these challenges is essential for the successful implementation of waste-to-energy technologies.

Recommendations

Enhance Public Awareness and Education: Implement campaigns to raise public awareness about the importance of waste segregation and the benefits of converting food waste into energy. Engaging communities can foster support for sustainable practices.

Develop a Comprehensive Policy Framework: Establish a cohesive policy and regulatory framework supporting the development and implementation of waste-to-energy technologies. This should include incentives for businesses and investments in infrastructure.

Invest in Infrastructure Development: Improve waste management infrastructure, including collection, sorting, and processing facilities, to facilitate the efficient conversion of food waste into energy. This infrastructure should be designed to handle increasing waste volumes and promote recycling.

Promote Research and Innovation: Encourage research and innovation in waste-to-energy technologies tailored to Albania's specific conditions. Collaborations with academic institutions and industry stakeholders can lead to the development of practical solutions.

Leverage International Support: Seek technical and financial assistance from international organizations and EU funding programs to support the implementation of sustainable waste management practices and technologies.

Monitor and Evaluate Progress: Establish a monitoring framework to assess the effectiveness of waste-to-energy initiatives and adjust strategies as needed. This will ensure continuous improvement and alignment with environmental and economic goals.

By addressing these conclusions and implementing the recommended strategies, Albania can sustainably enhance its capacity to process food waste, contributing to environmental protection and economic development.

REFERENCES

1. Digitemie, W. N., & Ekemezie, I. O. (2024). A review of sustainable project management practices in modern LNG industry initiatives. World Journal of Advanced Engineering Technology and Sciences. https://doi.org/10.30574/wjaets.2024.11.2.0075
2. Food Waste to Energy: Implementation, Benefits & Technologies; Food Solutions, https://shapiroe.com/blog/food-waste-to-energy/, December 26, 2023
3. Ismail, A. H., Kusbiantoro, A., Tajunnisa, Y., Ekaputrc, J. J., & Laory, I. (2024). A review of aluminosilicate sources from inorganic waste for geopolymer production: Sustainable approach for hydrocarbon waste disposal. Cleaner Materials. https://doi.org/10.1016/j.clema.2024.100259
4. Institute of Food Technologists. (2023). Food Science and Technology Solutions to Improve Food and Nutrition Security: Sustainable Production of Nutritious Foods Through Processing Technology. [Online]. Available at: https://www.ift.org/-/media/policy-advocacy/files/ift_spi_white-paper_processed-foods_1023.pdf
5. Lyon, S. (2023). The world has a food-waste problem. Can this wireless tech help fix it? [Online]. Princeton University. Available at: https://www.princeton.edu/news/2023/10/06/world-has-food-waste-problem-can-wireless-tech-help-fix-it?fbclid=IwAR3pjESR2_iQnSd4jcJL0nN6YSPjHXyqm28LtoyWSvVdxXI4iDQXMjxWBUU
6. Trace Genomics. (2023). Performance, Optimized. [Online] Available at: https://tracegenomics.com/solutions/agronomy-solutions/diagnostics/
7. AeroFrams. (2023). Cutting-Edge Vertical Farming Technology Platform. [Online]. Available at: https://www.aerofarms.com/how-we-grow/
8. Insignia Technologies. (2023). About Us. [Online]. Available at: https://www.insigniatechnologies.com/about
9. Escher, A., Megahd, H., Tavella, C., Comoretto, D., & Lova, P. (2023). Colourimetric polymer sensors for smart packaging. Macromolecular Chemistry and Physics, 224(14), 2300022. https://doi.org/10.1002/macp.202300022
10. Fooddrop. (2023). Ending hunger, one community at a time. [Online]. Available at: https://www.fooddrop.co.uk/
11. Recent Sustainable Food Technology Advancements – AzoCleantech, https://www.azocleantech.com/article.aspx?ArticleID=1802
12. As the world's population grows and climate change threatens food production, the development of sustainable food technologies has become increasingly important.
13. Technology Turning Food Waste into Renewable Energy: https://www.powermag.com/technology-turning-food-waste-into-renewable-energy/, April 2024
14. Emily Corkil, Food Waste to Energy: Driving Sustainability and Renewable Power, https://www.homebiogas.com/blog/food-waste-to-energy/
15. Besmir Buranaj Hoxha, Dael Dervishi, Kyle Sweeney. Waste-to-Fuel Technology in Albania——How to Implement a Renewable Energy System in Europe's Largest Onshore Oilfield. Journal of Earth Science, 2019, 30(6): 1311-1325
16. Waste-to-Fuel Technology in Albania——How to Implement a Renewable Energy System in Europe's Largest Onshore Oilfield, DOI: 10.1007/s12583-017-0782-0

17. Dirty deals: Case studies on corruption in waste management and trade, https://baselgovernance.org/sites/default/files/2023-11/231130_WP-49.pdf
18. The Effective Management of Organic Waste Policy in Albania, Energies 2020, 13(16), 4217; https://doi.org/10.3390/en13164217
19. Oncioiu I, Căpuşneanu S, Topor DI, Petrescu M, Petrescu A-G, Toader MI. The Effective Management of Organic Waste Policy in Albania. Energies. 2020; 13(16):4217. https://doi.org/10.3390/en13164217
20. (2021). Material and Energy Recovery from the Final Disposal of Organic Waste. Energies, 14(24), 8459.
21. Vito S, Boci I, Gheibi M, Dhoska K, Malollari I, Shehu E, Moezzi R, Annuk A. Data-Driven Strategies for Optimizing Albania's Utilization of Renewable Energy Sources from Urban Waste: Current Status and Future Prospects. World. 2024; 5(2):258-275. https://doi.org/10.3390/world5020014

PHYSICO-CHEMICAL CHARACTERIZATION OF MOROCCAN DOUM PLANT FIBERS FOR THE PREPARATION OF A BIO-COMPOSITE MATERIAL: POLYMER MATRIX/DOUM FIBER

Hayat Sami

Laboratory of Innovative Materials and Biotechnology of Natural Resources, UMI.FSM. Moulay Ismail University, Faculty of Sciences, Meknes, Kingdom of Morocco

Plastics Laboratory, National School of Arts and Crafts, Moulay Ismail University, Kingdom of Morocco

Oumayma Oulidi

Laboratory of Innovative Materials and Biotechnology of Natural Resources, UMI.FSM. Moulay Ismail University, Faculty of Sciences, Meknes, Kingdom of Morocco

Ibtissam Elaaraj

Laboratory of Innovative Materials and Biotechnology of Natural Resources, UMI.FSM. Moulay Ismail University, Faculty of Sciences, Meknes, Kingdom of Morocco

Afaf Chakir

Plastics Laboratory, National School of Arts and Crafts, Moulay Ismail University, Kingdom of Morocco

Mohammed Alami

Plastics Laboratory, National School of Arts and Crafts, Moulay Ismail University, Kingdom of Morocco

Noureddine El Moualij

Laboratory of Innovative Materials and Biotechnology of Natural Resources, UMI.FSM. Moulay Ismail University, Faculty of Sciences, Meknes, Kingdom of Morocco

Abstract

Nowadays, most advanced technologies use materials derived from natural resources, including bio-composites with a polymer matrix. These materials are being developed daily to replace other materials in applications such as construction, aerospace, automotive, and medical fields.

These materials are reinforced with natural fibers known for their low weight, low cost, and highly advanced mechanical properties. This type of material is of great interest to researchers in developing solutions that are more suitable and environmentally tolerated.

This work focuses on the development and characterization of new composite materials based on natural fibers. The study involves the using of doum fiber (*Chamaerops humilis* L.) in a polymer matrix (PPR). So, two types of bio-composites were manufactured: combinations with untreated fibers and fibers treated with sodium hydroxide (NaOH). The physicochemical properties were determined using Fourier-transform infrared spectroscopy (FTIR), and the chemical composition of the fiber was evaluated using the Van Soest method.

Keywords: Doum, bio-composite, cellulose, hemicellulose, lignin.

SERUM PARAOXONASE (PON-1) ACTIVITY AND LIPID PROFILE IN MASTITIC DAIRY COWS

Ahmed A. ELKADY

Faculty of Veterinary Medicine/ Misrata University- Misrata, Libya.

Taha NM

Department of Biochemistry, Faculty of Veterinary Medicine, Alexandria University, Alexandria, Egypt

Mandour AA

Department of Biochemistry, Faculty of Veterinary Medicine, Alexandria University, Alexandria, Egypt

Lebda, MA

Department of Biochemistry, Faculty of Veterinary Medicine, Alexandria University, Alexandria, Egypt

Ghareeb, DA

Department of Biochemistry, Faculty of Sciences, Alexandria University, Alexandria, Egypt

Gerish EKH

Department of Veterinary Medical Sciences, The Higher Institute of Agricultural Technology/Al-Gheran- Tripoli, Libya.

Aref N-EM

Department of Animal Medicine, Faculty of Veterinary Medicine, Assiut University, Assiut, Egypt

Abstract

Introduction and Purpose: Paraoxonase enzyme-1 (PON-1) is an estrase enzyme leading to reduction in oxidative stress in serum lipoproteins. PON-1 synthesis in the liver and secreted in the blood where associated with HDL-c. PON-1 protect both HDL-c and LDL-c against lipid perioxidation and prevention of atherosclerosis. The objective of the present study was to investigate paraoxonase-1, arylestrase (ARE) and glutathione perioxidase (GPX) activities and malondialdyhide (MDA) level in mastitic dairy cattle.

Materials and Methods: This study was carried out on a total number of 28 Friesian- Holstein cows divided in two groups as: Group 1: consist of 14 normal cows (control). Group 2: consist of 14 mastitic dairy cows. These animals were under same conditions in the feeding, lactating stage and environmental circumstances. Blood samples were collected for biochemical determinations.

Results: Our findings demonstrate that in oxidative stress subjects there were a high significant decrease of the activity of PON-1, Arylestrase and Glutathione Peroxidase (GPX) (93.46±4.93 U/L,5.59±0.32U/L and 5.43±0.47mU /mL), respectively. While the concentration of MDA was significantly increased in oxidative stress subjects (15.17±1.15 nmol/ml) as compared to normal subjects (6.64±0.43) at (*P*≤0.01).

Discussion and Conclusion: Serum paraoxonase-1 protect against lipid perioxidation. Significant reduction of the activity of PON-1 could be used as an indicator for early diagnosis of oxidative stress in lactating cattle.

Keywords: Paraoxonase (PON-1); Lipid Parameters; Oxidative Stress; Cow; Friesian Cattle

DETERMINATION OF GSH QUANTITY AND GST ACTIVITY INDUCED BY RESTRAINT STRESS IN WISTAR RATS

Retem Chahira

Laboratory of Applied NeuroEndocrinology, Department of Biology, Faculty of Sciences, Badji Mokhtar University, ANNABA, ALGERIA

Fertas Dounia Amani

Department of Biology, Faculty of Life and Natural Sciences, University May 8, 1945, Guelma, ALGERIA

Bairi Abd El Madjid

Laboratory of Applied NeuroEndocrinology, Department of Biology, Faculty of Sciences, Badji Mokhtar University, ANNABA, ALGERIA

Abstract

Psychological stress is a mechanism by which our body and brain react to things that we consider outside of our capabilities, and if this stress persists, over time it causes the emergence of neurobehavioral disorders. In laboratory rodents, the stress induced by the restraint of the animal is inspired, like all fear, by the fear of not being able to escape a tetanizing signal, thus putting the organism in a state of increased anxiety.

The objective of this work is to study the oxidative stress of rats following restraint stress by determining the quantity of glutathione GSH and the activity of glutathione S-transferase GST. Consequently, our work focused on a population of 12 rats divided into 2 batches of 6 rats in each batch: the control batch (T) and the stressed batch (S) (was subjected to restraint stress). After having identified the rats by a mark on the tail of each, they are subjected to two pressure sessions of 30 minutes over 1/2 day; in the morning at 9 a.m. and in the afternoon at 2 p.m., within a period of 10 days. At the end of the experimental period, the animals were sacrificed and the following organs were removed and then weighed using a precision balance, the organs of the stress axis: brain and liver.

Then we carried out a laboratory analysis of GSH and GST at the level of these samples, the results obtained were compared to those of the control batch, a clear disturbance of these two parameters was highlighted in the rats subjected to the stress of contention in the form of an increase in GST and a decrease in GSH. The results confirm the negative and harmful effect on the stressed body, and therefore health and psychological ethics must be respected for a healthy body.

Key words: restraint stress, rat, GSH, GST.

CLINICAL AND BIOLOGICAL ASPECT OF SODIUM VALPROATE (DEPAKINE) IN PATIENTS WITH EPILEPSY (POLYCLINIQUE MAY 8, 1945)

Retem Chahira

Laboratory of Applied NeuroEndocrinology, Department of Biology, Faculty of Sciences, Badji Mokhtar University, ANNABA, ALGERIA

Fertas Dounia Amani

Department of Biology, Faculty of Life and Natural Sciences, University May 8, 1945, Guelma, ALGERIA

Bairi Abd El Madjid

Laboratory of Applied NeuroEndocrinology, Department of Biology, Faculty of Sciences, Badji Mokhtar University, ANNABA, ALGERIA

Abstract

Epilepsy is a chronic, serious and complex neurological disease characterized by a predisposition to generate seizures and by the cognitive, behavioral and social consequences, sodium valproate is the most effective which treats all forms of seizures thanks to their robust mechanism.

The objective of this work is to study the effect of valproate in patients with epilepsy and to understand the different mechanisms of action of this molecule. In this study, it was decided to evaluate epilepsy in 50 patients suffering from epilepsy who use Dépakine as a monotherapy treatment who were referred to the polyclinic on May 8, 1945.

We observed that the most affected age between [40 and 49] years, and a disturbance in the statistics of sex, symptoms and other elements.

According to our results, there are many harmful effects of VPA such as hepatotoxicity and memory impairment.

Key words: epilepsy, sodium valproate, Dépakine, monotherapy, patients.

DETERMINATION OF STATISTICAL DIFFERENCES OF DATA SETS OBTAINED IN THE CONTROL OF *CACOPSYLLA PYRI* L. (HEMIPTERA: PSYLLIDAE) WITH TWO DIFFERENT STICKY YELLOW COLORED TRAPS AT DIFFERENT WAVELENGTHS

FARKLI DALGA BOYLARINDA Kİ İKİ FARKLI SARI RENKLİ YAPIŞKAN TUZAĞIN *CACOPSYLLA PYRI L*. (HEMIPTERA: PSYLLIDAE) MÜCADELESİNDE ELDE EDİLEN VERİ SETLERİNİN İSTATİSTİKSEL FARKINDALIKLARININ BELİRLENMESİ

Tuba ASLAN KÜÇÜKÖZER

Firat University, Faculty of Engineer, Department of Bioengineer, Elazığ, Turkey.

İnanç ÖZGEN

Firat University, Faculty of Engineer, Department of Bioengineer, Elazığ, Turkey.

Abstract

Cacopsylla pyri (Hemiptera: Psyllidae) is an important pear pest. In addition to chemical control, biotechnical control studies are important in the control of the pest. The mass hanging of yellow colored traps and revealing how and to what extent these traps affect the populations of the pest and its natural enemies with ecological parameters are of value within the scope of Integrated Pest Management. This study was carried out to statistically determine the population change of the pest with two different yellow sticky traps (traditional yellow sticky trap, no. 1023) against *Cacopsylla pyri* pests in pest-infested pear orchards in Merkez/Örençay village of Elazığ province in 2022-2023. For this purpose, four traps (north, south, west, east) were hung simultaneously for each tree and examined for a period of 60 days. Adult pest counts were made for two different traps and these data were recorded. In the study, analysis of variance was performed according to the criteria determined according to trap color parameters and directions. As a result of the statistical analysis, it was determined that there was a significant difference in the number of pests in the south direction for the determined parameters (number of adults, nymphs and pulsed adults) compared to the other directions according to the period degree. The results of the study show that by using ecological data, the integration of optimization-based artificial intelligence techniques in the control of the pest can be used to predict and predict the population change of the pest.

Key words: *Cacopsylla pyri*, Yellow sticky traps, Population Change, Statistical Analyses

ÖZET

Cacopsylla pyri (Hemiptera: Psyllidae) önemli bir armut zararlısıdır. Zararlının mücadelesinde kimyasala mücadele dışında Biyoteknik mücadele çalışmaları önem taşımakta, sarı renkli tuzaklarının kitle halinde asılması ve bu tuzakların zararlının ve doğal düşmanlarının popülasyonlarına nasıl ve ne oranda etki ettiğinin ekolojik parametrelerle ortaya konulması Entegre Mücadele kapsamında değer taşımaktadır. Bu çalışma 2022-2023 yıllarında, Elazığ ili Merkez/Örençay köyünde zararlı ile bulaşık armut bahçelerinde, *Cacopsylla pyri* zararlılarına karşı iki farklı tonda (geleneksel sarı yapışkan tuzak, 1023 no'lu) birbirinden farklı sarı yapışkan tuzaklar ile zararlının popülasyon değişiminin istatiksel olarak belirlenmesi amacıyla yapılmıştır. Bu amaçla her bir ağaç için eş zamanlı olacak şekilde dört tuzak (kuzey, güney, batı, doğu), asılarak 60 günlük zaman dilimi için incelenmiştir. İki farklı tuzak için ergin zararlı sayımları yapılarak bu veriler kaydedilmiştir. Çalışmada tuzak renk parametreleri ve yönlere göre belirlenen kriterlere göre Varyans analizi ile yapılmıştır. İstatistik analizler sonucunda güney yönündeki zararlı sayılarının belirlenen parametreler için (ergin, nimf ve darbe vuruşlu ergin sayısı) diğer yönlere göre dönem derecesine göre anlamlı farklılık olduğu saptanmıştır. Çalışmanın sonuçları ekolojik veriler kullanılarak, zararlının mücadelesinde optimizasyon temelli yapay zeka tekniklerinin entegrasyonu ile zararlının popülasyon değişiminde önceden tahmin ve erken uyarı çalışmalarına temel veri sağlayacaktır.

Anahtar Kelimeler: *Cacopsylla pyri*, Sarı yapışkan Tuzak, Popülasyon Değişimi, İstatistiki Analizler

GİRİŞ

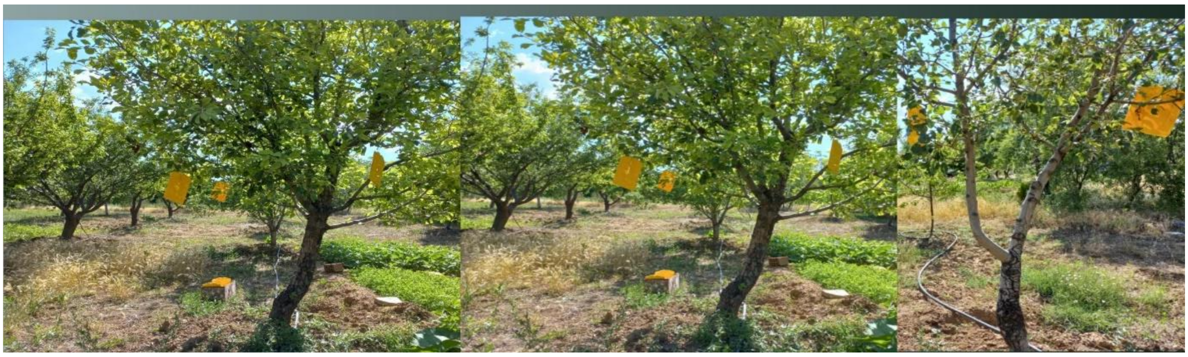
Bitkisel üretimde hastalık ve zararlılarla mücadele edilmediğinde yaklaşık olarak %30-35 oranında ürün kaybının yaşandığı bilinmektedir. Bu kayıp oranı salgın yapan zararlı organizmalarda %100'e çıkabilmektedir. Bitki hastalıkları ile mücadele dünya geneli ve ülkemizde önem arz etmekte olup, zararlılar ile mücadele de ülkemizde kimyasal mücadele kısa süre içerisinde sonuç alınmasını sağladığı için üreticiler daha fazla tercih edebilmektedirler. Oysaki zararlılara karşı mücadelede kimyasal mücadelenin tercih edilmesi insan sağlına ve çevreye olumsuz etkilere sebep olmaktadır (Oğuz, 1996). Kalıcılık etkisinden dolayı kimyasal mücadele yöntemlerinde tarımsal ürünlerde ve çevreye yönelik olumsuz etkilerinin büyük bir önemle dikkate alınması gerekmektedir (Tiryaki vd., 2010).

Bu nedenle zararlı mücadelesinde alternatif yöntemler uygulanmakta, bu yöntemlerin içerisinde biyoteknik mücadele yöntemi, hem çevresel bileşenlere zarar vermemekte, hem de agroekosistemi korumaktadır. Biyoteknik mücadele yöntemi içerisinde sarı yapışkan tuzaklar hem zararlıların popülasyon değişimini belirlemek, hem de kitlesel yakalama amacıyla farklı çalışmalarda kullanılmaktadır (Kavak et al., 2020; Özgen et al; 2013; Özgen et al; 2020). Özellikle bu çalışmalar psilla türlerinde yoğunlaşmıştır. Bu çalışma; özellikle Elazığ ilinde son yıllarda armut bahçelerinde yoğun zararlar oluşturan, *C. pyri'*nin biyoteknik mücadelesi için yapılmıştır. Yapılan bir başka zararlıya karşı çalışmada ise biyolojik ve biyoteknik mücadele yöntemleri çevreye zarar vermeyen, bitkilerde pestisit kalıntısına sebep olmayan ve uygulayan kişiler için herhangi bir sağlık problemi oluşturmayan uygulama avantajları sayesinde ön plana çıkmaktadır. Bozkurt (2015)'in yaptığı çalışmada, yapışkan tuzakların *C. pyricola*'nın mücadelesine karar vermek için faydalı olduğunu ancak *C. pyricola*'nın tuzak sayımlarındaki yoğunluğunu etkileyen başka etkenlerin bulunduğu bildirilmektedir. Bu çalışmada; iki farklı tuzak (geleneksel sarı yapışkan tuzak ve 1023 no'lu tuzak) için asım yöneyinin ve bu parametrelere etki eden abiyotik faktörlerin etkilerinin çalışma kapsamında geliştirilecek açıklayıcı istatistiksel uygulama çalışmalarının yapılarak, zararlı sayılarının belirlenen yön ve kademelere göre farklılığı amaçlanmaktadır.

MATERYAL VE METOT

Çalışmanın ana materyalini, Elazığ Merkez ve Merkez/Örençay köyünde bulunan 4 dönümlük armut bahçeleri, *Cacopsylla pyri* erginleri ve nimfleri, *C. pyri* zararlısının doğal düşmanları, 20x25 cm ebadında iki farklı tonda (Geleneksel, 1023) pleksiglas sarı yapışkan tuzaklar, yapışkan madde (Tanglefoot tangle-trap), stero-binoküler mikroskop, falcon tüpleri, kültür kapları, petri kapları, demir tel, spatula, streç film ve diğer malzemeler oluşturmuştur. Çalışmanın yapıldığı iki bahçedeki ağaçlar için daha önceden belirlenmiş olan tuzaklar uygun yön temelli olarak asılmıştır. Uygun saha çalışması için bahçede bulunan ağaçlar zararlının ortaya çıkışından sonra günlük olarak yön temeline uygun sayımları belirlenen metotlarla kontrol edilerek yapılmıştır.

Bu çalışmada daha önce hazırlanmış olan geleneksel sarı yapışkan tuzaklar (SYT) ve 1023 no'lu tuzaklar farklı tuzak sayılarında ve yön temelli olarak ağaçlara asılarak kullanılmıştır (Şekil 1). Kullanılan bu tuzaklar belirlenen mesafe koşullarına uygun şekilde asılarak elde edilen verilerin toplanılmıştır (Şekil 2).



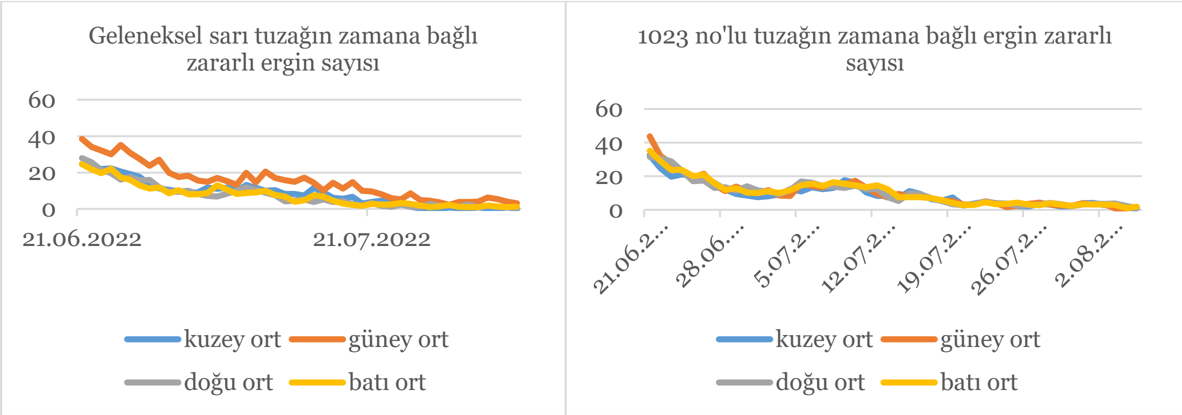
Şekil 1. Tuzakların (Geleneksel/1023 kodlu) Sayı ve Yöneye Göre Asılması

Şekil 2. *Cacopsylla pyri* Yakalanan Sarı Yapışkan Tuzaklar

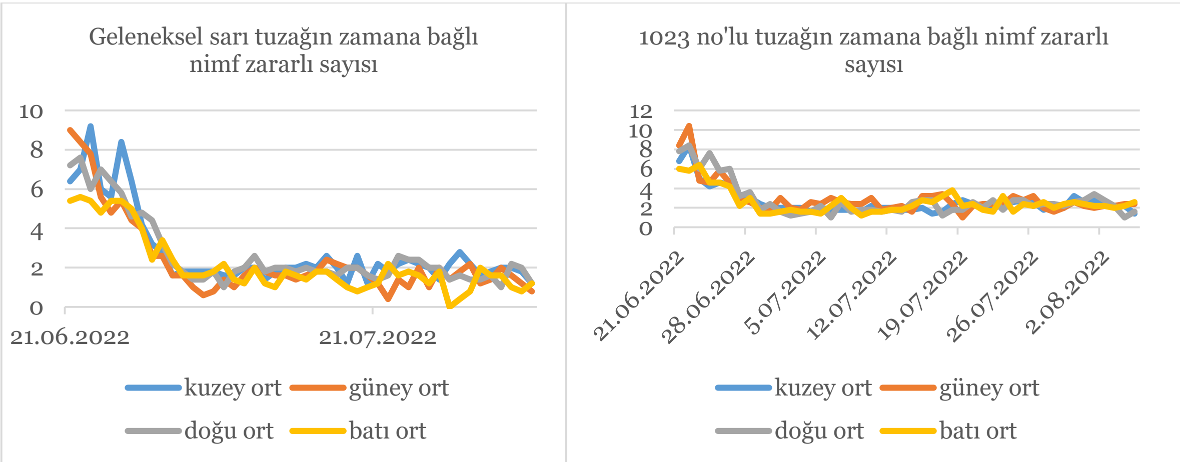
Tuzaklar, geleneksel ve 1023 kodlu tuzaklar olarak ağaç başına 4 tuzak şeklinde asılarak, günlük olarak tuzaklara yakalanan ergin bireyler, ağaç içi ergin ve nimf sayıları kaydedilerek zamana bağlı ve yönlere göre sayısal değişimleri grafiklendirilip istatistiki olarak farkları değerlendirilmiş ve sonuç değerlendirme tabloları yapılmıştır.

SONUÇLAR

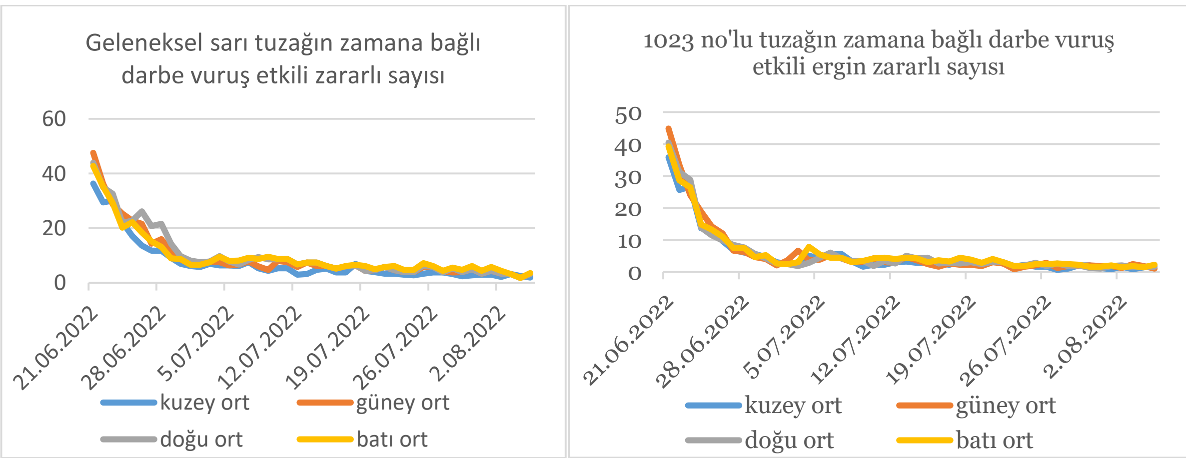
Çalışma sonucunda elde edilen veriler günlük olarak kaydedilerek çizelge haline getirilmiştir. Her iki tuzak içinde belirlenmiş olan sayım parametrelerine (tuzak ergin, ağaç içi darbe ile sayılan ergin ve yaprak nimf zararlı sayıları) göre tüm yönlerin zararlı sayılarının bir arada bulunduğu ve zamana bağlı değişimler gösterdiği belirlenmiştir. Geleneksel sarı yapışkan tuzak ve 1023 no'lu tuzak için belirlenen popülasyon dalgalanmalarını içeren grafikler, Şekil 3,4 ve 5 'de gösterilmiştir.



Şekil 3. Geleneksel sarı yapışkan tuzak ve 1023 no'lu tuzağın zararlı ergin sayısının tüm yönlere göre zamana bağlı değişimi



Şekil 4. Geleneksel sarı yapışkan tuzak ve 1023 no'lu tuzağın zararlı nimf sayısının tüm yönlere göre zamana bağlı değişimi



Şekil 5. Geleneksel sarı yapışkan tuzak ve 1023 no'lu tuzağın zararlı ergin sayısının ağaç içi populasyonun zamana bağlı değişimi

Sonuç olarak; iki farklı tuzak için (geleneksel sarı tuzak ve 1023 no'lu tuzak) bütün parametrelerde zamana bağlı zararlı birey sayılarının azalış gösterdiği, güney yönündeki ergin sayılarının daha fazla olduğu, nimf zararlı sayısının buna paralel olarak ekolojik faktörlerle birlikte azalma gösterdiği görülmektedir.

İstatistiki Modellemeler

Yapılan bu çalışmadan sonra bütün veriler kaydedilerek grafikler elde edilmiştir. Böylece daha iyi bir gözlem yapılarak belirlenen parametreler (ergin, nimf, darbe vuruşlu ergin sayısı) için belirlenen yönlere göre yorumlanması yapılarak, bir sonraki istatistik ve açıklanabilir yapay zekâ çalışmalarına geçilmiştir.

Öncelikle belirlenen tuzak türlerine ve yönlere uygun şekilde belirlenen kademelere göre SSPS programı aracılığıyla ANOVA (Varyans analizi) ile incelenmiştir. Bu çalışmada ki hipotez zararlı sayısının yönlere göre farklılıklarının incelenmesini amaçlanmıştır.

Tablo 1. Geleneksel tuzak için 4 yöne göre elde edilen zararlı değerleri

	GRUP	Mean (ort)	Mean Rank	SD (standart sapma)	*p*	İkili Karşılaştırmalar
Ergin sayısı	Kuzey	8.4870	86.05	7.03864	**0.000**	Güneyde gözlenen zararlı sayıları kuzey, batı ve doğuda gözlenen zararlı sayılarından anlamlı ölçüde daha yüksektir.
	Güney	14.9783	125.17	9.69868		
	Doğu	7.4478	78.84	6.92142		
	Batı	7.3870	79.93	6.30321		
Nimf sayısı	Kuzey	2.7826	110.45	1.94128	**0.006**	Kuzeyde gözlenen zararlı sayısı batı yönündeki zararlı sayısından anlamlı ölçüde daha yüksektir.
	Güney	2.3652	81.91	1.98362		
	Doğu	2.6435	101.25	1.78234		
	Batı	2.1348	76.39	1.50735		
DB ergin sayısı	Kuzey	7.4391	65.52	7.4391	**0.004**	Batı ve doğu yönündeki zararlı sayıları kuzey yönünde gözlenen zararlı sayısından anlamlı ölçüde daha yüksektir.
	Güney	9.3043	92.53	9.3043		
	Doğu	10.0783	101.18	10.0783		
	Batı	9.6130	106.76	9.6130		

Tablo 2. Geleneksel tuzağın ergin, nimf ve darbe vuruşlu ergin sayılarına göre elde edilen istatistik değerleri

	GRUP	Mean	Mean Rank	SD	*p*	İkili Karşılaştırmalar
Kuzey	Ergin	8.4870	82.23	7.03	**0.000**	Nimf zararlı sayısı ergin ve DB sayılarından anlamlı ölçüde daha düşüktür.
	Nimf	2.7826	43.24	1.94128		
	DB	7.4391	83.03	7.71453		
Güney	Ergin	14.9783	99.42	9.69868	**0.000**	Nimf zararlı sayısı ergin ve DB sayılarından anlamlı ölçüde daha düşüktür.
	Nimf	2.3652	29.48	1.98362		
	DB	9.3043	79.60	9.27129		
Doğu	Ergin	7.4478	74.02	6.92142	**0.000**	Nimf zararlı sayısı ergin ve DB sayılarından anlamlı ölçüde daha düşüktür.
	Nimf	2.6435	40.78	1.78234		
	DB	10.0783	93.70	9.27184		
Batı	Ergin	7.3870	78.82	6.30321	**0.000**	Nimf zararlı sayısı ergin ve DB sayılarından anlamlı ölçüde daha düşüktür.
	Nimf	2.1348	34.78	1.50735		
	DB	9.6130	94.90	8.21829		

Tablo 3. 1023 no'lu tuzak için dört yöne göre elde edilen zararlı değerleri

	GRUP	Mean	Mean Rank	SD	*p*	İkili Karşılaştırmalar
Ergin sayısı	Kuzey	9.3087	89.60	6.96004	**0.970**	Belirlenen yönler arasında fark yoktur.
	Güney	10.2565	91.99	8.83867		
	Doğu	9.9870	93.64	7.64111		
	Batı	10.2435	94.77	7.81303		
Nimf sayısı	Kuzey	2.6217	89.40	1.34741	**0.296**	Belirlenen yönler arasında fark yoktur.
	Güney	2.9130	105.38	1.66994		
	Doğu	2.7783	88.84	1.77600		
	Batı	2.5652	86.38	1.22587		
DB ergin sayısı	Kuzey	5.1261	84.60	7.13232	**0.384**	Belirlenen yönler arasında fark yoktur.
	Güney	5.7435	89.65	8.57289		
	Doğu	5.6217	92.42	8.00380		
	Batı	5.8870	103.33	7.52107		

Tablo 3 incelendiğinde, belirlenen tüm parametreler (ergin, nimf ve darbe vuruşlu ergin sayısı) için baz alınan yönlere göre *p* değerinin 0.05'ten büyük olması sebebiyle yönler arası bir fark yoktur.

Tablo 4. 1023 no'lu tuzağın dört yöne göre ergin, nimf ve darbe vuruşlu sayılarına bağlı istatistik değerleri

	GRUP	Mean	Mean Rank	SD	*p*	İkili Karşılaştırmalar
Kuzey	Ergin	9.31	97.93	6.96	**0.000**	Nimf zararlı sayısı ergin ve DB sayılarından anlamlı ölçüde daha düşüktür.
	Nimf	2.62	48.23	1.35		
	DB	5.13	62.34	7.13		
Güney	Ergin	10.26	95.98	8.84	**0.000**	Nimf zararlı sayısı ergin ve DB sayılarından anlamlı ölçüde daha düşüktür.
	Nimf	2.91	50.76	1.67		
	DB	5.74	61.76	8.57		
Doğu	Ergin	9.99	99.26	7.64	**0.000**	Nimf zararlı sayısı ergin ve DB sayılarından anlamlı ölçüde daha düşüktür.
	Nimf	2.78	44.91	1.78		
	DB	5.62	64.33	8.00		
Batı	Ergin	10.24	97.91	7.81	**0.000**	Nimf zararlı sayısı ergin ve DB sayılarından anlamlı ölçüde daha düşüktür.
	Nimf	2.57	40.77	1.23		
	DB	5.89	69.82	7.52		

Elde edilen istatistik analizler sonucunda iki farklı tuzak için belirlenen kademelere uygun istenen yönler arası zararlı sayılarının farklılıkları istatistiksel olarak incelenmiş olup yönler ve kademeler arası farklar ayırt edilmiştir. İstatistik analizler sonucunda genellikle güney yönündeki zararlı sayılarının belirlenen parametreler için (ergin, nimf ve darbe vuruşlu ergin sayısı) diğer yönlere göre daha anlamlı olduğu sonucuna varılmıştır.
Zararlı tahmininin yukarıda belirtilen çalışmalarda; iki farklı tuzak (Geleneksel sarı yapışkan tuzak ve 1023 no'lu tuzak)için değerlendirildiğinde güney yönündeki zararlı sayısının diğer yönlere göre daha fazla sayıda gözlemlenmesi sonucunda; ilgili istatistiksel çalışmalar belirlenmiştir.

TARTIŞMA

Armut, ülkemizde yetiştirilen yumuşak çekirdekli meyveler içerisinde üretim miktarı bakımından elmadan sonra ikinci sırada gelmektedir. Ancak, armut elmalara göre, sıcağa ve kurağa karşı daha az hassasiyeti olan Akdeniz'in sıcak iklimli bölgelerinde ekonomik olarak yetiştirilebilmektedir (Butar, 2014). Fakat ülkemiz armut yetiştirilme için son derece uygun olduğu halde üretim miktarı istenen düzeyde değildir. Bu durumun başlıca sebepleri hastalıklar, zararlılar ve armut bahçelerinde yapılan yanlış zirai uygulamalardır. Bu sebepler içerisinde; armut bahçelerinin önemli zararlısı olarak bilinen armut pisillidleri de bulunmaktadır. Zararlı konukçu olarak armut bitkisini tercih etmekte ve esas zararını nimflerinin, bitkinin yaprak ve sürgünlerde yapmış olduğu göstermektedir. Salgıladıkları tatlımsı maddeler ile fotosentezi engelleyerek ürün kayıplarına sebep olmaktadırlar (Erler, 2004). Bu kayıpları en aza indirmek amacıyla sarı yapışkan tuzak çalışmaları hem bu tür için hem de diğer zararlı türleri için yapılmaktadır. Sarı yapışkan tuzaklar doğrudan zararlılarla mücadele amaçlı kullanılabileceği gibi, monitör amaçlı olarak zararlıların varlığı, yoğunlukları ve yayılışlarının ve biyolojilerinin incelenmesi, mücadele zamanlarının doğru olarak belirlenmesi ile böcek populasyonlarının yayılış zamanını önceden belirleyerek erken uyarıda bulunabilmek amaçları ile de kullanılabilmektedir (Özgen ve ark., 2013; Sertkaya ve Yılmaz, 2017; Özgen ve ark., 2020).

Özellikle sarı yapışkan tuzaklarda yakalanan zararlı bireylerinin doğada ilk görünmesi ile, popülasyonlarının artış ve azalışları gözlemlenmekte, özellikle biyoteknik mücadele açısından bu artış ve azalışların popülasyon dinamiklerinin ortaya çıkarılması büyük önem arz etmektedir. Bu konuda Dünya'da ve ülkemizde yapılan bazı çalışmalar mevcuttur. ABD'de yapılan bir çalışmada; armut ağaçlarının farklı yükseklik, yön ve yüksekliklerine yerleştirilen sarı yapışkan tuzakların etkinliği konusunda Adams ve Los (1989) tarafından önemli farklılıklar saptanmıştır.

Bu çalışmada iki farklı tuzak için belirlenen yön ve kademelerde ki zararlı sayımlarının yapılıp kaydedilerek grafik haline getirilip, istatistiksel olarak yapılmasıdır. Sonuç olarak yön farkları kıyaslanmıştır. Yönlere göre de zararlı sayısının anlamlı farklar gösterdiği görülmüştür. Farklı yönlere asılan tuzaklarda ki popülasyon değişimleri açısından, hem ağaç içi ergin ve nimf, hem de tuzaklara yakalanan ergin ve nimf sayıları arasında tuzak asımlarına bağlı doğru orantılı bir farklılık görülmektedir. Yöneylere göre yakalanan ağaç içi ergin ve nimf sayılarında da farklılıklar ile popülasyondaki azalışlar, armut psillası mücadelesi açısından önemlidir.

GENEL SONUÇ

Sonuç olarak; bu çalışmada armut zararlısı olan *Cacopsylla pyri*'nin iki farklı tuzak tipi (geleneksel sarı yapışkan tuzak ve 1023 no'lu tuzak) için belirlenen yöneylerde ki tuzaklara yakalan ergin, ağaç içi nimf ve ağaç darbe ergin zararlı sayıları yakalanma oranları kaydedilerek çizelgeler oluşturulmuştur. Elde edilen sonuçlarda ağacın güney yönünde ki zararlı sayısının, diğer yöneylere göre yüksek olduğu gözlemlenmiştir. Ağacın güney yönünde ki sıcaklık farkının yüksek olması ve diğer çevresel koşulların etkisi bu yönde zararlı sayısının yüksek olmasına sebep olduğu düşünülmektedir. Yine popülasyon içerisinde dalgalanmaların olması ve zararlı sayılarında azalmadan sonra küçük bir artışın gözlemlenmesi zararlının ikinci dölüne denk gelmesine gibi sebeplerle açıklanabilir.

Çalışmada hem tuzaklara yakalanan hem de ağaç içi ergin ve nimf zararlı sayıları, ağaçların güney yönünde, diğer yönlere göre sayıca fazla, aynı zamanda zamana bağlı asılan tuzak etkisiyle sayılarının giderek azaldığı belirlenmiştir. Genel olarak; 4'lü yöneysel tuzak asımının iki farklı tuzak için karşılaştırılıp istatistiki parametrelerle etkinliğinin ortaya konulması, çalışmaların güvenirliliğini açısından önemli kazanımlar içerisindedir.

TEŞEKKÜR

Çalışmaya finansan destek sağlayan, TÜBİTAK 122O164 numaralı Armutta Zararlı *Cacopsylla pyri* L. (Hemiptera: Psyllidae)'nın Biyoteknik Mücadelesine Esas Farklı Sarı Yapışkan Tuzak Parametrelerinin Tespitinde Optimizasyon Temelli Açıklayıcı Yapay Zekâ Yöntemlerinin Geliştirilmesi isimli projeye, istatistiki analizleri yapan ve yorumlayan Fırat Üniversitesi Fen Fakültesi İstatistik Bölümü Dr. Öğretim Üyesi Yunus GÜRAL'a teşekkür ederiz.

KAYNAKLAR

1- Adams, R.G., Los, L.M. (1989): Use of sticky traps and limb jarring to aid in management decisions for summer populations of the pear psylla (Homoptera: Psyllidae) in Connecticut. Journal of Economic Entomology 82: 1448- 1454.

2- Bozkurt, V., 2015. Ankara ili Armut Bahçelerinde Zararlı *Cacopsylla pyri* (L.) (Hemiptera: Psyllidae)'nin Alternatif Mücadele Yöntemlerinin Araştırılması. Ankara Üniversitesi Fen Bilimleri Enstitüsü, Doktora Tezi. 132 s.

3- Bonnemaison, L., Missonnier, J. (1956): Le Psylle du poirier (*Psylla pyri* L.) morphologie et biologie méthodes de lutte. Annales des Épiphyties. 2: 263-331.

4- Erler, F. (2004). Bazı Armut Çeşitlerinin Armut Psyllidi, *Cacopsylla pyri* (L.) (Hom., Psyllidae)'ye Duyarlılık Düzeyleri. Akdeniz Üniversitesi Ziraat Fakültesi Dergisi, 17 (2): 121-125.

5- Butar, S. (2014). Armut Yetiştiriciliği. Meyvecilik Araştırma Enstitüsü Müdürlüğü (MAREM) Yayın No.60, 16 ss

6- Özgen İ, Ayaz T, Mutlu Ç, Bolu, H. (2013) The capture effects of yellow stick traps in the different wavelengths to the adults of *Agonescena pistaciae* Burc.& Laut. (Hemiptera: Psyllidae) from Turkey. Mun. Ent. Zool. 8(1): 486-492.

7- Özgen İ, Bolu H, Ayaz T, Koç İ, Mutlu Ç, Altun A.A (2020) Determining the efficiency of mass trapping of yellow sticky traps in different wavelengths agains pistachio psyllid in Siirt province (*Agonescena pistaciae* Burc. and Laut. (Hemiptera: Psyllidae)]. International Journal of Innovative Engineering Applications 4 (1): 19-29.

8- Kavak, A. E., Özgen, İ ve Y. Güral., (2020). Armut pisillidi [*Cacopsylla pyri* L. (Hemiptera: Psyllidae)]'ne karşı farklı dalga boylarındaki sarı yapışkan tuzakların çekim etkinliğinin araştırılması. Harran Tarım ve Gıda Bilimleri Derg. 24 (4): 381-390.

9- Sertkaya G, Yılmaz M (2017) Hatay İli Örtüaltı organik domates yetiştiriciliğinde bazı Begomovirüslerin enfeksiyon oranları ile doğal taşınması ve diğer konukçularının araştırılması. MKU. Tar. Bil. Derg. 22 (1): 1-15.

10- Tiryaki, O., Canhilal, R., & Horuz, S. (2010). Tarım ilaçları kullanımı ve riskleri. Erciyes Üniversitesi Fen Bilimleri Enstitüsü Fen Bilimleri Dergisi, 26(2), 154-169.

A STUDY IN TERMS OF AGRICULTURAL GEOGRAPHY: CARROT PRODUCTION IN BEYPAZARI DISTRICT

TARIM COĞRAFYASI AÇISINDAN BİR İNCELEME: BEYPAZARI İLÇESİNDE HAVUÇ ÜRETİMİ

Emine KOÇAK

Karabuk University, Faculty of Letters, Department of Geography, Karabuk, Turkey

ORCID ID: https://orcid.org/0000-0001-6370-488X

Fatih AYDIN

Karabuk University, Faculty of Letters, Department of Geography, Karabuk, Turkey

ORCID ID: https://orcid.org/0000-0002-8940-5332

Abstract

Introduction and Purpose: Carrot, one of the root vegetables, contains various nutrients, especially vitamins, minerals, antioxidants and fiber. The nutrients it contains are very important for human health. Due to these properties, it is one of the vegetables widely produced and consumed in the world and in Turkey. Carrot farming in Turkey is mainly done in an area of 130,342 decares in the provinces of Konya, Ankara, Hatay and Aksaray. One of the important centers where carrot production is made is Beypazarı district of Ankara province. Carrot production can be done for 12 months in the district, which has suitable climatic conditions, soil structure and water resources for carrot production. The aim of this research is; The aim is to determine the importance of carrot production in the district in terms of Turkey and the district economy by considering the current situation of carrot agriculture in Beypazarı district from a geographical perspective.

Materials and Methods: In the prepared study, a literature review was conducted on the subject and the field, and articles, books and reports were examined. Statistics on carrot production were obtained from the Turkish Statistical Institute (TUIK) database. The areas and production amounts of carrot cultivation in Turkey and Beypazarı district are presented in the form of a table. At the same time, interviews were held with Beypazarı District Directorate of Agriculture and Forestry officials and farmers, and field work was carried out. The data obtained from the interviews, TUIK data, official institution statistics, and publications related to the subject and field were used as materials. Maps of the district were prepared using the ArcGIS 10.4 program.

Results: Vegetables, especially carrots, are cultivated in most of the irrigated agricultural areas in Beypazarı district. In terms of carrot farming, the suitable climatic conditions and soil structure and easy water supply allow production in the district for 12 months. Especially the villages of Kuyucak, Fasıl, Kayabükü, Oymaağaç, Akçakavak, Kırbaşı and Kırşehler are the areas where intensive production takes place. There are also modern facilities with machinery in these villages where production is intense for the washing and packaging of carrots. According to TUIK data for 2023, Beypazarı district constitutes 17.5% of the total carrot growing areas in Turkey with a production area of 24,000 decares, and 18.5% of Turkey's total carrot production with a product yield of 144,000 tons. Most of the carrots produced in Beypazarı district are marketed to vegetable markets in Istanbul and Ankara. Efforts are also being made to open the carrots produced to international markets through export and to expand the export market in order to increase the producer's profit rate. Carrot, which is a very important agricultural product for the district's economy, also constitutes the raw material source of the geographically indicated registered carrot delight, which is identified with the region. Carrot juice production is also quite common. In order to increase the recognition of Beypazarı carrot and protect the brand value of the product, geographical indication registration should be obtained for the carrot. Being a geographical indication registered agricultural product will also increase the marketing power of carrots by ensuring that the production method and product quality are protected. At the same time, various events should be included in the International Beypazarı and Region Agriculture, History, Culture and Tourism Festival held in the district to increase the recognition of carrots.

Key Words: Agricultural geography; carrot production; Beypazarı District

ÖZET

Giriş ve Amaç: Kök sebzelerden biri olan havuç, vitaminler, mineraller, antioksidanlar ve lif başta olmak üzere çeşitli besin maddeleri içermektedir. İçerdiği besin maddeleri insan sağlığı açısından oldukça önemlidir. Bu özellikleri nedeniyle dünyada ve Türkiye’de yaygın olarak üretilen ve tüketilen sebzelerden biridir. Türkiye’de havuç tarımı ağırlıklı olarak Konya, Ankara, Hatay, Aksaray illerinde 130.342 dekarlık (da) alanda yapılmaktadır. Havuç üretiminin yapıldığı önemli merkezlerden biri Ankara ilinin Beypazarı ilçesidir. Havuç üretimi açısından uygun iklim koşulları, toprak yapısı ve su kaynaklarına sahip olan ilçede 12 ay boyunca üretim yapılabilmektedir. Bu araştırmada amaç; Beypazarı ilçesinde havuç tarımının mevcut durumunu, coğrafi bir perspektifte ele alarak ilçede havuç üretiminin Türkiye ve ilçe ekonomisi açısından önemini tespit etmektir.

Materyal ve Metot: Hazırlanan çalışmada konu ve sahayla ilgili literatür taraması yapılmış, makale, kitap ve raporlar incelenmiştir. Türkiye İstatistik Kurumu (TÜİK) veri tabanından havuç üretimine ait istatistikler temin edilmiştir. Türkiye’de ve Beypazarı ilçesinde havuç ekimi yapılan alanlar ve üretim miktarları tablo şeklinde sunulmuştur. Aynı zamanda Beypazarı İlçe Tarım ve Orman Müdürlüğü yetkilileri ve çiftçilerle görüşmeler yapılmış, arazi çalışması gerçekleştirilmiştir. Görüşmelerden elde edilen veriler, TÜİK verileri, resmi kurum istatistikleri, konu ve sahayla ilgili yayınlar materyal olarak kullanılmıştır. ArcGIS 10.4 programından yararlanılarak ilçeye ait haritalar hazırlanmıştır.

Bulgular ve Sonuç: Beypazarı ilçesinde sulu tarım alanlarının büyük bölümünde sebze, özelliklede havuç tarımı yapılmaktadır. Havuç tarımı açısından iklim şartlarının ve toprak yapısının uygun olması, su teminin kolay olması 12 ay boyunca ilçede üretim yapılmasına imkân tanımaktadır. Özellikle Kuyucak, Fasıl, Kayabükü, Oymaağaç, Akçakavak, Kırbaşı ve Kırşehler köyleri yoğun üretimin yapıldığı sahalardır. Havucun yıkanması ve paketlenmesi için üretimin yoğun olduğu köylerde makineli modern tesisler de bulunmaktadır. 2023 yılı TÜİK verilerine göre Beypazarı ilçesi 24.000 da üretim alanıyla Türkiye’de toplam havuç yetiştiriciliği yapılan alanların %17,5’ini, 144.000 ton ürün verimiyle Türkiye’nin toplan havuç üretiminin %18,5’ini oluşturmaktadır. Beypazarı ilçesinde üretilen havucun büyük bölümü İstanbul ve Ankara illerinde yer alan sebze hallerine pazarlanmaktadır. Üreticinin kâr oranın artması için üretilen havucun ihracat yoluyla uluslararası pazarlara açılması ve ihracat pazarının genişletilmesi için çalışmalar da yapılmaktadır. İlçe ekonomisi açısından oldukça önemli bir tarım ürünü olan havuç, yöre ile özdeşleşmiş coğrafi işaret tescilli havuç lokumunun da ham madde kaynağını oluşturmaktadır. Ayrıca havuç suyu üretimi de oldukça yaygındır. Beypazarı havucunun tanınırlığının artması, ürünün marka değerinin korunması açısından havuca coğrafi işaret tescili alınmalıdır. Coğrafi işaret tescilli bir tarım ürünü olması havucun üretim şeklinin, ürün kalitesinin korunmasını sağlayarak pazarlama gücünü de artıracaktır. Aynı zamanda ilçede düzenlenen Uluslararası Beypazarı ve Yöresi Tarım, Tarih, Kültür ve Turizm Festivalinde havucun tanınırlığını artırmak amacıyla çeşitli etkinliklere yer verilmelidir.

Anahtar Kelimeler: Tarım Coğrafyası; Havuç Üretimi, Beypazrı İlçesi

A COMPARATIVE STUDY ON COTTON PRODUCTION IN CIS COUNTRIES

Res. Asst. Aytan Zeynalova

Azerbaıjan State Agricultural University, Faculty of Agronomy, Department of General Agriculture, Genetics and Selection, Ganja-Azerbaijan

ORCID ID: https://orcid.org/0000-0001-6672-9142

Prof. Dr. Sait Engindeniz

Ege University, Faculty of Agriculture, Department of Agricultural Economics, Izmir-Türkiye

ORCID ID: https://orcid.org/0000-0002-7371-3330

Abstract

The Warsaw Pact, which began to collapse as a result of the unification of East Germany and West Germany, completely disappeared with the dissolution of the USSR. Wanting not to lose its influence in the region and its political power in the world, Russia embarked on a new quest and decided to establish the community as a result of its negotiations with Belarus and Ukraine on December 8, 1991. The establishment of the community was realized with the participation of 11 of the 15 states that left the USSR. Currently, due to the separation of Turkmenistan, Georgia and Ukraine, there are 9 member countries in the community (Azerbaijan, Moldova, Russia, Armenia, Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan and Belarus). In CIS countries, wheat and cotton are the two main strategic crops and the production and marketing of these crops are under government tenders. The aim of this study is to comparatively analyze cotton production in CIS countries in the period 2013-2022. Since cotton data of other CIS countries cannot be accessed, Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan were included in this study and the developments were evaluated. The main material of the study consists of the data obtained from FAOSTAT, International Cotton Advisory Committee (ICAC), and the results obtained from previous researches on the subject. The collected statistical data were arranged in the form of tables and figures and interpreted by making percentage and index calculations. Cotton production increased by 23% in the 2013-2022 period in the CIS countries covered. In the same period, the share of these countries in the world's total cotton production varied between 6-8.6%. In 2022, this share was 8.6%. The country with the highest cotton production is Uzbekistan. This country is followed by Turkmenistan and Tajikistan.

Keywords: cotton, cotton yield, cotton marketing, CIS countries.

INTRODUCTION

The Commonwealth of Independent States (CIS) was established in order to fill the gap in international authority that emerged over the vast territory of this country after the collapse of the Soviet Union and to continue the economic and, in a sense, cultural cooperation between possible member countries (Loukoianova and Unigovskaya, 2004; Tiusanen and Kinnunen, 2005). It is a political and economic community established with the participation of 11 countries. Participating countries; they are Azerbaijan, Armenia, Belarus, Kazakhstan, Moldova, Kyrgyzstan, Russia, Tajikistan, Turkmenistan, Uzbekistan and Ukraine (Eren, 2012; Saracoglu and Kortan, 2014). The location of CIS countries in the world can be seen in Figure 1.

Figure 1. Location of CIS countries

Source: Anonymous, 2023.

Georgia, which did not join the community during its establishment, joined in 1993, but left the community in 2008 due to Russia's occupation of Georgian territory (South Ossetia War). On August 15, 2008, the Georgian parliament approved the decision to leave the CIS. Georgia's membership in the CIS officially ended on 17 August 2009. Turkmenistan left the community in 2005 and is currently an observer country. Ukraine left the community after Russia's annexation of Crimea in March 2014.

The Warsaw Pact, which began to collapse as a result of the unification of East Germany and West Germany, completely disappeared with the dissolution of the USSR. Wanting not to lose its influence in the region and its political power in the world, Russia embarked on a new quest and decided to establish the community as a result of its negotiations with Belarus and Ukraine on December 8, 1991 (Huseynov, 2003; Demirbugan, 2005; Agayev and Yamak, 2009). The establishment of the community was realized with the participation of 11 of the 15 states that left the USSR. Currently, due to the separation of Turkmenistan, Georgia and Ukraine, there are 9 member countries in the community (Azerbaijan, Moldova, Russia, Armenia, Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan and Belarus). There are two entities under the Community: the Common Economic Area Agreement and the Eurasian Economic Community. The language of the community is Russian and the rotating presidency is currently held by Kyrgyzstan.

With the collapse of the Soviet Union, a socialist system and deep-rooted commercial relations emerged. The decline in agricultural production typically occurred in response to the introduction of market forces, the reduction of subsidies, and the decline in citizens' purchasing power. Governments are implementing reforms to encourage agricultural growth and productivity improvements and establishing new business partnership networks to sustain this sector as a major employer in rural areas. The agricultural sector has an important role in the CIS countries. It is revealed by the share of rural population, the share of agricultural Gross Value Added in the country's GDP and the share of agricultural employment. After gaining their independence, the structure of agricultural production has changed depending on the agricultural policies in the crop and livestock production systems of all CIS countries. In CIS countries, wheat and cotton are the two main strategic products, and the production and marketing of these products are under state tenders. Since the first years of independence, agricultural policy in the countries has been shaped by the government's intention to increase the volume of wheat production in order to achieve food self-sufficiency. As a result, more land was allocated to wheat production. However, in the following years, cotton gained strategic importance for many countries (Lerman, 2009; Kim et al., 2018).

It is seen that many studies have been conducted on the developments in the agricultural sector in the countries of the CIS (Osborne and Trueblood, 2002; Spoor, 2004; Lerman, 2009; Jadraliyev, 2010; Öztürk et al., 2013; Brink, 2014; Lerman, 2015; Philippidis et al., 2016; Kim et al., 2018; Mizik et al., 2018; Djuric et al., 2018).

It is seen that some studies have been carried out on different aspects of cotton production in the CIS countries (Sugonyaev, 1994; Isengildina et al., 1998; Nurzhanovna., 2011; Azhimetova, 2012; MacDonald, 2012; Shtaltovna and Hornidge, 2014; Mombekova et al., 2016; Hofman, 2019; Kahriz et al., 2019). However, closely monitoring cotton production in these countries and continuing research can contribute to the creation of policies that can be developed to meet domestic demand and increase export opportunities.

PURPOSE AND METHODS

The aim of this study is to comparatively analyze cotton production in CIS countries in the period 2013-2022. Since cotton data of other CIS countries cannot be accessed, Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan were included in this study and the developments were evaluated. The main material of the study consists of the data obtained from FAOSTAT, International Cotton Advisory Committee (ICAC), and the results obtained from previous researches on the subject. The collected statistical data were arranged in the form of tables and figures and interpreted by making percentage and index calculations.

RESULTS AND DISCUSSION

Population and Employment Characteristics of Countries

The six countries covered constitute 1.1% of the world's total population and 1.3% of the world's rural population. The country with the largest population is Uzbekistan, followed by Kazakhstan and Azerbaijan. The countries with the highest rural population ratio are Kyrgyzstan and Kazakhstan. The country with the highest share of agriculture in the employed population is Tajikistan, followed by Azerbaijan and Uzbekistan (Table 1).

Table 1. Rural population and labor employment in agriculture by countries (2021)

Countries	Total poulation (1,000)	Rural population (1,000)	Share of rural population (%)	Employment in agriculture (1,000)	Share of agriculture in total employment (%)
Azerbaijan	10,313	4,400	42.7	1,681	36.3
Kazakhstan	19,196	7,996	41.6	1,340	13.7
Kyrgyzstan	6,528	4,011	61.4	400	25.2
Tajikistan	9,750	6,979	71.6	1,003	45.8
Turkmenistan	6,342	2,875	45.3	429	22.3
Uzbekistan	34,081	16,681	48.9	3,027	26.9
Total (1)	86,210	42,942	49.8	7,880	-
World (2)	7,909,295	3,417,047	43.2	872,097	26.6
% (1/2)	1.1	1.3	-	0.9	-

Source: FAOSTAT, 2024.

GDP from Agriculture and State Supports by Countries

Among the countries covered, the country with the highest GDP is Kazakhstan. Tajikistan is the country with the least GDP. The countries with the highest GDP per capita are respectively; Turkmenistan, Kazakhstan and Azerbaijan. The rate of GDP derived from agriculture is higher in Uzbekistan and Tajikistan than in others. The countries with the highest government expenditures rate on agriculture are; Uzbekistan, Kazakhstan and Tajikistan (Table 2).

Table 2. GDP from agriculture and government expenditures for agriculture by countries (2022)

Countries	Gross Domestic Product (GDP) (Million USD)	GDP per capita (USD)	Share of agriculture in GDP (%)	Share of agriculture in government expenditure (%)
Azerbaijan	78,429	7,572	4.9	1.2
Kazakhstan	216,041	11,137	5.3	4.2
Kyrgyzstan	10,931	1,649	12.1	0.9
Tajikistan	10,267	1,032	23.3	2.3
Turkmenistan	78,003	12,130	8.0	2.1
Uzbekistan	79,974	2,310	23.8	5.1
Total (1)	474,645	-	-	-
World (2)	99,357,499	12,566	4.3	2.1
% (1/2)	0.5	-	-	-

Source: FAOSTAT, 2024.

Agricultural Land Availability and Usage Characteristics by Countries

The total land of the countries covered have a share of 3.1% in the world. These countries constitute 6.1% of the world's total agricultural land. The country with the most agricultural land is Kazakhstan. Turkmenistan and Uzbekistan follow this country. The countries with the highest rate of agricultural land in the total land are Kazakhstan, Turkmenistan and Uzbekistan (Table 3).

Table 3. Distribution of total land by countries (2021)

Countries	Total country land (1,000 ha) (1)	Agricultural land (1,000 ha) (2)	% (2/1)	Forest land (1,000 ha)	Other land (1,000 ha)
Azerbaijan	8,265	4,781	57.8	1,143	2,341
Kazakhstan	269,970	213,796	79.2	3,484	52,690
Kyrgyzstan	19,180	10,366	54.0	1,334	7,480
Tajikistan	13,879	4,917	35.4	425	8,537
Turkmenistan	46,993	33,838	72.0	4,127	9,028
Uzbekistan	44,065	25,691	58.3	3,715	14,659
Total (1)	402,352	293,389	72.9	14,228	94,735
World (2)	13,014,612	4,787,552	36.8	4,053,907	4,143,009
% (1/2)	3.1	6.1	-	0.3	2.3

Source: FAOSTAT, 2024.

Permanent meadows and pastures have the highest rate of agricultural land in the countries covered. Temporary crops constitute the other important share. These countries constitute 7.9% of the world's permanent meadow and pasture lands and 2.9% of temporary crop lands (Table 4).

Table 4. Agricultural land use by countries (2021)

Countries	Agricultural land (1,000 ha)	Temporary crops (1,000 ha)	Temporary meadows and pastures (1,000 ha)	Temporary fallow (1,000 ha)	Permanent crops (1,000 ha)	Permanent meadows and pastures (1,000 ha)
Azerbaijan	4,781	2,050	-	39	274	2,418
Kazakhstan	213,796	23,104	2,884	3,682	132	183,994
Kyrgyzstan	10,366	1,002	283	2	77	9,002
Tajikistan	4,917	816	-	22	204	3,875
Turkmenistan	33,838	1,511	212	217	60	31,838
Uzbekistan	25,691	3,128	440	449	421	21,253
Total (1)	293,389	31,611	3,819	4,411	1,168	252,380
%	100.0	10.8	1.3	1.5	0.4	86.0
World (2)	4,787,552	1,087,574	144,133	164,968	183,204	3,207,673
% (1/2)	6.1	2.9	2.6	2.7	0.6	7.9

Source: FAOSTAT, 2024.

Developments in Cotton Production and Yield by Countries

In the countries covered, cotton havested areas decreased by 8% in the 2013-2022 period. In the same period, the share of these countries in the world's total cotton harvested area varied between 6-7.2%. In 2022, this share was 6.6%. The country with the largest cotton harvested area is Uzbekistan. This country is followed by Turkmenistan and Tajikistan. The country with the highest increase in cotton harvested area in the 2013-2022 period is Azerbaijan (Table 5).

Table 5. Cotton harvested area by countries (1000 ha)

Countries	Years									
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Azerbaijan	23	23	19	51	136	132	100	100	101	104
Kazakhstan	138	128	99	110	135	133	131	126	110	126
Kyrgyzstan	23	23	14	17	21	23	24	22	19	22
Tajikistan	191	178	160	163	174	186	186	195	177	200
Turkmenistan	550	540	540	546	546	546	551	621	620	580
Uzbekistan	1,309	1,301	1,300	1,265	1,201	1,108	1,051	1,058	1,022	1,027
Total (1)	2,234	2,193	2,132	2,152	2,213	2,128	2,043	2,122	2,049	2,059
Index (2013=100)	100	98	95	96	99	95	91	95	92	92
World (2)	31,990	34,478	31,473	30,048	34,519	32,761	33,977	32,136	32,643	31,427
% (1/2)	7.0	6.4	6.8	7.2	6.4	6.5	6.0	6.6	6.3	6.6

Source: FAOSTAT, 2024.

Cotton production increased by 23% in the 2013-2022 period in the CIS countries covered. In the same period, the share of these countries in the world's total cotton production varied between 6-8.6%. In 2022, this share was 8.6%. The country with the highest cotton production is Uzbekistan. This country is followed by Turkmenistan and Tajikistan. The country with the highest increase in cotton harvested area in the 2013-2022 period is Azerbaijan (Table 6).

Table 6. Cotton (unginned) production by countries (1,000 tons)

Countries	Years									
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Azerbaijan	45	41	35	89	207	234	295	337	287	322
Kazakhstan	397	321	274	287	330	344	344	327	290	362
Kyrgyzstan	69	69	44	52	65	75	80	73	67	76
Tajikistan	393	373	270	285	386	300	403	450	531	512
Turkmenistan	600	745	764	1,071	1,109	1,101	1,110	1,280	1,280	1,201
Uzbekistan	3,361	3,400	3,361	2,959	2,854	2,286	2,692	3,064	3,373	3,501
Total (1)	4,865	4,949	4,748	4,743	4,951	4,340	4,924	5,531	5,828	5,974
Index (2013=100)	100	102	98	97	102	89	101	114	120	123
World (2)	72,382	76,122	65,886	67,803	74,020	72,285	83,681	71,459	74,298	69,668
% (1/2)	6.7	6.5	7.2	7.0	6.7	6.0	5.9	7.7	7.8	8.6

Source: FAOSTAT, 2024.

Cotton yield increased by 33% in the 2013-2022 period in the countries covered. During the same period, although cotton yield in these countries remained below the world average in some years, significant increases were recorded, especially in the last three years. The countries with the highest cotton yield are Kyrgyzstan, Uzbekistan and Azerbaijan, respectively. The country with the highest productivity increase in the 2013-2022 period is Azerbaijan (Table 7).

Table 7. Cotton yield by countries (kg/ha)

Countries	Years									
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Azerbaijan	1,932	1,788	1,883	1,761	1,527	1,763	2,949	3,360	2,854	3,094
Kazakhstan	2,875	2,514	2,758	2,616	2,439	2,592	2,625	2,593	2,640	2,866
Kyrgyzstan	2,925	2,956	3,095	3,141	3,179	3,242	3,285	3,344	3,480	3,539
Tajikistan	2,057	2,098	1,692	1,751	2,222	1,616	2,170	2,309	2,999	2,560
Turkmenistan	1,091	1,380	1,414	1,963	2,031	2,015	2,014	2,062	2,065	2,071
Uzbekistan	2,568	2,613	2,586	2,339	2,376	2,062	2,562	2,897	3,299	3,409
Total	2,178	2,257	2,227	2,204	2,237	2,039	2,410	2,606	2,844	2,901
Index (2013=100)	100	104	102	101	103	94	111	120	131	133
World	2,263	2,208	2,093	2,265	2,144	2,206	2,463	2,224	2,276	2,217

Source: FAOSTAT, 2024.

Cotton Prices Received by Producers by Countries

When the cotton (unginned) prices received by producers in the 2013-2022 period in the countries covered are examined; it was determined to vary between 273-534 $/ton in Azerbaijan, 334-722 $/ton in Kazakhstan, 550-1,273 $/ton in Kyrgyzstan, 565-727 $/ton in Tajikistan, 505-641 $/ton in Turkmenistan, 532-917 $/ton in Uzbekistan (FAOSTAT, 2024). When the cotton prices received by producers in 2022 are examined, it is seen that the highest price was obtained by producers in Kyrgyzstan and Uzbekistan (Figure 2).

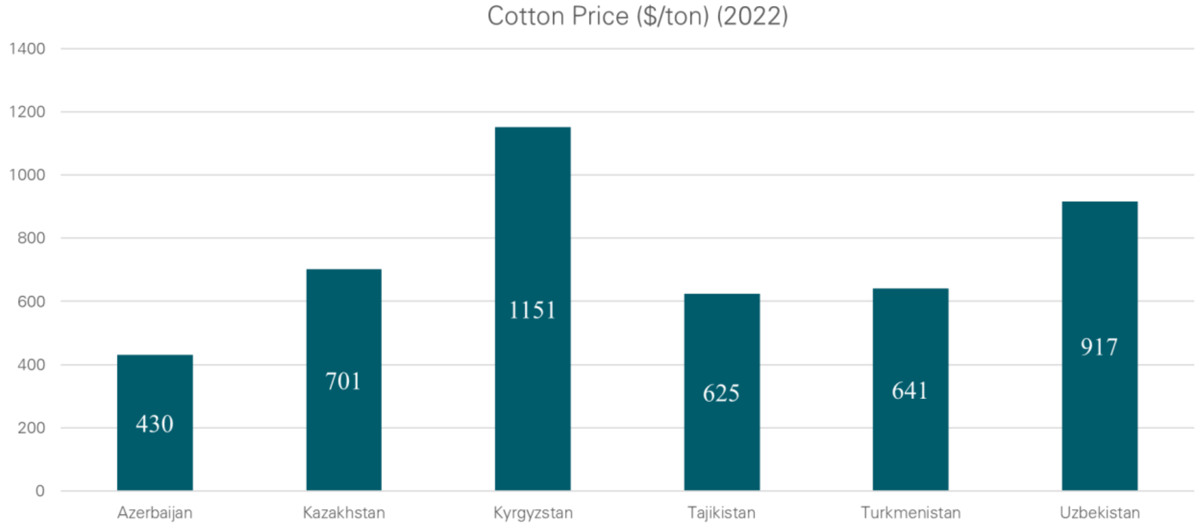


Figure 2. Prices of cotton (unginned) received by producers (2022)

Source: FAOSTAT, 2024.

Cotton Consumption and Foreign Trade by Countries

Information on cotton (ginned) consumption and foreign trade in the countries covered is presented in Table 8. As seen in the table, 58.4% of the total beginning stocks and production in these countries in 2022 was allocated for consumption and 15.6% was exported. In the same year, these countries realized 2.6% of the world's total cotton exports. In 2013, Turkmenistan and Uzbekistan exported a total of 969,000 tons of cotton. However, the total exports of these two countries in 2022 is 31 tons. The countries that export the most cotton in 2022 are Tajikistan, Kazakhstan and Azerbaijan (Table 8).

Table 8. Cotton (ginned) production, consumption and foreign trade by countries (1,000 tons)

Countries	Years	Beginning stocks	Production	Import	Export	Consumption	Ending stocks
Azerbaijan	2013	20	16	-	2	15	19
	2022	31	68	-	38	30	31
Kazakhstan	2013	17	74	-	61	13	17
	2022	17	80	1	57	13	28
Kyrgyzstan	2013	5	19	3	20	1	6
	2022	5	16	-	16	2	3
Tajikistan	2013	21	105	-	83	11	32
	2022	23	109	-	76	25	31
Turkmenistan	2013	463	337	-	354	131	315
	2022	124	220	-	26	144	174
Uzbekistan	2013	321	910	1	615	345	272
	2022	111	590	5	5	600	101
Total (1)	2013	847	1,461	4	1,135	516	661
	2022	311	1,083	6	218	814	368
World (2)	2013	19,510	26,258	8,858	9,035	24,092	21,499
	2022	18,578	24,385	8,263	8,280	23,694	19,252
% (1/2)	2013	4.3	5.6	0.04	12.6	2.1	3.1
	2022	1.7	4.4	0.07	2.6	3.4	1.9

Source: ICAC, 2024.

CONCLUSION

Developments in the agriculture and food sectors may vary from country to country. In determining the characteristics of the agriculture and food sectors; the diversity of selected reforms and national agricultural and food policies, aspects of foreign policy, geographical, geological and climatic conditions, etc. are effective. The main advantage of the agriculture and food sectors in all countries covered by the study is favorable agro-climatic conditions that allow the development of niche agricultural products (Brink, 2014). One of the main advantages of the CIS countries is relatively low input costs, which provides higher competitiveness. Labor costs in the agricultural and food sectors of CIS countries are lower than in countries with well-functioning market economies. However, national support policies generally contribute to lower start-up costs in the agriculture and food sectors (Kim et al., 2018).

The countries with the highest rural population are Uzbekistan, Kazakhstan and Tajikistan. After gaining their independence, the structure of agricultural production has changed depending on the agricultural policies in the plant and livestock production systems of all CIS countries. Agricultural policy in countries has been shaped by the government's goal of increasing wheat production in order to ensure self-sufficiency in food. However, countries have also turned to cotton production in recent years in order to meet their own needs and improve export opportunities. The country with the highest cotton production is Uzbekistan. This country is followed by Turkmenistan and Tajikistan.

There are many opportunities to increase rural productivity and income growth in CIS countries. In order to ensure the sustainability of cotton growing in these countries; agricultural technology should be modernized, irrigation water should be used more efficiently, climate-resistant agricultural systems should be adopted, producers should be able to apply advanced techniques and business principles more effectively, state supports should be maintained, high-yield local varieties should be developed, export-oriented production should be encouraged, producers should be organized through cooperatives.

REFERENCES

Agayev, S., Yamak, N. (2009).,Determinants of Economic Growth in Countries of the Community of Independent States, Journal of Economics and Administrative Sciences, 23(4):179-204.

Anonymous (2023). History of the Commonwealth of Independent States and Member Countries, https://www.neoldu.com/bagimsiz-devletler- toplulugu- ve- olusumu-565h.htm, Access date: May 2024.

Azhimetova, G. (2012). World Practice and Development History of Cotton Growing in Kazakhstan, Actual Problems of Economies, 1: 342-351.

Brink, L. (2014). Countries in the Commonwealth of Independent States: Agricultural Policy Issues in the Context of the World Trade Organization, Food and Agriculture Organization of the United Nations, Rome, E-ISBN 978-92-5-108449-6.

Demirbugan, M.A. (2005). Basic Tendencies Eastern European Countries and Commenwealth of Independent States in the Transition Process, Afyon Kocatepe University Journal of Economics and Administrative Sciences, 7(2):165-179.

Djuric, I., Götz, L., Svanidze, M., Glauben, T. (2018). Agricultural Market Integration in the Commonwealth of Independent States: What Are the Main Driving Forces and Challenges?, Agricultural Value Chain (Editors: G. Egilmez), IntechOpen, ISBN: 978-1-78923-007-9.

Eren, K. (2012). Turkish Republics in the Commonwealth of Independent States, Journal of Economics and Management Research, 1(1):43-73.

FAOSTAT (2024). Agricultural Statistics, http://faostat.fao.org, Access date: May 2024.

Hofman, I. (2019). Cotton, Control, and Continuity in Disguise: The Political Economy of Agrarian Transformation in Lowland Tajikistan, Leiden University, The Netherlands, https://hdl.handle.net/1887/68273, Access date: April 2024.

Huseynov, F. (2003). Legal Dimensions of Community of Independent States Formation, Journal of Law Faculty of Ankara University, 52(4):387-401.

International Cotton Advisory Committee (ICAC) (2024). Cotton Production, Area, Consumption, Export and Import Statistics, https://www.cac.org. Access date: May 2024.

Isengildina, O., Herndon, C.W., Cleveland, O.A. (1998). Cotton Industry in Uzbekistan: Structure and Current Developments, Proceedings of the Beltwide Cotton Conference, January 5-9, 1998, San Diego, pp.297-301.

Jadraliyev, M. (2010). Economic Cooperation in Agricultural Sector of CIS Countries, Euroasian Development Bank, Sector Report, Almaty-Kazakhstan, ISBN 978-601-7151-05-8.

Kahriz, M.P., Kahriz, P.P., Khawar, K.M. (2019). Cotton Production in Central Asia, World Agriculture Series: Cotton Production, (Editors: K. Jabran, B.S. Chauhan), Wiley Blackwell, ISBN:9781119385493, pp.323-339.

Kim, K.R., Sanaev, G., Babakholov, S. (2018). Economic and Agricultural Development after Transition in CIS Countries, Journal of Agricultural, Life and Environmental Sciences. 30(3):200-225.

Lerman, Z. (2009). Land reform, farm structure, and agricultural performance in CIS countries. China Economic Review, 20:316-326.

Lerman, Z. (2015). Privatization and Changing Farm Structure in the Commonwealth of Independent States (CIS), The Center for Agricultural Economic Research, The Hebrew University of Jerusalem, Discussion Paper No. 1.15, Rehovot-Israel, pp.1-17.

Loukoianova, E., Unigovskaya, A. (2004). Analysis of Recent Growth in Low-Income CIS Countries, International Monetary Fund, Working Paper:WP/04/151, pp.1-40.

MacDonald, S. (2012). Economic Policy and Cotton in Uzbekistan, Munich Personal RePEc Archive (MPRA), Paper No. 70882, Germany.

Mizik, T., Torok, A., Jambor, A., Kovacs, S., Sipos, L. (2018). The Agricultural Competitiveness of the CIS Countries in International Trade, Proceeding of 30th International Conference of Agricultural Economists, July 28-August 2, 2018, Vancouver-Canada, pp.1-15.

Mombekova, G., Turysbekova, G., Baimbetova, A. (2016). Managing Innovational Processes at Cotton Processing Enterprises in Central Asia Countries, International Journal of Economics and Financial, 6(Special Issue 2):164-171.

Nurzhanovna, A.G. (2011). Cotton and Textile Branch of Kazakhstan State: Problems and Prospects for the Development, African Journal of Agricultural Research, 6(17):4034-4045.

Osborne, S., Trueblood, M.A. (2002). Agricultural Productivity and Efficiency in Russia and Ukraine: Building on a Decade of Reform, Economic Research Service-USDA, Agricultural Economic Report No. 813, pp.1-34.

Öztürk, F., Saracoglu, S., Kortan, I. (2013). Competitiveness Analysis of Selected Members of Commonwealth of Independent States and Turkey in Vegetables and Fruit Sector, Procceeding of International Conference on Eurasian Economies, 17-18 September 2013, St.Petersburg-Russia, pp.768-777.

Philippidis, G., Berkum, S.V., Tabeau,A., Verma, M. (2016). Agricultural and Food Trade in the Commonwealth of Independent States: Assessing the impact of Alternative Trade Arrangements, Proceeding of 155th EAAE Seminar 'European Agriculture towards 2030 Perspectives for further East-West Integration', 19-21 September, 2016, Kiev-Ukraine, pp.1-25.

Saracoglu, S., Kortan, I. (2014). Analysis of Intra-Industry Trade between Turkey and Selected Transition Economies at the Bilateral Trade, Pamukkale Journal of Eurasian Socioeconomic Studies, 1(2):45-70.

Shtaltovna, A., Hornidge, A.K. (2014). A Comparative Study on Cotton Production in Kazakhstan and Uzbekistan, Center for Development Research (ZEF), University of Bonn, Germany.

Spoor, M. (2004). Agricultural Restructuring and Trends in Rural Inequalities in Central Asia: A Socio-Statistical Survey, United Nations Research Institute for Social Development, Civil Society and Social Movements Programme Paper Number 13, pp.1-56.

Sugonyaev, E.S. (1994). Cotton Pest Management: A Commonwealth of Independent States Perspective, Annual Review of Entomology, 39:579-92.

Tiusanen, T., Kinnunen, J. (2005). The Commonwealth of Independent States-CIS Countries in Transition, Lappeenranta University of Technology, Northern Dimension Research Centre, Publication 24, Lappeenranta-Finland, ISBN 952-214-176-3.

CLIMATE FINANCE: THE IMPACT OF CLIMATE CHANGE TO BEHAVIORAL FINANCE

Prof. Assoc. Dr. Mateo SPAHO

Dean, Faculty of Economics, Governance and Law “Barleti University,” Albania

Abstract

The ongoing climate transformation provides novel opportunities, along with associated risks, for the banking and behavioral finance sector: the elements contributing to climate change can have an impact on this system, leading to potential exposure to various forms of climate risk. Describing through a " *macroprudential* " perspective, the current paper considers that it is crucial to consider how regulatory bodies have recently advocated for the development of standardized models to evaluate vulnerability to climate risk and enhance the analysis of climate-related scenarios especially in countries with significant climate change impact as the Western Balkans. By opting for soft law mechanisms and leaning towards a risk-centric approach, it becomes feasible to adjust regulations to the dynamic and unpredictable nature of the subject matter, while also ensuring a swift and precautionary response to potential systemic crises arising from inadequate incorporation of climate risks. However, on a micro-management level, bank staff bear the responsibility of integrating climate and environmental factors into the risk management function when assessing exposure to different risks and during monitoring activities. Consequently, the system is witnessing the emergence of new dimensions of accountability, particularly towards external entities who may hold non-monetary interests associated with environmental conservation. It is imperative therefore that the entirety of the economic rights and freedoms of the European Union Regulatory Acts must now align with the imperative of environmental preservation, biodiversity, ecosystems, and sustainable development.

Keywords: Climate finance, risk-centric approach, behavioral finance, soft law mechanisms, environmental preservation

Introduction

The international community has long acknowledged the imperative to harmonize economic progress with environmental preservation and the fulfillment of communal objectives as defined in the common interest (Meyer & Clemens,2022; Acevedo et al.,2020). The focus on the economic ramifications of climate change has reached a considerable magnitude particularly in emerging economies (Kumar & Maiti,2024). Recent projections have delineated a further escalation in global temperatures over the twenty-first century, resulting in amplified occurrences and severity of extreme natural events, with significant repercussions on ecosystems and public health. The correlation between human actions and climate variations underscores the necessity to redefine the sustainable development approach, commencing with the gradual phasing out of fossil fuels (Acevedo et al.,2020). The reformation of the conventional economic growth model necessitates the sustainable management of the impending societal and economic transformations, including the impacts of climate change. A framework of "sustainable development" hinges on the thorough integration of the extensively debated environmental, social, and governance (ESG) factors within market dynamics

(Leogrande &Costantiello,2023). This abbreviation denotes the incorporation of novel criteria that prompt the evaluation of companies' structure and performance while considering their responsiveness to social and environmental concerns. Owing to the ubiquitous nature of climatic and environmental phenomena, ESG standards have garnered attention from the banking and financial sector, a domain tasked with facilitating the ecological transition of our nation (Leogrande & Costnatiello,2023). Henceforth, events concerning climate change have garnered the attention of the European Regulator, given that sustainable business models of intermediaries can facilitate the advancement of finance towards virtuous standards of social inclusion (see the European Climate Law,2021). This, in turn, enables resistance to both external and internal shocks, leading to the achievement of ecologically sustainable objectives (Hassani & Bahini,2022). The ongoing climate transition offers novel opportunities, alongside new risks, for the banking and financial sector. Factors contributing to climate change may manifest within this system, leaving it vulnerable to various forms of climate risk, known as Climate-Related Financial Risk (CRFR) (Battiston et al.,2021). Consequently, banking supervision and the financial system's actions must undergo reassessment in this evolving landscape. While traditionally focused on overseeing the health and prudent management of intermediaries, they are now tasked with identifying and addressing emerging risks associated with global climate changes (Su et al.,2022; Battiston et al.,2021). This approach aligns with developments at the European and international levels for the neighboring countries. Such reflections suggest that the subject of "environment" necessitates attention from a wide array of stakeholders. Moreover, besides the essential supervisory role played by authorities, proactive measures are crucial from supervised intermediaries. These entities are experiencing a surge in demand for sustainable products, highlighting the need to incorporate "sustainability" into their operations, thereby becoming a fundamental aspect of all legal activities (Knez et al.,2022). The current reflections, thus, commence from the conceptual premise that climate risks may predominantly impact the integrity of individual intermediaries and, consequently, also on the resilience of the financial system: there exists a profound acknowledgment that environmental sustainability could serve as a defining aspect of the operations of a banking and financial sector grounded on a precise set of values(Knez et al.,2022; Battiston et al.,2021). Throughout the course of these reflections, my aim is to initiate from a fundamental assumption: that sustainability represents a systemic goal in the present times.

Interaction between Climate Risks and Traditional Risks for the economic development

The transformations in climate change and environmental decline have instigated structural modifications impacting economic operations and consequently, the overall framework of the banking sector (Wu et al.,2023; Anginer et al.,2018). To delve deeper into this subject matter, it is imperative to initially recognize the emergence of novel risk attributes that coexist with the conventional features of the banking industry (namely credit risk, operational risk, market risk), with which they interplay and occasionally become indistinguishable. Within the sphere commonly denominated as Climate related financial risks, there are two principal risk elements, as discerned by the European Central Bank and the EBA: physical risk and transition risk (see Sustainable EBA,2024). *Physical risk* denotes the economic repercussions of climate variations, encompassing more frequent severe weather occurrences, gradual climate shifts, and environmental deterioration such as air, water, and soil pollution, water scarcity, diminishing biodiversity, and deforestation. This risk type is categorized as "acute" if triggered by extreme incidents like droughts, floods, and storms, and "chronic" if induced by progressive alterations like temperature escalations, rising sea levels, water scarcity, biodiversity depletion, changes in land use, habitat destruction, and resource inadequacy. Such risk has the potential to directly result in tangible impairments or reduced efficiency, as well as indirectly lead to subsequent consequences like disruptions in production chains**.** In addition to physical hazards, there exists *transition risks*, which signify potential financial repercussions that an organization might face, either directly or indirectly, due to the process of shifting towards a low-carbon economy and greater environmental sustainability (see Sustainable EBA,2024). This scenario could arise from abrupt policy changes, technological advancements, or evolving market sentiments. These risks impact the robustness of companies' business models over the medium to long term, particularly those relying on specific sectors and markets like banking, which are highly sensitive to external variables. Moreover, it is essential to note how both physical and transition risks can lead to additional financial losses through legal actions (referred to as "legal liability risk") and reputational harm if stakeholders associate the entity with negative environmental impacts (known as "reputational risk"). Despite the distinct nature of climate and environmental risks, their manifestation results in consequences for the conventional prudential risks inherent in the banking sector. Climate and environmental risks can act as key factors influencing multiple established risk categories and subcategories concurrently (Gourdel et al.,2023). An illustrative instance can shed light on this matter. For instance, regions highly susceptible to physical risks may experience diminished real estate collateral valuations (credit risk) due to increased flood hazards. Nevertheless, the management of climate risks presents numerous complexities, primarily stemming from the considerable uncertainty and unpredictability regarding the impacts of climate change on entities (Goudel et al.,2023). To facilitate the integration of climate risks within the banking framework, various regulatory mechanisms have been implemented, all aimed at a common overarching objective. Expounding on the preceding point is permissible. Historically, the environment was viewed as an external constraint on European and global economic and monetary policies. However, the escalating significance of sustainable development necessitates a policy reorientation. The harmonization of European and international systems is pivotal in resolving the dichotomy between economic imperatives (ensuring banking system stability and averting systemic shocks) and environmental conservation and enhancement. Thus, a progressive "greening" of European and international policies and regulations is imperative, aligning sustainability goals with the safeguarding of investments (Almeida et al.,2023).

Soft-Law Sources and choice of an Approach Risk-Based

Climate change, as research endeavored to observe, is a phenomenon characterized by risks that permeate the entire system (Battiston et al.,2021; Acevedo et al.,2020). For the system to function in accordance with its governing rules, it is imperative not only to identify these risks but also to regulate and manage them effectively. A prompt response to this objective was necessitated from supranational regulators. The European political stance aims at fulfilling the goals of the Paris Agreement through robust legal frameworks, particularly focusing on the nature of legislative acts such as regulations and directives (see UN Climate Change policies,2016). However, it is noteworthy that alternative regulatory tools have proliferated in practice, leading to a diverse array of norms that align more with soft law. The proximity of these instruments to the stakeholders, in the context of subsidiarity, enhances the value of regulatory competence in addressing pertinent interests. Acknowledgment must first be given to the heightened interest in addressing climate change within European institutions. The current regulations, encompassing the amalgamation of CRR2-CRD5, mandate public disclosure requirements related to ESG issues for major listed intermediaries like banks and investment firms (Almeida et al.,2023; Leogrande & Costantiello,2023). Notably, these entities are obliged to disclose the Green Asset Ratio (GAR) among other pertinent information to demonstrate how their business strategies align with the objectives of the Paris Agreement. These obligations have come into effect from January 2023, with provisions extending until

December 2023 for GAR information and until June 2024 to incorporate emissions from debtor companies across the entire value chain (known as Scope 3 emissions) (Brühl,2023). Moreover, a recent proposal for a Regulation was introduced by the European Commission, focusing on innovations primarily directed towards the Second and Third Pillars. Concerning the Second Pillar, which pertains to prudential oversight, amendments to articles 73, 74, and 76 of the CRD Directive require banks to establish governance structures, strategies, and processes capable of assessing their internal capital requirements considering ESG risks over a medium to long-term horizon (Brühl,2021). Intermediaries are also tasked with devising transition plans that encompass quantitative objectives for at least a decade to monitor risks of potential misalignments with the Union's climate objectives. As for the Third Pillar, which involves specific disclosure obligations, an extension of disclosure requirements on ESG matters to all intermediaries (banks and investment firms subject to bank prudential regulations) is outlined through amendments to Article 430 of the Regulation, thereby encompassing even smaller banks (see the European Climate Law,2021). Differentiation holds significant importance, particularly in the realm of supervision. It is imperative that regulatory bodies are provided with sufficient and comparable data to ensure a precise assessment of supervisory activities. In addition to the strict European regulatory landscape, there appears to be a noticeable shift towards the importance of more adaptable and efficient mechanisms that are now intelligently categorized as "unconventional regulations." Notably, major global central banks, among others, have initiated substantial efforts and investments in researching climate change and its diverse repercussions, prompting a response, including regulatory actions, either individually or in cooperative endeavors (Dikau & Vizou,2021). Initially, it is crucial to highlight the widespread interest in environmental issues that has given rise to the establishment of an international network, the Network for Greening the Financial System (NGFS), tasked with setting standards, guidelines, and climate scenarios to facilitate the assimilation of climate-related and environmental aspects into financial operations and risk management practices(see NGFS,2024). NGFS climate scenarios, set up with the purpose of establishing a shared foundation for analyzing climate-related risks within the economy and the financial sector, were primarily designed for utilization by central banks and supervisory authorities. However, these scenarios can also be beneficial for the direct recipients of supervisory oversight, encompassing not only banks but also financial intermediaries, SIMs, and the broader financial community (see NGFS Scenarios Portal,2024). Consequently, the initial emphasis lies on the significance of the chosen framework due to its comprehensive scope, intending to provide guidance to both public and private entities. The primary objective is to delineate the potential implications of climate change as a significant source of financial risk, irrespective of the specific entities involved. From the viewpoint of banking, these risks should be recognized as financial vulnerabilities arising from the exposure of banking operations to external factors that can disrupt their regular functions (e.g., disruptions caused by extreme weather conditions that could potentially impact credit evaluation processes) (see NGFS Scenarios Portal,2024). Transitioning to a purely prudential perspective, it becomes imperative to acknowledge the efforts of international entities such as the Basel Committee on Banking Supervision (BCBS) (2004) at the global level and the European Banking Authority (EBA) (2024) at the regional level. These organizations have undertaken the crucial task of assessing the adequacy of the existing regulatory framework in addressing the financial risks associated with climate change comprehensively. The Basel Committee has established a dedicated Task Force focused on climate-related financial risks, aimed at supporting the Committee's mission to enhance the regulatory standards, supervisory practices, and risk management protocols of banks worldwide with the overarching goal of fortifying financial stability. The Committee has placed the emphasis on relevance on the accurate assessment of ESG risks to facilitate the integration of sustainability risks within the Second Pillar, pertaining to the prudential control process. The

Committee aims to foster principles-based standardization for enhancing risk management and supervisory practices concerning financial risks related to climate change. This approach is rooted in the reassessment of the existing Framework of Basel, particularly the core principles for effective banking supervision (BCP) from September 2012 and the supervisory review process (Supervisory Review and Evaluation Process, SREP) (see SREP,2024). Nevertheless, it is important to note that the EBA has also underscored the significance of appropriately evaluating ESG factors. The EBA is currently developing a consultation document to facilitate constructive discourse and prerequisites for implementing specific prudential measures for assets vulnerable to ESG factors. This document focuses on "*the impact of environmental risks on the prudential landscape*" and is designed to solicit assistance and opinions to establish robust supervisory frameworks and tools that can bolster the European banking industry in transitioning towards a more sustainable economy and managing risks stemming from climate change and broader ESG considerations. The most typical modality of the risk-based approach provides that the risk assessment and identification of appropriate mitigation measures are conducted directly by the recipients of the regulation. In this way, a system of rules is preferred based on a pre-established case series, a flexible model by virtue of which it will be up to the obliged subjects to evaluate in which situations to regulate the frequency and intensity of obligations, based on an assessment of the concrete impacts of the risks climatic conditions have in certain areas; all of which, moreover, is in line with that vision for which it is necessary to "*respect the singularity of the concrete fact and the dynamics of ordering*" (see Sustainable EBA,2024).

Sustainable Banking and Risk supervision on Climate Change

The role and expertise of central banks in analyzing economic and monetary policies have initiated a discourse on the necessity of their expanded participation in addressing climate change. Specifically, there is a discourse on whether central banks should widen their range of actions to promote the shift towards a low-emissions economy using existing policy tools. At the European level in 2019, the European Central Bank (ECB) had foreseen that one of the focal points during the assessment of its monetary policy framework would be the aspect concerning climate change (see ECB Masterplan,2024). The ECB emphasized the necessity, rather than the option, of integrating actions against climate change into the functions of a central bank while upholding its traditional responsibilities. In 2020, the ECB issued the "*Guide on climate and environmental risks: supervisory expectations in risk management and disclosure matters*," in which it highlighted climate risks as primary factors in the risk assessment framework of the Single Supervisory Mechanism (SSM) for the banking sector in the euro area. The ECB asserted that financial institutions should address climate and environmental risks through a strategic, all-encompassing, and forward-thinking approach. Subsequently, in early 2021, institutions were requested to self-evaluate their current procedures against the standards outlined in the Guide and to communicate their strategies for advancing climate risk management and environmental considerations to the ECB. Based on this, the ECB evaluated the readiness of the institutions and the effectiveness of their implementation strategies. The evaluation revealed that although some institutions had made significant advancements, none had completely conformed to supervisory expectations, and the quality of their implementation strategies varied significantly. Moreover, only a few institutions had integrated climate and environmental risk practices that noticeably influenced their operational strategies and risk profiles. In recognition of the impact of climate and environmental risks on traditional financial services, including banks and non-bank financial intermediaries within its regulatory purview, the Bank of Albania (2023) has issued a document outlining initial supervisory expectations concerning the incorporation of climate and environmental risks into corporate strategies, governance and control frameworks, risk management practices, and disclosure protocols of supervised financial institutions (see Bank of Albania Climate Change Strategy,2024). Aligned with similar efforts by the ECB and the EBA, this regulation intends to provide high-level and non-mandatory guidance, with the practical execution thereof delegated to individual intermediaries. A careful review reveals the imperative for each supervised entity to autonomously conduct thorough analyses and assessments to determine the pertinence of these issues within the context of their business model. Consequently, these considerations facilitate progress towards the sustainable transformation of the banking sector, emphasizing the significance of sustainability within the internal governance structures of banking entities. Confronted with a multitude of novel challenges, ranging from technological innovations and global economic downturns to the pressing issue of climate change, financial institutions find themselves compelled to adapt and realign their strategies in response to these evolving circumstances (Wu et al.,2023; Sun et al.,2022; Dikaku & Voltz,2021). Given the intertwined nature of financial risks and climate-related risks, it is imperative in the present context to have a comprehensive and contemporary interpretation of the regulation that underscores the proficiency of corporate officers in handling risks stemming from Environmental, Social, and Governance (ESG) factors. While the observation pertains to businesses in general, the argument can be readily extrapolated to the banking sector, emphasizing the need for organizations to scrutinize, evaluate, and validate their frameworks, particularly in the realm of ESG considerations and the associated risk management protocols, a responsibility that falls on corporate bodies, given their pivotal role in realizing the economic pursuits(De Arriba-Sellier,2021; Anginer et al.,2018).

Concluding Remarks

On crucial matters such as the incorporation of climate risk elements internally within banking corporate governance, or the essential assessment of climate risk factors throughout all stages of banking operations, there remain aspects that warrant further investigation. Numerous inquiries arise from this issue: a comprehensive perspective, a multidimensional field of study, and engagement on various fronts are imperative to ensure a comprehensive focus on objectives and proper evaluation of interests at stake, while simultaneously offering effective remedies. Nevertheless, the extension of regulations and principles, particularly those of a technical nature, could amplify the volume and specific gravity of the regulations, leading to challenges in interpretation and implementation. A concerning aspect is the intricate web of mandatory regulations and non-binding guidelines that hinder the establishment of a coherent framework on the subject: an intricate level of detail that might heighten the intricacy of an already complex issue filled with nuances. Hence, it is expected that to ensure a balanced safeguarding of interests, all regulatory bodies can utilize the array of their regulatory tools, contributing to the establishment of "legal certainty" within the contemporary society of risks. The recognition of the fact that methodologies evolve over time within legislative frameworks signifies an openness to the global arena, thereby fostering the exchange of various models. The mention of the emerging duties of banking officials appeared pertinent for a specific reason: within an industry distinguished by considerable unpredictability and complexity, the failure or inaccurate internalization of risks necessitates efficient protection against external entities. Within the banking framework, communal interests adopt a meta-individual standpoint, as it is within this domain that the interests of those representing a crucial element are also actualized within the structure of the organization. It is at this level that the role of management necessitates scrutiny, with a focus on ensuring the appropriate risk governance while acknowledging the imperative protection of third-party interests. It becomes evident therefore that the pursuit of "sustainability" is progressively evolving into a genuine systemic objective.

Sustainability emerges as the conduit between present circumstances and the future, thereby becoming the ultimate objective of all human endeavors. The development of such a multifaceted and evolving regulatory objective demands the continual and collaborative engagement of the entire financial system, including the various other independent regulatory bodies that, alongside the National Banks, engage with the system. To conclude, the entire banking activity as an expression of economic freedom, cannot today fail to relate to the preservation of the environment, biodiversity, and ecosystems. Although with some doubts regarding the actual need for constitutionalizing, environmental protection, including the fight against climate change constitutes a ramification, through which the fundamental rights that the human person is entitled to must be reread and therefore, deserves to be strengthened at every level.

References

1. Acevedo, S., Mrkaic, M., Novta, N., Pugacheva, E., & Topalova, P. (2020). The Effects of Weather Shocks on Economic Activity: What are the Channels of Impact? *Journal of Macroeconomics*, *65*, 103207. https://doi.org/10.1016/j.jmacro.2020.103207

2. Almeida, D. V., Kolinjivadi, V., Ferrando, T., Roy, B., Herrera, H., Gonçalves, M. V., & Van Hecken, G. (2023). The "Greening" of Empire: The European Green Deal as the EU first agenda. *Political Geography*, *105*, 102925. https://doi.org/10.1016/j.polgeo.2023.102925

3. Anginer, D., Demirgüç-Kunt, A., & Mare, D. S. (2018). Bank capital, institutional environment, and systemic stability. *Journal of Financial Stability*, *37*, 97–106. https://doi.org/10.1016/j.jfs.2018.06.001

4. Battiston, S., Dafermos, Y., & Monasterolo, I. (2021). Climate risks and financial stability. *Journal of Financial Stability*, *54*, 100867. https://doi.org/10.1016/j.jfs.2021.100867

5. Brühl, V. (2023). The Green Asset Ratio (GAR): a new key performance indicator for credit institutions. *Eurasian Economic Review*, *13*(1), 57–83. https://doi.org/10.1007/s40822-023-00224-0

6. Brühl, V. (2021). Green Finance in Europe – strategy, regulation, and instruments. *Intereconomics*. https://www.intereconomics.eu/contents/year/2021/number/6/article/green-finance-in-europe-strategy-regulation-and-instruments.html

7. De Arriba-Sellier, N. (2021). Turning gold into green: Green Finance in the mandate of European Financial Supervision. *Common Market Law Review*, *58*(Issue 4), 1097–1140. https://doi.org/10.54648/cola2021068

8. Dikau, S., & Volz, U. (2021). Central bank mandates sustainability objectives and the promotion of green finance. *Ecological Economics*, *184*, 107022. https://doi.org/10.1016/j.ecolecon.2021.107022

9. Gourdel, R., Monasterelo, I., Dunz, N., Mazzocchetti, A., & Parisi, L. (2023). *The double materiality of climate physical and transition risks in the euro area* (No 2665). European Central Bank. https://www.ecb.europa.eu/pub/pdf/scpwps/ecb.wp2665~622858d454.en.pdf

10. Hassani, B. K., & Bahini, Y. (2022). Relationships between ESG Disclosure and Economic Growth: A Critical Review. *Journal of Risk and Financial Management*, *15*(11), 538. https://doi.org/10.3390/jrfm15110538

11. Knez, S., Štrbac, S., & Podbregar, I. (2022). Climate change in the Western Balkans and EU Green Deal: status, mitigation, and challenges. *Energy, Sustainability and Society*, *12*(1). https://doi.org/10.1186/s13705-021-00328-y

12. Kumar, N., & Maiti, D. (2024). Long-run macroeconomic impact of climate change on total factor productivity — Evidence from emerging economies. *Structural Change and Economic Dynamics*, *68*, 204–223. https://doi.org/10.1016/j.strueco.2023.10.006

13. Leogrande, A., & Costantiello, A. (2023). The role of GDP growth in the ESG approach at world level. *Social Science Research Network*. https://doi.org/10.2139/ssrn.4434206

14. Meier, V., & Clemens, F. (2022). Sustainable finance and climate change: wasteful but a political commitment device? *CESifo Working Paper, No. 9537 Center for Economic Studies, and Ifo Institute (CESifo).* https://www.econstor.eu/bitstream/10419/252054/1/cesifo1_wp9537.pdf

15. Sun, L., Fang, S., Iqbal, S., & Bilal, A. R. (2022). Financial stability role on climate risks, and climate change mitigation: Implications for green economic recovery. *Environmental Science and Pollution Research International*, *29*(22), 33063–33074. https://doi.org/10.1007/s11356-021-17439-w

16. Wu, X., Bai, X., Qi, H., Lu, L., Yang, M., & Taghizadeh-Hesary, F. (2023). The impact of climate change on banking systemic risk. *Economic Analysis and Policy*, *78*, 419–437. https://doi.org/10.1016/j.eap.2023.03.012

Online resources

Bank of Albania. (2023). *Strategjia -Plan veprimi per administrimin dhe mbikeqyrjen financiare te lidhura me klimen ne sektroin financiar faza i 2023-2025*. https://www.bankofalbania.org/rc/doc/Strategjia_GREEN_shqip_final_with_cover_25493.pdf

Banking services for central banks. (2004, June 28). https://www.bis.org/banking/index.htm?l=2&m=152

European Central Bank. (2024, May 28). *Supervisory review (SREP)*. European Central Bank - Banking Supervision. https://www.bankingsupervision.europa.eu/banking/srep/html/index.en.html

European Central Bank. (2024, January 30). *Climate change and the ECB*. https://www.ecb.europa.eu/ecb/climate/html/index.en.html

European Parliament. (2021). *REGULATION (EU) 2021/1119 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 June 2021 Establishing the Framework for Achieving Climate Neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law')* (L 243/1). European Union. Publications Office (europa.eu)

NGFS. (2024). Banque De France. https://www.ngfs.net/en

NGFS Scenarios Portal. (2024). NGFS Scenarios Portal. https://www.ngfs.net/ngfs-scenarios-portal/

Sustainable EBA | European Banking Authority. (2024). https://www.eba.europa.eu/about-us/sustainable-eba#:~:text=The%20EBA%20will%20support%20the,and%20cutting%20our%20carbon%20footprint.

UN Climate Change Conference (COP21). (2016, November 4). *Paris Agreement*. https://unfccc.int/process-and-meetings/the-paris-agreement

GENOTOXICITY ASSESSMENT IN CICER PLANT GROWN ON SOIL POLLUTED WITH HEAVY METALS

Dr. Sazada Siddiqui

Department of Biology, College of Science, King Khalid University, Abha, K.S.A

ORCID N0: 0000-0001-5448-7617

Abstract

In recent years industrialization is growing rapidly due to which the pollution load in water, air and soil is increasing day by day. Heavy metal pollution of the soil has raised concern in recent years due to its possible impact not only on human health but also on the plant system. To understand the consequences on plant systems, in the present study we cultivated the Cicer plant in soil polluted with heavy metals (Cd, Pb, Cr and Zn) collected from the Jhansi City of Uttar Pradesh, India with a geographical area of 502.75 thousand hectares. Seeds of Cicer were germinated in polluted soil sites such asT1(Garden Soil, Control);T2(Bharat Heavy Electrical Limited (BHEL)-Industrial); T3 (BHEL-Agricultural); T4 (Bijouli-Industrial); T5 (Bijouli Agricultural). The effect of soil polluted with the heavy metals was analyzed by studying the per centage of seed germination, radicle length (RL), mitotic index (MI) and chromosomal aberrations (CAs) in root tip meristems. The results revealed that polluted soil with heavy metalsT2 (BHEL Industrial site) and T4 (Bijouli-Industrial site) had a significant impeding effect on the root meristem activity in *Cicer* as noticed by there duction in seed germination percentage and RL compared to the control. Additionally, the variation in the percentage of mitotic abnormalities was observed. In general, increased percentage of chromosomal aberrations was observed in root tip cells of seedlings grown in polluted soil. Among these abnormalities laggards, bridges, stickiness, precocious separation and fragments were the most common. The obtained results demonstrated that heavy metal polluted soils led to a significant MI reduction and CA increase in root tip meristems of Cicer.

Keywords: Chromosomal aberrations; Genotoxicity; Mitotic index; Radicle length; Seed germination

EDIBLE PLANTS USED AS VEGETABLES IN KYRGYZSTAN

Dilbar SATYNBEKOVA

Kyrgyz-Turkish Manas University, Faculty of Agriculture, Department of Horticulture and Agronomy, Bishkek, Kyrgyz Republic

ORCID ID: https://orcid.org/0009-0003-8887-7076

Melek KUL BAŞARAN

Igdir University, Faculty of Agriculture, Department of Horticulture, Igdir, Türkiye

ORCID ID: https://orcid.org/0009-0004-7581-6626

Assoc. Prof. Dr. Eren ÖZDEN

Igdir University, Faculty of Agriculture, Department of Horticulture, Igdir, Türkiye

Kyrgyz-Turkish Manas University, Faculty of Agriculture, Department of Horticulture and Agronomy, Bishkek, Kyrgyz Republic

ORCID ID: https://orcid.org/0000-0001-7507-9815

Abstract

Wild plants are those that grow and spread without human intervention. These plants do not require special conditions or care, as they are adapted to their natural environments. In recent years, there has been a significant increase in interest in wild edible herbs for healthy and balanced nutrition. This study aims to identify the main herbs consumed as vegetables in Kyrgyzstan. It has been determined that Kyrgyzstan hosts numerous species of wild edible plants, with various consumption methods across different regions. Additionally, these plants are not only popular among the local population but are also sold in local markets as a source of income. As a result, this preliminary study indicates the need for a detailed examination and classification of edible plants with vegetable potential across Kyrgyzstan. Efforts to cultivate these plants can prevent excessive harvesting from natural habitats, thereby preserving the natural flora, and provide alternative income sources for producers. Kyrgyzstan is one of the Central Asian countries known for its rich natural resources and steppe areas. Vegetable herbs are an important part of Kyrgyz cuisine and have an important role in economic, social and cultural aspects. As a conclusion, we saw that edible wild plants have a very important place for Kyrgyzstan. We have seen that it is widely used in rural areas, primarily in nutrition and alternative medicine. Apart from this, edible herbs have a very important commercial value and are marketed in Kyrgyzstan. It is also used extensively in traditional festivals and ceremonies. Detailed classification, recording and protection of these species should be among the priority goals.

Key Words: Kyrgyzstan plants, Edible plants, Edible vegetable, Vegetable herbs, Local plants, Wild Herbs

ÖZET

Yabani bitkiler, insan müdahalesi olmadan büyüyen ve yayılan bitkilerdir. Bu bitkiler, doğal ortamlarına uyum sağladıkları için özel koşullar veya bakım gerektirmezler. Son yıllarda, sağlıklı ve dengeli beslenme için yabani yenilebilir otlara olan ilgi önemli ölçüde artmıştır. Bu çalışma, Kırgızistan'da sebze olarak tüketilen başlıca otları belirlemeyi amaçlamaktadır. Kırgızistan'da birçok yabani yenilebilir bitki türünün bulunduğu ve farklı bölgelerde çeşitli tüketim yöntemlerinin olduğu belirlenmiştir. Ayrıca, bu bitkilerin sadece yerel halk arasında popüler olmadığı, aynı zamanda yerel pazarlarda bir gelir kaynağı olarak satıldığı da görülmüştür. Bu ön çalışma sonucunda, Kırgızistan genelinde sebze potansiyeli olan yenilebilir bitkilerin detaylı bir şekilde incelenmesi ve sınıflandırılması gerektiği belirtilmiştir. Bu bitkilerin kültüre alınması, doğal habitatlardan aşırı toplamanın önlenmesini sağlayarak doğal florayı koruyabilir ve üreticilere alternatif gelir kaynakları sunabilir. Kırgızistan, zengin doğal kaynakları ve bozkır alanları ile bilinen Orta Asya ülkelerinden biridir. Sebze otları, Kırgız mutfağının önemli bir parçasıdır ve ekonomik, sosyal ve kültürel açılardan önemli bir role sahiptir. Sonuç olarak, yenilebilir yabani bitkilerin Kırgızistan için çok önemli bir yeri olduğu görülmüştür. Bu bitkilerin kırsal alanlarda, özellikle beslenme ve alternatif tıp alanlarında yaygın olarak kullanıldığı gözlemlenmiştir. Bunun yanı sıra, yenilebilir otların çok önemli bir ticari değeri olduğu ve Kırgızistan'da pazarlanmakta olduğu tespit edilmiştir. Ayrıca, geleneksel festivaller ve törenlerde de yaygın olarak kullanılmaktadır. Bu türlerin detaylı sınıflandırılması, kayıt altına alınması ve korunması öncelikli hedefler arasında olmalıdır.

Anahtar Kelimeler: Kırgızistan bitkileri, Kırgızistan sebzeciliği, Yenilebilir bitkiler, Yenilebilir sebze, Yerel bitkiler, Yabani Otlar

INTRODUCTION

Wild plants are those that grow and spread without human intervention. These plants do not require special conditions and do not need special care as they have adapted to their natural environments. Wild plants have high energy value, and therefore, they are increasingly being used as food additives or independent dishes. However, it is important to use wild beneficial plants wisely by understanding their biological properties. Many wild plants are edible or can be used as raw materials in industry; they are used in the production of medicines, perfumes, cosmetics, dyes, and tannins. Wild plants can supplement our diet with vitamins.

Kyrgyzstan is a country that stands out with its rich historical and cultural heritage in Central Asia. The unique vegetation and various climate conditions of this geography have brought about the richness and diversity of Kyrgyz cuisine. However, there is a significant gap in the comprehensive research and documentation of herbs frequently consumed and considered an important part of the local culinary culture in Kyrgyzstan.

The aim of this study is to identify, classify, and evaluate the herbs consumed as vegetables in Kyrgyzstan. In this context, by examining the relationship between Kyrgyz cuisine and plant culture, the richness and importance of local plant diversity are emphasized. Additionally, an analysis is presented on the botanical characteristics, nutritional values, economic and social roles, and future prospects of herbs consumed as vegetables.

AN OVERVIEW OF THE GEOGRAPHICAL, CULTURAL AND AGRICULTURAL STRUCTURE OF KYRGYZSTAN

Kyrgyzstan is, a Turkic state, a country located in Central Asia, bordered by Kazakhstan to the north, China to the east, Tajikistan to the south, and Uzbekistan to the west. The country's geographical structure is mountainous and rugged. The diversity of flora and fauna, as well as the agricultural production potential, is uniquely shaped by this landscape. Culturally, Kyrgyzstan is a country with a rich history and traditions. The majority of the population makes a living through agriculture and livestock farming, which is a significant part of the local plant diversity and agricultural practices.

Kyrgyz Cuisine and Local Plant Culture

Kyrgyz cuisine, nourished by the rich and diverse heritage of Central Asia, is a delicious and nutritious culinary tradition. It offers a rich variety of dishes from Central Asia, known for being hearty, satisfying, and flavorful. Key features of this cuisine include the widespread use of meat, flour, dairy products, and sugar. Kyrgyz cuisine has been shaped over centuries by the lifestyle, climate, and geography of the Kyrgyz people. Particularly influenced by nomadic culture, this cuisine is known for its simple and nutritious meals.

Vegetables and other grains are consumed less in Kyrgyzstan compared to many other countries around the world due to the aforementioned reasons and lifestyle. There are two main reasons for this: first, ecologically, many types of vegetables are not grown or the conditions for growing them are not known; second, sociologically, in the dietary habits of the people, vegetables and other plants come after products like meat, milk, and honey. However, in recent years, parallel to technological advancements, as the local people have learned about the nutritional properties of various types of vegetables, as vegetable transportation from other countries has increased, and as the local people have started to learn how to cultivate these plants, the consumption and production areas of vegetables have seen a significant increase. Nevertheless, some vegetables or medicinal aromatic plants have been used for a long time and continue to adorn Kyrgyz tables.

Plants grown in various regions of Kyrgyzstan play an important role in Kyrgyz cuisine. For example, wild herbs, greens, and spices are often used to add flavor and aroma to dishes. Additionally, local plants have traditionally been used for various medicinal purposes.

DEFINITION AND CLASSIFICATION OF HERBS CONSUMED AS VEGETABLES IN KYRGYZSTAN

There are dozens of edible plants in Kyrgyzstan, known or unknown, that are consumed directly or processed by the local population. The list of species for which we could provide detailed information in our research is shown in Table 1.

Karalcın, Kızıl Piyaz (Tr. Kırmızı soğan, Lat. *Allium atrosanguineum*)

Kızıl Piyaz (Allium atrosanguineum) is a perennial herbaceous plant of the Allium genus in the Alliaceae family. It grows in mountainous areas at altitudes of 2400-5400 meters in China, Siberia, Mongolia, and Central Asia. This plant typically thrives in rocky and thin-soiled areas within alpine and subalpine mountain belts, often forming large thickets (Asanov, 2012).

Table 1.1 Some species consumed as vegetables in Kyrgyzstan

	Kırgızca adı	**Türkçe adı**	***Latince adı***
1	Karalcın, Kızıl Piyaz	Kırmızı soğan	*Allium atrosanguineum*
2	Amarant	Amarant	*Amaranthus*
3	İt Uygak	Dulavratotu	*Arctium lappa*
4	Hren, hren yaprağı	Bayır turp	*Armoracia rusticana*
5	Çiriç, Çiriş, Şiryaş,Şireş, Ülkön	Çiriş otu	*Asphodelus aestivus*
6	Malva	Gömeç otu	*Malva sylvestris*
7	Rayhan, Rayhon	Fesleğen	*Ocimum basilicum*
8	Too kımızdık, koy kımızdık	Dağ Kuzukulağı	*Oxyriadidyna* (L.) Hill
9	Suu kımızdık	Söğütotu	*Persicari amaculosa*
10	Baka Calbırak	Bağa Yaprağı	*Plantago major* L.
11	Kımızdık	Madımak	*Polygonum cognatum* Meissn
12	Portulak	Semis otu	*Portulaca oleracea*
13	Işkın, Botkok	Işgın, Uşgun, Uçkun,	*Rheum ribes* L.
14	At Kulak	Kuzukulağı	*Rumex acetosella* L.
15	Kaakım-Küküm	Karahindiba	*Taraxacum officinale*
16	Kiyik Ot, Timyan	Kekik	*Thymus serpyllum*
17	Çalkan	Isırgan otu	*Urtica dioica* L.

It is a perennial herbaceous plant. The flower umbel is solitary or clustered, cylindrical, with a diameter of 5-10 mm. The flower stem is round in cross-section, up to 60 cm tall. Its leaves are palmate-shaped, with a rounded cross-section, usually shorter than the leaves, 1-3, 5-8 mm wide (Anonymous, 2010). From a distance, the umbels appear spherical, generally containing 6-15 flowers and having unequal pedicels.

Figure 3.1 It is a flowering plant. In Kyrgyzstan, it is found in the Osh region, Pamir, Trans-Alay Mountain Range, Petrovsky Peak ridge, at an altitude of ~4000 meters above sea level, on rocky, dry slopes. (Marina Skotnikova, 07/05/2022)

Figure 3.2 Flowering. Osh region, Pamir, Trans-Alay Mountain Range, Istikharat, at the Lukovaya Polyana level, at an altitude of ~3800 meters above sea level, in mountain meadows, Kyrgyzstan. (Marina Skotnikova, 07/03/2022)

In Kyrgyzstan, this plant is used as a filling for some national dishes such as samsa (savory pastries), mantı (dumplings), or oromo (stuffed flatbread). Sometimes in early spring, Karalcın (wild garlic) is used as a substitute for green onions (Figure 3.1; 3.2).

Amarant (Tr. Amarant, Lat. *Amaranthus)*

Amaranth is a genus within the Amaranthaceae family, encompassing both annual and perennial flowering plants. Some may grow into tree-like structures up to 1-2 meters tall, while others are smaller and grow in clustered, bushy forms. The flowers are often showy and densely clustered, appearing in colors like red, yellow, green, or purple. In Kyrgyzstan, Amaranthus leaves and seeds are used with the belief that they can help regulate blood sugar, lower cholesterol levels, and support heart health (Kaya, 2017).

Certain species of Amaranthus have leaves that can be cooked and consumed similar to vegetables or used fresh. Due to their nutritional richness, Amaranthus plants are utilized as food. The leaves are commonly cooked similar to spinach or used in salads. The seeds can be ground into flour or consumed whole, and they are used in breads, pasta, muesli, and other baked goods. Some species of these plants are also grown for decorative purposes and used as ornamental or garden plants (He et al., 2020).

Figure 3.3 View of flowers and leaves of Amaranth plant in Kyrgyzstan

Amaranth can be found in various regions of Kyrgyzstan, especially in agricultural fields, gardens, and farms. The price of Amaranth in markets may vary depending on the season, region, and supply situation. Generally, a bunch averages between 20 to 50 Kyrgyz soms (Figur 3.3).

İt Uygak (Tr. Dulavratotu, Lat. *Arctium lappa)*

The it uygak is a large, herbaceous plant that can reach heights of 60-120 cm (sometimes up to three meters). It is typically considered a weed but is used as food in some regions. The plant's stems are believed to contain many mineral substances and are considered beneficial for intestinal health.

The roots of the plant are peeled, sliced, and cooked in various ways such as roasting, boiling, or adding to soups and salads. Young leaves can be used in salads or cooked similar to spinach. However, mature leaves can be bitter and tough. The young stems of the plant are peeled and used in salads or for pickling (Figure 3.4).

Figure 3.4 *Arctium lappa* plant growing in nature (Anna Malihina, 2014)

In Kyrgyzstan, it grows on garden edges, around ponds, roadsides, ditches, and many other places. It is used in Kyrgyz cuisine by adding it to soups and salads. Its roots are harvested in the most nutritious periods, typically in autumn or spring. Before using "It uygak" as food, ensure that it has been collected in a clean environment free from toxins, as the plant can accumulate toxins from its growing environment.

Hren, Hren Calbırak (Tr. Bayır turpu, Lat. *Armoracia rusticana)*

Hren (*Armoracia rusticana*) is a plant that holds an important place among root vegetables, known for its sharp and pungent taste. It typically grows with thick stems and large green leaves, reaching heights of 1 to 1.5 meters. The root part is white or slightly pinkish in color and is quite sharp (Ulbricht et al., 2012). It is believed to have supportive effects on the digestive system and may strengthen the immune system (Alekseev, 1971). Hren is often grated or crushed for use in dishes, adding flavor to salads or meat dishes (Anonymous, 2024). Moreover, it can be used in herbal medicine to treat certain health issues (Gruenwald and Jaenicke, 2007).

Figure 3.5 Views of the leaves and radishes of the Hren plant

In Kyrgyzstan, regions where horseradish (hren) grows are typically areas conducive to agriculture and have suitable soil conditions. Particularly, southern regions like Osh, Chuy, and Jalal-Abad have climate and soil conditions suitable for cultivating horseradish. It is also known that horseradish can be grown in other regions of the country as well (Figure 3.5).

Çırıç, Çırış, Çiriç, Şiryaş, Şireş, Ülkön (Tr. Çiriş otu, Lat. *Asphodelus aestivus)*

Çırıç (*Asphodelus aestivus*) is a perennial plant species belonging to the Asphodelaceae family, which grows on mountain slopes. It typically reaches heights of about 1-1.5 meters and has long, pointed leaves. The roots, leaves, and flowers of çırıç are used as a natural remedy for various health issues. In some regions, the roots of çırıç, especially for digestive problems and fever, are consumed as a remedy (Dural and Korakaki, 2018). Its leaves are used in salads or cooked dishes. Additionally, in some areas, çırıç flowers are brewed as a tea for a sweet taste.

Figure 3.6 Çiriş as prepared for sale and food in the Osh market in its natural environment (Jalalabad) in Kyrgyzstan

Çırıç (*Asphodelus aestivus*) is used cooked as a filling in baked goods like samsa, mantı, or oromo. In some regions, during spring when çırıç leaves mature, locals harvest them by cutting off the upper part and sell them in local markets. As of 2024, they are sold for 90 som per kilogram (Figure 3.6).

Malva (Tr. Gömeç Otu, Ebegümeci, Lat. *Malva sylvestris)*

Malva is a genus from the Malvaceae family, consisting of a diverse group of flowering plants that thrive in temperate and subtropical climates (Nosal, 1959). These plants generally have a mild taste and leaf texture, which is why in some regions, particularly species like *Malva sylvestris*, their flowers and leaves are used as food for human consumption (Figure 3.7).

Figure 3.7 View of Malva leaves, flowers and buds (Tulkin Tillaev, 05.15.2020)

The leaves and flowers can be added to salads, soups, or brewed into tea (Bruneton, 1999; Stuart, 2007). The medicinal and culinary use of Malva can provide various health benefits, but it may also involve potential risks (Anonymous, 2022).

Rayhon, Rayhan (Tr. Reyhan, Fesleğen, Lat. *Ocimum basilicum)*

Rayhon belongs to the Lamiaceae family and generally grows in temperate and tropical regions.

Its' leaves are oval and bright green in color, but may be purplish in color in some varieties. Its flowers are small, white or purplish in color and bloom in summer. It prefers to grow in well-drained, fertile soil and in places receiving full sun. It is a widely preferred herb in Kyrgyzstan, as well as being widely used in cuisines around the world. Its fresh leaves are used in salads, sauces (especially pesto sauce), soups, meat and vegetable dishes. Dried rayon leaves can also be used as a spice to add flavor to various dishes (Figure 3.8).

Figure 3.8 Appearance of green and violet Basil plant.

Rayhon grows in different places in Kyrgyzstan, but is mostly grown in warm regions. In general, it is added to dishes as a spice in fresh or dried form, and it is also used as a flavoring in vegetable pickles. It costs around 20-25 som per bunch in local markets.

Too Kımızdık, Koy Kımızdık (Tr. Dağ Kuzukulağı, Lat. *Oxyria didyna* (L.) Hill*)*

Too kımızdık (*Oxyri adigyna*) is a flowering species of the buckwheat family (Polygonaceae) and is native to the polar regions and mountainous regions of the northern hemisphere. It is a perennial herb with a tough taproot; The plant grows to a height of 10 to 30 cm. Its leaves are kidney-shaped and slightly fleshy. Its flowers are small, green and later reddish, grouped in an upright panicle. It is an annual or perennial plant.

Figure 3.9 Flowering plant. Chui region, Alabel pass, Kyrgyzstan (Pavel Gorbunov, 21.07.2022)

It grows naturally in state-owned fruit and vegetable farms and private gardens in Kyrgyzstan. It blooms in June-July. Its fruits ripen in July. It grows in pebbles and rocky habitats in the upper mountain belt. It is considered as an ornamental plant or edible (Lazkov, 2016). It is found especially in mountainous areas in Kyrgyzstan. Plant leaves are used for medicinal purposes. They are used as antipyretics, anti-scurvy, or used as anti-diarrheals (Figure 3.9).

Suu Kımızdık (Tr. Söğütotu, Lat. *Persicari amaculosa*)

It is an annual or perennial herbaceous, bushy or climbing plant that usually grows on river banks, swamps, wet meadows and moist soils. Its root is prepared as an ointment and used in the treatment of hemorrhoids or open wounds (Asanov, 2010). In Kyrgyzstan, its leaves can be boiled and used (Figure 3.10).

Figure 3.10 Appearance of Suu kımızdık plant

Baka Calbırak (Tr. Bağa Yaprağı, Lat. *Plantago major* L.)

Baka Calbırak is a perennial plant with broad leaves. It generally has oval and broad leaves. It can grow in various areas such as roadsides, gardens, lawns and field edges. It contains high antioxidants and anti-inflammatory compounds. This herb is used to support the digestive system, strengthen the immune system and improve skin health (Figure 3.11).

Figure 3.11 Leaf view of Baka calbırak plant

In Kyrgyzstan, its leaves can be used fresh in salads, soups and various dishes. The leaves have a slightly bitter taste and are usually consumed cooked like spinach. It can also be dried and used as tea.

Kımızdık (Tr. Madımak, Lat. *Polygonum cognatum* Meissn)

Kımızdık has an annual or perennial herbaceous, bushy or climbing structure. Its trunk grows upright or horizontal, in the form of an arch, and may be dark green in color. There are 22 species in Kyrgyzstan. The root of the Kmissus plant is used in many areas, especially to obtain dyestuffs and for medicinal purposes (Figure 3.12).

Figure 3.12 Appearance of Kımızdık plant

Portulak (Tr. Semizotu, Lat. *Portulaca oleracea)*

Portulak (Portulaca oleracea) is a annual plant known for its succulent, oval-shaped leaves. It is recognized for being nutritious, healthy, and low in calories. Additionally, it is rich in nutrients such as fiber, vitamin C, vitamin A, and it possesses antioxidant properties. Portulak is also noted for containing the highest amount of Omega-3 among vegetables (Anonim, 2021), (Figure 3.13).

Figure 3.13 View of the flowering Portulak plant. Kyrgyzstan, Bishkek. (Galina Chulanova, 09.06.2015)

In Kyrgyzstan, it grows in many places such as garden edges, ponds, roads, ditches, and is considered a weed. However, Purslane can be consumed raw in salads and added to sandwiches. It is also used in dishes such as soup, omelet or sauté.

Işkın, Botkok (Tr. Işgın, Uşgun, Uçkun, Lat. *Rheum ribes* L.)

Işkın is a perennial plant with thick, woody, branched rhizomes. Aboveground stems are annual, straight, thick, hollow. The height of the flowering stem is 20-100 cm, width 30-80 cm, thick, branchless, hollow or full. The stems and roots are used medicinally. 7 species are known in Kyrgyzstan. It is drought resistant and grows well in shade. The fruit is a triangular, wide or narrow winged walnut. The seed is proteinaceous and the embryo center.

It grows in plateaus and pastures at an altitude of 2000-3500 meters in Kyrgyzstan. In the spring, people collect the shoots from the mountains, peel them and consume them raw. Or they bring it to the market and sell it. The price of 1 kg of light is approximately 20-25 soms (Figure 3.14).

Figure 3.14 Harvesting Işkın and making it suitable for consumption in the mountains of Kyrgyzstan (Suusamir, 2022)

At Kulak (Tr. Kuzukulağı, Lat. *Rumex acetosella* L.*)*

Members of the Polygonaceae family, they are generally upright plants with long tap roots. At kulak plant is rich in group vitamins A, B and C (Dorofeeva, 1988). It is a very low-calorie plant and there is an average of 21 Kcal in 100 g of plant.

Figure 3.15 Flowering Atkulak plant growing in nature (Viktor Kolesnikov, 18.06.2012) and the plant cultivated in Kyrgyzstan. (Osh market, April 6, 2024)

At kulak plant is widely found in nature in almost every region of Kyrgyzstan. 13 species grow in Kyrgyzstan. They grow in many places such as garden edges, ponds, roads and ditches. They are collected from nature by local people in the spring. They are consumed for breakfast or added to salads. It costs around 50-70 Som per kilogram in local markets (Figure 3.15).

Kaakım-Küküm (Tr. Karahindiba, Lat. *Taraxacum officinale)*

Kaakim is a plant belonging to the Asteraceae family, its flowers are yellow and its leaves are green. It is a perennial herbaceous plant that can grow up to 50 cm tall. Its roots, stems and leaves generally contain a white, very bitter, milky sap. The roots of the plant are used as raw materials for medicinal drugs. It is used to increase appetite and improve digestion. Fresh young kaem leaves are added as a spice to soups, cabbage soups, meat and fish dishes. The flower buds are used in salad dressings and to spice up meat dishes, and the root is ground into powder and used as a coffee substitute (Nurmatova, 2018). In Kyrgyzstan, yellow flowers are also collected and dried or made into jam in May-June. Its green leaves are collected and consumed by adding them to various salads. The leaves can be consumed cooked or raw (Figure 3.16).

Figure 3.16 Leaves and flower appearance of Kaakım-Küküm plant

Kiyik Ot, Timyan (Tr. Kekik, Lat. *Thymus serpyllum*)

Kiyik is a plant belonging to the Lamiaceae family, with an average height of 20 cm and a lifespan of 6 years. The growing season of this plant is from spring to autumn. The plant is rich in essential oil and is grown for its aromatic leaves used in cooking. Thymol and carvalol in forms of essential oils are used in medicine, perfumery and food industries. Its leaves are used as a spice in the culinary, canning and beverage industries. Plant stems, leaves and flowers can be used as tea.

Figure 3.17 Dried thyme plant and flowering plant appearance

In Kyrgyzstan, 8 species grow in medium and high mountain meadows, water edges, among bushes, rock crevices and gravel surfaces. Kyrgyz people have been boiling and drinking water for the treatment of gastrointestinal diseases since ancient times. In Kyrgyzstan, thyme is used mainly as a seasoning in cooking and in salads and pickles for the winter. Those used as spices are sold in local markets for around 30-40 som (Figure 3.17).

Çalkan (Tr. Isırgan otu, Lat. *Urtica dioica* L.)

It is an annual or perennial plant in the Urtica genus of the Urticaceae family, blooming between May and August. The stems and leaves of plants of this genus are covered with stinging hairs (Kravtcova, 2017). Although some species are used in medicine, they can generally be used as food and animal feed. It is used in salads, soups, sauces, pie fillings and marinades. It is a low-calorie plant, 25 grams of raw shake contains 7 calories. It is rich in vitamins A, C and K and the minerals iron, calcium and potassium (Harkevich, 1991), (Figure 3.18).

In Kyrgyzstan, Çalkan grows almost everywhere and is considered a weed, and people used it in food to add to salads. Before preparing any food, they would soak the nettle in boiling water to get rid of its pungency. It is sold per kilogram at local sellers for approximately 45-75 som.

Figure 3.18 Leaf view of the Çalkan plant

ECONOMIC AND SOCIAL ROLE OF HERBS CONSUMED AS VEGETABLES IN KYRGYZSTAN

Commercial value and marketing of herbs that can be consumed as vegetables

Herbs consumed as vegetables in Kyrgyzstan are sold fresh in local markets and markets. In particular, widely consumed herbs such as gin, horse ear, hren and rhubarb are among the products with high commercial value. These herbs can be sold both fresh and processed (pickled, spiced, pickled). In this way, the cultivation and trade of herbs that can be consumed as vegetables in Kyrgyzstan make significant contributions to the local and national economy (Atakulov, 2018). In the spring, local people collect these plants and sell them in local markets, making a living by earning income through the production and sale of these plants. Additionally, growing these herbs as vegetables increases employment in the agricultural sector and promotes rural development. This positively affects social life by increasing the welfare of the local community.

Use in traditional festivals and ceremonies

In Kyrgyzstan, traditional festivals and ceremonies are an important part of the local plant heritage and cultural values. Herbs consumed as vegetables at these events are often used in the preparation of meals and treats. For example, various vegetable dishes and salads are served at weddings and holidays. In addition, herbs consumed as vegetables in some traditional ceremonies are used symbolically and are a part of the rituals.

Future and protection of herbs consumed as vegetables in Kyrgyzstan

Impact of global changes on local plant diversity: Global factors such as climate change have a significant impact on local plant diversity in Kyrgyzstan. Climate change may change the habitats of some plant species or cause their extinction by affecting plant growing conditions. This could lead to a reduction in native plant diversity and loss of native plant heritage.

Protection and sustainability of traditional knowledge and practices: It is important to preserve traditional knowledge and practices for the protection and sustainable use of herbs consumed as vegetables in Kyrgyzstan. The local people's knowledge and experience from the past have an important role in the cultivation, collection and processing of these plants. The transfer and preservation of this knowledge and practices ensures the sustainability of local plant diversity and cultural heritage. Policy recommendations for biodiversity conservation and sustainable use of herbs: Various policy measures can be taken to protect the biodiversity and sustainable use of herbs consumed as vegetables in Kyrgyzstan. These; conservation and restoration of natural habitats, creation of conservation and management plans that ensure the participation of local communities, promotion and support of sustainable agricultural practices, and making legal regulations for the official recognition and protection of traditional knowledge and practices. These conservation policies offer an important perspective on protecting the future and ensuring the sustainability of herbs consumed as vegetables in Kyrgyzstan. The conservation and sustainable use of these plants is vital for the future of both the natural environment and local culture.

CONCLUSION

Kyrgyzstan is one of the Central Asian countries known for its rich natural resources and steppe areas. The geographical structure and climate of the country allow various vegetables to be grown and used by the society. Herbs that can be consumed as vegetables are an important part of Kyrgyz cuisine and have an important role in economic, social and cultural aspects.

In Kyrgyzstan, edible plants play an important role in local markets and trade. Especially in Bishkek and other major cities, there are markets selling various herbs and greens. These herbs are sold fresh or dried to generate income. Some of them are exported and contribute to the country's economy. Especially in recent years, with the increase in healthy eating trends, the demand for organic and natural products has increased, which has increased the commercial value of vegetable herbs in Kyrgyzstan. In many parts of the world, edible herbs are included in people's nutrition, diet and rituals like cultivated vegetables and grains. In Kyrgyzstan, which has a unique ecological structure, the etymological and sociological discovery of such plants used in the past is of great importance for the continuity of our cultural heritage. Examining and listing these species in detail is very important for our healthier and more sustainable life. Developing rules to prevent excessive collection of species and cultivating edible herbs are very important for the continuity of these valuable species in Kyrgyzstan, and it is necessary to focus on these issues.

References

Alekseev, Z. (1971). ТравянистыерастенияСССР. хрен.

Anonymous. (2010). Лукчёрно-красный (*Allium atrosanguineum* Kar. & Kir. or Schrenk). Available from: https://fungi.su/articles.php?article_id=455.

Anonymous. 2021. Purslane: Nutrition, Benefits, and Uses, in Medical News Today.

Anonymous. (2022). Natural Medicines Database. Available from: https://naturalmedicines.therapeuticresearch.com/databases/food,-herbs supplements/professional.aspx?productid=1280.

Anonymous. (2024). Natural Medicines Comprehensive Database. Horseradish Monograph. Available from: https://naturalmedicines.therapeuticresearch.com/databases/food,-herbs-supplements

Asanov, Y. (2010). Суукымыздык, in Суусамыр: Энциклопедия.

Asanov, Y. 2012). Кызыл пияз, Кыргыз мамлекеттик энциклопедиясы.

Atakulov, A. (2018). The role of agriculture in the economy of Kyrgyzstan. Mediterranean Journal of Social Sciences, p. 131-135.

Bruneton, J. (1999). Pharmacognosy, Phytochemistry, Medicinal Plants. Lavoisier Technique & Documentation, Paris. (In French).

Dorofeeva, D. (1988). Культурная флора СССР. Rumex L. - Щавель.

Dural, A., Korakaki, RSV. (2018). Asphodelus aestivus: a Wild Edible Plant in Crete, Greece. Proceedings of the International Conference on Food Innovation.

Gruenwald, JBT., Jaenicke C. (2007). PDR for Herbal Medicines. Thomson Healthcare.

Harkevich, CC. (1991). Сосудистые растения советского Дальнего Востока. p. 105-109.

He, S., Tang, Y., Qin, Y., Chen, Y. (2020). Amaranthus: a comprehensive review on its nutritional properties and health benefits. Food and Function.

Kaya, Z. (2017). Amaranthus: A Promising Crop of Future. Journal of Medicinal Plants Studies. p. 01-03.

Kravtcova, M. (2017). Большая российская энциклопедия.

Lazkov, D., Milko, M., Ganybaeva, A. (2016). Борбордук Тянь-Шандын өзгөчө корголуучу жаратылыш аймактарынын флора жана фауна атласы (КыргызРеспубликасы).

Nosal, MA. 1959. Лекарственные растения испособы их применения в народе. мальва.

Nurmatova, A. (2018). Каакым-күкүм. Кыргыз медия 2018; Available from: https://ru.kyrgyzmedia.kg/oduvanchik-kaakym-k-k-m/.

Stuart, M. (2007). The Encyclopedia of Herbs and Herbalism, in Hermes House. ISBN: 9780517353264.

Ulbricht, CBE., Cheung, L., et al. (2012). Evidence-Based Systematic Review of Horseradish Natural Standard Research Collaboration.

THE CURRENT STATE OF GREENHOUSE AGRICULTURE IN KYRGYZSTAN

Myrzagul SHARSHEBAEVA

Kyrgyz-Turkish Manas University, Faculty of Agriculture, Department of Horticulture and Agronomy, Bishkek, Kyrgyz Republic

ORCID ID: https://orcid.org/0009-0007-2870-528X

Assoc. Prof. Dr. Eren ÖZDEN

Igdir University, Faculty of Agriculture, Department of Horticulture, Igdir, Türkiye

Kyrgyz-Turkish Manas University, Faculty of Agriculture, Department of Horticulture and Agronomy, Bishkek, Kyrgyz Republic

ORCID ID: https://orcid.org/0000-0001-7507-9815

Abstract

Kyrgyzstan is a country located in Central Asia with land highly suitable for agriculture. The agricultural sector holds a significant place in the country's economic and social fabric, with a substantial portion of the population engaged in farming. Greenhouse agriculture, one of the modern farming methods, is the practice of growing plants in controlled environments under structures like greenhouses or tunnels. This study examines the current state of greenhouse agriculture in Kyrgyzstan and provides recommendations for increasing the number of greenhouse structures. In Kyrgyzstan, greenhouse farming is applied in various regions for different purposes. These practices are generally carried out for off-season crop production, plant protection, increased productivity, and enhancing agricultural income. Greenhouse farming in Kyrgyzstan has started to be recorded and become widespread in the last 10 years. As of January 1, 2023, the total number of greenhouses operating in Kyrgyzstan reached 1,765, covering an area of 203.1 hectares. Most greenhouses in Kyrgyzstan are small and operated as family businesses. The Jalal-Abad, Chuy, and Osh regions are the areas where greenhouse farming is most intensively practiced. Small greenhouses are made of plastic materials, while larger enterprises consist of polycarbonate greenhouses. To improve the current state of greenhouse agriculture in Kyrgyzstan, priority should be given to addressing issues such as infrastructure deficiencies, financing challenges, educational needs, and marketing problems. These issues hinder the broader adoption of greenhouse farming and limit the sector's development. Due to its proximity to major consumer countries like China, Russia, and Kazakhstan, products that can be produced with high quality in greenhouses have the potential for easy export opportunities. Closing the gap in trained personnel, raising awareness among producers, and ensuring market logistics should be among the primary goals to increase productivity and quality.

Key Words: Central Asian greenhouse, Greenhouse farming, Greenhouses in Kyrgyzstan, Kyrgyzstan agriculture, Vegetable production in Kyrgyzstan

ÖZET

Kırgızistan, tarıma son derece elverişli arazilere sahip olan Orta Asya'da bulunan bir ülkedir. Tarım sektörü, ülkenin ekonomik ve sosyal yapısında önemli bir yere sahiptir ve nüfusun büyük bir kısmı çiftçilikle uğraşmaktadır. Modern tarım yöntemlerinden biri olan örtüaltı tarımı, bitkilerin seralar veya tüneller gibi kontrollü ortamlarda yetiştirilmesi uygulamasıdır. Bu çalışma, Kırgızistan'daki örtüaltı tarımının mevcut durumunu incelemekte ve sera yapılarının sayısını artırmaya yönelik önerilerde bulunmaktadır. Kırgızistan'da örtüaltı tarımı, farklı amaçlar için çeşitli bölgelerde uygulanmaktadır. Bu uygulamalar genellikle mevsim dışı ürün üretimi, bitki koruma, verimliliği artırma ve tarımsal geliri artırma amacıyla gerçekleştirilmektedir. Kırgızistan'da örtüaltı tarımı son 10 yılda kaydedilmeye başlanmış ve yaygınlaşmıştır. 1 Ocak 2023 itibarıyla Kırgızistan'da faaliyet gösteren sera sayısı 1.765'e ulaşmış ve bu seralar toplam 203.1 hektar alanı kaplamaktadır. Kırgızistan'daki seraların çoğu küçük ve aile işletmeleri olarak faaliyet göstermektedir. Örtüaltı tarımının en yoğun uygulandığı bölgeler Calal-Abad, Çüy ve Oş bölgeleridir. Küçük seralar plastik malzemelerden yapılmışken, daha büyük işletmeler polikarbonat seralardan oluşmaktadır. Kırgızistan'da örtüaltı tarımının mevcut durumunu iyileştirmek için altyapı eksiklikleri, finansman sorunları, eğitim ihtiyaçları ve pazarlama problemleri gibi konulara öncelik verilmelidir. Bu sorunlar, örtültı tarımının daha geniş çapta benimsenmesini engellemekte ve sektörün gelişimini sınırlamaktadır. Çin, Rusya ve Kazakistan gibi büyük tüketici ülkelere olan yakınlığı nedeniyle, seralarda yüksek kalitede üretilebilecek ürünler kolay ihracat fırsatlarına sahip olabilecektir. Eğitimli personel açığının kapatılması, üreticilerin bilinçlendirilmesi ve pazar lojistiğinin sağlanması, verimliliği ve kaliteyi artırmak için öncelikli hedefler arasında olmalıdır.

Anahtar Kelimeler: Orta Asya seracılığı, Örtüaltı tarımı, Kırgızistan'da seracılık, Kırgızistan tarımı, Kırgızistan'da sebze üretimi

INTRODUCTION

The agricultural sector plays a key role in the economic and social development of many countries, today. However, factors such as changing climate conditions, increasing population, and limited use of natural resources have led to questioning traditional farming methods and seeking alternative production models. In this context, greenhouse agriculture stands out as one of the modern agricultural practices.

Greenhouse farming, an innovative approach used to increase efficiency in the agricultural sector and accelerate harvest cycles, has gained increasing importance in recent years. Greenhouse farming refers to agricultural activities carried out in artificial environments such as greenhouses and tunnels. It allows for production throughout all four seasons, independent of climatic conditions, in a controllable environment. This method is used for the cultivation of both vegetables and fruits and can play a significant role in the future of agriculture.

Today, we see that greenhouse areas in the world are concentrated in three regions. The largest concentration area is the Mediterranean Basin, where 40% of the total greenhouse areas are located. The second center is the Far East, which accounts for approximately 35% of global greenhouse cultivation. The third major center is the Central-Western European countries, with a 15% share. The remaining 10% is distributed across other regions (Bennetzen et al., 2016).

At the country level, Spain ranks first in terms of the number of greenhouses, followed by China, Japan, and Turkey; then South Korea, Italy, and Israel. Countries with greenhouse areas ranging from 10 to 15 thousand hectares include the USA, France, Morocco, and the Netherlands. The top 11 countries hold approximately half of the world's greenhouse assets, while the remaining countries share the other half (Badji et al., 2022).

The aim of this study is to examine the current state of greenhouse farming in Kyrgyzstan and to scientifically present the problems and opportunities encountered in this field. The main objective of the research is to seek answers to the questions of where and how much greenhouse farming is done in Kyrgyzstan, what types of structures are used, and what is produced, and to develop solutions based on these answers. In this context, it aims to provide information for policymakers, farmers, researchers, and other relevant stakeholders.

To this end, the following research questions have been focused on:

What is the current state of greenhouse farming in Kyrgyzstan?

What is the role and importance of greenhouse farming in the agricultural sector of Kyrgyzstan?

What are the advantages and disadvantages of greenhouse farming in Kyrgyzstan?

How can the future of greenhouse farming in Kyrgyzstan be shaped?

These research questions have been used to understand the current state of greenhouse farming in Kyrgyzstan and to identify potential development areas in the sector.

AGRICULTURE IN KYRGYZSTAN

Kyrgyzstan is a country located in Central Asia with land highly suitable for agriculture. The agricultural sector holds a significant place in the country's economic and social fabric, with a substantial portion of the population engaged in farming (Anonymous, 2021).

The agricultural sector in Kyrgyzstan constitutes a crucial part of the national economy. Despite the extensive agricultural land, agricultural productivity is low, and modern agricultural technology is not widespread. Agriculture serves as a livelihood, particularly for people living in rural areas, with many families relying on farming for their sustenance.

In Kyrgyzstan's agricultural sector, farmers, cooperatives, agricultural enterprises, and state institutions play important roles. While small family farms form the backbone of agriculture, large-scale enterprises also exist. Additionally, a number of cooperatives and private sector entities operate within the agricultural sector.

The Kyrgyzstan government implements various policies to support and develop the agricultural sector. These policies generally aim to increase agricultural production, support farmers, strengthen agricultural infrastructure, and improve marketing opportunities. However, inconsistencies and inadequacies in policy implementation frequently cause problems (Anonymous, 2021).

Kyrgyzstan's agricultural sector faces a number of challenges, including low productivity, infrastructure deficiencies, the impacts of climate change, marketing issues, and financial difficulties. Additionally, demographic issues such as labor shortages in the agricultural sector and the tendency of the young population to migrate from rural areas are also present (Chi et al., 2020).

GREENHOUSE FARMING PRACTICES IN KYRGYZSTAN

In Kyrgyzstan, greenhouse farming is practiced in different regions for various purposes. These practices are generally carried out to grow off-season products, protect plants, increase productivity, and boost agricultural income. Here's how greenhouse farming is applied in various regions of the country, along with the techniques and methods used:

Issyk-Kul Region: One of the most important agricultural regions of Kyrgyzstan, where greenhouse farming is widely practiced. It is rich in geothermal hot water sources. In this region, modern greenhouse farming techniques are used, especially for growing fruits and vegetables in greenhouses. The fertile lands around Lake Issyk-Kul provide a suitable ground for the development of greenhouse farming.

Chuy Region: An agricultural region located in the north of Kyrgyzstan. In this region, greenhouse farming is generally used for vegetable cultivation. Small-scale family businesses grow vegetables using simple greenhouses covered with plastic sheets.

Osh Region: An agricultural center located in the south of Kyrgyzstan, it is the region with the highest average temperature in the country. In this region, greenhouse farming is generally used for growing off-season products. Particularly around Osh city, modern greenhouses and covered structures are used to cultivate fruits, vegetables, and flowers.

Jalal-Abad Region: Similar to the Osh region, it is one of the southern regions of the country, with an annual average temperature above the national average. Early-season greenhouse production is common.

Batken Region: The southwestern region of the country. Along with the Osh and Jalal-Abad regions, it is one of the hottest regions and intensive agriculture is practiced. In this region, early-season greenhouse farming is primarily carried out in plastic greenhouses and tunnels.

Talas Region: Located in the west of Kyrgyzstan, greenhouse farming is less common in this region, but the use of modern agricultural techniques is gradually increasing. Especially around Talas city, covered structures such as plastic greenhouses are being set up for vegetable cultivation.

Naryn Region: A region located in the central part of the country, generally characterized by a mountainous and semi-arid climate. The use of greenhouse farming is more limited in this region, but in some areas, geothermal greenhouse farming and other covered farming techniques are known to be applied.

The way and prevalence of greenhouse farming in different regions of Kyrgyzstan vary depending on factors such as climatic conditions, soil structure, and local agricultural traditions. However, in recent years, the use of greenhouse farming has increased across the country, and modern agricultural techniques have been adopted.

Overview of Greenhouse Farming in Kyrgyzstan

Greenhouse farming is a relatively new production branch in Kyrgyzstan, with statistics being recorded since 2010. However, the number of greenhouse producers and the presence of greenhouses are increasing each year. Despite numerous ecological disadvantages, they have great potential in terms of geothermal water (up to 20,000 hectares, Issyk-Kul-Tamchi). Currently, 85% of the greenhouse products sold in the Kyrgyz market during winter are imported from countries such as Uzbekistan, Kazakhstan, Turkey, and China, with Kyrgyzstan-produced greenhouse vegetables holding about 15% of the market share (Anonymous, 2018). Greenhouse-produced vegetables are sold at high prices, competing with meat prices. Despite the climatic disadvantages, greenhouse production is profitable due to high prices.

According to a press release from the Kyrgyzstan Ministry of Agriculture, as of December 1, 2023, the total number of greenhouses operating in Kyrgyzstan is 1,765, with a total area of 203.1 hectares (Table 3.1).

Table 3.1 Greenhouses and their sizes by region in Kyrgyzstan as of 2023 (Anonymous, 2023)

Region (Oblast)	Structured area	Number of greenhouse structures
Chuy Region	53 hektar	265 adet
Issyk-Kul Region	5 hektar	74 adet
Naryn Region	5 hektar	38 adet
Talas Region	4 hektar	15 adet
Osh Region	53 hektar	370 adet
Batken Region	13,1 hektar	191 adet
Jalal-Abad Region	70 hektar	812 adet

The figures given are 1.5 times higher than in 2022 (Anonymous, 2023). Greenhouses are built mostly in the Jalal-Abad, Batken, Osh and Chuy regions. Greenhouses are being built and operated in the country by companies originating from South Korea, China and Russia. In addition, on the advice of local experts, farmers themselves build and operate various types of greenhouses using only available spare parts and equipment. The main purpose of greenhouse construction is to obtain sufficient income at minimum cost by arranging and developing agricultural areas in the Kyrgyz Republic, ensuring food security of the country's population.

Greenhouse farming systems commonly used in Kyrgyzstan

Plastic film greenhouses: Plastic film greenhouses are one of the most widely used greenhouse systems in Kyrgyzstan. These greenhouses are covered with durable plastic films stretched over metal or wooden frames. Due to their low costs and easy installation, they are especially preferred by small farmers and home garden growers.

Glass greenhouses: This system is preferred by larger-scale commercial greenhouse enterprises. Glass greenhouses consist of steel or aluminum frames covered with double-glazed panels. They are more durable and long-lasting but come with higher costs.

Polycarbonate greenhouses: PCA greenhouses are made of steel or aluminum frames covered with durable and lightweight polycarbonate sheets. These greenhouses provide the thermal insulation and light transmission benefits offered by glass greenhouses.

Soilless systems: In soilless systems, plants are grown in media such as peat, rock wool, cocopeat, or in hydroponic systems where the roots are in water or a nutrient solution. These methods allow for more efficient use of water and nutrients and improve plant growth. In recent years, soilless systems have been gaining increasing popularity in Kyrgyzstan's greenhouse farming. These systems offer a range of advantages over traditional soil-based agriculture, including higher efficiency, water savings, protection from soil-borne diseases, and the creation of a controlled environment. These advantages have led to the growing popularity and adoption of soilless systems by greenhouse enterprises in the country. For example, a South Korean private sector enterprise named "In Water Solutions Agro," established in the Chuy region, practices soilless farming. These greenhouses use soilless systems to produce vegetables and fruits. In Water Solutions Agro's greenhouses cover a total area of 10 hectares, making them the largest covered farming enterprises in the Chuy region (Figure 3.1).

Figure 3.1 Views from inside private sector (In Water Solutions Agro) greenhouses

"Eco Jemish", another large-scale greenhouse agriculture enterprise in the country, attracts attention in Kyrgyzstan as a business working with hydroponic systems. The greenhouses of this enterprise are located throughout Kyrgyzstan in the Jalal-Abad and Sokuluk regions. Off-season strawberry production is carried out in these greenhouses (Figure 3.2).

Figure 3.2 View from the strawberry greenhouses of Eco Jemish

In Kyrgyzstan, 30% of the products grown in greenhouses are exported, while 70% are sold in domestic markets. In recent years, Kyrgyzstan has made significant strides in greenhouse farming and plant protection. This can be attributed to the increased interest in using greenhouses, especially for growing vegetables and flowers, and the rise in consumption of these products. Greenhouse enterprises have now become an integral part of Kyrgyzstan's agriculture, providing fresh vegetables and fruits year-round and creating additional opportunities for farmers. However, regional farmers generally use greenhouses for themselves and the local population. They also sell their products in local markets. These greenhouses are typically small-scale and generally small in size. Only a few farmers have succeeded in this sector and can export to neighboring countries.

The main products commonly grown in greenhouses in Kyrgyzstan include tomatoes, cucumbers, peppers, strawberries, flowers, and greens. Additionally, vegetable and flower seedling production is widely carried out in greenhouse tunnels. There is a growing interest among producers in covered structures due to the advantages of controlling climate conditions, protecting plants from external factors, and achieving high yields.

Research and experimental greenhouses often use polycarbonate materials. Universities that provide education in agriculture are constructing greenhouses and tunnels for teaching and practical purposes. For example, the Agricultural University and Kyrgyzstan-Turkey Manas University (KTMU) are setting up Polycarbonate Greenhouses (Figure 3.3).

Figure 3.3 Kyrgyz-Turkish Manas University (KTMU) Faculty of Agriculture application greenhouse

Although greenhouse agriculture is increasing day by day in Kyrgyzstan, there are still a number of problems and difficulties in the development of the sector. These problems include high costs for the construction and equipment of greenhouses, limited access to financing, lack of qualified personnel and technical support, as well as the lack of effective mechanisms for marketing and distribution of products grown in greenhouses.

PROBLEMS AND SOLUTION SUGGESTIONS IN GREENHOUSE FARMING IN KYRGYZSTAN

Infrastructure Deficiencies:

Problem: Kyrgyzstan lacks the necessary infrastructure to expand greenhouse farming. There are inadequacies in greenhouse facilities, irrigation systems, fertilization infrastructure, and energy sources.

Solution Proposals: The government and relevant institutions need to invest in developing greenhouse farming infrastructure.

Prioritize infrastructure projects to provide modern greenhouse facilities, irrigation systems, and energy sources.

Collaborate with the private sector and international organizations to support infrastructure improvements.

Financial Difficulties:

Problem: There is insufficient financing to start and sustain greenhouse farming. Farmers face challenges in accessing enough resources for greenhouse equipment, seeds, fertilizers, and irrigation systems.

Solution Proposals: The government should provide financial incentives and credit opportunities to support the agricultural sector.

Low-interest credit programs, grants, and agricultural insurance can help farmers.

Encouraging private banks to provide more loans to the agricultural sector is also important.

Educational Needs:

Problem: Successful implementation of greenhouse farming requires technical knowledge and skills. However, farmers and agricultural workers often lack sufficient training and technical knowledge.

Solution Proposals: Agricultural education and advisory services need to be expanded and strengthened.

The government should train agricultural experts and provide technical knowledge and education to farmers through agricultural institutes and vocational training institutions.

Regular training programs on agricultural technologies and modern farming practices should be organized.

Marketing Problems:

Problem: The marketing and distribution of products is another challenge faced by greenhouse farming. The lack or inefficiency of marketing channels can make it difficult for farmers to sell their products and reduce their income.

Solution Proposals: Strengthening marketing infrastructure and developing marketing skills is important.

Agricultural cooperatives and unions can be effective tools for the collective marketing and distribution of products.

Using digital marketing techniques and providing farmers with marketing training can also be beneficial.

Future Perspectives

Potential Growth Areas:

Potential growth areas in greenhouse farming in Kyrgyzstan include the use of technological innovations and methods to increase efficiency. Especially, the spread of innovative applications such as automation technologies, smart irrigation systems, and climate-controlled greenhouses is expected.

In addition to the local market, increasing production and marketing activities aimed at exports is also one of the potential growth areas for greenhouse farming. Developing trade relations with neighboring countries and increasing access to international markets for agricultural products is important.

Innovative Practices:

In the future, the importance of innovative practices to make greenhouse farming more sustainable and environmentally friendly will increase. Topics such as organic farming methods, greenhouse systems based on renewable energy sources, and waste management are expected to be emphasized more.

Another innovative practice area is the use of digital agricultural technologies. The use of smart farming applications, data analytics, and remote monitoring systems in greenhouse farming is expected to become more widespread.

Future Trends:

Future trends in the greenhouse farming sector in Kyrgyzstan will include combating environmental and climate change, efficient use of water resources, and digitalization of agriculture.

Additionally, changes in consumer demands will determine future trends. The increasing demand for healthy and organic products may trigger a rise in organic product production in greenhouse farming.

Supportive Policies:

It is important for the Kyrgyzstan government to adopt and implement appropriate policies to support the greenhouse farming sector. Policies encouraging the digitalization of agriculture, incentives supporting capital investments, and programs offering technical education and advisory services to farmers should be prioritized.

CONCLUSION

The current state and future of greenhouse farming in Kyrgyzstan form an important part of the country's agricultural sector. Increasing and developing the use of this method can enhance the country's food security and contribute to the agricultural economy. Greenhouses are a vital tool in addressing food security shortages and combating climate change. It is crucial to continue investing in research and development in this field. With the right investments and focus, greenhouses can play a significant role in solving issues and making them more accessible and sustainable. This, in turn, can contribute to feeding the global population and creating a sustainable future for all.

In conclusion, this study on the current state of greenhouse farming in Kyrgyzstan serves as an important resource for understanding the transformation of the country's agricultural sector and determining future strategies. The findings of this study can guide agricultural policymakers, farmers, and other relevant stakeholders to make the most of the potential of greenhouse farming.

References

Anonymous. (2018). Development of Greenhouse Agriculture in Kyrgyzstan. Development of Greenhouse Agriculture in Kyrgyzstan. Reports of the Kyrgyz Ministry of Agriculture. теплиц функционируют в Кыргызстане — Минсельхоз

Anonymous. (2021). Kyrgyzstan Agricultural Policies Report 2021. Kyrgyzstan Ministry of Agriculture. Bishkek, Kyrgyzstan.

Anonymous. (2022). Kyrgyz Republic Agriculture Sector Overview. [Online]. Online access, 2021. https://climateknowledgeportal.worldbank.org/sites/default/files/2019-06/CSA%20_Profile_The%20Kyrgyz%20Republic.pdf

Anonymous. (2023). Ministry of Agriculture of Kyrgyzstan. Press Service, Bishkek. Умная ферма IWS | Многостороннее агентство по инвестиционным гарантиям

Badji, A., Benseddik, A., Bensaha, H., Boukhelifa, A., Hasrane, I. (2022). Design, technology, and management of greenhouse: A review. Journal of Cleaner Production. 373, 133753.

Bennetzen, EH., Smith, P., Porter, JR. (2016). Agricultural production and greenhouse gas emissions from world regions—The major trends over 40 years. Global Environmental Change. 37, 43-55.

Chi, G., Gao, J., Wang, D., Hagedorn, A., Kelgenbaeva, K., Smith, ML., Henebry, GM. (2020). Agricultural production at the oblast level in post-Soviet Kyrgyzstan, 1990–2014: Implications of demographic and climate changes. Research in Globalization. 2, 100027.

THE CURRENT STATE OF VEGETABLE GROWING IN KYRGYZSTAN

Cyldyz ASKANBEKOVA

Kyrgyz-Turkish Manas University, Faculty of Agriculture, Department of Horticulture and Agronomy, Bishkek, Kyrgyz Republic

ORCID ID: https://orcid.org/0009-0006-7791-2034

Assoc. Prof. Dr. Eren ÖZDEN

Igdir University, Faculty of Agriculture, Department of Horticulture, Igdir, Türkiye

Kyrgyz-Turkish Manas University, Faculty of Agriculture, Department of Horticulture and Agronomy, Bishkek, Kyrgyz Republic

ORCID ID: https://orcid.org/0000-0001-7507-9815

Abstract

Vegetables have been fundamental elements in nutrition since the beginning of human history. This study presents a general investigation of the current state of vegetable growing in Kyrgyzstan. The aim of the research is to highlight the positive and negative aspects of Kyrgyzstan's vegetable cultivation in comparison to the world, based on regions and cities, and to make recommendations for increasing vegetable production. The study found that the highest vegetable production in Kyrgyzstan takes place in the Chuy, Issyk-Kul, and Osh regions. While many types of vegetables can be grown, potatoes, tomatoes, carrots, and onions are the most widely cultivated and produced vegetables. The most traded vegetables within the country are tomatoes, carrots, and onions, with the highest exports in carrots, onions, and cabbage, and the highest imports in tomatoes, carrots, and onions. The presence of favorable natural and climatic conditions suitable for growing various high-quality vegetable types is the country's greatest advantage. Additionally, having adequate water resources offers significant opportunities for vegetable cultivation, which requires a high-water demand. Due to the small size and low yield of existing vegetable production areas, it is of great importance to increase the volume and yield of vegetable planting through the adoption of modern agricultural methods. The regional proximity to the markets of China, Russia, and Kazakhstan, where there is high demand for Kyrgyz products and marketing opportunities, provides a significant sales advantage. It is crucial to organize incentive programs by state institutions to develop vegetable cultivation in Kyrgyzstan, as high-yield and quality vegetable production can help increase the income levels of the local population.

Key Words: Central Asian vegetable growing, Kyrgyzstan agriculture, Vegetable farming, Vegetable growing in Bishkek, Vegetable growing in Kyrgyzstan

ÖZET

Sebzeler insanlık tarihinin başlangıcından bu yana beslenmede temel unsurlar olmuştur. Bu çalışma, Kırgızistan'daki sebze yetiştiriciliğinin mevcut durumunu genel olarak incelemektedir. Araştırmanın amacı, Kırgızistan'ın sebze yetiştiriciliğinin dünya genelindeki bölge ve şehirlere göre pozitif ve negatif yönlerini ortaya koymak ve sebze üretimini artırmak için önerilerde bulunmaktır. Çalışma, Kırgızistan'da en yüksek sebze üretiminin Çuy, Issık-Kul ve Oş bölgelerinde gerçekleştiğini göstermiştir. Kırgızistan'da birçok sebze türünün yetiştirilebildiği ancak en çok patates, domates, havuç ve soğanın en yaygın olarak yetiştirilen sebzeler olduğu belirlenmiştir. Ülke içinde en çok ticareti yapılan sebzeler domates, havuç ve soğan olup, en fazla ihracat yapılanlar havuç, soğan ve lahanadır. En fazla ithalat ise domates, havuç ve soğanda gerçekleşmektedir. Yüksek kaliteli çeşitli sebze türlerini yetiştirmek için uygun doğal ve iklim koşullarına sahip olmak ülkenin en büyük avantajıdır. Ayrıca yeterli su kaynaklarına sahip olmak, yüksek su talebi gerektiren sebze yetiştiriciliği için önemli fırsatlar sunmaktadır. Mevcut sebze üretim alanlarının küçük boyutlu ve düşük verimli olması nedeniyle modern tarımsal yöntemlerin benimsenmesiyle üretim hacmini ve verimini artırmak büyük önem taşımaktadır. Çin, Rusya ve Kazakistan gibi pazarlara olan bölgesel yakınlık, Kırgız ürünlerine yüksek talep ve pazarlama fırsatları sağlamaktadır. Yüksek verim ve kaliteli sebze üretimi, yerel halkın gelir düzeylerini artırabileceğinden devlet kurumları tarafından teşvik programları düzenlemek, Kırgızistan'da sebze yetiştiriciliğini geliştirmek için önemlidir.

Anahtar kelimeler: Bişkek'te sebzecilik, Kırgızistan'da sebze yetiştiriciliği, Kırgızistan tarımı, Orta Asya sebzeciliği, Sebze yetiştiriciliği

INTRODUCTION

Vegetable cultivation plays an important role in global agriculture and nutrition, significantly impacting human health and the economies of various countries. The benefits and importance of vegetable cultivation for the world are substantial and multifaceted.

Vegetables are an important source of vitamins, minerals, dietary fiber, and antioxidants. They reduce the risk of developing many chronic diseases, such as cardiovascular diseases, certain types of cancer, and type 2 diabetes. Expanding and improving vegetable production helps ensure food security. Vegetables can be grown on small and scattered lands, allowing even the poor to cultivate them. Additionally, they require less time to grow compared to cereal crops, enabling multiple harvests per year (Kaiser et al., 2014).

Vegetable cultivation can be a significant source of income for both large agricultural enterprises and small farmers. Thanks to their short growing periods and high efficiency relative to costs, vegetable cultivation becomes a profitable activity. Vegetable exports also help increase the income of a country.

The diversity of vegetable plants and their production methods helps reduce the risks associated with diseases and pests and contributes to the sustainability of agricultural ecosystems. Growing a wide variety of vegetable products aids in preserving plant genetic diversity, which is critical for adapting to climate change and combating new pests and diseases. Intensive vegetable production, when done sustainably, can reduce the need for chemical fertilizers and pesticides, thereby reducing pollution and conserving natural resources (Yanmaz et al., 2020). Therefore, the development and support of vegetable production not only contribute to improving the health and nutrition of the world's population but also play a critical role in achieving sustainable development goals such as eradicating hunger, reducing poverty, and combating climate change.

The vegetable cultivation sector is a large industry that includes seed production, seedling cultivation, greenhouse farming, irrigation, fertilization, agricultural pest control systems, smart farming techniques, packaging, and marketing sectors.

AGRICULTURE IN KYRGYZSTAN

The agricultural sector significantly contributes to the national income, employment, and foreign trade of Central Asian economies. Indeed, agriculture is a very important sector for the economy in Kyrgyzstan.

In Kyrgyzstan, tobacco, cotton, potatoes, various types of vegetables, grapes, strawberries, and other fruits hold significant places in agriculture. The most produced products, in parallel with livestock farming, are animal feed types. Following these, winter wheat, barley, rice, and corn come second. In 2019, more than 440,000 enterprises were registered in agriculture, forestry, and fisheries in Kyrgyzstan, with 75.6% consisting of farmer associations and 24.2% private agricultural enterprises. In 2022, the total arable land was 1,216.7 thousand hectares. The most cultivated vegetables are potatoes (approximately 1.257 million tons), tomatoes (247.474 tons), cucumbers (126.811 tons), beans (95 tons), and melons and watermelons (250 tons) (FAOSTAT, 2024).

The agricultural sector is of great importance as it provides income for a large part of the population of the Kyrgyz Republic. Agriculture accounts for 15% of the country's total GDP and 40% of the economically active population working in this sector. While only 6.8% of the total land area is used for crop production, 44% of the land is used as pastures for livestock. More than 64% of the population, which is approximately 7.2 million, lives in rural areas, and most agricultural activities are carried out by families on small plots of land. Between 2012 and 2016, about 9.9% of total exports and 14.9% of total imports came from the agricultural sector (NSCK, 2020).

Vegetable cultivation plays an important role in the agricultural sector of Kyrgyzstan. The country's land use varies due to unique natural and climatic conditions that allow the cultivation of a wide variety of vegetable types. Primarily, livestock farming holds a significant place in the agricultural economy due to Kyrgyzstan's mountainous terrain. The Fergana, Chuy, and Talas regions are the most suitable areas for agriculture.

Kyrgyzstan has rich and fertile soils, and the local climate, characterized by hot summers and relatively mild winters, creates favorable conditions for vegetable cultivation. Although vegetable production is spread across almost every region of the country, its proportion in total production varies depending on the ecological structure and size of the region. In addition to these traditional vegetables unique to the region's ecology, some farmers are also trying to experiment with more exotic varieties and adapt them to local conditions.

CURRENT SITUATION OF VEGETABLE GROWING IN KYRGYZSTAN

The development of vegetable cultivation in Kyrgyzstan is closely linked to the development of irrigation systems, as most types of vegetables require abundant irrigation. The government and various international organizations are investing in the establishment and modernization of irrigation systems that allow for increased productivity and the expansion of vegetable cultivation areas.

Another important aspect is the initiatives taken towards transitioning to organic vegetable cultivation in Kyrgyzstan. This is due to the increasing domestic demand for organic products as well as the potential for exporting these organic products to high-income countries where the demand for such products is also rising.

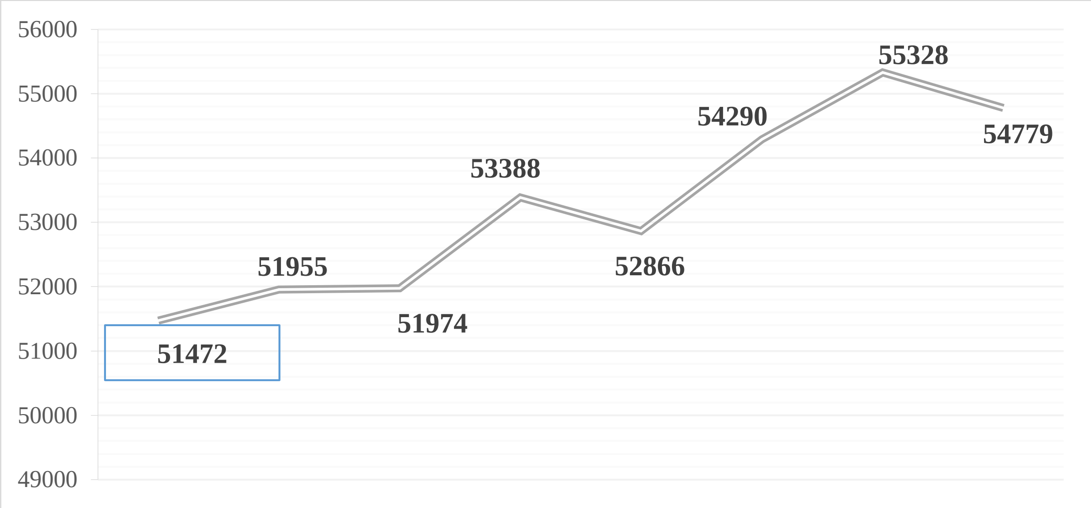


Figure 3.1 Vegetable production area (hectare) in Kyrgyzstan between 2016 and 2023 (Anonymous, 2024)

Although the amount of vegetable production area in Kyrgyzstan shows a small annual increase-decrease, there has been a significant increase in the amount of vegetable production area in the last 8 years (Figure 3.1).

Table 3.1 Kyrgyzstan's vegetable cultivation areas (in hectares) are distributed across its regions and the special cities of Bishkek and Osh.

Region (Oblast)	Cultivation area		Difference compared to previous year	
	2022	**2023**	**%**	**+,-**
Batken Region	3593	3481	-3,1	-111
Jalal-Abad Region	12887	12573	-2,4	-314
Issyk-Kul Region	3154	3066	-2,8	-88
Naryn Region	487	490	0,6	3
Osh Region	9710	9764	0,6	55
Talas Region	4790	4548	-5,1	-242
Chuy Region	20155	20240	0,4	75
Bishkek City	153	153	0	0
Osh City	400	463	15,8	63
Kyrgyzstan	**55329**	**54779**	**-1,0**	**-559**

In the year 2023, the total area used for vegetable cultivation was 54,779 hectares, showing a decrease of 1% compared to the previous year. The largest vegetable production area is in the Chuy region, while the smallest is in the Naryn region. In the special administrative cities of Bishkek and Osh, the total areas used for vegetable cultivation were 153 hectares and 463 hectares, respectively. There was no change in land area in Bishkek, whereas Osh saw an increase of 63 hectares compared to the previous year (Table 3.1).

Table 3.2 Cultivation areas of vegetables (hectares) according to cities and districts of Batken Region

City or District Name	Cultivation area		Difference compared to previous year	
	2022	2023	%	+,-
Batken City	320	312	-2,5	-8
Kadamjay City	2024	2026	0,1	2
Leilek City	824	782	-5,1	-42
Razzakov District	140	140	0	0
Batken District	105	107	1,8	2
Kyzyl-Kiya District	317	252	-20,4	-65
Suluktu District	3	3	0	0
Batken Region	3593	3481	-3,1	-111

In Batken region, the total area used for vegetable cultivation in 2023 was 3,481 hectares, which marks a decrease of 111 hectares compared to the previous year. Kadamjay city had the largest cultivated area for vegetables, totaling 2,026 hectares (Table 3.2).

Table 3.3 Cultivation areas of vegetables (hectares) according to cities and districts of Jalal-Abad Region

City or District Name	Cultivation area		Difference compared to previous year	
	2022	2023	%	+,-
Aksy City	347	347	0	0
Kerben District	23	23	0	0
Ala-Buka Cit	2625	1984	-24,4	-641
Bazar-Korgon City	2876	2897	0,7	21
Nooken City	2297	2478	7,9	181
Kochkor-Ata District	39	42	7,7	3
Suzak City	3228	3263	1,1	35
Kök-Jangak City	130	109	-16,2	-21
Toguz-Toroo City	140	140	0	0
Toktogul City	731	847	15,9	116
Chatkal City	292	297	1,7	5
Jalal-Abad District	82	80	-2,4	-2
Kara-Köl District	21	21	0	0
Mailuu-Suu District	16	16	0	0
Tash-Kömür District	232	203	-12,5	-29
Jalal-Abad Region	**12887**	**12573**	**-2,4**	**-314**

In Calal-Abad region, the total area used for vegetable cultivation in 2023 was 12,573 hectares, which is 314 hectares lower than the previous year. Suzak city accounted for the majority of vegetable cultivation with 3,263 hectares (Table 3.3).

Table 3.4 Cultivation areas of vegetables (hectares) according to cities and districts of Issyk-Kul Region

City or District Name	Cultivation area		Difference compared to previous year	
	2022	2023	%	+,-
Ak-Suu City	1010	931	-7,8	-79
Jeti-Oghuz City	875	876	0,1	1
Issyk-Kul City	249	260	4,4	11
Cholpon-Ata District	3	5	66,7	2
Ton City	130	130	0	0
Tüp City	733	718	-2,0	-15
Karakol District	149	144	-3,4	-5
Balykchy District	8	7	-12,5	-1
Issyk-Kul Region	**3154**	**3066**	**-2,8**	**-88**

In Isyk-Gol region, the total area used for vegetable cultivation in 2023 was 3,066 hectares, representing a decrease of 2.8%, or 88 hectares, compared to the previous year. The majority of vegetable cultivation in the region, totaling 931 hectares, was conducted in Ak-Suu city (Table 3.4).

Table 3.5 Cultivation areas of vegetables (hectares) according to cities and districts of Naryn Region

City or District Name	Cultivation area		Difference compared to previous year	
	2022	2023	%	+,-
Ak-Talaa City	71	70	-1,4	-1
At-Bashi City	59	62	5,1	3
Cumgal City	170	170	0	0
Kochkor City	74	74	0	0
Naryn City	106	107	0,9	1
Naryn District	7	7	0	0
Naryn Region	**487**	**490**	**0,6**	**3**

In Narın region, the total area used for vegetable cultivation in 2023 was 490 hectares, which reflects an increase of 3 hectares, or 0.6%, compared to the previous year. The majority of vegetable production, totaling 170 hectares, was in Cumgal city (Table 3.5).

Table 3.6 Cultivation areas of vegetables (hectares) according to cities and districts of Osh Region

City or District Name	Cultivation area		Difference compared to previous year	
	2022	2023	%	+,-
Alay City	136	136	0	0
Aravan City	2257	2252	-0,2	-5
Kara-Kulja City	409	409	0	0
Kara-Suu City	3577	3630	1,5	53
Kara-Suu District	3	3	0	0
Nookat City	1597	1611	0,9	14
Nookat District	1	1	0	0
Uzgen City	1721	1714	-0,4	-7
Uzgen District	55	50	-9,1	-5
Chon-Alay City	13	13	0	0
Osh Region	**9710**	**9764**	**0,6**	**55**

In Osh region, the total area used for vegetable cultivation in 2023 was 9,764 hectares, marking an increase of 55 hectares compared to the previous year. The majority of vegetables were grown in Kara-Suu city on an area of 3,630 hectares (Table 3.6).

Table 3.7 Cultivation areas of vegetables (hectares) according to cities and districts of Talas Region

City or District Name	Cultivation area		Difference compared to previous year	
	2022	**2023**	**%**	**+,-**
Bakay-Ata City	855	872	2,0	17
Aytmatov City	637	638	0,2	1
Manas City	2810	2550	-9,3	-260
Talas City	404	404	0	0
Talas District	84	84	0	0
Talas Region	**4790**	**4548**	**-5,1**	**-242**

In Talas region, the total area used for vegetable cultivation in 2023 decreased by 242 hectares from the previous year to 4,548 hectares. The majority of vegetable production, totaling 2,550 hectares, was in Manas city (Table 3.7).

In the Chuy region, the total cultivated area is 20,240 hectares, which represents an increase of 75 hectares, or 0.4%, from the previous year. The majority of vegetable production, totaling 4,862 hectares, was in the city of Moskova (Table 3.8).

Based on the information provided, it appears that there has been a slight decrease in the area used for vegetable cultivation compared to the previous year in most regions of Kyrgyzstan. However, there have been increases observed in the Chuy, Osh, and Narın regions.

Table 3.8 Cultivation areas of vegetables (hectares) according to cities and districts of Chuy Region

City or District Name	Cultivation area		Difference compared to previous year	
	2022	**2023**	**%**	**+,-**
Alamüdün City	3356	3674	9,5	318
Chayyl City	1508	1403	-7,0	-105
Kara-Balta District	123	123	0	0
Kemin City	232	236	1,7	4
Moskow City	4520	4862	7,6	342
Panfilov City	349	255	-26,9	-94
Sokuluk City	4774	4726	-1,2	-58
Shopokov District	58	58	0	0
Isyk-Ata City	4599	4434	-3,6	-165
Kant District	55	55	0	0
Chuy City	669	502	-25,0	-167
Tokmok District	148	148	0	0
Chuy Region	**20155**	**20240**	**0,4**	**75**

Table 3.9 Cultivation areas (hectares) by vegetable type in Kyrgyzstan

Vegetables	Cultivation area		Difference compared to previous year	
	2022	2023	%	+,-
Brassica family	6 167,5	6 045,3	-2,0	-122,3
Cucumber	6 367,5	6 330,8	-0,6	-36,7
Tomato	12 078,5	11 945,8	-1,1	-132,6
Beetroot	1 319,3	1 340,9	1,6	21,6
Carrot	8 305,1	8 013,7	-3,5	-291,4
Onion	9 177,0	8 961,3	-2,4	-215,7
Garlic	4 733,0	4 841,4	2,3	108,4
Radish	238,1	2 28,3	-4,1	-9,8
Green Radish	157,3	179,5	14,1	22,3
Herbs (dill, parsley, celery)	596,6	591,2	-0,1	-5,4
Other Vegetables	6 188,7	6 301,5	1,8	112,8
Kyrgyzstan	**55329**	**54779**	**-1,0**	**-559**

In Kyrgyzstan, tomatoes (11,945.8 ha) are the most cultivated vegetable, followed by onions (8,961.3 ha) and carrots (8,013.7 ha). Cucumber, cabbage, garlic, and other greens are also actively grown, but there is a decrease in the cultivation areas of almost all major vegetable types compared to the previous year (Table 3.9).

In Batken region, the most cultivated vegetable is tomatoes (853 ha), followed by carrots (933.8 ha) and onions (853.8 ha). The region has seen a decrease of 110.8 hectares in vegetable cultivation area, with significant reductions observed in garlic, green radish, and beetroot cultivation areas (NSCK, 2023).

In Jalal-Abad region, onions (3,063 ha), tomatoes (2,864 ha), and carrots (1,682 ha) are predominantly cultivated vegetables. The region has experienced a decrease of 314 hectares in vegetable cultivation area, with notable reductions in radish, greens, and carrot cultivation areas (NSCK, 2023).

In Issyk-Kul region, garlic (1,103 ha) is the most cultivated vegetable, followed by carrots (509 ha) and cucumbers (431 ha). Cabbage, tomatoes, and beetroot are also actively grown. The region has seen an 88-hectare decrease in vegetable cultivation area (NSCK, 2023).

In Naryn region, carrots (113.4 ha), garlic (96.4 ha), and beetroot (75.4 ha) are the most cultivated vegetables. There is a 3-hectare decrease in vegetable cultivation area (NSCK, 2023).

In Osh region, tomatoes (2,647 ha), onions (1,589 ha), and carrots (1,421.4 ha) are predominantly cultivated vegetables, with cucumbers, cabbage, and other greens also actively grown. There has been a 54.4-hectare decrease in vegetable cultivation area in 2023, with increases observed in carrot, onion, beetroot, cabbage, and green radish cultivation areas (NSCK, 2023).

In Talas region, tomatoes (931 ha), onions (565 ha), and carrots (534 ha) are predominantly cultivated vegetables. The region has experienced a decrease of 242 hectares in vegetable cultivation area in 2023 (NSCK, 2023).

Table 3.10 Harvested area, gross harvest and yield of vegetables in Kyrgyzstan, 2020–2022

Sebze adı	2020			2021			2022		
	Production area (ha)	Gross harvest (tons)	Yield (tons/ha)	Production area (ha)	Gross harvest (tons)	Yield (tons/ha	Production area (ha)	Gross harvest (tons)	Yield (tons/ha)
	52866	**1 131 237,1**		**54 291**	**1 114 154,2**	**193,3**	**55 328,6**	**1 163 633,8**	**194,4**
Cabbege	5 721,5	131 798,9	203,4	6 129,4	135 373,0	196,3	6 166,5	142 555,2	200,9
Cucumber	6 244,0	129 122,4	193,7	6 571,0	129 158,7	187,3	6 367,5	126 811,0	181,0
Tomato	11 587,4	237 155,5	199,2	11 655,0	231 053,1	197,5	12 078,5	247 474,1	185,3
Beetroot	1 182,3	23 423,9	191,1	1 213,1	21 947,1	177,8	1 319,3	25 359,3	202,1
Carrot	7 828,3	178 841,7	197	7 923,4	169 102,1	180,6	8 305,1	186 362,7	188,6
Onion	9 240,0	213 023,4	230,3	9 223,8	204 778,3	222	9 177,0	209 949,6	194,1
Garlic	4 173,8	68 350	163,7	4309,5	67 473,1	156,6	4 733,0	75 561,9	228,3
Radish	272,5	5 150,6	182,2	251,2	4 307,1	171	238,1	3592,3	166,0
Herbs	565,1	9 987,6	149,2	592,0	10 630,3	147,3	157,3	13 948,2	180,9
Aubergine	946,0	17 628,2	-	1 008	18 312,0	-	596,6	8 635,7	143,1
Pepper	4 762,0	95 795,4	-	4 722	96 372,5	-	6 189,8	120 203,6	193,6
Others	343,5	17 899,7	-	692,7	22 847,9	-	1 091,8	19 416,9	-
Outdoor vegetable production	**52 866,3**	**1 128 177,3**	**-**	**54 291,0**	**1 111 355,2**	**-**	**4 884,2**	**97 109,8**	**-**
Greenhouse vegetable production	**-**	**3 059,8**	**-**	**-**	**2 799,0**	**-**	**-**	**2 820,1**	**-**

In Chuy region, tomatoes (4,104 ha), cabbage (3,292 ha), and carrots (2,798 ha) are predominantly cultivated vegetables. Onions, cucumbers, garlic, and other greens are also actively grown. Despite decreases in vegetable cultivation areas in most regions, Chuy region has seen an increase of 85 hectares, or 0.4%, compared to the previous year (NSCK, 2023).

In Bishkek city, the vegetable cultivation area has remained unchanged from the previous year, with tomatoes (56 ha), cucumbers (37 ha), and other vegetables (42 ha) being predominantly cultivated. In Osh city, tomatoes (133 ha), onions (77 ha), and other vegetables (145 ha) are predominantly cultivated, with increases observed in cucumber, onion, garlic, carrot, and other vegetable cultivation areas (NSCK, 2023).

Table 3.10 shows data on the total planting area, gross harvest and yield of vegetables for 2020, 2021 and 2022. When the data is analyzed, we can observe the dynamics of development and increase in production. During these years, tomatoes, onions and carrots continue to be the most grown vegetables. In 2022, the total gross vegetable harvest was 1 163 633,8 tons and the average yield per hectare was 194,4 tons/ha. Cabbage, onion and pepper showed the best efficiency.

MARKETING AND TRADE

Fruit and vegetable sales involve intermediaries known as distributors who purchase products from producers. In Kyrgyzstan, 85% to 90% of sales are conducted through distributors. These intermediaries collect, sort, and load products at temporary purchase points. They either rent transport vehicles or use their own to purchase goods from farmers or processors, selling them to markets (small wholesale or retail stores) or directly to small wholesale companies.

The supply network consists of numerous participants performing various functions based on region, product type, delivery and distribution locations, demand for exported and imported products, etc., creating a multi-level structure. Therefore, retail prices can vary significantly, several times higher than producer prices depending on the product type and season.

Distributors, as key participants in the process, collaborate with transportation and logistics companies based on conditions. Transportation companies handle long-distance domestic transport and export transportation based on their transport capacity and available vehicles, or they deliver goods to the nearest domestic points.

Logistics companies operate their own warehouses which they also rent out, though serious deficiencies exist in storage facilities, especially those equipped with freezing and cooling units. Due to inadequate storage of fruits and vegetables, farmers often have to sell their products at lower prices offered by intermediaries. It should be noted that intermediaries generally make more profit from fruit and vegetable sales compared to farmers (NSCK, 2020).

Kyrgyzstan exports limited quantities of vegetables, with the Russian Federation being the main export market, accounting for 90% to 95% of exported products. Kyrgyzstan also exports to other Commonwealth of Independent States (CIS) countries, followed by European Union countries, Turkey, and the United Arab Emirates. In recent years, Turkish companies have encouraged guaranteed-buyer bean production in Talas region, leading to a new village population known as Talas beans due to farmers' increased interest. The majority of beans produced by farmers are sent to Turkey, becoming a significant source of foreign exchange (NSCK, 2020).

According to data from the Eurasian Economic Commission (EEC) for 2022, the most exported vegetables from Kyrgyzstan in 2021 included cabbage, carrots, and onions. Export figures were $900,000 for 21.1 thousand tons of cabbage, $2.7 million for 14.2 thousand tons of carrots, and $2.9 million for 13.9 thousand tons of onions. Overall, vegetable exports from Kyrgyzstan amounted to $8.9 million in 2019, $6.1 million in 2020, and $13.3 million in 2021, showing a significant increase in its share within the foreign trade balance (EEC, 2023).

CONCLUSION

Considering all the above data and facts, there are main strengths and weaknesses of agriculture and vegetable growing in our country (NSCK, 2022).

In terms of vegetable production, Kyrgyzstan's strengths include:

- Favorable natural and climatic conditions conducive to growing various high-quality vegetable products,
- Increasing vegetable planting volumes and improving yield,
- Regional proximity to markets in Russia and Kazakhstan where there is demand for Kyrgyz products,
- Sufficient water resources available,

- Development of small-scale agriculture, with many households in Kyrgyzstan growing vegetables on their own land, enhancing food security and providing fresh, quality vegetables to families,
- Ability to attract environmentally conscious consumers by utilizing Kyrgyzstan's natural resources and traditional cultivation methods to produce organic vegetables, especially as demand for organic products increases worldwide,
- Potential for greenhouse vegetable farming to become a promising area for agricultural development in Kyrgyzstan due to climate change and increasing year-round vegetable consumption,
- Introduction of modern technologies and innovations in plant production, such as irrigation systems and mechanization of cultivation and harvesting processes, to improve agricultural productivity and efficiency.
-

Weaknesses in vegetable production in Kyrgyzstan include:

- Low participation of the scientific community in agricultural sciences and lack of scientific equipment, materials, and professional knowledge,
- Farmers' low level of knowledge and practical skills in modern technologies and vegetable cultivation methods,
- Inappropriate and inefficient use of water on farms and improper application of crop irrigation Technologies,
- Low levels of plant health control by the state,
- Limited availability of mineral fertilizers, especially potassium and phosphorus, as well as organic fertilizers (approximately 30% to 35%), due to their high cost and lack of funds for agricultural producers to purchase them,
- Underdeveloped food storage network with insufficient cooling units, leading to high levels of spoilage,
- Lack of equipment for post-harvest processing and storage facilities, particularly freezers and refrigerators, causing up to 25% product spoilage,
- Low share of agricultural exports in the country's total trade turnover,
- High wear and tear of agricultural machinery,
- Weak implementation of advanced technologies and innovations,
- Insufficiently developed agricultural risk insurance system.

Key threats to the sustainability of the vegetable sector include:

- Decrease in land productivity due to irrational use,
- Climate change, natural disasters, and associated losses,
- Fluctuations and increases in market prices of fuels and agricultural inputs,
- Spread of pests and diseases,
- Lack of financial resources,
- Emergence of political conflicts and imposition of sanctions.

Examining these strengths and weaknesses highlights the continued importance of the vegetable sector in Kyrgyzstan's future, but also underscores the need for necessary measures and innovations to sustain its strength in the sector. Developing approaches to address these challenges is essential.

Recommendations for enhancing Kyrgyzstan's agriculture include:

- Implementation of modern irrigation systems like drip irrigation for efficient use of water resources,
- Providing training to agricultural producers on modern methods of vegetable cultivation and fertilizer use,
- Implementing measures to improve soil fertility, such as composting and organic fertilizer use,
- Developing infrastructure for storing and transporting vegetables, including construction of warehouses and cold storage facilities,
- Modernizing the vegetable sector through state support for educational programs targeting agricultural producers and increasing planting volumes and improving product quality,
- Introducing and utilizing advanced production technologies,
- Cultivating and distributing high-profit vegetable,
- Expanding domestic and export markets, increasing farmer incomes, and enhancing investment attractiveness in vegetable-growing regions,
- Increasing supply of processed fruit and vegetable products to local and export markets, as well as potential for increasing organic product supply,
- Establishing a stronger system to support farmers.

In conclusion, as the world's population grows, demand for vegetables will continue to increase. Vegetable science is one of the most dynamic and important fields of agricultural sciences. The importance of vegetables is increasing every day in the world. The availability and accessibility of these foods for most people do not meet the recommended daily nutritional requirements. The absence of these foods in meals leads to widespread malnutrition and reduces the well-being of people worldwide. It is a priority to enable small farmers in low- and middle-income countries to increase fresh vegetable production through sustainable practices in environmental, economic, and social terms. Sustainable vegetable production is an intensive process that requires labor and knowledge and also offers many opportunities for dignified employment. In addition, logistics for data digitalization services in rural and urban areas require more use. The development of agriculture in Kyrgyzstan can be parallel to the development of the country. Therefore, vegetable production policies should make it easier for farmers to produce and support farmers. The development of agricultural engineers and encouragement programs to increase their number of efficient knowledge should be promoted. To encourage more product development, it is essential to improve legislation governing the internal market.

References

Anonymous. (2024). https://www.statista.com/statistics/264065/global-production-of-vegetables-by-type/ Online erişim tarihi: 12.05.2024

EEC. (2023). Продовольственная и сельскохозяйственная организация Объединённых Наций FAO, «ОБЗОР ПЛОДООВОЩНОГО СЕКТОРА ГОСУДАРСТВ-ЧЛЕНОВ ЕВРАЗИЙСКОГО ЭКОНОМИЧЕСКОГО СОЮЗА.

FAOSTAT. (2024). Food and Agricultural Organization of The United Nations, Food and Agriculture Data. Online erişim: https://www.fao.org/faostat/en/#home

Kaiser, KA., Brown, AW., Bohan, MM., Shikany, JM., Mattes, RD., Allison, DB. (2014). Increased fruit and vegetable intake has no discernible effect on weight loss: a systematic review and meta-analysis. American Journal of Clinical Nutrition. 100(2):567-76.

NSCK. (2020). National Statistics Committee of the Kyrgyz Republic. Национальный Статистический Комитет Кыргызской Республики, Институт статистических исследований и повышения квалификации, «АНАЛИТИЧЕСКАЯ ЗАПИСКА. ОСОБЕННОСТИ И ПЕРСПЕКТИВЫ РАЗВИТИЯ СЕЛЬСКОГО ХОЗЯЙСТВА В КЫРГЫЗСКОЙ РЕСПУБЛИКЕ,» pp. 20-22.

NSCK. (2022). National Statistical Committee of the Kyrgyz Republic. Национальный Статистический Комитет Кыргызской очные площади, валовой сбор и урожайность сельскохозяйственных kyul 2022 год,» pp. 28-31, 2022.

NSCK. (2023). National Statistics Committee of the Kyrgyz Republic. Национальный Статистический Комитет Кыргызской Руспублики, «Заключительный отчёт о размерах посевных площадей сельскохозяйственных культур под урожай 2023 года,» pp. 3-42.

Yanmaz, R., Kaymak, Ç., Sarıkamış, G., Önal, UK., Karaağaç, O., et al. (2020). Sebzecilik Sektörü: Dünü, Bugünü ve Geleceği. Türkiye Ziraat Mühendisliği IX. Teknik Kongresi, pp. 1-2.

DETERMINATION OF THE TEXTURAL AND SENSORY PROPERTIES OF THE NOODLES PRODUCED BY USING DIFFERENT RATIOS OF KAVILCA (*Triticum dicoccum* L.) FLOUR

Lect. Samet MISIR

Ardahan University, School of Tourism and Hospitality Management, Department of Gastronomy and Culinary Arts, Ardahan, Türkiye

ORCID: 0000-0002-5502-5497

Asst. Prof. Dr. Duygu ALP BALTAKESMEZ

Ardahan University, School of Tourism and Hospitality Management, Department of Gastronomy and Culinary Arts, Ardahan, Türkiye

ORCID: 0000-0003-3268-9677

Abstract

It is portended that spelt wheat varieties (siyez, kavılca, dinkel) will start to overtake the wheat varieties (*Triticum aestivum, Triticum durum*) which are widely used today due to their high fibre, mineral, protein content, and low toxicity forms of gliadins. In the present study, Kavılca (*Triticum dicoccum* L.) flour, a wheat variety known to have been cultivated in 5000 BC and still cultivated, was used to produce noodles, which have an important place in Turkish cuisine culture. Kavılca is evaluated within the Emmer group of wheat, and it appears as a wheat type that has increased the number of shells surrounding the seed and thickened the forks in the spike to adapt to the cold climate. Kavılca which is also known by various names such as kabulca, kablıca, and gernik is less elastic than the doughs obtained from the wheat cereals that are widely used today due to its high gliadin and low glutenin ratio. The ancestral seed Kavılca wheat with geographical indication grown in Ardahan province of Eastern Anatolia region in Türkiye offers a multi-purpose alternative to gastronomic products. Various flours, semolina, bulgur, etc. semi-finished products can be produced from Kavılca, which has a rich nutrient profile (protein, fiber, iron, calcium, vitamins B and C), is also preferred for making bread, muffins, pancakes, and cookies due to its unique taste, and texture. In addition to this, it is added to a variety of dishes, including smoothies, soups, and stews, to increase the nutrient profile. Kavılca flour can be used in various recipes created by chefs (from making pasta and pizza dough to bread coatings and thickening agents for sauces). Kavılca wheat is becoming a valuable ingredient for chefs, and it also accompanies salads in the form of wheat grains. It is used to create new flavor profiles in traditional and innovative culinary recipes and allows for creativity in the kitchen. In the present study, 2 different blends were made for the flours to be used for noodle production (Kavılca flour 60% - traditional white flour 40%, Kavılca flour 80% - traditional white flour 20%). As a control group, noodles were produced completely from traditional white flour and the results were compared. The noodles' color, texture, and sensory properties were determined, and the results of texture profile analysis (hardness, stickiness, elasticity, chewiness, binding, chewy) clearly showed the effect of the low gluten content of roasted spelt on the structure. The hardness values of the noodles produced were determined as 22.633, 19.338 and 17.430 g. It was determined that the group containing 80% flour had the highest hardness. In terms of chewability and structure binding, noodles containing 60% obtained good results. When the color values of the noodles were compared, it was seen that the noodles obtained from traditional flour had the lightest color, and the a* values of 60% and 80% with Kavılca were higher than the control group. In the results of sensory evaluation of texture, odour, color, taste, and general acceptability of the noodles, it was determined that the lowest results in terms of chewability were found in 80% and the odour score was lower in noodles with Kavılca compared to the control group. In terms of general taste, it was observed that the group containing 60% was preferred. In the present study, texture profile analysis, color analysis, and sensory evaluation of noodles prepared by adding different proportions of Kavılca flour (*Triticum dicoccum* L.) were carried out and it was investigated whether Kavılca flour with low gluten quality positively affects the textural effects and sensory properties of the dough.

Keywords: Kavılca wheat; Kavılca flour; noodles with Kavılca; Ancestral seed; Product development

CONCEPTUAL FRAMEWORK

Nowadays, with the increasing trend towards healthy and sustainable food sources, there is a growing interest in Einkorn (*Triticum monococcum*), Emmer (*Triticum dicoccum*), and Spelt (*Triticum spelta*), the ancestors of modern wheat (Sırakaya 2023). Cultivated wheat species are divided into 3 groups based on chromosome number. Among these, Emmer-Kavılca (*Triticum dicoccum L.*) (2n=28, AABB) is a primitive (ancient, ancestral) spelt wheat variety that has recently been re-cultivated (Özgören and Işık 2023). Kavılca (*Triticum dicoccum* L.) flour which is a wheat variety known to have been cultivated in 5000 BC and still cultivated, was used to produce noodles, which has an important place in Turkish cuisine culture. Kavılca is evaluated within the Emmer group of wheat, and it appears as a wheat type that has increased the number of shells surrounding the seed and thickened the forks in the spike to adapt to the cold climate (Aydar 2022).

The ancestral seed Kavılca wheat with geographical indication grown in Ardahan province of Eastern Anatolia region in Türkiye offers a multi-purpose alternative to gastronomic products (Dhanavath and Rao 2017; Yüksel 2018; Çetinkata-Turkey and Gülbaz 2022; Özgören and Işık 2023). It is mostly grown around; Ardahan-Kars province and is also known by various names such as kavlıca, kabulca, kablıca, and gernik. Kavılca wheat is rich in fibre and has high gliadin and low glutenin ratio (Atak 2017). Thanks to these features, the ancestral seed Kavılca wheat with geographical indication grown in Ardahan province of Eastern Anatolia region in Türkiye offers a multi-purpose alternative to gastronomic products. Various flours, semolina, bulgur, etc. semi-finished products can be produced from Kavılca, which has a rich nutrient profile (fibre, iron, calcium, vitamins B and C), and is also preferred for making bread, muffins, pancakes, and cookies due to its unique taste and texture. In addition to this, it is added to a variety of dishes, including smoothies, soups, and stews, to increase the nutrient profile. Kavılca flour can be used in a variety of recipes created by chefs (from making pasta and pizza dough to bread coatings and thickening agents for sauces) (Aydar 2022; Özgören and Işık 2023).

From this point, in the present study, noodles were produced using Kavılca flour at 2 different ratios (Kavılca flour 60% - traditional white flour 40%, Kavılca flour 80% - traditional white flour 20%). As a control group noodle were produced completely from traditional white flour and the results were compared. The color, texture, and sensory properties of noodles were determined. In addition, aimed to increase the functionality and usage possibilities of the resulting noodles with Kavılca, especially in terms of gastronomy and the food industry.

METHODOLOGY

Raw materials

The Kavılca wheat used in the noodle production was supplied from the local producer in Ardahan, Türkiye. The egg, and salt used in the production were supplied from the domestic market. After all the raw materials were procured, they were stored in the Ardahan University Food Microbiology Laboratory.

Production of noodles produced by using different ratios of Kavılca (*Triticum dicoccum* L.) flour

Ardahan Kavılca wheat (Registration No: 1537); one of the tetraploid wheat grown in Ardahan province, with 2n=28 chromosome number *Triticum dicoccum*, which is a subspecies of *Triticum turgidum L.* and known as "culture Emmer (Gernik)" It is obtained from *farrum* variety of wheat (Türk Patent, 2024).

It is used in bread making as well as pasta, seed, and edible. It can be consumed as bulgur with a low gluten content of 8.2-12.3%. In Ardahan province, it is used in local dishes such as bulgur pilaf made with goose meat, milk soup, and stuffed cabbage (Atak, 2017). Within the scope of the study, the formulations of the noodles produced traditionally using different ratios of Kavılca are given in Figure 1, and 2.

Figure 1 Production of noodles produced by using different ratios of Kavılca (a: untreated dough, b: raw noodles, c: cooked noodles)

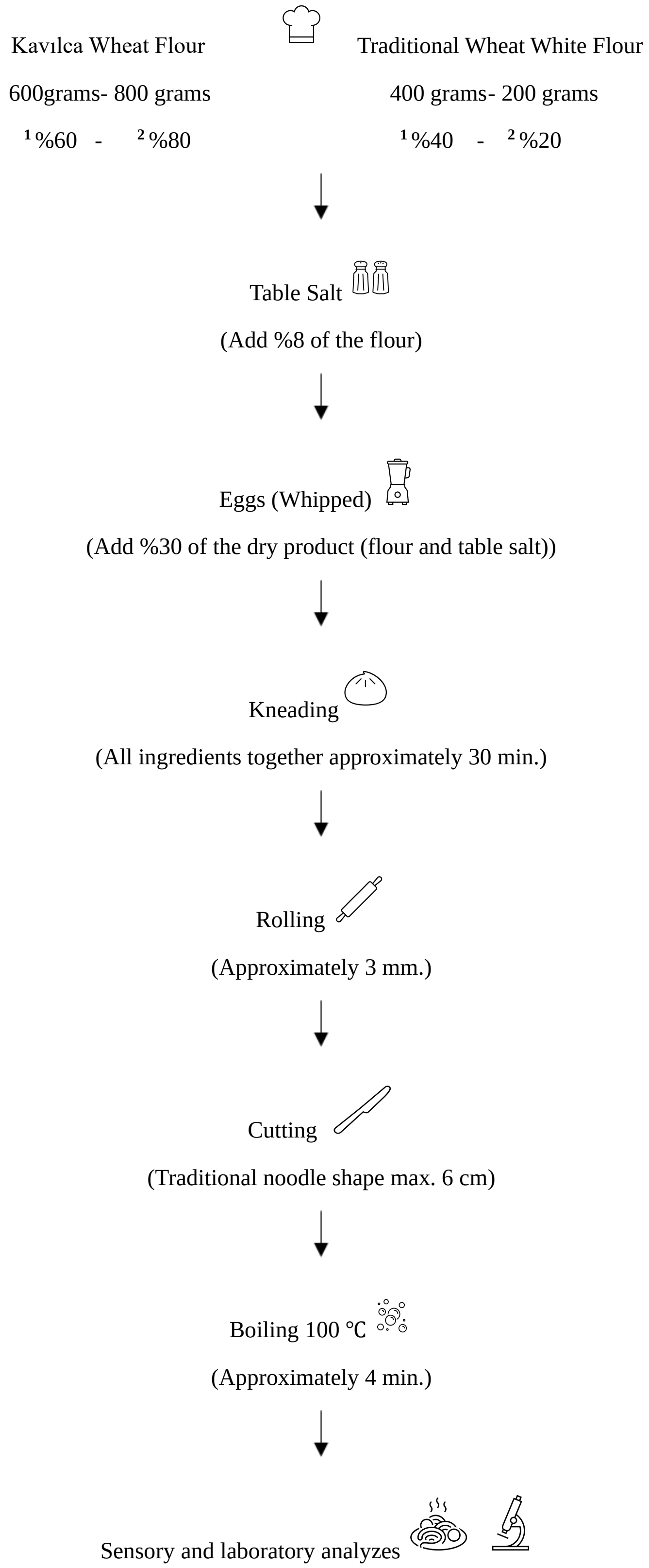


Figure 2 Production Scheme of Noodle with Kavılca

Noodles Analyses

Color properties of noodles

The noodles samples' color values (L*, a*, b*) were measured using a Color Spectrophotometer (Hunterlab Colorquest XE, USA) based on the CIE-LAB system (Kirca et al., 2007).

Texture profile of noodles

Analysis of noodle texture was performed at Central Research Laboratory Application and Research Center of Ardahan University according to the method of Hayıt et al., (2023) by TA-XT Plus C texture analyzer (Lloyds Instruments, UK). 5 of the pasta were taken from the pasta cooked in the optimum cooking time. Then they were placed side by side on the base. A 2 cm diameter flat cylindrical probe was used to compress the pasta. The compression distance was taken as 50% of the original size of the pasta. Hardness, stickiness, elasticity, chewiness, binding, and chewy values were determined from the time force curve. Test parameters were determined as; pre-test speed 1 mm/2, test speed 5 mm/s, post-test speed 5 mm/s, and load cell 5 g (Figure 3).

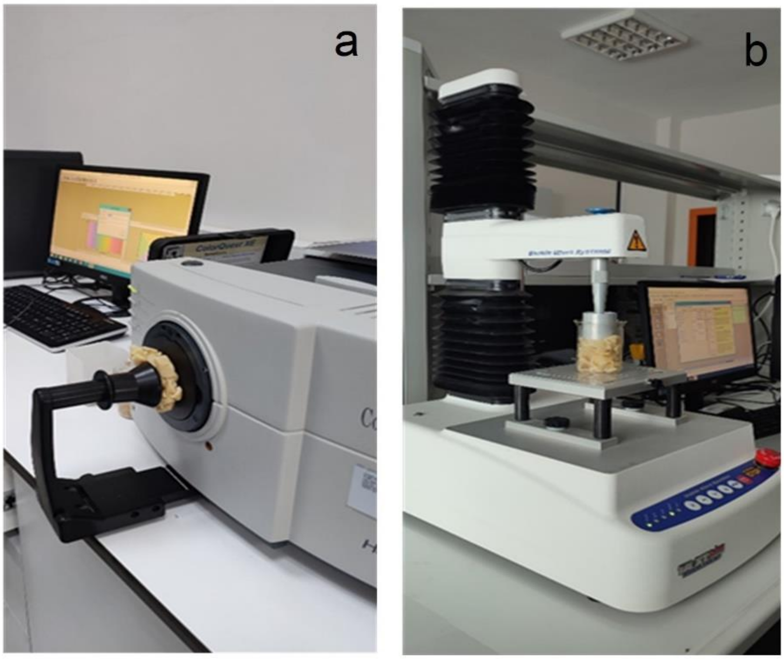


Figure 3 Color properties (a) and texture profile (b) analysis of noodles

Sensory profile of noodles

The study conducted descriptive sensory analysis and determined the degree of differences among the products at Ardahan University Gastronomy and Culinary Arts Department. The panelists consisted of department employees and students and there were 30 people. Sensory data were obtained by the methods used by Demir-Özer et al., (2021). The sensory characteristics of noodles samples were evaluated using a five-point Likert scale (with 1: extremely dislike, 5: extremely like). The panelists were given only one application for each product and the products were presented sequentially on different plates. The noodle sample was served hot (75-80˚C). The products were evaluated for appearance, texture, color, taste, odour, and overall acceptability. The sensory analysis consisted of two stages. In the first stage, noodles prepared with six different Kavılca ratios as group *A* (50%, 60%, 70%) and group *B*

(80%, 90%, 100%) were presented to the panelists. The noodles with the highest sensory score ratio between groups *A* and *B*, *A* with 60% and *B* with 80% Kavılca, were again sensory analyzed in the second stage.

Statistical analysis

The experiments (color, texture, etc.) were conducted in triplicate, and the acquired data were reported as mean ± standard deviation. The statistical software Minitab 17 (Minitab, Inc., State College, PA, USA) was employed for data analysis.

The experimental design was completely randomized as control (without Kavılca), noodles with Kavılca (%60 and % 80). Statistical evaluation of the sensory analysis results was performed using SPSS 26.0 (SPSS Inc., Chicago, USA). The non-parametric Kruskal-Wallis test was used to determine the differences among the means of the groups in evaluating the sensory analysis results of noodles with Kavılca. The results of this test were tabulated.

RESULT

The average color values found in the samples are given in Table 1. The color results of the noodles were compared, and it was seen that the noodles obtained from traditional flour had the lightest color, and the* values of 60% and 80% of noodles with Kavılca were higher than the control group.

Table 1 Color values in noodles samples

Noodles Sample	Color (*L*)	Color (a^*)	Color (b^*)
Control Group	76.18 ± 1.36	3.43 ± 1.87	25.32 ± 2.27
With 60% Kavılca	63.19 ± 0.23[b]	4.48 ± 0.70[b]	19.42 ± 0.37[b]
With 80% Kavılca	64.17 ± 1.28[a]	5.57 ± 1.05[a]	21.24 ± 1.77[a]

a-b Statistical differences between jam samples in the same column ($p < 0.05$).

The textural properties of noodles samples were measured using TA-TX Plus C texture analyzer (Lloyds Instruments, UK). Textural profile analysis in all the noodle samples was performed to evaluate as hardness, chewiness, adhesiveness, springiness, resilience, cohesiveness, and gumminess (Figure 4).

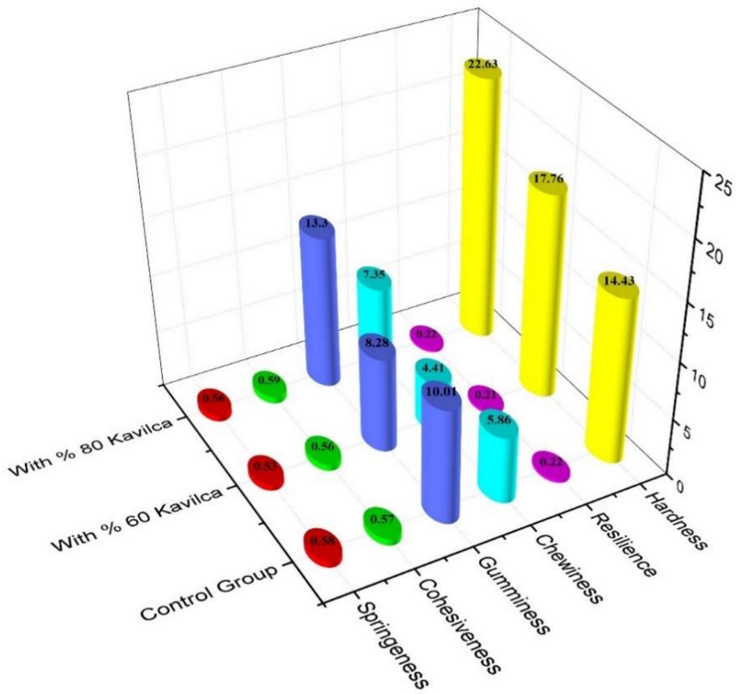


Figure 4 The results of all the noodle samples of textural profile analysis

In the results of sensory evaluation of texture, odour, color, taste, and general acceptability of the noodles, it was determined that the lowest results in terms of chewability were found in 80% and the odour score was lower in noodles with Kavılca compared to the control group. In terms of general taste, it was observed that the group containing 60% was preferred. The noodles with 60% Kavılca were close to the control group in the general evaluation. This is attributed to the panelists likening it to the flavor they were familiar with. Noodles with 80% kavılca had the lowest score for sensory properties ($p<0.05$). The sensory properties of the noodles in the second stage are given in Figure 5.

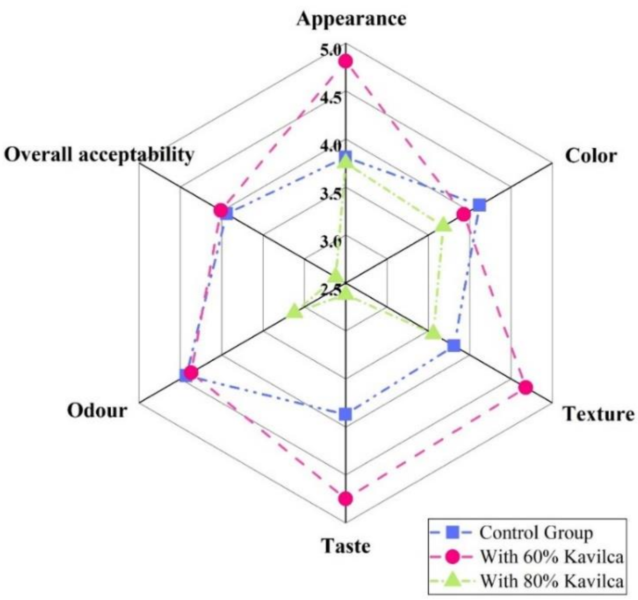


Figure 5 Sensory profile of all noodles

CONCLUSION AND DISCUSSION

Çetinkaya-Turkey and Gülbaz (2022) studied various microbial and physicochemical properties of bulgur produced with 100% Kavılca. The color values of bulgur results were quite high compared to our study. This result is attributed to the fact that bulgur is produced from 100% Kavılca. As the amount of Kavılca increases, the *L value in the products decreases and the color reaches a darker tone.

Hardness is defined as the force needed to compress food between the teeth at the first bite (Bourne, 2002). When the hardness property was evaluated in the study, the lowest values were obtained in the control group (14.43 N) and the highest values were obtained in noodles made with % 80 Kavılca (22.63 N). The higher hardness values of the % 80 Kavılca were attributed to its high gliadin and low glutenin ratio.

Springiness (formerly elasticity) relates to the ability to return to the undeformed state after the deformation force is undone (Bourne, 2002). This value was close in all three groups. Gumminess is known as the energy expended to break down food to make it ready for swallowing (Bourne, 2002). In the present study, it was determined that the most energy was consumed in the % 80 Kavılca sample and the control group.

Unlike other texture profile analysis results, adhesiveness shows a negative force field in the texture profile analysis curves (Şirin 2019). The adhesiveness values of the %60 and % 80 Kavılca samples were determined as -220.482 g/s and -236.258 g/s, respectively. Additionally, this value was determined as -299.225 g/s in the control group.

When the mean values of the sensory analysis results of noodles with Kavılca are examined, it is seen that they have a wide range of tastes in terms of naturalness and suitability for use. In a study conducted on *Triticum monococcum* and *Triticum dicoccum* wheats, it was stated that Gernik group wheat was suitable for use in yeast products in terms of gluten quality (Zengin 2015). In the present study showed that the flours obtained from Gernik group wheat can also be used in noodle production by making the blending process.

Ardahan Kavılca wheat has an important place in the agricultural economy within its geographical borders. It was registered with geographical indication number 1537 by the Turkish Patent and Trademark Office on 07. February 2024. It is envisioned that Kavılca, which is resistant to cold climates and has a very good product yield, will come to the forefront with its unique sensory properties and satiety.

Although people's consumption habits are changing day by day, the consumption of grains and grain products in the nutrition of the world population is increasing compared to the past. However, wheat, other grains, and processed products from the grain group may cause problems in some people with intestinal disorders (Gül et al., 2021).

Recently, gluten-free foods have not only been demanded by celiac patients, it has also become very important for individuals who are disturbed by gluten sensitivity or people who want to eat a gluten-free with their lifestyle (Masure et al., 2016). In this respect, it is thought that Kavılca wheat, which has low levels of gluten in its structure, will be a natural alternative to new consumption habits.

The present study is important in terms of developing and improving the qualities of the products with Kavılca, which are produced in different flavours in the Ardahan region, in terms of taste and health compatibility. According to the sensory analysis results showed that noodle with 60% Kavılca prepared with traditional methods were highly accepted.

REFERENCES

Atak, M. (2017). Wheat and Wheat Landraces of Turkey. *Journal of Agricultural Faculty of Mustafa Kemal University 22*(2), 71-88.

Aydar, E. F. (2022). Investigation of the functional properties and health effects of flour and bread prepared from Kavılca wheat grown in Kars and modern bread wheat. *(Master's thesis of İstanbul Technical University,* 70pp.*)*

Bourne, M. (2002). Food texture and viscosity: concept and measurement. *Elsevier*.

Çetinkaya-Turkey, A., & Gülbaz, G. (2022). Physicochemical and microbiological properties of Kavılca bulgur (A traditional cereal product of Turkey). *Emirates Journal of Food and Agriculture*, 34(11), 931-937.

Dhanavath, S., & Prasada Rao, U. J. S. (2017). An overview of nutritional and nutraceutical properties of Triticum dicoccum wheat and its health benefits. *Journal of Food Science*, *82*(10), 2243-2250.

Gül, H., Hayıt, F., Özer, B., & Acun, S. (2021). Usage of Red Beet Flour for Gluten Free Bıscuıt Productıon. *Mühendislik Bilimleri ve Tasarım Dergisi*, *9*(4), 1166-1173.

Hayıt, F., Acun, S., & Gül, H. (2023). Determination of Some Physical, Chemical, and Textural Quality of Commercially Available Gluten-Free Pasta. *Journal of The Institute of Science and Technology*, *6*(1), 700-719.

Kirca A, Özkan M, Cemeroğlu B (2007) Effects of temperature, solid content and pH on the stability of black carrot anthocyanins. *Food Chem* 101:212–218. https://doi.org/10.1016/j.foodchem.2006.01.019

Masure, H.G., Fierens, E., Delcour, J.A. (2016). Current and Forward Looking Experimental Approaches in Gluten-Free Bread Making Research. *Journal of Cereal Science*, 67, 92–111.

Özer, E. D., Esen, M. K., İçigen, M., & Özer, C. O. (2021). Investigation of usage possibilities of Kalaba Yoghurt (local cream yoghurt) in cheesecake production. *International Journal of Gastronomy and Food Science*, *25*, 100376.

Özgören, E., & Işık, F. (2023). Some quality properties of tulumba desserts are produced from ancient wheat varieties [dinkel (*Triticum spelta*), einkorn (*Triticum monococcum*), and kavılca (*Triticum dicoccum*)]. *Food and Health*, 9(2), 148-159.

Sırakaya, S. (2023). Feed Value of Emmer Wheat (Triticum dicoccum) and By-products for Ruminant Animals, *KSU J. Agric Nat*, *26*(1), 210-217.

Şirin, P. (2019). Rheological, textural, physicochemical, and sensory properties of low sugar apple marmalade *(Master's thesis, Izmir Institute of Technology (Turkey)).*

Türk Patent ve Marka Kurulu, (2024). *Geographical Indications Platform.* Access Address: https://ci.turkpatent.gov.tr/cografi-isaretler/detay/2485. Access Date: 08.06.2024.

Yüksel, F. (2019). The Effect of Addition of Agar and Cellulose Gums on the Rheological and Textural Properties of Kavilca (*Triticum Spelta* L.) Flour and Bread. *Journal of the Institute of Science and Technology*, *9*(2), 855-861.

Zengin, G. (2015). A Research on Determınatıon of Qualıty Parameters of Some Ancıent. *(Master's thesis of Selçuk Unıversıty,* 81pp.)

USE OF SOME BOTANICAL POWDERS TO PROTECT COWPEA SEEDS AGAINST *CALLOSOHUS MACULATUS* PEST DAMAGE

Asmae Baghouz

Laboratory of biotechnology, conservation and valorisation of natural resources (LBCVNR), Dhar El Mehraz Faculty of Sciences, Sidi Mohamed Ben Abdellah University, Fez, Morocco.

Rajae El Brahimi

Laboratory of Biotechnology, Environment, Agri-food and Health (LBEAS), Dhar El Mehraz Faculty of Science, Sidi Mohamed Ben Abdellah University, Fez, Morocco.

Raja Guemmouh

Laboratory of biotechnology, conservation and valorisation of natural resources (LBCVNR), Dhar El Mehraz Faculty of Sciences, Sidi Mohamed Ben Abdellah University, Fez, Morocco.

Abstract

Pulses play an important role in the diets of people around the world, especially in the developing world. For many African populations, they are an essential part of the diet. This importance is due to a number of benefits: in tropical Africa, cowpea is a major crop eaten by about two hundred million people. However, cowpea seeds are subject to insect infestation, particularly the cowpea pest (*Callosobruchus maculatus)*, and suffer considerable damage during storage.

Chemical methods have traditionally been used to control insect pests in crops. Given the unpleasant effects of pesticides, alternative methods must be considered, particularly the use of plant substances with insecticidal activity. To develop a safe strategy and environmentally friendly approach to pest management in stored produce, trials were conducted using plant powders from *Eugenia caryophyllus*, *Rosmarinus officinalis* and *Capsicum frutescens*, were evaluated on some biological parameters of the cowpea weevil, such as mortality, fecundity, fertility of females and emergence of *Callosobruchus maculatus* adults, on cowpea seeds (*Vigna unguiculata*) during storage at 27 ± 1 °C and 70 ± 5% relative humidity. The best results against the biological parameters of *Callosobruchus maculatus* were obtained with the plant powders of *Eugenia caryophyllus* and *Capsicum frutescens*, knowing that their biocidal potential increases with the doses used.

According to the obtained results, the bioinsecticides evaluated in this study might represent a rich source of bioactive compounds possessing potent insecticidal activities.

Keywords: Cowpea; *Callosobruchus maculatus*; Plant powder; *Eugenia caryophyllus*; *Rosmarinus officinalis*; *Capsicum frutescens*; Biological parameters.

INTODUCTION

Pulses are an important part of global diets, particularly in developing countries, and are the staple food of many populations in Africa, South America and Asia [1]. They are the main source of human protein, considered the second most important food after cereals [2]. Including them in diets, especially in developing countries, can be instrumental in combating malnutrition [3,4].

One of the native African legumes with the highest nutritional content is the cowpea (*Vigna unguiculata* L.), it is highly beneficial to food quality and nutritional health [5]. Cowpea grains are high in fiber, protein, and carbs. Their leaves and pods are also a great source of vitamins and minerals. Morocco has a reputation for cowpeas; they are produced in limited regions in the southern Atlas oases, and seeds are sold in the souks and markets of the country's largest cities, especially Fez [6]. Unfortunately, cowpea seeds suffer considerable damage during storage due to attack by insect pests, particularly the beetle *Callosobruchus maculatus*, whose larvae develop inside the seeds, depleting the reserves of the cotyledons and causing significant quantitative and qualitative losses, which can reach 100% after a few months [7]. Due to *C. maculatus's* significant harm to cowpea seeds, several strategies have been implemented to manage this pest successfully [8].

The phytosanitary products have been and are being used to control this pest during seed storage. However, the effectiveness of synthetic pesticides is hampered by some issues, including their high cost, the potential for environmental contamination, the toxicity of residues that accumulate in food, problems with pest resistance, the elimination of natural predators, and adverse effects on non-target organisms [9,10].

An alternative to the use of chemical pesticides is the valorization of botanicals. Using the right tools, these techniques make it possible to extract active ingredients from a variety of plant species with unique properties, creating bioproducts that can be used to control pests in preserved foods [11]. Many plant families offer viable alternatives to chemical treatments for strengthening storage systems, with their proven insecticidal properties against stored seed pests. The plant powders have long been combined with preserved seeds. These treatments offer a natural, reliable, and more affordable way of preventing pests from attacking stored seeds [12,13].

Our work included a proposal to investigate the insecticidal activity of three plants commonly used in Morocco, belonging to different botanical families: *Eugenia caryophyllus* (Myrtaceae), *Rosmarinus officinalis* (Lamiaceae), and *Capsicum frutescens* (Solanaceae). These plants would be studied in form powders to harness their insecticidal properties and develop natural methods for the sustainable preservation of cowpea seeds.

MATERIALS AND METHODS

Breeding of Pests

Vigna unguiculata (healthy cowpea) seeds were used for the mass culture of *C. maculatus*. The jars are placed in a culture chamber maintained at 28°C, 75% relative humidity, with a photoperiod of 14 hours light and 10 hours dark. The original strain of pests is housed in our Faculty for breeding purposes and was obtained from a nearby warehouse [14,15].

Plant material preparation

The test plant's leaves and fruits were cleaned, allowed to dry in the shade for 15 days at room temperature (24 to 27 °C), and then ground using an electric grinder until they were reduced to a powder. to get a fine, uniform powder, the grind was run through a 0.5 mm mesh screen.

Doses and applications

Ten grams of healthy cowpea seeds were placed in plastic Petri dishes (9 cm in diameter and 1 cm in height) of five adult males and five females of *C. maculatus* (0-48 hours old). The tested vegetable powders (*Eugenia caryophyllus*, *Rosmarinus officinalis*, and *Capsicum frutescens*) were added to each dish in varying doses (0.5%, 1%, 1.5%, 2% of powder weight per seed weight). Only healthy seeds - five female and two male *C. maculatus* pests - were included in the control group. Three duplicates were used to evaluate the powders and their biological effects [16].

Biological parameters assessed

The parameters fecundity, fertility, and mortality of adult *C. maculatus* were used to determine the insecticidal activity of the powders under investigation. Dead bugs that did not respond to multiple interactions with the tweezers were counted every 24 hours until the three islands of the three doses tested had a total mortality rate. The dead bugs were removed from the Petri dishes every day.

Data Analysis

Analysis of variance (two-way ANOVA) was performed to determine any significant differences between the effects of the powders tested on *C. maculatus*. Using GraphPad Prism 8, significant means ± SD of the treatments were separated using Tukey's multiple interval test at $p < 0.05$.

RESULTS AND DISCUSSION

Effect of plant powders on adult mortality

Eugenia caryophyllus

E. caryophyllus powder was highly lethal to *C. maculatus* pests, causing total mortality after 5 days exposure at the four doses tested (Figure 1).

The insecticidal activity of *E. caryophyllus* powder was highly significant at different concentrations ($F = 180.55$; $df= 4, 60$; $P < 0.0001$) and exposure times ($F = 226.56$; $df= 5, 60$; $P < 0.0001$).

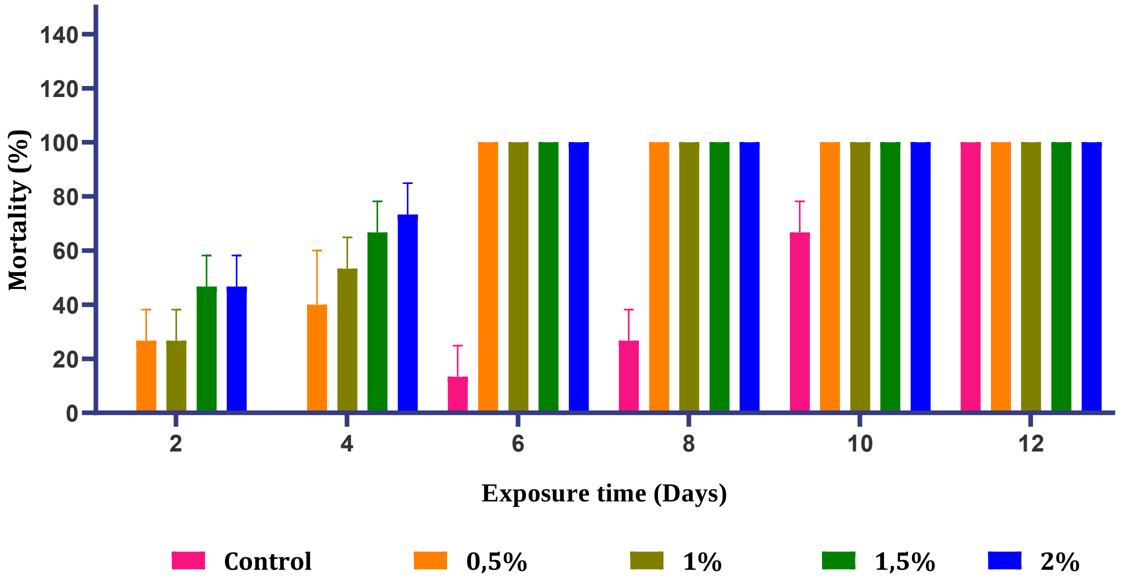


Figure 1. *C. maculatus* adults treated with *E. caryophyllus* powder (Mean Mortality %±SD)

Rosmarinus officinalis

R. officinalis powder showed moderate efficacy against *C. maculatus* adults, with 100% mortality after 7 days' exposure (Figure 2).

The insecticidal activity of *R. officinalis* powder was highly significant at different concentrations (F = 25,83 ; df= 4, 60 ; P < 0,0001) and exposure times (F = 127,91 ; df= 5, 60 ; P < 0. 0001).

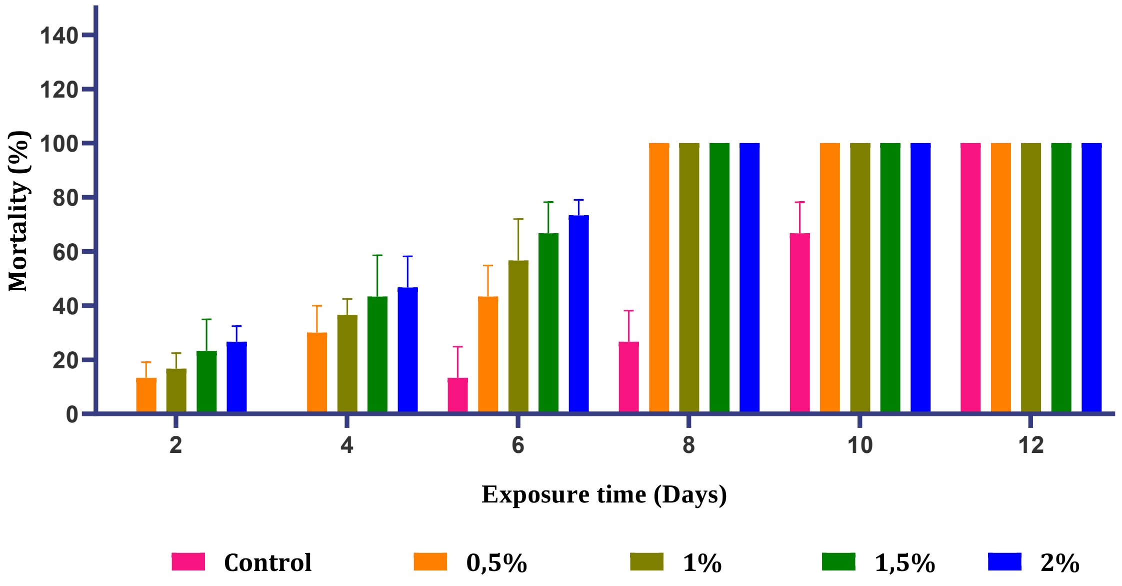


Figure 2. *C. maculatus* adults treated with *R. officinalis* powder (Mean Mortality %±SD)

Capsicum frutescens

C. frutescens powder showed high power against *C. maculatus* adults, with a total mortality after 6 days exposure (Figure 3).

The insecticidal activity of *C. frutescens* powder was highly significant at different concentrations (F = 120,18 ; df= 4, 60 ; P < 0,0001) and exposure times (F = 76,73 ; df= 5, 60 ; P < 0. 0001).

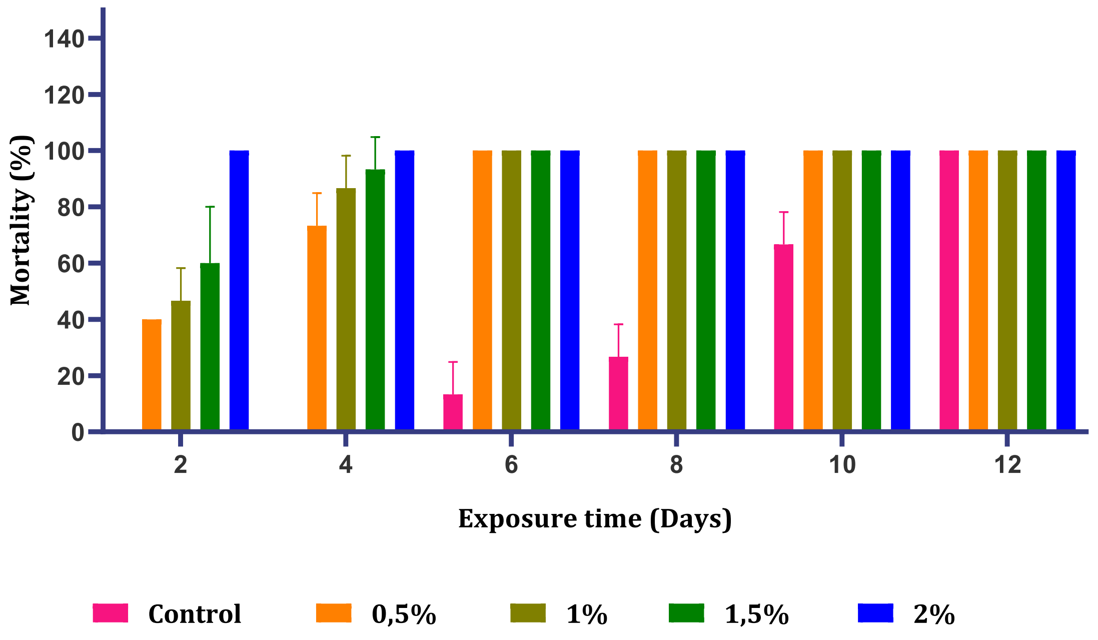


Figure 3. *C. maculatus* adults treated with *C. frutescens* powder (Mean Mortality %±SD)

Effect of the plant powders on fecundity and fertility of females and adult emergence of *C. maculatus*

The effectiveness of the powders tested in reducing the Fecundity (number of eggs laid), egg fertility, and adult emergence of *C. maculatus* was variable compared to the no-treatment control (Table 1).

C. frutescens powder has been shown significantly to reduce the fecundity or ability of female *C. maculatus* to lay eggs on cowpea seeds. So, no oviposition was observed on cowpea seeds treated with *C. frutescens* powder at any dose. On the other hand, an average of 233.9 eggs were laid in the untreated control group. Furthermore, *E. caryophyllus* powder showed remarkable efficacy in preventing *C. maculatus* from ovipositing on cowpea seeds, with complete suppression of oviposition reported at 1.5%/20g. while *R. officinalis* powder was not as effective, although fewer eggs were laid than in the control group.

C. frutescens and *E. caryophyllus* powders totally inhibited adult fertility and emergence adult of *C. maculatus* at al all doses assessed.

Table 1. Biological parameters of adult *C. maculatus* on cowpea seeds exposed to powders of *R. officinalis*, *E. caryophyllus* and *C. frutescens*

Plant powders	Dose (%)	Fecundity	Fertility (%)	F1 adult Emergence (%)
R. officinalis	0.5	163,34 ± 9,04^{d}	90,35±1,27^{da}	88,15 ± 1,89^{d}
	1	141,34 ± 11,84^{c}	84,57±1,81^{c}	81,73 ± 1,96^{c}
	1.5	125 ± 12,49b^{c}	81,85±4,23^{b}	77,51 ± 5,44^{b}
	2	109,33 ± 8,62^{b}	80,87±1,92^{b}	75,24 ± 2,40^{b}
E. caryophyllus	0.5	12,34 ± 1,53^{b}	0 ± 0^{b}	0 ± 0^{b}
	1	8 ± 1,74^{b}	0 ± 0^{b}	0 ± 0^{b}
	1.5	0± 0^{b}	0 ± 0^{b}	0 ± 0^{b}
	2	0 ± 0^{b}	0 ± 0^{b}	0 ± 0^{b}
C. frutescens	0.5	0 ± 0^{b}	0 ± 0^{b}	0 ± 0^{b}
	1	0 ± 0^{b}	0 ± 0^{b}	0 ± 0^{b}
	1.5	0 ± 0^{b}	0 ± 0^{b}	0 ± 0^{b}
	2	0 ± 0^{b}	0 ± 0^{b}	0 ± 0^{b}
Control	--	233,9 ± 11,66^{a}	96,03± 1,40^{a}	94,30 ± 1,30^{a}

A significant difference is indicated by different letters (a, b, c, d and e) following the means (± SD, n = 3) in the same column, as determined by Tukey's multiple interval test at $p < 0.05$.

DISCUSSION

Many plant families, given their insecticidal properties that have been shown to be effective against insect pests of stored seeds, offer real alternatives to pesticide treatments for strengthening storage systems. Traditionally in Morocco, plant powders have been mixed with stored seeds since ancient times.

The results obtained in this study showed that the biological parameters related to the cowpea pest *C. maculatus* depend to the plant species, plant powder doses and exposure time.

The present study shows that *C. frutescens* and *E. caryophyllus* powders have very powerful insecticidal effects on *C. maculatus* adults, causing complete mortality of the pests even at brief periods exposure. These powders also exhibit ovicidal, larvicidal and adulticidal properties of *C. maculatus* ; preventing perforation of cowpea seeds at different developmental stages of *C. maculatus* from egg to adult emergence. Many authors have highlighted the biological activity of certain plants as powders against the pests of stored seed such as *C.maculatus*.

According to Ileke et al. [17] *E. caryophyllus* powder resulted 100% mortality of rice weevils (*Sitophilus oryzae*) within 96 hours of treatment for all doses tested. In the same vein, **Oluwafemi.** [18] reported that *Tetrapleura tetraptera* powder has a toxic effect on adult *C. maculatus*, resulting a total mortality at 4% concentration for 4 days after treatment.

Black pepper powder (*Piper nigrum*) inhibited oviposition of female *C. maculatus* according to Nwosu et al. [19]. The most effective inhibitor of egg laying and hatching was *Alchornea cordifolia* leaf powder at a concentration of 5 g (w/w)/20 g on cowpea seeds [20]. Tapondjou al. [21] demonstrated that a 0.4% dose of *Chenopodium ambrosioides* leaves powder caused 60% mortality of adult *A. Obtectus* after two days of exposure, while 6.4% dose of the same plant was effective by causing total a mortality of adult maize weevils *Sitophilus zeamais* (Coleoptera: Curculionidae) after the same time of exposure.

This is reflected on the emergence of adults, our results co-agree with those of Kellouche and Soltani [22], who found that *E. caryophyllus* powder had a very significant effect on the emergence of *C. maculatus* adults, preventing all adult emergence from the lowest dose (0.2%).

We suggested that the insecticidal potential of *C. frutescens* and *E. caryophyllus* powders against *C. maculatus* pests could be the result of the action of one or more of these substances or their synergy since these powders release toxic substances that have contributed to the decline of this insect. This was demonstrated by Dike and Mbah [23], who claimed that *Monodora myristica* powder can protect cowpea seeds from damage by *C. maculatus* due to its oil content, which could have blocked the insects' airways, resulting in increased mortality. On the other hand, Engelmann [24], confirmed that the marked reduction in egg laying may be a consequence of the inhibitory effect of the volatile plant compounds on insect mating, which is a crucial factor in the subsequent number of eggs laid by the beetles, or that these bioactive substances may disrupt the genitalia of males and females. The reduction of fecundity could be related to the disruption of the vitellogenesis process and not only to the limitation of the laying period or the survival of adult females [22] . As in the case of Raja et al. [25], which suggested that when eggs are laid on seeds treated with Citrus powder, the toxic substances present in the skin of this plant can penetrate the egg through the chorion and suppress embryonic development, resulting in reduced emergence of adults.

CONCLUSION

This study demonstrates that plant powders of *C. frutescens* and *E. caryophyllus* have powerful insecticidal properties on the biology of the pest *C. maculatus*. These results are consistent with previous research that has highlighted the promise of plant powders as bio-insecticides to protect stored food products from infestations of pests. This effectiveness can be attributed to the complex chemical composition of these plants, which contain compounds such as terpenoids and phenols. These compounds act by several mechanisms, including repelling insects, disrupting their behavior, and exerting direct toxicity

Therefore, these plants present an ecological and effective alternative for the conservation of stored food and the mitigation of problems associated with synthetic insecticides.

However, further research is needed to refine these methods for large-scale, particularly commercial, applications.

REFERENCES

1. Singh, U.; Singh, B. Tropical Grain Legumes as Important Human Foods. *Econ Bot* **1992**, *46*, 310–321, doi:10.1007/BF02866630.

2. Kouris, -Blazos Antigone; Belski, R. Health Benefits of Legumes and Pulses with a Focus on Australian Sweet Lupins. *Asia Pacific Journal of Clinical Nutrition* **2020**, *25*, 1–17, doi:10.3316/ielapa.908100617189705.

3. Hueda, M.C. *Functional Food: Improve Health through Adequate Food*; BoD – Books on Demand, 2017; ISBN 978-953-51-3439-8.

4. Maphosa, Y.; Jideani, V.A. The Role of Legumes in Human Nutrition. *Functional food-improve health through adequate food* **2017**, *1*, 13.

5. Abebe, B.K.; Alemayehu, M.T. A Review of the Nutritional Use of Cowpea (*Vigna Unguiculata* L. Walp) for Human and Animal Diets. *Journal of Agriculture and Food Research* **2022**, *10*, 100383, doi:10.1016/j.jafr.2022.100383.

6. Bryssine, P. Comportament Des Varietes de Vigna Sinens-Savi et Possibilites de Sa Culture Au Maroc. *Al Awamia PRESS: Rabat* **1962**, *3*, 1–56.

7. Seri-Kouassi, B.P.; Kanko, C.; Aboua, L.R.N.; Bekon, K.A.; Glitho, A.I.; Koukoua, G.; N'Guessan, Y.T. Action des huiles essentielles de deux plantes aromatiques de Côte-d'Ivoire sur *Callosobruchus maculatus* F. du niébé. *Comptes Rendus. Chimie* **2004**, *7*, 1043–1046, doi:10.1016/j.crci.2003.12.031.

8. Kébé, K.; Alvarez, N.; Espíndola, A. Oviposition Choice and Larval Development of the Seed Beetle *Callosobruchus Maculatus* (F.) (Coleoptera: Chrysomelidae: Bruchinae) on Three Cowpea Varieties. *Journal of Stored Products Research* **2020**, *86*, 101578, doi:10.1016/j.jspr.2020.101578.

9. Ileke, K.D.; Idoko, J.E.; Ojo, D.O.; Adesina, B.C. Evaluation of Botanical Powders and Extracts from Nigerian Plants as Protectants of Maize Grains against Maize Weevil, *Sitophilus Zeamais* (Motschulsky) [Coleoptera: Curculionidae]. *Biocatalysis and Agricultural Biotechnology* **2020**, *27*, 101702, doi:10.1016/j.bcab.2020.101702.

10. Mohan, S.; Pretheep-Kumar, P.; Balasubramanian, P. Insecticide Resistance-Stored-Product Insects. *Dusseldorf, LAP Lambert Academic Publishing* **2010**.

11. Aker, O.; Eser, F.; Yildirim, C. The Laboratory Evaluation of Insecticidal Activities and Phytochemical Analysis of Marrubium Astracanicum Jacq. Subsp. Astracanicum Jacq. against Callosobruchus Chinensis (L.) and Callosobruchus Maculatus (F.). *South African Journal of Botany* **2023**, *160*, 667–672.

12. Fouad, H.A.; Abdelmeged, H.B.; Salman, A.M.A. Insecticidal Activity of Six Botanical Powders against the Cowpea Seed Beetle Callosobruchus Maculatus F. (Coleoptera: Bruchidae). *Journal of Plant Protection and Pathology* **2020**, *11*, 237–240, doi:10.21608/jppp.2020.96011.

13. Deme, G.G.; Malann, Y.D.; Chundusu, E.S.; Chup, J.A. Insecticidal Effects of Cassia Tora and Cassia Alata against Cowpea Weevil (Callosobruchus Maculatus). *Science World Journal* **2019**, *14*, 144–147.

14. Baghouz, A.; Bouchelta, Y.; Es-safi, I.; Bourhia, M.; Abdelfattah, E.M.; Alarfaj, A.A.; Hirad, A.H.; Nafidi, H.-A.; Guemmouh, R. Identification of Volatile Compounds and Insecticidal Activity of Essential Oils from Origanum Compactum Benth. and Rosmarinus Officinalis L. against Callosobruchus Maculatus (Fab.). *Journal of Chemistry* **2022**, *2022*, 7840409, doi:10.1155/2022/7840409.

15. Baghouz, A.; Bouchelta, Y.; Es-safi, I.; El Brahimi, R.; Imtara, H.; AlZain, M.N.; Noman, O.M.; Shahat, A.A.; Guemmouh, R. Biocidal Activity of Ziziphora Hispanica L and Satureja Calamintha Scheele L Essential Oils against the Callosobruchus Maculatus (Fabricius) Pest on Cowpea Seeds during Storage. *Front. Sustain. Food Syst.* **2024**, *8*, doi:10.3389/fsufs.2024.1329100.

16. Asmae, B.; Yamna, B.; Bouchra, R.; Raja, G. INSECTICIDAL ACTIVITY OF THREE AROMATIC AND MEDICINAL PLANTS AGAINST Callosobruchus Maculatus (FAB.) (Chrysomelidae: Bruchinae). *PLANT CELL BIOTECHNOLOGY AND MOLECULAR BIOLOGY* **2020**, 44–52.

17. Ileke, K.D.; Ogungibite, O.C.; Olayinka-Olugunju, J.O. Powders and Extracts of Syzygium Aromaticum and Anacardium Occidentale as Entomocides against the Infestation of Sitophilus Oryzae (L.) [Coleoptera: Curculionidae] on Stored Sorghum Grains. *African Crop Science Journal* **2014**, *22*, 267–273.

18. Oluwafemi, A.R. Comparative Effects of Three Plant Powders and Pirimiphos-Methyl against the Infestation of Callosobruchus Maculatus (F.)(Coleoptera: Bruchidae) in Cowpea Seeds. *SOAJ Entomol* **2012**, *1*, 87–99.

19. Nwosu, L.C.; Obi, O.A.; Adanyi, D.D.; Okereke, V.C.; Azoro, V.A.; Ukpai, K.U.; Nzewuihe, G.U.; Lawal, I.A.; Uwalaka, O.A.; Ugagu10, G.M. Insecticidal Activities of Five Medicinal Plant Materials against Callosobruchus Maculatus Fabricius (Coleoptera: Chrysomelidae) Infesting Cowpea Seeds in Storage. *International Journal of Biotechnology* **2018**, *7*, 64–69.

20. Koomson, C.K. The Efficacy of Alchornea Cordifolia Leaf Powder on Cowpea Beetle, Callosobruchus Maculatus (Coleoptera: Bruchidae) as Oviposition and Egg Hatching Deterrent. *International Journal* **2020**, *6*, 156–160.

21. Tapondjou, L.A.; Adler, C.; Bouda, H.; Fontem, D.A. Efficacy of Powder and Essential Oil from Chenopodium Ambrosioides Leaves as Post-Harvest Grain Protectants against Six-Stored Product Beetles. *Journal of stored products research* **2002**, *38*, 395–402.

22. Kellouche, A.; Soltani, N. Activité Biologique Des Poudres de Cinq Plantes et de l'huile Essentielle d'une d'entre Elles Sur Callosobruchus Maculatus (F.). *International Journal of Tropical Insect Science* **2004**, *24*, 184–191, doi:10.1079/IJT200420.

23. Dike, M.C.; Mbah, O.I. Evaluation of the Lemon Grass Products in the Control of Callosobruchus Maculatus on Stored Cowpea. *Nigerian Journal of Crop Protection* **1992**, *14*, 88–91.

24. Engelmann, F. The Physiology of Insect Reproduction. **1970**.

25. Raja, N.; Albert, S.; Ignacimuthu, S. e; Dorn, S. Effect of Plant Volatile Oils in Protecting Stored Cowpea Vigna Unguiculata (L.) Walpers against Callosobruchus Maculatus (F.)(Coleoptera: Bruchidae) Infestation. *Journal of stored products Research* **2001**, *37*, 127–132.

SOIL QUALITY ASSESSMENT OF SELECTED AGRICULTURAL SOILS OF KUNDHELA

Ganesh Kumar

School of Environment and Sustainable Development, Central University of Gujarat, Gandhinagar-382030, Gujarat, India

R.Y Hiranmai

School of Environment and Sustainable Development, Central University of Gujarat, Gandhinagar-382030, Gujarat, India

Harshita Marwal

School of Environment and Sustainable Development, Central University of Gujarat, Gandhinagar-382030, Gujarat, India

Abstract

Understanding soil quality is crucial for sustainable agricultural practices in supporting ecosystem health and plant growth. By analysing soil health, policymakers can promote sustainable agricultural practices that helps in environmental resilience and ensures long term productivity. The present study was aimed to assess the quality of agricultural soil that could be employed to optimize productivity and sustainability. Soil samples collected from agricultural fields at two different depths viz., 0-15cm and 15-30cm by following random sampling method. Collected soil samples were analyzed for physico-chemical and biological parameters. Results indicated diverse soil characteristics, with pH ranging from slightly alkaline to strongly alkaline, with low electrical conductivity. Organic matter content was moderate in all selected sites, whereas available nitrogen and phosphorous concentration were to be low in all the sampling sites. Heavy metals concentrations were observed to be within permissible limits.Additionally some sampling sites revealed lower diversity of microbes, highlighting possible concerns for sustainability and soil health in agriculture fields. Without proper management practices , such as soil conservation measures and nutrients replenishment strategies, the current soil quality poses challenges to local farmers for long term agricultural productivity. To address these critical issues it is important to implement sustainable agricultural strategies along with biodiversity conservation.

Keywords: Soil quality, agricultural soil, sustainability, nutrient management

HISTORICAL ADVENTURE OF ROOF GARDENS

Ayşenur AKBANA

Bingol University, Faculty of Agriculture, Department of Landscape Architecture, Bingol, TÜRKİYE

ORCID ID: https://orcid.org/0000-0003-0394-7278

Zeynep DUMANOGLU

Bingol University, Faculty of Agriculture, Department of Biosystem Engineering, Bingol, TÜRKİYE

ORCID ID: https://orcid.org/0000-0002-7889-9015

Abstract

Introduction and Purpose: The first examples of roof gardens, which are one of the important components of green infrastructure, are the ziggurats and temple structures created by the Sumerians in Mesopotamia in 2000 BC. Some sources consider the Hanging Gardens of Babylon, built in Mesopotamia in the VI and VII centuries BC, to be the first example of this type. In the 1st century A.D., roof garden applications are seen in civil architectural structures in the Roman period and especially in villa structures belonging to high-level individuals. Similarly, in the Medieval and Renaissance periods, roof gardens were frequently applied on buildings as an indicator of wealth. It is stated that some of the structures identified in Canada's L'Anseaux Meadows, a UNESCO World Heritage site dating back to 1000 AD, constitute the first examples of extensive roof garden / green roof applications. In the Ottoman period, especially in palace gardens, terraced garden applications shaped by the effect of topography and enriched with plant material and balcony-like structures are observed. In the 18th century, the roof garden concept gained another dimension with the covering of the roof surface with soil in order to provide thermal insulation in houses in Northern Europe and the inclusion of soil-retaining herbaceous plants, and set an example for today's extensive roof gardens. In France in the early 1900s, Le Corbusier designed roof spaces as gardens, turning them into actively used living spaces. Since the 1960s, it has been designed as layered systems in many countries, especially in Germany, and has become widespread. Roof gardens, which are seen as an important part of urban green space systems today, have become widespread with different usage patterns since the 1980s. The aim of this study is to reveal the application and development processes of roof gardens in different civilizations and cultures in the historical process.

Key Words: Roof garden, Green roof, Landscape, Historical Adventure

LAMINITIS AND NUTRITIONAL MANAGEMENT IN HORSES

Gulsah KAYA KARASU
Van Hall Larenstein University of Applied Sciences, Velp, Netherlands
ORCID ID: https://orcid.org/0009-0000-4741-2545

Abstract

Laminitis is a severe and painful condition affecting horses' hooves, often leading to lameness due to inflammation and damage to the sensitive laminae. These structures connect the hoof wall to the pedal bone, and their damage can cause the bone to rotate, making laminitis potentially life-threatening if not managed properly. The condition is particularly concerning due to its serious clinical signs, systemic changes, poor prognosis, and high recurrence likelihood. Sudden increases in grain consumption can trigger laminitis by altering the caecal environment, increasing fermentation, and disrupting microbial balance, which leads to metabolic disturbances and endotoxemia. Key experimental models studying laminitis include carbohydrate overload, black walnut extract administration, oligofructose overload, and insulin-induced laminitis, each highlighting different triggers and mechanisms of the disease. Multiple factors contribute to laminitis, including breed predisposition, diet, endocrine disorders, obesity, trauma, and systemic illnesses. Ponies and smaller horse breeds are especially susceptible, as are horses consuming high-starch diets or suffering from conditions like Equine Metabolic Syndrome (EMS) and Cushing's disease. Overweight and obese horses are at a significantly higher risk, emphasizing the need for careful weight and diet management. Immediate veterinary attention is crucial for laminitis management, which involves pain relief, proper hoof care, dietary adjustments, and controlled exercise. Regular monitoring and tailored care, such as using low-sugar diets and therapeutic shoes, are essential for preventing and treating laminitis effectively, underscoring the importance of holistic and proactive health management in horses.

Key Words: Laminitis; Horse; Diet; Nutrition

THE MEDIA USED FOR *PHYTOPHTHORA INFESTANS* ISOLATION IN SEVERAL STUDIES

Aysun CAVUSOGLU

Kocaeli University, Faculty of Agriculture, Department of Plant Protection, 41285, Kocaeli, Türkiye

ORCID ID: https://orcid.org/ 0000-0001-6921-7097

Mehmet Erhan GÖRE

Bolu Abant İzzet Baysal University, Faculty of Agriculture, Department of Plant Protection, 14030, Bolu, Türkiye

ORCID ID: https://orcid.org/ 0000-0003-4229-2673

Abstract

One of the most famous examples of plant diseases affecting humans is *Phytophthora infestans* (Mont.) de Bary, which belongs to the *Phytophthora* genus as a member of the Oomycetes. The first step of any scientific study carried out on this devastating disease, which can be pathogenic in plants that are of vital importance in human nutrition, is undoubtedly the process of isolating the pathogen. Successful isolation will be achieved by using the right methods, and the artificial or semi-artificial media. For some reason, the same nutrient media cannot be used in the first stage of the plant diseases diagnosis, the pathogen isolation, and the continuation of pure cultures of the pathogen. These reasons include specific factors such as the pathogen lifestyle in nature, the life cycle, and reproduction type, and the host diversity. In this case, it will not be easy to decide on the isolation medium of an important disease such as *P. infestans*, which is separated from fungi by being an Oomycete, has a hemibiotrophic infection strategy and sexual-asexual reproduction forms. In this review, the studies carried out for this laborious and time-consuming first step are discussed, and the nutrient media used in the isolation of *Phytophthora infestans* and their differences are revealed.

Keywords: *Phytophthora infestans*; Plant Pathogen; Isolation Media; Identification

INTRODUCTION

Phytophthora infestans (Mont.) de Bary belongs to the *Phytophthora* genus and is a member of the Oomycetes, which is a pseudo-fungus and considered Chromist thus distinguished from true fungi. The most important aspect of this disease is that it can capacitate genetic diversity because it has both mating types and can create new races that are likely to be more aggressive. The mycelium, sporangia, zoospore, and oospore are used for reproduction (Agrios, 2005). This devastating pathogen made history with its unforgettable potato epidemic in the 1840s in some of the Northwestern countries in Europe. It is understood from the studies that its presence in the world has persisted and spread to every country where potatoes are grown, so it is required to be controlled under normal conditions (Saville & Ristaino, 2021). Although its main hosts are potatoes and tomatoes, it is now known that it may also have hosts from other members of the Solanaceae family, such as *Solanum muricatum* (pepino) (Forbes et al., 2013; Huo et al., 2023; Lindqvist-Kreuze et al., 2020), *Physalis peruviana* (cape gooseberry) (Danies et al., 2015; Vargas et al., 2009) *Solanum betaceum*, *S. quitoense*, *S. caripense*, *S.*

juglandifolium, *S. marginatum*, *Datura stramonium* (Forbes et al., 2013), *Iochroma grandiflorum* and more than ten *Solanum* spp. (Lindqvist-Kreuze et al., 2020), and *Petunia x hybrida* (petunia) (Forbes et al., 2013).

Apart from the field studies which did not include microorganism isolation, carried out on *Phytophthora infestans* to date (Hansen et al., 2005; Islam et al., 2013; Iob et al., 2022; Rakotonindraina et al., 2012), the isolation of the pathogen from the soil, water and symptomatic tissues, and obtaining a pure culture have been the first and most important steps following the observation of this pathogen in almost all *in vitro* and *in vivo* studies (Dhingra & Sinclair, 1995; Drenth & Sendall, 2001; Tsao & Ocana, 1969). These studies have been aimed mostly at determination of genetic diversity, infection mechanisms, pesticide resistance testing *in vitro* methods, techniques that can be used in the combat against pathogens and revealing new resistant crop plant varieties as explained in the following sections.

The review article aims to evaluate the studies that have the isolation media used for *Phytophthora infestans* isolation in different studies for the different hosts aiming for genetic structure, population diversity, resistance to fungicide and cultivars, environmental differences, pathogen-host interactions and/or protection and combat methods.

LITERATURE SEARCH

The literature search was conducted using various scientific databases, including Scopus, Google Scholar, and Web of Science, by using keywords such as "*Phytophthora*", "*P. infestans*", "Late Blight", "Oomycetes", "Solanaceae", "Plant Disease", "Isolation", "Medium", "Media" and their cross combinations which were published from the earliest reachable date to the present day in English. Following this, they were discussed in order from earlier dates to the present day in subtopics.

ISOLATION MEDIA USED FOR *PHYTOPHTHORA INFESTANS*

Isolation to Assess Genetic Structure, Population Diversity and First Reports of *P. infestans*

Although *P. infestans* has been identified in many countries, and the first reports have been made specifically for its hosts in most countries for plants, well known to be hosts, the first reports are still ongoing. The first report was published about *P. infestans* on cape gooseberry (*Physalis peruviana*) in Colombia. The solanaceous fruit is an important export plant in the country. The study mentioned dramatic increases in the pathogen on the cultivated *P. peruviana* plant with symptoms such as small, necrotic, and irregular leaf margins which are in increasing necrotic area, white mycelium and sporangia observation on the old lesion, and reducing yield. For further information, the mycelial growth was obtained directly from potato slices, and then the grown mycelium was transferred to the Rye agar. After the morphological notes and genetic studies, the pathogen was reported as first on *P. peruviana* (Vargas et al., 2007).

Similarly, the other first report was published on the Colombian *P. infestans* population for the A2 mating type. In the study, besides potatoes and tomatoes, *Solanum phureja*, *S. betaceum*, *S.*

quitoense, and *Physalis peruviana* were used. Their isolation and sporangia transferring studies were on the Rye agar (Vargas et al., 2009).

A gen flow is a significant subject in plant pathogenicity for disease management. In two neighboring countries, India and China, *P. infestans* populations in potatoes and tomatoes were searched and the genetic variation was found higher in tomatoes than potatoes. In addition, the Indian populations had a higher genetic variation than Chinese populations. Briefly, no gene flow was between these countries. In the first step sterilized leaf samples showing symptoms were incubated Water-Agar medium to obtain mycelium. After the mycelium occurrence, the sporulating lesions were transferred to the Rye-B medium to obtain colony development. After that, the purification was also maintained on the same medium (Wang et al., 2020).

Another study was conducted on potatoes in Yemen in 2023 and, it was stated that *P. infestans* had been detected observationally up to the study. The study was the first to detect the disease at the molecular level. It is emphasized that the macroscopic and microscopic morphological characters are made in the V8 agar medium, which provides radial growth. The study also provided information about uncommon details such as chlamydospore formation (Al Harethi et al., 2023).

For a study of the population structure of *P. infestans*, the population obtained from commercial fields of potatoes and tomatoes in western and eastern Canada was monitored (Babarinde et al., 2024). Before isolation, the tissue samples showing late blight symptoms were prepared and incubated to obtain mycelium. After the mycelium was obtained with sporangia, the structure was transferred onto the Pea agar or the V8 Rye PAR (Sapkota et al. 2023). The pathogen identifications as colony, mycelium and sporangia morphology were done on the same media. Although this study performed genotype analysis with the SSR method using FTR cards directly from the diseased tissue, which is a new technology and does not require fungal isolation, it is important to emphasize that isolation is significant and necessary in this study as in the step including resistance to metalaxyl.

Isolation to Assess Resistance of Cultivars and Environments

Resistance to a disease is one of the most studied subjects in recent years. If it is successful, it will be the most significant protection method. Many efforts are underway in this direction via trying to find out resistant cultivars and environmental factors. A study was conducted more than 20 years ago to reveal the differences in testing resistance of potatoes against *P. infestans* in the controlled environment or the field, after micropropagation-derived plants were transplanted to the field or the controlled rooms, previously isolated and preserved in liquid nitrogen, sporangiospores belonging to *P. infestans* were incubated by plated them on the Rye-A agar supplemented with 20 g/L sucrose (Caten & Jinks, 1968). Afterward, zoospores were obtained, and the study was continued by the infection of zoospores (Vleeshouwers et al., 1999).

Measurements of aggressiveness in cultivars and different environments can be a realistic step to detect a resistant cultivar. A study tested the same two potato cultivars for *P. infestans* disease in France and Morocco potato fields. In the first step, single lesion isolates were left on potato tuber slices for mycelium growth. After this step, the mycelia were transferred to the

Pea agar to obtain sporangial suspension or inoculation of leaves in cultivars (Andrivon et al., 2007).

Similarly, another study was carried out to predict the varietal differences in potatoes and resistance to *P. infestans* both *in vitro* and in the field. In this study, the previously obtained isolates were used to grow the pathogen and obtain sporangia in the Rye-B nutrient medium. Before infecting the tuber, these sporangia had to be kept in the refrigerator at 4^{0}C for the least one hour to release the zoospores and the study was continued with these zoospores (Nyankanga et al., 2008).

Different environmental factors can change disease development, the effect of fungicide usage, and resistance such as climate, and growing areas such as greenhouse or open fields. In a study, one susceptible and two partially resistant cultivars were used in field and greenhouse conditions to obtain a synergistic interaction of BABA which is a resistance inducer, and fungicide. For this aim, *P. infestans* culture was continued on the Rye agar or the Pea agar along with the study to obtain sporangial suspension to reach zoospores (Liljeroth et al., 2010).

Tuber storage condition is one of the important issues for the healthy seeds that will be planted in the following years. A study tested different potato varieties infected with different clonal strains of *P. infestans* and different storage temperatures. In this study, the isolates obtained from the stock cultures were used, firstly, the Rye-A nutrient medium was used to revive previous isolates, then the Rye-B nutrient medium was used to ensure sporulation with sporangia and zoospores were obtained (Çavuşoğlu, 2023).

Isolation to Assess Sensitivity or Resistivity to Fungicide

Resistance to fungicides has long been one of the most significant problems in agricultural production. Therefore, new fungicides need to be tested and used. In a study, fungicides were tested under field conditions against *P. infestans* in potatoes and then fungi were isolated from diseased leaves obtained from each application to test leaf lesions. For this purpose, selective (containing antibiotics and fungicide) or regular Rye-A (Caten & Jinks, 1968) nutrient media were used after mycelial growth on the tuber slices step (Grünwald et al., 2006).

Similarly, a study was conducted to determine the difference between laboratory and field studies for the determination of resistance to fungicides against *P. infestans* in potatoes, the sporulation of lesions on samples in Petri-dishes was followed by mycelium formation on potato slices. After this process, the mycelium was incubated in the Rye-A agar to induce sporangia formation. These sporangia were used as the main inoculum material in the next experiments (Sharma et al., 2011).

The Oomycete-targeted compounds are important chemical combat methods that have been revealed over many years. However, the compounds need to be tested against newly identified clonal lineages. In the USA, the six compounds were experimented on seven clonal lineages. For this reason, the isolates were grown on non-amended Rye-V8 media or non-amended Pea agar media. The fungicides were tested by the addition of certain concentrations to these media (Saville et al., 2015).

Population changes, movement of asexual individuals, and emerging subclonal pathogens are important in the outbreak and in decision of management strategy. In a study, all the topics were revealed, and the isolates were categorized by important factors including mefenoxam sensitivity. The sensitivity study was conducted *in vitro*. After the collection of symptomatic leaf materials, the sterilized leaves were placed in Petri containing the Water-Agar to stimulate sporulation. Then pure cultures were obtained from the Rye-A agar amended with antibiotics. Resistance to mefenoxam was tested on the Pea agar and the results were reached from the medium (Göre et al., 2019).

Conventional fungicide usage is very common among farmers, and they continually apply them in their tomato farms during the growing season against tomato early blight (*Alternaria solani*) and late blight (*Phytophthora infestans)* unless organic farming. For this reason, a series of active ingredients were tested for evaluation of their sensitivity to the pathogen. In the first step the two pathogens were isolated on the Potato Dextrose Agar (PDA) and then purified on the Corn Meal Agar media. The obtained conidial suspension for pathogenicity test and fungicide assessment were conducted on the Corn Meal Agar media (Ogolla et al., 2021).

Isolation to Assess Protection and Combat Methods

The first method that comes to mind among farmers for protection and combat against plant diseases in crops is the application of fungicides. When environmental impact is ignored, fungicide application is always the first choice because it provides rapid results and is relatively easy to apply. For these reasons, an active substance developed, Cyazofamid, has been tested against both *Phytophthora infestans* and *Pythium* species belonging to Oomycetes and against fifteen plant pathogenic fungi outside this group. For this purpose, all *P. infestans* isolates including A1 and A2 mating types, were maintained on the Rye-A agar. After the step, the mycelial discs from the medium were transferred to the Rye-B agar and the fungicide was tested on the media. According to the definition made in the study, the Rye-A media contained rye infusion, sucrose, and agar, and the Rye-B media contained supernatant of rye infusion, sucrose, and agar (Mitani et al., 2001).

Although the main control and combat strategy of *P. infestans* is fungicide application, natural, cheap, and safe ways are still waiting to be discovered. One of the ways is the usage of plant extract. In a study, two of three potato varieties are susceptible, and one is partially resistant to the pathogen, were treated with sugar beet extract. The highly virulent isolate culture was maintained on the Pea agar medium before obtaining sporangia on detached leaves. Direct toxicity bioassays were also done in the same medium before the following studies (Moushib et al., 2013).

Another study about plant extract was the treatment of tomatoes against *P. infestans* for protection. The interesting aspect of this application is that the leaf extracts taken from disease-resistant wild tomatoes were also applied to disease-susceptible tomatoes. In this study, which provides a better understanding of resistance, the Rye-Sucrose agar medium was used to maintain the *P. infestans* culture (Arafa et al., 2022).

Similarly, essential oils which are plant-based products are another part of botanicals, they have antifungal activities besides lots of benefits. In a study, essential oils of seven plants were applied separately to *P. infestans* beside control treatment copper sulphate. They emphasized that all chosen essential oils have anti-oomycete activity at different levels. For this purpose, the pathogen culture was maintained on the V8 agar medium. After the sporangial growth, the glucose-peptone medium was used for the microplate assays with a certain sporangium (Deweer et al., 2023).

CONCLUSION

The decision of the isolation media of phytopathogenic microorganisms including *Phytophthora infestans,* from soil, water, or symptomatic plant tissues, is one of the important steps in the studies on plant pathology. As a result of the correct choices, the working time will be shortened, and the next steps will be more reliable. Concentration of ingredients in the culture media determines the growth side which can be in vegetative or sporulation ways. In general, weak media control vegetative growth and stimulate sporulation. The sporulation step is more important than mycelial growth because of true identification and to continue the studies. The review article aims to evaluate the studies that have the isolation media used for *P. infestans* isolation in the different studies for the different hosts aiming for genetic structure, population diversity, resistance to fungicide and cultivars, environmental differences, pathogen-host interactions and/or protection, and combat methods. It is seen that in most studies, the Rye, Pea, Corn and V8 media added with agar, which are plant-base, and have natural structure were used including the isolation of *Phytophthora infestans*. The reason for using these media can be associated with the hemibiotrophic life cycle of the pathogen and strongly supporting the sporulation.

REFERENCES

Agrios, G. N. (2005). Plant pathology. 5th Edition, Burlington, Massachusetts, USA Elsevier. Academic Press Publication. ISBN 0-12-044565-4, 922 p.

Al Harethi, A. A., Abdullah, Q. Y. M., Al Jobory, H. J., Al Aquil, S. A., & Arafa, R. A. (2023). First report of molecular identification of *Phytophthora infestans* causing potato late blight in Yemen. *Scientific Reports*, *13*(1), 16365. doi: 10.1038/s41598-023-43510-2

Andrivon, D., Pilet, F., Montarry, J., Hafidi, M., Corbière, R., Achbani, E. H., ... & Ellisseche, D. (2007). Adaptation of *Phytophthora infestans* to partial resistance in potato: evidence from French and Moroccan populations. *Phytopathology*, *97*(3), 338-343. doi: 10.1094/PHYTO-97-3-0338

Arafa, R. A., Kamel, S. M., Taher, D. I., Solberg, S. Ø., & Rakha, M. T. (2022). Leaf extracts from resistant wild tomato can be used to control late blight (*Phytophthora infestans*) in the cultivated tomato. *Plants*, *11*(14), 1824. doi: 10.3390/plants11141824

Babarinde, S., Burlakoti, R. R., Peters, R. D., Al-Mughrabi, K., Novinscak, A., Sapkota, S., & Prithiviraj, B. (2024). Genetic structure and population diversity of *Phytophthora infestans* strains in Pacific western Canada. *Applied Microbiology and Biotechnology*, *108*(1), 237. doi: 10.1007/s00253-024-13040-6

Caten, C. E., & Jinks, J. L. 1968. Spontaneous variability of singleisolates of *Phytophthora infestans*. I. Cultural variation. *Can. J. Bot.*46:329-348.

Çavuşoğlu, A. (2023). Effect of different clonal lineages of *Phytophthora infestans* and temperature on tuber disease development (MSc Thesis). Bolu Abant İzzet Baysal University, Bolu, Türkiye.

Danies, G., Antolínez, C. A., Cantillo, J., Peña, G., Vargas, A. M., Cárdenas, M., ... & Restrepo, S. (2015). *Physalis peruviana* responses to *Phytophthora infestans* are typical of an incompatible interaction. *Canadian Journal of Plant Pathology*, *37*(1), 106-117. doi: 10.1080/07060661.2014.975157

Deweer, C., Sahmer, K., & Muchembled, J. (2023). Anti-oomycete activities from essential oils and their major compounds on *Phytophthora infestans*. *Environmental Science and Pollution Research*, *30*(51), 110240-110250. doi: 10.1007/s11356-023-29270-6

Dhingra, O. D. & Sinclair, J. B. (1995). Basic Plant Pathology Methods (2nd ed.). CRC Press. 448 p. doi: 10.1201/9781315138138

Drenth, A., & Sendall, B. (2001). Practical guide to detection and identification of *Phytophthora*. CRC for *Tropical Plant Protection*, Version 1, Brisbane, Australia, 41 p.

Forbes, G. A., Morales, J. G., Restrepo, S., Pérez, W., Gamboa, S., Ruiz, R., ... & Oliva, R. (2013). *Phytophthora infestans* and *Phytophthora andina* on Solanaceous hosts in South America. (In ed. K. Lamour *Phytophthora: a global perspective)*, 48-58.

Göre, M. E., Altın, N., Yaman, T., Myers, K., Çağlı, A., Cooke, D. E. L., ... & Özer, G. (2019). Severe outbreaks of *Phytophthora infestans* on potato in Turkey caused by recent changes in the pathogen population structure. *Phytoparasitica*, *47*, 693-709. doi: 10.1007/s12600-019-00768-5

Grünwald, N. J., Sturbaum, A. K., Montes, G. R., Serrano, E. G., Lozoya-Saldaña, H., & Fry, W. E. (2006). Selection for fungicide resistance within a growing season in field populations of *Phytophthora infestans* at the center of origin. *Phytopathology*, *96*(12), 1397-1403. doi:10.1094/PHYTO-96-1397

Hansen, J. G., Koppel, M., Valskyte, A., Turka, I., & Kapsa, J. (2005). Evaluation of foliar resistance in potato to *Phytophthora infestans* based on an international field trial network. *Plant Pathology*, *54*(2), 169-179. doi: 10.1111/j.1365-3059.2005.01166.x

Huo, C., Cao, J., Yin, R., Yang, M., & Zhao, Z. (2023). First report of *Phytophthora infestans* causing late blight on pepino (*Solanum muricatum*) in China. *Plant Disease*, *107*(10), 3321. doi: 10.1094/PDIS-04-22-0892-PDN

Iob, D., Pansera, M. R., & dos Santos, M. C. (2022). Phytosanitary treatment program for tomato late blight control. *Revista Ciência Agrícola*, *20*(1):49-55. doi: 10.28998/rca.v20i1.12419.

Islam, M. R., Mondal, C., Hossain, I., & Meah, M. B. (2013). Organic management: an alternative to control late blight of potato and tomato caused by *Phytophthora infestans*. *International Journal of Theoretical & Applied Sciences*, *5*(2), 32-42.

Liljeroth, E., Bengtsson, T., Wiik, L., & Andreasson, E. (2010). Induced resistance in potato to *Phytphthora infestans*—effects of BABA in greenhouse and field tests with different potato varieties. *European Journal of Plant Pathology*, *127*, 171-183. doi: 10.1007/s10658-010-9582-4

Lindqvist-Kreuze, H., Gamboa, S., Izarra, M., Pérez, W., Correa, M. Y., Astete, A., ... & Gonzáles, P. (2020). Population structure and host range of the potato late blight pathogen *Phytophthora infestans* in Peru spanning two decades. *Plant Pathology*, *69*(2), 334-346. doi: 10.1111/ppa.13125

Mitani, S., Araki, S., Yamaguchi, T., Takii, Y., Ohshima, T., & Matsuo, N. (2001). Antifungal activity of the novel fungicide cyazofamid against *Phytophthora infestans* and other plant pathogenic fungi *in vitro*. *Pesticide Biochemistry and Physiology*, *70*(2), 92-99. doi: 10.1006/pest.2001.2541

Moushib, L. I., Witzell, J., Lenman, M., Liljeroth, E., & Andreasson, E. (2013). Sugar beet extract induces defence against *Phytophthora infestans* in potato plants. *European Journal of Plant Pathology*, *136*, 261-271. doi: 10.1007/s10658-012-0160-9

Nyankanga, R. O., Olanya, O. M., Wien, H. C., El-Bedewy, R., Karinga, J., & Ojiambo, P. S. (2008). Development of tuber blight (*Phytophthora infestans*) on potato cultivars based on *in vitro* assays and field evaluations. *HortScience*, *43*(5), 1501-1508. doi: 10.21273/HORTSCI.43.5.1501

Ogolla, F. O., Nyakinywa, R., Chabari, S. K., & Onyango, B. O. (2021). *In-vitro* evaluation of fungicide sensitivity of tomato leaf blight pathogens. *Jurnal Pertanian Tropik*, *8*(1), 11-25. doi: 10.32734/jpt.v8i1.5842

Rakotonindraina, T., Chauvin, J. É., Pellé, R., Faivre, R., Chatot, C., Savary, S., & Aubertot, J. N. (2012). Modeling of yield losses caused by potato late blight on eight cultivars with different levels of resistance to *Phytophthora infestans*. *Plant Disease*, *96*(7), 935-942. doi: 10.1094 / PDIS-09-11-0752

Sapkota, S., Burlakoti, R. R., & Punja, Z. K. (2023). Diversity in virulence and metalaxyl-m sensitivity of *Phytophthora rubi* isolates has implications for raspberry root rot and wilting complex management. *Canadian Journal of Plant Pathology*, *45*(3), 263-276. doi: 10.1080/07060661.2023.2175912

Saville, A., Graham, K., Grünwald, N. J., Myers, K., Fry, W. E., & Ristaino, J. B. (2015). Fungicide sensitivity of U.S. genotypes of *Phytophthora infestans* to six oomycete-targeted compounds. *Plant Disease*, *99*(5), 659-666. doi: 10.1094/PDIS-05-14-0452-RE

Saville, A. C., & Ristaino, J. B. (2021). Global historic pandemics caused by the FAM-1 genotype of *Phytophthora infestans* on six continents. *Scientific Reports*, *11*(1), 12335. doi: 10.1038/s41598-021-90937-6

Sharma, B. P., Manandhar, H. K., Forbes, G. A., Shrestha, S. M., & Thapa, R. B. (2011). Efficacy of fungicides against *Phytophthora infestans* in potato under laboratory and field conditions. *Nepal Agric. Res*. J. 11, 28-39.

Tsao, P. H., & Ocana, G. (1969). Selective isolation of species of Phytophthora from natural soils on an improved antibiotic medium. *Nature*, *223*, 636-638.

Vargas, A. M., Correa, A., Lozano, D. C., González, A., Bernal, A. J., Restrepo, S., & Jiménez, P. (2007). First report of late blight caused by *Phytophthora infestans* on cape gooseberry (*Physalis peruviana*) in Colombia. *Plant Disease*, *91*(4), 464-464. doi: 10.1094/PDIS-91-4-0464B

Vargas, A. M., Ocampo, L. M. Q., Céspedes, M. C., Carreño, N., González, A., Rojas, A., ... & Restrepo, S. (2009). Characterization of *Phytophthora infestans* populations in Colombia: first report of the A2 mating type. *Phytopathology*, *99*(1), 82-88. doi:10.1094 / PHYTO-99-1-0082

Vleeshouwers, V. G. A. A., van Dooijeweert, W., Paul Keizer, L. C., Sijpkes, L., Govers, F., & Colon, L. T. (1999). A laboratory assay for *Phytophthora infestans* resistance in various *Solanum* species reflects the field situation. *European Journal of Plant Pathology*, *105*, 241-250. doi: 10.1023/A:1008710700363

Wang, Y. P., Xie, J. H., Wu, E. J., Yahuza, L., Duan, G. H., Shen, L. L., ... & Zhan, J. (2020). Lack of gene flow between *Phytophthora infestans* populations of two neighboring countries with the largest potato production. *Evolutionary Applications*, *13*(2), 318-329. doi: 10.1111/eva.12870

POSTBIOTICS: TRENDS IN NUTRITION AND FOOD TECHNOLOGICAL APPLICATIONS

Lect. Dr. Pelin ERTÜRKMEN

Burdur Mehmet Akif Ersoy University, Burdur Food, Agriculture and Livestock Vocational School, Food Processing Department, Burdur, Turkey[1]

ORCID ID: https://orcid.org/0000-0003-4321-7886

Abstract

The gastrointestinal (GI) microbial ecosystem begins to develop from birth and plays a critical role in the emergence of the immune system, allergies, obesity, inflammatory diseases, and neurological disorders. The beneficial effects of probiotics on the GI system have been studied for many years. The term "postbiotic" has been established to highlight the health benefits beyond the natural viability of probiotics and broaden the concept of probiotics, the term "postbiotic" has been established. This term refers to bioactive metabolites released from live probiotic bacteria or after bacterial degradation due to their safe profile, resistance to enzymes, and durability under digestive system conditions. Although this term has emerged in recent years, it has been rapidly adopted in food technology and markets, and its potential applications in human health and nutrition have begun to be explored. Postbiotics are metabolites such as short-chain fatty acids, exopolysaccharides, enzymes, peptides, bacteriocins, vitamins, plasmalogens, and peptidoglycans. Due to the postbiotic's bioactive peptide content and antimicrobial, antioxidant, antidiabetic, anti-inflammatory, hypocholesterolemic, and lactose intolerance properties, their use as functional agents in food technology and nutrition are current research topics.

Keywords: Probiotic, postbiotic, functional food, health

INTRODUCTION

Among bioactive compounds, probiotics and postbiotics hold a significant share in the functional food market and have become increasingly prevalent in consumers' diets in recent years. Probiotics, as live microorganisms, encompass bacteria such as *Lactiplantibacillus*, *Bacillus* and *Bifidobacterium*, as well as yeasts from the genus *Saccharomyces* (Hill et al., 2014). Probiotic microorganisms play a crucial role in the prevention and treatment of intestinal diseases. They are beneficial against infectious disorders, irritable bowel syndrome, inflammatory disease, *Helicobacter pylori* infection, allergies, lactose-intolerance and atopic diseases (Lunjani et al., 2018; Castan et al., 2020).

Non-viable bacterial cells or their components cannot be classified as probiotics. The term "postbiotic" was suggested to emphasize the health benefits of probiotics beyond their natural viability and to expand the concept of probiotics (Aguilar-Toalá et al., 2018; Homayouni-Rad et al., 2021). Although this term has emerged recently, it has been rapidly adopted in the field of food science and has begun to find potential applications in human health and nutrition. Postbiotics, known as non-viable probiotics, are also defined as inactivated probiotics and non-living cells (de Almada et al., 2016). These cells are released from viable bacteria or after bacterial lysis. These by-products provide additional physiological benefits to the host by offering bioactivity (Paparo et al., 2019).

For many years, probiotic therapy has been used to alter the existing gut microbiome by consuming beneficial bacterial cultures (Gökırmaklı et al., 2021). However, the effect of the administered probiotic has depended on the bacteria maintaining their viability upon reaching the small and large intestines (Hernández-Granados & Franco-Robles, 2020). Furthermore, growing concerns about safety issues related to the widespread use of live microbial cells and shelf-life issues have increased interest in non-viable microorganisms or microbial cell extracts. Postbiotics offer a higher safety advantage than some probiotics for individuals with immune balance disorders or weakened immunity by reducing the risk of infection, microbial translocation or enhanced inflammation (Homayouni-Rad et al., 2021). The purpose of this study is to provide information about the applicability of postbiotics in the fields of food and nutrition and to compile current studies on their effects on health.

CONCEPTUAL FRAMEWORK

Gastrointestinal (GI) Microbial Ecosystem

The human gut microbiota begins to develop from birth and plays an extremely important role in maintaining health. The gastrointestinal (GI) microbial ecosystem comprises a unique structure of bacteria, archaea, viruses, and fungi. The microbiota is not only crucial for food processing but also plays a significant role in the immune system, allergies, inflammatory diseases, obesity, and neurological disorders (Homayouni-Rad et al., 2020).

This colonization typically occurs in the large intestine, which includes the most densely active microbial community in healthy adults. In addition to *Proteobacteria*, *Actinobacteria*, *and Verrucomicrobia*, the colon is predominantly controlled by anaerobic bacteria of the Firmicutes and Bacteroidetes phyla. These bacteria provide many benefits by metabolizing indigestible compounds, supplying essential nutrients, preventing the colonization of opportunistic pathogens, and even contributing to the development of gut structure (Aguilar-Toalá et al., 2018; Paparo et al., 2019). Furthermore, specific attributes and roles influencing the development of the immune system are connected to interactions with the human microbiota. Consequently, the microbiota can elicit both pro and antiinflammatory responses. The composition of bacterial communities in the gut is closely linked to the effective functioning of the immune system (Marchesi et al., 2016).

Postbiotics and Immunomodulation Effect

Postbiotics are typically obtained by separating the cell-free supernatant of a probiotic strain after fermentation and purifying the desired target molecule using various methods such as ultrafiltration and chromatography. They contain soluble components including ribonucleic acid, deoxyribonucleic acid, peptidoglycan-derived muropeptides, endo and exo-polysaccharides, teichoic acids, cytoplasmic components, short-chain fatty acids, enzymes, antimicrobial peptides, vitamins, and organic acids, as well as bioactive compounds secreted by live bacteria during fermentation (İçier et al., 2022). These substances are used as immunomodulatory agents that enhance immunity and neutralize endotoxins. It has been suggested that postbiotics exert their immunomodulatory effects by improving gastrointestinal barrier function, preventing pathogen translocation, interacting with eukaryotic cells, and regulating the formation, function, and communication of immune cells. These effects indicate that postbiotics enhance immune response in allergic conditions, infections, and cancers in both children and adults (Devran & Saka, 2023).

Contribution to the formation of cofactors and vitamins in the microbiome. Bacteria from the genera *Bifidobacterium* and *Lactobacilli* can synthesize vitamins such as A, C, and B1, B2, B3, B5, B7, B9 and B12 (Tomasik & Tomasik, 2020). The biosynthesis of vitamins such as B7 (biotin), B2 (riboflavin), B5 (pantothenic acid), B1 (thiamine), B9 (folic acid), and ascorbic acid requires biosynthetic enzymes (Baroudi et al., 2016). Biotin (B7) plays a crucial role as a cofactor for carboxylase enzymes. It is particularly important in, fatty acid biosynthesis, branched-chain amino acid catabolism and gluconeogenesis pathways.

Studies on micronutrients, gut microbiota, and minerals are gaining increasing importance. Generally, some minerals such as calcium, iron, phosphorus and zinc depend on bacteria for absorption and/or the maintenance of homeostasis in the body (Vazquez-Gutierrez et al., 2015). For instance, iron-binding probiotic bacteria minimize the formation of free radicals and, as a result, reduce the occurrence of changes that trigger oxidative processes and/or chronic diseases (Skrypnik et al., 2019).

The microbiota plays a critical role in regulating primary bile acid metabolism and is indispensable for the synthesis of secondary bile acids. This synthesis is facilitated by the secretion of bile acid hydrolase enzymes, primarily by bacteria such as *Clostridium* and *Lactobacillus* genera. These enzymes facilitate the processes of bile acid dehydrogenation, dihydroxylation, and deconjugation. The interaction between the microbiota and bile acids is crucial for regulating lipid and lipoprotein metabolism (Staley et al., 2017).

Studies on the application of postbiotics in the food industry

In studies related to postbiotics in the food sector, both at the laboratory and industrial levels, it has been reported that they can be produced using different cell disruption methods. Production methods include the use of chemical agents (e.g., formalin), ultrasonic, enzymatic processes, and solvent extraction (Cuevas-González et al., 2020). Additionally, methods such as centrifugation, dialysis, freezing, spray drying, or lyophilization have been used. Among all these methods, thermal inactivation is the most commonly used (Nataraj et al., 2020). Figure 1 illustrates the addition of postbiotics to the food matrix and their effects.

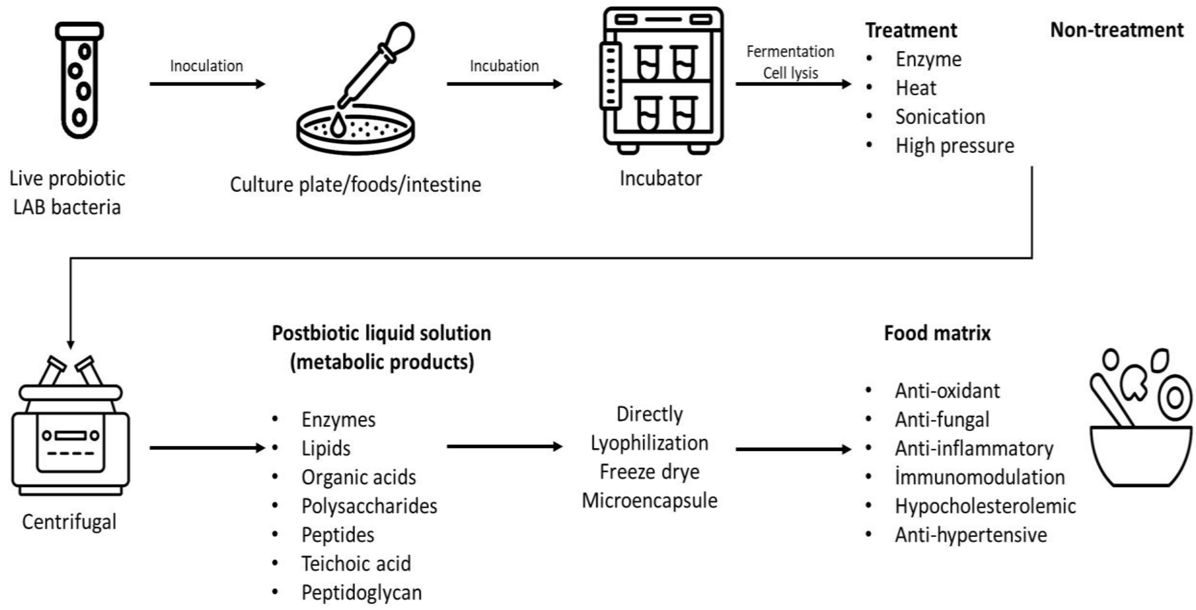


Figure 1. The addition of postbiotics to the food matrix and their effects

Generally, pasteurized and lyophilized postbiotics increase antimicrobial activity and minimize moisture increase in food compared to postbiotic solutions. Spraying postbiotics on the surface of food is an effective alternative to inhibit the growth of spoilage and pathogenic microorganisms (Moradi et al., 2021a). The viability and functionality of these microorganisms depend on specific parameters of the food (such as pH, titratable acidity, oxygen levels, water activity, salt content), manufacturing conditions (including time, temperature, inoculation rate, oxygen exposure, packaging materials), as well as various stressors encountered during digestion. (Barros et al., 2020; Alp, 2022).

Postbiotics offer therapeutic and technological advantages to food producers. Postbiotics are more stable for industrial use compared to their sources derived from live microorganisms, providing therapeutic and technological advantages to food producers (Barros et al., 2020). They are used as food additives in the removal of biofilms, breakdown of chemical contaminants, edible coatings, and inhibition of food pathogens (Gökırmaklı et al., 2021; İçier et al., 2022). For example, to extend the shelf life of chicken sausages and semi-processed chicken products, the production of protective postbiotic-containing culture fermentation (PPCP) with *Lactobacillus paracasei* and *Saccharomyces cerevisiae* var *boulardii* has been targeted. Additionally, the impact of the cold chain on product shelf life has been evaluated. Studies have indicated that when the concentration of PPCP added to raw chicken sausages or semi-cooked chicken products is below 0.5%, contaminants are not inhibited; partial inhibition is achieved with the addition of 1.0% and 1.5% PPCP. Total inhibition is achieved with the addition of more than 3.0% PPCP, which is considered to significantly impact costs. PPCP has been observed to be used as a preservative in raw chicken sausages and semi-cooked chicken products to control aerobic mesophiles at less than 5 log CFU/g during 60 days of cold storage (de Almeida Godoy et al., 2022). Another study comparing three different *Lactobacillus* spp. indicated that the cell-free supernatant of *L. salivarius* could be an effective natural preservative for controlling *Listeria monocytogenes* in meat and milk (Moradi et al., 2019).

Studies on bacteriocins indicated that direct use of the culture supernatant is sufficient for bacteriocins to exhibit antimicrobial effects. The protective potential of *L. plantarum* Cys5-4 strain, which produces bacteriocins, has been investigated in two forms: active substances and precipitated peptides in both fresh orange juice and chicha, a fermented beverage specific to Latin America. The antimicrobial effects of *L. plantarum* Cys5-4 against *Escherichia coli* and *Salmonella* have been observed (Tenea & Barrigas, 2018). In another study, bacteriocin-like postbiotics from *L. plantarum* ST16Pa, added as a culture supernatant to chicken breast meat, showed antimicrobial activity that persisted during 7 days of storage at 4°C (da Silva Sabo et al., 2017).

In a study conducted on grains, the supernatant obtained from *Lactobacillus* spp. RM1 was found to exhibit antifungal activity against *Aspergillus flavus*, *Aspergillus parasiticus* and *Aspergillus carbonarius*. It effectively inhibited the production of aflatoxin B1 and ochratoxin A. When used to process wheat grains, the supernatant completely prevented the growth of *Aspergillus parasiticus* for up to 2 weeks compared to untreated grains (Shehata et al., 2019). Additionally, postbiotics could be a good alternative to increase the B vitamin content in cereal-based products (Tomasik & Tomasik, 2020). Therefore, all these findings suggest that postbiotics could be an innovative way to reduce deterioration in food product quality (Tenea & Barrigas, 2018).

CONCLUSION AND DISCUSSION

Current state and potential of postbiotics in food technology although not yet widely commercially produced, postbiotics continue to be researched for their nature and potential health effects through various studies. Compared to probiotics, they pose fewer challenges in terms of storage and shelf life, making them a promising alternative in food technology (Moradi et al., 2021b). While the full mechanisms of postbiotics are not fully understood, they have been noted to contribute to host health with potential immunomodulatory, anti-inflammatory, antihypertensive, anti-obesogenic, hypocholesterolemic, antimicrobial, anticancer and antioxidant properties. However, further in vivo and in vitro studies are needed. There is a need for expert consensus for a precise definition. Additionally, in the field of nutrition, postbiotics could effectively enhance the conversion of probiotics into functional components or therapeutic agents. Lastly, there is still no clear approach on how to name a product that evolves from a probiotic to a postbiotic over time. Furthermore, studies have suggested finding alternatives to laboratory media that increase fermentation costs and affect the color of postbiotics due to the presence of meat or yeast extracts and sugar content (İçier et al., 2022). Over time, it is anticipated that rapid and high-accuracy scientific methods suitable for industrial requirements related to postbiotics could increase production and consumption.

REFERENCES

Alp D. (2022). Strain-dependent effectivity, and protective role against enzymes of S-layers in Lactiplantibacillus plantarum strains. *Journal of Basic Microbiology*.;1–13. https://doi.org/10.1002/jobm.202100590.

Aguilar-Toalá, J. E., Garcia-Varela, R., Garcia, H. S., Mata-Haro, V., González-Córdova, A. F., Vallejo-Cordoba, B., & Hernández-Mendoza, A. (2018). Postbiotics: An evolving term within the functional foods field. *Trends in food science & technology*, *75*, 201:105-114. https://doi.org/ 10.1016/j.tifs.2018.03.009

Baroudi, K., Dagli, R., Dagli, N., & Darwish, S. (2016). Oral microbial shift: factors affecting the microbiome and prevention of oral disease. *The Journal of Contemporary Dental Practice*, *17*(1), 90-96. https://doi.org/10.5005/jp-journals-10024-1808

Barros, C. P., Guimarães, J. T., Esmerino, E. A., Duarte, M. C. K., Silva, M. C., Silva, R., Ferreira, B. M., Sant'Ana, A. S., Freitas, M. Q., & Cruz, A. G. (2020). Paraprobiotics and postbiotics: concepts and potential applications in dairy products. In *Current Opinion in Food Science* (Vol. 32, pp. 1–8). Elsevier Ltd. https://doi.org/10.1016/j.cofs.2019.12.003

Castan, L., K. L. Bøgh, N. Z. Maryniak, M. M. Epstein, S. Kazemi, L. O'Mahony, M. Bodinier, J. J. Smit, J. H. M. Bilsen, C. Blanchard, et al. (2020). Overview of in vivo and ex vivo endpoints in murine food allergy models: Suitable for evaluation of the sensitizing capacity novel proteins?. Allergy 75 (2):289–301. https://doi.org/10.1111/all.13943.

Cuevas-González, P. F., Liceaga, A. M., & Aguilar-Toalá, J. E. (2020). Postbiotics and paraprobiotics: From concepts to applications. In *Food Research International* (Vol. 136). Elsevier Ltd. https://doi.org/10.1016/j.foodres.2020.109502

da Silva Sabo, Sabrina, Noelia Pérez-Rodríguez, José Manuel Domínguez, & Ricardo Pinheiro de Souza Oliveira. (2017). Inhibitory substances production by Lactobacillus plantarum ST16Pa cultured in hydrolyzed cheese whey supplemented with soybean flour and their antimicrobial efficiency as biopreservatives on fresh chicken meat. *Food Research International* 99(4):762–69. https://doi.org/10.1016/j.foodres. 2017.05.026

de Almada, C. N., Almada, C. N., Martinez, R. C., & Sant'Ana, A. S. (2016). Paraprobiotics: evidences on their ability to modify biological responses, inactivation methods and perspectives on their application in foods. *Trends in food science & technology*, *58*, 96-114. https://doi.org/ 10.1016/j.tifs.2016.09.011

de Almeida Godoy, C. L., Costa, L. M., Guerra, C. A., de Oliveira, V. S., de Paula, B. P., Lemos Junior, W. J. F., Silva Duarte, V., Luchese, R. H., Bautitz, I. R., Guerra, A. F. (2022). Potentially postbiotic-containing preservative to extend the use-by date of raw chicken sausages and semifinished chicken products. *Sustainability*, 14(5): 2646, https://doi.org/10.3390/su14052646

Devran, B. S., & Saka, M. (2023). Postbiyotikler ve İnsülin Direnci. *Van Sağlık Bilimleri Dergisi*, *16*(3), 268-273. https://doi.org/10.52976/vansaglik.1261880

Gökırmaklı, Ç., Üçgül, B., Güzel-Seydim, Z. B. (2021). Fonksiyonel gıda kavramına yeni bir bakış: postbiyotikler. *Gıda*, 46(4): 872-882, https://doi.org/10.15237/gida.GD21035

Hernández-Granados, M. J., & Franco-Robles, E. (2020). Postbiotics in human health: Possible new functional ingredients? *Food Research International*, *137*. https://doi.org/10.1016/j.foodres.2020.109660

Hill, C., F. Guarner, G. Reid, G. R. Gibson, D. J. Merenstein, B. Pot, L. Morelli, R. B. Canani, H. J. Flint, S. Salminen, et al. (2014). Expert consensus document: The International Scientific Association for Probiotics and Prebiotics consensus statement on the scope and appropriate use of the term probiotic. *Nature Reviews Gastroenterology & Hepatology*, 11 (8):506. https://doi.org/10.1038/nrgastro.2014.66

Homayouni Rad, A., Aghebati Maleki, L., Samadi Kafil, H., & Abbasi, A. (2021). Postbiotics: A novel strategy in food allergy treatment. *Critical reviews in food science and nutrition*, *61*(3), 492-499. https://doi.org/10.1080/10408398.2020.1738333

Homayouni Rad, A., L. Aghebati Maleki, H. Samadi Kafil, H., Fathi Zavoshti & Abbasi, A. (2020). Postbiotics as novel health-promoting ingredients in functional foods. Health

Promotion Perspectives 10 (1):3–4. https://doi.org/10.15171/hpp.2020.02.

İçier, S., Güzelcan, C., Hıdır, Ş., Türköz, B. K. (2022). Postbiyotikler ve gıda endüstrisinde kullanım alanları. *Gıda*, 47(2): 252-265. https://doi.org/10.15237/gida.GD21145

Lunjani, N., Satitsuksanoa, P., Lukasik, Z., Sokolowska, M., Eiwegger, T., & O'Mahony, L. (2018). Recent developments and highlights in mechanisms of allergic diseases: Microbiome. *Allergy*, *73*(12), 2314-2327. https://doi.org/10.1111/all.13634

Marchesi, J. R., Adams, D. H., Fava, F., Hermes, G. D. A., Hirschfield, G. M., Hold, G., Quraishi, M. N., Kinross, J., Smidt, H., Tuohy, K. M., Thomas, L. V., Zoetendal, E. G., & Hart, A. (2016). The gut microbiota and host health: A new clinical frontier. *Gut*, *65*(2), 330–339. https://doi.org/10.1136/gutjnl-2015-309990

Moradi, M., Mardani, K., & Tajik, H. (2019). Characterization and application of postbiotics of Lactobacillus spp. on Listeria monocytogenes in vitro and in food models. *LWT*, *111*, 457–464. https://doi.org/10.1016/j.lwt.2019.05.072

Moradi, M., Molaei, R., & Guimarães, J. T. (2021)a. A review on preparation and chemical analysis of postbiotics from lactic acid bacteria. *Enzyme and Microbial Technology*, *143*. https://doi.org/10.1016/j.enzmictec.2020.109722

Moradi, M., Guimarães, J. T., Sahin, S. (2021)b. Current applications of exopolysaccharides from lactic acid bacteria in the development of food active edible packaging. *Current Opinion in Food Science*, *40*, 33-39. https://doi.org/10.1016/j.cofs. 2020.06.001

Nataraj, B.H., Ali, S.A., Behare, P.V. Yadav H. (2020). Postbiotics-parabiotics: the new horizons in microbial biotherapy and functional foods. *Microbial Cell Fact* 19, 168 https://doi.org/10.1186/s12934-020-01426-w

Paparo, L., R. Nocerino, C. Di Scala, G. Della Gatta, M. Di Costanzo, A. Buono, C. Bruno, and R. Berni Canani. (2019). Targeting food allergy with probiotics. In Probiotics and child gastrointestinal health: Advances in microbiology, infectious diseases and public health, eds. S. Guandalini & F. Indrio, Vol. 10, 57–68. Cham: Springer International Publishing.

Shehata, M. G., Badr, A. N., El, S. A., Asker, D., & Awad, T. S. (2019). Annals of Agricultural Sciences Characterization of antifungal metabolites produced by novel lactic acid bacterium and their potential application as food biopreservatives. *Annals of Agricultural Sciences*, *64*(1), 71–78. https://doi.org/10.1016/j.aoas.2019.05.002

Skrypnik, K., Bogdański, P., Schmidt, M., & Suliburska, J. (2019). The effect of multispecies probiotic supplementation on iron status in rats. *Biological trace element research*, *192*, 234-243.

Staley, C., Weingarden, A. R., Khoruts, A., & Sadowsky, M. J. (2017). Interaction of gut microbiota with bile acid metabolism and its influence on disease states. *Applied microbiology and biotechnology*, *101*, 47-64. https://doi.org/10.1007/s00253-016-8006-6

Tenea, G. N., Barrigas, A. (2018). The efficacy of bacteriocin-containing cell-free supernatant from Lactobacillus plantarum Cys5-4 to control pathogenic bacteria growth in artisanal beverages. *International Food Research Journal*, 25(5): 2021-2137.

Toalaa, J. E., Garcia Varelab, R., Garciac, H. S., & Harod, V. (2018). Postbiotics: an evolving term within the functional foods field. *Trends Food Sci Technol*, *75*, 105-114. https://doi.org/10.1016/j.tifs.2018.03.009

Tomasik, P., Tomasik, P. (2020). Probiotics, non-dairy prebiotics and postbiotics in nutrition. Appl Sci, 10: 1470. https://doi.org/10.3390/app10041470

Vazquez-gutierrez, P., Lacroix, C., Jaeggi, T., Zeder, C., Zimmerman, M. B., & Chassard, C. (2015). Bifidobacteria strains isolated from stools of iron deficient infants can efficiently sequester iron. 1–10. https://doi.org/10.1186/s12866-014-0334-z

THE ROLE OF MODERN AGRICULTURAL TECHNIQUES IN THE SUSTAINABLE DEVELOPMENT OF AGRICULTURE

Samir Mehdiyev Shahin
Azerbaijan Academy of Labor and Social Relations, Economy, Baku, Azerbaijan
ORCID 0009-0001-4073-0740

Abstract

Ensuring the sustainable development of agriculture requires the application of science-intensive technologies and the expansion of innovative activities. In the modern era, the importance of new generation technologies in accelerating innovative development in agriculture is steadily increasing. These technologies not only enhance productivity but also ensure environmental protection, more efficient use of resources, and the optimization of agricultural processes.

In addressing the tasks facing our country's agriculture, projects implemented within the framework of scientific and technical cooperation between the Ministry of Agriculture and the Azerbaijan National Academy of Sciences (ANAS) play a significant role. The research conducted and innovative technologies applied within these projects facilitate the development of the agricultural sector in line with modern requirements and enhance its competitiveness.

The application of science-intensive technologies in agriculture not only reduces the inefficiency of traditional methods but also increases productivity and improves quality. For instance, new generation biotechnologies and genetic engineering methods can boost the productivity of plants and animals. Additionally, the use of digital technologies and databases allows for the optimization of field management and irrigation systems**.**

Investments must be made in applying existing knowledge and technologies and constantly developing new technologies and approaches for sustainable development in agriculture and combating emerging threats. The practice of developed world countries proves it. Investments in the food production sector should be aimed at improving sustainable development while maintaining the integrity of ecosystems. At the same time, the correct identification and stimulation of scientific research priorities is also important.

Key Words: sustainable development, application of science-intensive technologies, Ministry of Agriculture, Azerbaijan National Academy of Sciences, digital technologies.

GİRİŞ

Azərbaycanın kənd təsərrüfatı sektorunda qarşıya qoyulan əsas məqsədlərdən biri, məhsul istehsalının ekoloji təmiz və dayanıqlı şəkildə artırılmasıdır. Bu məqsədə nail olmaq üçün elmi tədqiqatların nəticələrinin praktikada tətbiqi vacibdir. Kənd Təsərrüfatı Nazirliyi və AMEA arasında əməkdaşlıq, bu istiqamətdə mühüm addımların atılmasına imkan yaradır. Əməkdaşlıq çərçivəsində reallaşdırılan layihələr, innovativ texnologiyaların kənd təsərrüfatına inteqrasiyasını sürətləndirir.

AMEA-nın müxtəlif institutları və tədqiqat mərkəzləri, kənd təsərrüfatının müxtəlif sahələrində tədqiqatlar apararaq, innovativ texnologiyaların inkişafına və tətbiqinə töhfə verirlər. Bu tədqiqatlar nəticəsində əldə olunan yeniliklər, kənd təsərrüfatı istehsalçıları üçün daha effektiv və ekoloji cəhətdən təmiz texnologiyaların tətbiqinə imkan yaradır. Məsələn, torpaq münbitliyinin artırılması, suvarma texnologiyalarının optimallaşdırılması və pestisidlərin istifadəsinin azalması istiqamətində həyata keçirilən tədqiqatlar, kənd təsərrüfatının dayanıqlı inkişafına mühüm təsir göstərir.

Yeni nəsil texnologiyaların tətbiqi, kənd təsərrüfatının müxtəlif sahələrində məhsuldarlığın artırılmasına və resurslardan daha səmərəli istifadəyə imkan verir. Məsələn, sensor texnologiyaları və dronların istifadəsi ilə əkin sahələrinin monitorinqi və suvarma sistemlərinin idarə olunması mümkündür. Bu, su ehtiyatlarının daha səmərəli istifadəsinə, məhsul itkisini minimuma endirməyə və əkin sahələrinin daha effektiv idarə olunmasına imkan yaradır.

Eyni zamanda, kənd təsərrüfatında rəqəmsal texnologiyaların tətbiqi, məlumatların toplanması və analizi proseslərini optimallaşdırır. Bu məlumatlar əsasında daha dəqiq və elmi əsaslandırılmış qərarlar qəbul edilə bilər. Rəqəmsal texnologiyalar və məlumat bazaları, fermerlərə əkin sahələrinin vəziyyəti, torpağın münbitliyi və bitkilərin sağlamlığı haqqında dəqiq məlumatlar təqdim edir. Bu, məhsul istehsalının keyfiyyətini və həcmini artırmaqla yanaşı, xərclərin də azalmasına kömək edir.

Azərbaycanın kənd təsərrüfatı sektorunda innovativ texnologiyaların tətbiqi, həm də iqlim dəyişikliyinin təsirlərinin azaldılmasına və ekoloji problemlərin həllinə töhfə verir. Müasir texnologiyalar, əkin sahələrinin iqlim dəyişikliyinə uyğunlaşdırılmasına, torpaq və su ehtiyatlarının qorunmasına və ətraf mühitin mühafizəsinə imkan verir. Bu, kənd təsərrüfatının dayanıqlı inkişafını təmin etməklə yanaşı, gələcək nəsillər üçün sağlam və təhlükəsiz mühitin yaradılmasına kömək edir.

Beləliklə, elmtutumlu texnologiyaların və innovativ fəaliyyətin genişləndirilməsi, Azərbaycanın kənd təsərrüfatının dayanıqlı inkişafının təmin edilməsində mühüm rol oynayır. Kənd Təsərrüfatı Nazirliyi və AMEA arasında elmi-texniki əməkdaşlıq çərçivəsində reallaşdırılan layihələr, aqrar sektorun müasir tələblərə uyğun inkişafına, rəqabətqabiliyyətliliyinin artırılmasına və ekoloji problemlərin həllinə mühüm töhfə verir. Bu əməkdaşlıq, Azərbaycanın kənd təsərrüfatı sektorunun gələcək inkişafını təmin edərək, ölkənin iqtisadi və sosial rifahına mühüm təsir göstərəcəkdir.

KONSEPTUAL ÇƏRÇİVƏ

Müasir dövrdə kənd təsərrüfatının dayanıqlı inkişafı və ərzaq təhlükəsizliyinin təmin edilməsi üçün elm, elmtutumlu texnologiyalar və innovativ fəaliyyət əsas aparıcı qüvvələrdən biri olmalıdır. Kənd təsərrüfatının inkişafında yüksək məhsuldar agroekosistemlərin qurulması və ekoloji təhlükəsizliyin qorunub saxlanılması elmi yanaşmaların tətbiqi ilə mümkündür. Qlobal iqlim dəyişiklikləri və artan əhali səbəbindən, inkişaf etmiş ölkələrdə rəqəmsal və genom texnologiyaların tətbiqi ilə ciddi elmi araşdırmalar aparılır ki, bu da qida məhsullarının istehsalında dayanıqlığı təmin edir.

Azərbaycanda kənd təsərrüfatının dayanıqlı inkişafını təmin etmək və əhalinin ərzaq təhlükəsizliyini gücləndirmək məqsədilə Kənd Təsərrüfatı Nazirliyi ilə Azərbaycan Milli Elmlər Akademiyasının (AMEA) müvafiq institutları arasında qarşılıqlı əməkdaşlıq şəraitində birgə elmi-tədqiqat layihələrinin həyata keçirilməsi çox mühümdür. Möhtərəm Prezident İlham Əliyevin bəyan etdiyi kimi, ölkəmizin ərzaq təhlükəsizliyi üzrə tam müstəqilliyə nail olunması milli hədəflərdən biridir. Prezidentin sözlərinə görə, "hazırda qarşıda duran ən başlıca məqsəd daxili imkanlar hesabına kənd təsərrüfatı və ərzaq məhsulları ilə özünütəminata və dayanıqlı inkişafa nail olmaqla Azərbaycanı inkişaf etmiş ölkələr səviyyəsinə çatdırmaqdır."

Bu strategiyanın həyata keçirilməsi üçün ölkədəki mövcud potensialın qiymətləndirilməsi və məsələnin həllinə elmi-analitik yanaşma tələb olunur. Dövlət başçısının iradəsi və göstərişləri ilə həyata keçirilən elmi əsaslı islahatlar və texnoloji yeniliklər qeyd olunan məqsədə xidmət etməklə artıq öz bəhrəsini verməkdədir.

Dünya alimləri kənd təsərrüfatının inkişafının iki əsas istiqamətini fərqləndirirlər: ekstensiv və intensiv. Ekstensiv inkişaf istifadə edilən resursların artırılmasını, məsələn əkin sahələrinin və otlaq sahələrinin genişləndirilməsini nəzərdə tutur. Lakin artıq əksər təsərrüfat əhəmiyyətli ərazilər istifadədə olduğundan, bu istiqamət yüksək xərclər tələb edir və məhdud resurslar səbəbindən praktiki olaraq həyata keçirilməsi çətinləşir. İntensiv inkişaf isə mövcud resursların bioloji məhsuldarlığının artırılması və biotexnologiyanın istifadəsinə əsaslanır. Bu inkişaf yolu yeni, yüksək məhsuldar sort və cinslərin istifadəsini, müasir əkin üsullarının tətbiqini və texnoloji yeniliklərin istifadəsini nəzərdə tutur. [1;31s.]

Məhsuldarlığı həm kəmiyyət, həm də keyfiyyətcə yüksəltməyə imkan verən yeni texnologiyaların axtarışı bu sahədə mühüm əhəmiyyət kəsb edir. Bu texnologiyalar, kənd təsərrüfatında "ikinci yaşıl inqilab"ın baş verməsinə səbəb ola bilər. İlk "yaşıl inqilab" qlobal qida təhlükəsizliyinin artırılmasında əhəmiyyətli rol oynamışdı. Bu dövr kənd təsərrüfatının intensivləşdirilməsi, sintetik gübrələrin və pestisidlərin kütləvi istifadəsi, yüksək məhsuldar sortların genetik yaxşılaşdırılması və proseslərin mexanizasiyası hesabına dünyada qida məhsullarının, xüsusən də buğda, düyü və qarğıdalı kimi dənli bitkilərin istehsalının güclü artımı ilə xarakterizə olunurdu. [5; 44s.]

Lakin "yaşıl inqilab"ın mənfi təsirləri də ortaya çıxmışdır. Ətraf mühitə göstərilən zərərli təsirlər, ekosistemlərin keyfiyyətinin azalmasına səbəb olmuşdur. Bu səbəbdən, gələcəkdə kənd təsərrüfatının inkişafında ekoloji təhlükəsizliyin təmin edilməsi və dayanıqlığın qorunub saxlanılması üçün yeni texnologiyaların və innovativ metodların tətbiqi vacibdir. Azərbaycanda bu istiqamətdə aparılan elmi-tədqiqatlar və texnoloji yeniliklər, ölkəmizin kənd təsərrüfatının davamlı inkişafına, ərzaq təhlükəsizliyinin təmin edilməsinə və ekoloji problemlərin həllinə mühüm töhfə verir.

Müasir kənd təsərrüfatının inkişafında elmtutumlu texnologiyaların və aktiv innovativ fəaliyyətin rolu böyükdür. Rəqəmsal və genom texnologiyaların tətbiqi, kənd təsərrüfatı proseslərinin optimallaşdırılması, resursların səmərəli istifadəsi və məhsuldarlığın artırılması üçün mühüm əhəmiyyət daşıyır. Azərbaycan bu sahədə irəliləyişlər əldə etmək və kənd təsərrüfatının davamlı inkişafını təmin etmək üçün elmi-tədqiqat işlərini və texnoloji yenilikləri daha da genişləndirməlidir. Bu məqsədlə Kənd Təsərrüfatı Nazirliyi və AMEA-nın müvafiq institutları arasında əməkdaşlığın gücləndirilməsi və birgə layihələrin həyata keçirilməsi böyük əhəmiyyət kəsb edir. Bu istiqamətdə atılan addımlar, Azərbaycanın kənd təsərrüfatının inkişafına, ərzaq təhlükəsizliyinin təmin edilməsinə və ölkənin iqtisadi rifahına mühüm töhfə verəcəkdir.

Buna görə hal-hazırda qarşıda duran əsas məsələ - elmtutumlu innovativ texnologiyaları kənd təsərrüfatında tətbiq etməklə stabil, keyfiyyətli qida məhsullarının əldə edilməsi üçün agroekosistemlərin bütövlüyünü saxlamaqla kənd təsərrüfatında dayanıqlı inkişafa nail olmaqdır. "İkinci Yaşıl İnqilab" kənd təsərrüfatına fərqli prizmadan yanaşan yeni nəsil alimlərin ideyalarından asılı olacaqdır (Kasliwal, 2021).

Genom-redaktə texnologiyaları. Genomun redaktəsi -gen mühəndisliyinin ən son uğurlarından biridir. Bu texnologiya xüsusi "molekulyar qayçıların", elmi dildə desək spesifik dizayn edilmiş endonukleazaların iştirakı ilə genomda müəyyən sahələrin əvəz edilməsi, daxil edilməsi, yaxud kəsilərək götürülməsinə əsaslanır. Bu metodda 4 tip nukleazalardan istifadə edilir: meqanukleazalar, sink barmaqları olan nukleazalar, TALEN nukleazaları və CRİSPR-Cas sistemi.

[4;22s.]

CRISPR-Cas9 texnologiyası nədir? CRISPR-Cas9 DNT molekulunun müxtəlif sahələrində delesiyalar və ya əlavələr edən yeni texnogiyadır. CRISPR-Cas9 sistemi, DNT-də mutasiya yaradan 2 molekuldan təşkil olunmuşdur: bunlardan biri Cas9 adlı ferment – genomun müəyyən hissələrindən DNT zəncirini kəsir, bir sözlə bu molekul "qayçı" funksiyasını daşıyır. İkincisi gid RNT (İng. Guide RNA – gRNA) – kiçik (~20 n.c.) RNT zəncirindən təşkil olunmuşdur. RNT zənciri DNT molekulu ilə əlaqəyə girir və Cas9-un genomun uyğun hissəsinə oturmasına rəhbərlik edir və beləliklə Cas9 fermenti müvafiq nukleotidləri kəsir. Bu mərhələdə hüceyrədə DNT-nin zədələnməsinə qarşı reparasiya mexanizmi işə salınır. Mütəxəssislər DNT molekulunun reparasiya mexanizmindən istifadə edərək hüceyrənin 1-dən artıq genində dəyişiklik yarada bilirlər. Hazırda bu sistem bir sıra heyvan və bitki orqanizmlərində tətbiq edilməkdədir (Prabin & Mousami, 2020). CRISPR-Cas9 sistemi hazırda gen redaktəedilmədə ən sürətli, ucuz və etibarlı sistem kimi tanınır. Bu metodun rekombinativ DNT texnologiyasından əsas fərqi ondadır ki, canlı orqanizmə yad gen daxil edilmir, orqanizmin öz geni dəyişdirilir, yaxud bərpa olunur. Bu zaman yaranan məhsul GMO hesab olunmur!

Kənd təsərrüfatında rəqəmsal transformasiyalar – süni intellektin tətbiqi. Süni intellekt texnologiyalarının tətbiqi insan fəaliyyətinin bütün sferalarına daxil olmuşdur. Son dövrlərdə artıq bu texnologiyalar kənd təsərrüfatında da tətbiq olunmağa başlanılmışdır. Bu baxımdan qarşıda duran problemlərdən ən əsası abiotik və biotik stres amillərinin inkişaf dinamikasının qabaqcadan proqnozlaşdırılmasıdır. Bu yanaşmada artıq maşınöyrənmə üsulları tətbiq edilməyə başlanmışdır. Zərərvericilərin hansı ərazilərdə yayılacağını, iqlim faktorlarının onların intensivliyinə təsirini qabaqcadan proqnozlaşdırmaqla epifitotiyaların qarşısını almaq olar. Süni intellekt texnologiyalarına əsaslanan peyk müşahidə sistemləri, yaxud bitkinin vəziyyətini qiymətləndirərək vaxtında gübrələrlə, boy stimulyatorları ilə, zərərvericilrərə qarşı kimyəvi maddələrlə işlənməsini özü idarəedən "ağıllı texnika"nın tətbiqi gələcəkdə məhsuldarlığın artırılmasına çox böyük təkan verəcəkdir.

Kənd təsərrüfatının dayanıqlı inkişafının təmin edilməsi, elmtutumlu və innovativ texnologiyaların tətbiqi ilə əlaqədar, stabil və keyfiyyətli qida məhsullarının əldə edilməsi üçün agroekosistemlərin bütövlüyünü qorumaq ən başlıca məsələlərdən biridir. "İkinci Yaşıl İnqilab" adlanan bu yeni mərhələ kənd təsərrüfatında yeni nəsil alimlərin fərqli yanaşmaları və ideyaları ilə formalaşacaqdır (Kasliwal, 2021).

CRISPR-Cas9 Texnologiyası

CRISPR-Cas9, DNT molekulunun müxtəlif sahələrində delesiyalar və ya əlavələr edən yeni bir texnologiyadır. Bu sistem, DNT-də mutasiyalar yaradan iki molekuldan ibarətdir: Cas9 adlı ferment və gid RNT (guide RNA – gRNA). Cas9 fermenti genomun müəyyən hissələrindən DNT zəncirini kəsir, gRNA isə bu fermenti uyğun hissəyə yönəldir. Bu mərhələdə hüceyrədə DNT-nin zədələnməsinə qarşı reparasiya mexanizmi işə salınır və mütəxəssislər bu mexanizmdən istifadə edərək hüceyrənin bir genindən çoxunda dəyişiklik yarada bilirlər. CRISPR-Cas9 sistemi, bitki və heyvan orqanizmlərində tətbiq olunur və ən sürətli, ucuz və etibarlı genom redaktə sistemi kimi tanınır. Rekombinativ DNT texnologiyasından fərqli olaraq, CRISPR-Cas9 canlı orqanizmə yad gen daxil etmədən orqanizmin öz genini dəyişdirir və ya bərpa edir, bu səbəbdən yaranan məhsul GMO hesab olunmur (Prabin & Mousami, 2020).

Yeni Nəsil Sekvens Texnologiyaları

Effektiv genetik tədqiqatların aparılması üçün genomun oxunması zəruridir. Genom ardıcıllıqları, gen və gen şəbəkələrinin identifikasiyası kimi fundamental məsələlərin həllində mühüm rol oynayır. Bu texnologiyalar, təsərrüfat əhəmiyyətli əlamətləri kodlaşdıran gen lokuslarının, mühüm metabolik yolların və siqnalötürmə şəbəkələrinin tədqiqində açar rolunu oynayır. Yeni molekulyar bridinq proqramları da genom xəritələrinə əsaslanaraq aparılır. Hal-hazırda 300-dən çox bitkinin genomu tam və ya qismən oxunaraq NCBİ-də yerləşdirilmişdir. Yeni nəsil sekvens texnologiyaları, əvvəlki metodlarla müqayisədə qısa zaman intervalında nisbətən daha aşağı xərclə genomda nukleotid ardıcıllıqlarını təyin etməyə imkan verir. Bu texnologiyalar, həmçinin ekzom sekvensini, yəni zülal kodlaşdıran sahələrin sekvensini də həyata keçirir və gen ekspressiyası haqqında zəngin məlumat təqdim edir (Sirangelo & Calabrò, 2020).

Kənd Təsərrüfatında Rəqəmsal Transformasiyalar

Süni intellekt texnologiyaları artıq kənd təsərrüfatında da geniş tətbiq olunmağa başlanmışdır. Bu texnologiyalar, abiotik və biotik stres amillərinin inkişaf dinamikasını qabaqcadan proqnozlaşdırmağa imkan verir. Maşınöyrənmə üsulları, zərərvericilərin yayılacağı əraziləri və iqlim faktorlarının onların intensivliyinə təsirini qabaqcadan proqnozlaşdırmaqla epifitotiyaların qarşısını almağa imkan verir. Süni intellekt texnologiyalarına əsaslanan peyk müşahidə sistemləri və bitkinin vəziyyətini qiymətləndirərək vaxtında gübrələrlə, boy stimulyatorları ilə, zərərvericilərə qarşı kimyəvi maddələrlə işlənməsini idarə edən "ağıllı texnika"nın tətbiqi, məhsuldarlığın artırılmasına böyük təkan verəcəkdir. [3; 2s.]

Elmtutumlu innovativ texnologiyaların kənd təsərrüfatında tətbiqi, stabil və keyfiyyətli qida məhsullarının əldə edilməsində mühüm rol oynayır. Genom-redaktə texnologiyaları, yeni nəsil sekvens texnologiyaları və süni intellektin tətbiqi, kənd təsərrüfatında dayanıqlı inkişafın təmin edilməsi üçün geniş imkanlar yaradır. Bu texnologiyalar, agroekosistemlərin bütövlüyünü qorumaqla, kənd təsərrüfatının məhsuldarlığını və keyfiyyətini artırmağa kömək edir. Azərbaycanda bu istiqamətdə aparılan elmi-tədqiqatlar və texnoloji yeniliklər, ölkənin kənd təsərrüfatının davamlı inkişafına və ərzaq təhlükəsizliyinin təmin edilməsinə mühüm töhfə verir. (Talavia et al., 2020). [6; 12s.]

Rəqəmsal fenotipləmə. Bitki seleksiyasında vacib aspektlərdən biri düzgün fenotipləmənin aparılmasıdır. Rəqəmsal fenotipləmə qeyri-invaziv olaraq bitkinin fizioloji vəziyyətini analiz etməyə imkan verir. Rəqəmsal verilənlər alqoritmlərin köməyi ilə analiz edilir ki, bu da nəticənin etibarlılığını dəfələrlə artırır (Omari et al., 2020).

Mikrobiomlar və bioloji pestisidlər. Gen mühəndisliyinin tətbiqi ilə yaradılan faydalı mikroorqanizmlərdən istifadə kənd təsərrüfatını yeni mərhələyə qaldırır. Bu yanaşma iqtisadi cəhətdən sərfəlidir, belə ki, pestisid və gübrələrə sərf olunan xərclər azalır. Məsələn, gen mühəndisliyi yolu ilə yaradılan mikroorqanizmlər birbaşa havadan atmosfer azotunu mənimsəyərək bitkiyə gübrə şəklində verə bilirlər. Bu cür faydalı mikroorqanizmlərin süni şəkildə çoxaldılması hesabına bitkilərin məhsuldarlığını, qeyri-əlverişli iqlim şəraitinə, zərərvericilərə qarşı davamlılığını artırmaq mümkün olacaqdır.

RNT-nin interferensiyası. Artıq alimlər tərəfindən RNT-nin interferensiyasına əsaslanan yeni innovativ metod işlənib hazırlanmışdır. Bu metod RNT-ni bitki yarpaqlarına yeritməklə genlərin ekspressiyasını effektiv şəkildə inhibirləşdirməyə imkan verir. Bitkiyə bu və ya digər stres faktoruna qarşı həssaslıq verən genlərin ekspressiyasının dayandırılması bitkinin əlverişsiz şəraitdə inkişaf etməsinə şərait yaradacaqdır. Belə bitkilər genetik modifikasiya edilmiş bitkilər sırasına aid edilmir, çünki bu texnologiya "yad" genlərin daxil edilməsini həyata keçirmədən müvəqqəti olaraq bitkinin öz genlərini "söndürür".

"Omiks" yanaşmalar. "Omiks" texnologiyaların inkişafı (genomiks, transkriptomiks, proteomiks, metabolomiks və s.) bitkilərin biologiyası sahəsində tədqiqatlarda inqilabi sıçrayışa gətirib çıxartmışdır. Bu yanaşmalar genlər, metabolitlər, zülallar və tənzimləyici elementlərin inteqrasiyası şəbəkələrindən istifadə yolu ilə bioloji komponentlər arasında qarşılıqlı əlaqənin daha yüksək səviyyədə tədqiq edilməsini mümkün etmişdir. "Omiks" texnologiyaları geniş spektrdə tətbiq olunur. Dəyişən ətraf mühit şəraitində streslə mübarizə aparmaq üçün bitkilər "omiks" profillərini dəyişirlər. "Omiks" verilənlər kombinasiyaları molekulyar səviyyədən bütöv bitki səviyyəsinə kimi bitkidə yaranan prosesləri dəqiq izləməyə imkan verir (Majumdar & Keller, 2020).

NƏTİCƏ

Ölkəmizdə aqrar sektorun qarşısında duran mühüm vəzifələrə, aqrar sahədə mövcud olan problemlərin həllində elmin rolunun artırılmasına gəldikdə, Kənd Təsərrüfatı Nazirliyi ilə AMEA arasında elmi-texniki əməkdaşlığın gücləndirilməsinə dair imzalanmış "Niyyət Sazişi" böyük əhəmiyyət kəsb edir. Bu baxımdan hər iki qurumun institutları arasında birgə icra olunması planlaşdırılan "Rəqəmsal və genom texnologiyaların tətbiqi əsasında buğdanın quraqlığa davamlı və yüksək məhsuldar rüşeym plazmasının seçilməsi və seleksiya proqramlarında istifadəsi" (rəhbər: AMEA-nın vitse-prezidenti, Molekulyar Biologiya və Biotexnologiyalar İnstitutunun direktoru, akademik İradə Hüseynova), "Molekulyar genetik və xromosom mühəndisliyi metodları ilə pambıq genofondunun zənginləşdirilməsi, iqtisadi əhəmiyyətli yeni sortların yaradılması" (rəhbər: Genetik Ehtiyatlar İnstitutunun direktoru, AMEA-nın müxbir üzvü Zeynal Əkpərov), "Azərbaycan Respublikasında təbii örüş, biçənək və otlaqların davamlı idarəedilmə sisteminin yaradılması ilə onların yem bazasının möhkəmləndirilməsi və bitki biomüxtəlifliyinin qorunub saxlanılması" (Botanika İnstitutu, rəhbər: professor Səyyarə İbadullayeva), "Torpaqların şorlaşması, şorakətləşməsi və eroziyaya uğrama dərəcələrinin və qida maddələrinə tələbatının dəqiqləşdirilməsi" (Torpaqşünaslıq və Aqrokimya İnstitutu, rəhbər: AMEA-nın müxbir üzvü Əlövsət Quliyev) layihələri ölkəmizdə aqrar sahənin inkişafına dəyərli töhfələr verəcəkdir.

Kənd təsərrüfatında dayanıqlı inkişaf və yeni yaranacaq təhlükələrlə mübarizə üçün mövcud bilik və texnologiyaların tətbiqi və daim yeni texnologiya və yanaşmaların işlənib hazırlanması üçün investisiyalar qoyulmalıdır. İnkişaf etmiş dünya ölkələrinin praktikası bunu sübut edir. Qida məhsullarının istehsalı sektorunda investisiyalar ekosistemlərin bütövlüyünü saxlamaqla dayanıqlı inkişafın yaxşılaşdırılmasına yönəldilməlidir. Eyni zamanda, elmi tədqiqatların prioritetlərinin düzgün müəyyən edilməsi və stimullaşdırılması da əhəmiyyət kəsb edir.

Ədəbiyyat

1. Aguilar-Rivera N., Michel-Cuello C., Cárdenas-González J.F. (2019) Green Revolution and Sustainable Development. In: Leal Filho W. (eds) Encyclopedia of Sustainability in Higher Education. Springer, Cham. https://doi.org/10.1007/978-3-030-11352-0_87
2. Kasliwal R. "The New Green Revolution: A Just Transition to Climate-Smart Crops," ORF Issue Brief No. 433, January 2021, Observer Research Foundation.
3. Majumdar, S. & Keller A.A. (2020). Omics to address the opportunities and challenges of nanotechnology in agriculture. Critical Reviews In Environmental Science And Technology, 1-42.
4. Omari M.K., Lee J., Faqeerzada M.A., Joshi R., Park E. & Cho B.K. (2020). Digital image-based plant phenotyping: A review. Korean Journal of Agricultural Science, 47(1), 119-130.

5. Prabin A. & Mousami P. (2020). CRISPR-Cas9 in agriculture: Approaches, applications, future perspectives, and associated challenges. Malaysian Journal of Halal Research. 3. 10.2478/mjhr-2020-0002.
6. Talaviya T., Shah D., Patel N., Yagnik H. & Shah M. (2020). Implementation of artificial intelligence in agriculture for optimisation of irrigation and application of pesticides and herbicides. Artificial Intelligence in Agriculture.

SYNTHESIS, CHARACTERIZATION, AND EVALUATION OF ANTIBACTERIAL AND ANTIFUNGAL ACTIVITIES OF BIOLOGICALLY DERIVED SELENIUM NAOPARTICLES FROM GREEN LEAVES OF NIGELLA SATIVA L.

NIGELLA SATIVA L. YEŞIL YAPRAKLARI ILE BIYOLOJIK KAYNAKLI SELENYUM NAOPARTIKÜLLERIN SENTEZI, KAREKTERIZASYONU, ANTIBAKTERIYEL VE ANTIFUNGAL AKTIVITELERININ DEĞERLENDIRILMESI

Ayşe BARAN

Mardin Artuklu Üniversitesi Lisansüstü Eğitim Enstitüsü, Biyoloji Bölümü, 47200, Mardin, Türkiye

ORCİD: https://orcid.org/0000-0002-2317-0489

ABSTRACT

In this study, to obtain selenium nanoparticles (SeNPs), the green parts of Nigella sativa L. were purchased commercially and were extracted with ethanol and used in the reduction process of selenium nanoparticles. For the characterization of the obtained biologically derived NS-SeNPs, their morphology and dimensions were examined with FE-SEM, TEM, XRD, EDX, TGA-DTA, UV-Vis, Zeta potential, Zeta size and FT-IR analyses. When the morphological properties of NS-SeNPs were examined. It was seen in the TEM analysis that the diameters of the nanoparticles obtained varied between 28 and 45 nm and that they had a spherical structure. Minimum inhibition concentration technique (MİC) was used for the antimicrobial activities of NS-SeNPs synthesized from biological origin. By MIC method, candida albicans was tested for fungal strain, Escherichia coli (E. coli) was tested for gram-negative bacterial strain, and Bacillus subtilis was tested against Staphylococcus aureus (S. aureus) for gram-positive bacteria. Commercial antibiotics were used as the control group. It was determined that the results obtained showed strong activity when compared to commercial antibiotics.

Keywords: Nigella sativa L., NS-SeNPs, SEM, EDX, XRD, TEM and FESEM.

ÖZET

Bu çalışmada selenyum nanopartiküllerinin (SeNP'ler) eldesi için Nigella sativa L.'nin yeşil kısımları ticari olarak satın alındı ve etanol ile ekstrakte edildilerek selenyum nanopartiküllerini indirgenme işleminde kullanıldı. Elde edilen biyolojik kaynaklı NS-SeNP'lerin karekterizasyonu için FE-SEM,TEM, XRD, EDX, TGA-DTA, UV-Vis, Zeta potansiyel, Zeta boyut ve FT-IR analizleri ile morfolojik ve boyutları incelendi. NS-SeNP'lerin morfolojik özellikleri incelendiğinde elde edilen nanaoparçacıkların çapları 28 ile 45 nm arasında değişmekte ve küresel yapıda oldukları yapılan TEM analizinde görüldü. Biyolojik kaynaklı sentezlenen NS-SeNP'lerin antimikrobiyal aktiviteleri için minimum inhibisyon konsantrasyon tekniği kullanıldı. MİK yöntemiyle mantar suşu için candida albikans, gram negatif bakteri suşu için Escherichia coli (E. coli), gram pozitif bakteriler için Bacillus subtilis Staphylococcus aureus'a (S. aureus) karşı test edildi. Kontrol grubu olarak ticari antibiyotikler kullanıldı. Elde edilen sonuçların ticari antibiyotiklere karşı kıyaslandığında aktivite güçlü gösterdikleri tespit edildi.

Anahtar kelimeler: Nigella sativa L., NS-SeNP'ler, SEM, EDX, XRD, TEM ve FESEM.