CEFood 2026 CONGRESS

23 – 26 September

Radisson Hotel
Plovdiv
Bulgaria



BOOK OF ABSTRACTS

CEFood 2026

13th CENTRAL EUROPEAN CONGRESS ON FOOD

The congress is organized with the financial support of the National Science Fund of the Republic of Bulgaria under Contract No. KP-06-MNF/4 of 15 May 2026. The National Science Fund of the Republic of Bulgaria bears no responsibility for the content of the papers presented at the scientific forum, nor for the content of any advertising or other materials related thereto.

ISBN 978-954-24-0394-4

CEFOOD 2026

Book of abstracts

https://cmebg.com/en/sabitia/cefood_2026/

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Академично издателство на УХТ - Пловдив
UFT Academic Publishing House, Plovdiv
2000

Formatting: Georgi Atanasov Kostov, Rositsa Denkova-Kostova

CEFOOD 2026: CONNECTING EXCELLENCE IN FOOD

Preface to the Book of Abstracts

It is a profound honour and a pleasant obligation for us to welcome you to the *13th Central European Congress on Food* (CEFood 2026), held in the historical and modern city of Plovdiv. As we gather at this forum, we celebrate 24 years of a remarkable tradition – a pan-European network bridging scientific advances with industrial practice and addressing the future needs of food science.

The legacy of the Central European Congresses on Food was forged through a shared vision of creating an open international platform for knowledge-based solutions. Since its inception, this inspiring journey has spanned across generations and host nations: Ljubljana, Slovenia (2002); Budapest, Hungary (2004); Sofia, Bulgaria (2006); Cavtat, Croatia (2008); Bratislava, Slovakia (2010); Novi Sad, Serbia (2012); Ohrid, North Macedonia (2014); Kyiv, Ukraine (2016); Sibiu, Romania (2018); Sarajevo, Bosnia and Herzegovina (2021); Čatež ob Savi, Slovenia (2022); and Szeged, Hungary (2024). For those of us who had the privilege of organising CEFood 2006 in Bulgaria, seeing this congress series thrive, expand, and return to our country two decades later is a matter of immense delight.

The landscape of the global food sector has undergone a profound transformation. Our community must now navigate complex paradigms: optimising processing through deep theoretical modelling, driving energy and resource efficiency, embracing the circular economy, and safeguarding human, animal, and environmental well-being through a unified *"One Health"* approach. Within this multifaceted agenda, we also address critical advancements in the food cold chain, featuring dedicated discussions on unconventional refrigeration technologies, ultra-low-temperature storage, heat transfer in porous products, and sustainable R&D engineering strategies.

The contributions compiled in this *Book of Abstracts*, aligned with the slogan *"Connecting Excellence in Food",* report on significant achievements of intellectual endeavour. They reflect our collective determination to bridge the gap between high-risk scientific innovation and everyday industrial practice, fostering the sustainable growth required for future generations.

The abstracts presented here mirror the diverse and multidisciplinary nature of our programme. From the application of artificial intelligence in quality control and the development of alternative protein matrices, to the intricate dynamics of food structure and shelf-life extension, each paper addresses a vital component of current food research. This collection highlights an impressive synergy between fundamental science and applied engineering, showcasing how cross-sectoral collaboration can transform theoretical breakthroughs into practical solutions that elevate the standards of the entire food supply chain.

We extend our deepest gratitude to all authors, keynote speakers, session chairs, organisational partners and sponsors whose dedication has brought CEFood 2026 to life. We invite you to use this pan-European forum to build enduring partnerships and exchange the visionary ideas that will define the next era of food research and engineering.

Once again, welcome to the ancient and eternal Plovdiv and to the CEFood 2026 congress. May the new alliances of professional collaboration and personal friendship, along with the inspiring insights exchanged within these halls, become the driving force behind tomorrow's innovations, shaping the trajectory of food science and the sustainable food and beverage industry for years to come.

Prof. DSc Georgi Kostov

Organiser of CEFood 2026

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CONGRESS TOPICS

C

Circularity & Consumer Science

Circular food systems: by-product valorization and waste reduction; Smart and biodegradable packaging; Consumer perception and eco-labeling; Communication and preparedness for sustainable choices.

E

Emerging Technologies & Education

Novel processing and preservation of foods and beverages: thermal and non-thermal techniques; Biotechnologies for agriculture and foods; Cold chain transformation and refrigeration ecosystem for food security; AI and robotics in production storage and distribution; Hygienic engineering and design of food processing and preservation facilities; Academic and vocational education, lifelong learning in food science and technology.

F

Functional & Future Foods

Functional ingredients, probiotics, prebiotics, synbiotics, and postbiotics; Personalized nutrition and AI-assisted diets; Plant-based and alternative proteins; Targeted nutrition; Future food technologies.

O

One Health & Omics

One Health - connecting human, animal, and environmental well-being; Omics tools for food innovation; Food safety, authenticity, and traceability (biosensors, blockchain); Microbiome and its health implications.

O

Open Innovation & Opportunities

Entrepreneurship in food innovation; Academia–industry–policy collaboration; Cultural heritage and gastronomy as innovation engines; Food, tourism, and hospitality for regional growth.

D

Digital & Green Dimensions

Green and renewable technologies: energy-water-food nexus; Resource efficiency; Digital food chains; AI-based risk and safety management; Policies for sustainability; Digital twins, VR/AR; E-learning in food education; EU Green Deal and competitiveness.

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UNIVERSITY OF FOOD TECHNOLOGIES

The University of Food Technologies (UFT) in Plovdiv has a rich history of more than seventy years and remarkable traditions. It is one of the most important centers in Bulgaria in the field of food science and technology, the only one of its kind on the Balkan Peninsula. UFT-Plovdiv was founded in 1953 as a Higher Institute of Food and Flavor Industry, and in 2003, by a decision of the National Assembly of the Republic of Bulgaria, it was transformed into a university. Since its establishment, the university has been a national and regional center for the development of food science, technique and technology. At the moment, training at the UFT is carried out in the following main areas: food technology, biotechnology, tourism, hospitality and catering, catering, industrial management, heating and cooling technology, machines and apparatuses for the food industry, computer systems and production automation in the food industry. UFT-Plovdiv has a campus located on 17,000 m^2, which includes: 4 academic buildings, 5 dormitories, a sports complex. All classrooms, as well as bases for practical training, are located in the educational buildings. About 370 people work at the UFT-Plovdiv, about 190 of which are academic staff (25 professors, 85 associate professors, and the rest are assistant professors and head assistant professors). UFT-Plovdiv covers scientific and practical developments in the field of food science and technology, food and beverage production techniques, food and pharmaceutical biotechnology, tourism, the economy of the food and tourism industry. UFT-Plovdiv cooperates with over 70 foreign academic and scientific institutions within the framework of its international cooperation and under the Erasmus+ program. More than 100 mobilities of teachers and students are realized annually within the framework of this academic exchange, which allows the university to carry out significant research work as well as publication activity. In the last 20 years, more than 50 scientific projects funded by various institutions have been developed and finalized at the university. The University of Food Technologies is an active participant in projects funded under various European programs.

Our strategic goals derive from our SMART vision

Based on the unique combination between natural, engineering and socioeconomic sciences, our mission is to create the educational and research background for sustainable development in the Food & Beverage, Wine, Hospitality & Tourism, Essential Oil & Cosmetics, Biotech and Tobacco industries.

Sustainable development

The UFT provides high quality education, cutting-edge research and ground-breaking innovations (Global Sustainable Development Goals 4 and 9).

Modern thinking

The UFT promotes modern thinking through its international orientation, attracting students and academics worldwide and educating graduates that can operate in a variety of contexts both at home and abroad

Attractiveness for students

The UFT focuses on fulfilling the needs of both its students and society, establishing degree programms where purpose, global impact and long-term success govern their existence. Students are inspired to follow their dreams and explore their potential.

Reliable partnership

The UFT is a reliable partner for the transfer of knowledge and technology in business, the scientific community and the civil society at regional, national or international level

Tradition and values

The UFT follows the principle that academia is most successful when research and teaching are conducted hand-in-hand and academics are given the freedom to develop.

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PLENARY SPEAKERS



Assoc. Prof. James K. Carson. Assoc. Prof. James Carson holds a PhD in Food Engineering from Massey University, as well as ME and BE(Hons) degrees in engineering from the University of Canterbury. His research focuses on the measurement and prediction of thermal properties, thermal process modelling – particularly in food refrigeration and drying – and broader topics within food engineering. His publications include work on air-blast freezing in the food industry, heat pump integration in meat processing, advances and challenges in isochoric freezing, improved prediction of food thermal properties, and reliability assessment of thermal conductivity measurements.

Decarbonization in the food processing industry

James K Carson[1*]

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Background: With the drive to minimize carbon emissions, food processing industries in many countries are being required to reduce their reliance on fossil-fuel derived heating for processes including drying, cooking, sterilization/pasteurization and cleaning.

Aims: This presentation will overview the different options for replacing fossil-fuel-derived process heat and discuss analytical methods and tools that may be used to identify optimal solutions. A case study will be presented to illustrate the methodology.

Methods: Decarbonization options include fuel switching (e.g. to biomass or direct electric heating), or replacement of boilers by heat pumps. While electrode and biomass boilers operate in a similar manner to fossil-fuel boilers, heat pumps are different in that their performance is affected by changes in the flow-rates and temperatures of both their source and sink streams.Pinch analysis and and Total Site Heat Integration (TSHI) methods may be used to identify optimal heating and cooling utilities usage and optimal heat pump placement (i.e. identification of which stream should serve as the heat source, and which should serve as the heat sink). These analytical methods have largely been developed for processes that operate continuously for the vast majority of time, in which case average, steady-state data for stream flows and temperatures are sufficient for the analyses. However, many industries including most food production processes, exhibit dynamic behaviour, with significant seasonal, weekly and even daily variability, making the use of traditional Pinch and TSHI analyses difficult. To address this challenge, we have developed a method to apply Pinch and TSHI principles to non-continuous processes, which we believe is the first of its kind in the World.

Results: This methodology was applied to a meat processing case study site that is representative of the variable, non-continuous industries that dominate the food sector in New Zealand. In this case study, hourly time slices were used to identify multiple successive heat pump opportunities including a 1.9 MW MVR that recompresses waste steam from the rendering dryers with a COP of 10, and a central 1.5 MW heat pump that supplies heat at 70 °C to the site ring main with a COP of 3.4. In addition, it was found that the 90 °C heat pump, already installed on the case study site, would have the potential to increase utilization on the case study site if the two other heat pump opportunities identified were implemented. Thermal storage opportunities were also identified that can be used to buffer heat demands on the 70°C heat pump opportunity, thereby allowing the heat pump to be resized to 1.04 MW in comparison to the initially hypothesized 1.5 MW, reducing both capital and operational costs of the heat pump.

Conclusions: This amalgamated method provides novel Total Site Heat Integration additions, which when compared to conventional heat integration methods, provide more accurate and more useful heat pump decarbonization strategies for non-continuous industrial sites, ultimately aiding industrial decarbonization.



Assoc. Prof. Angela Capece. Assoc. Prof. Capece's research centers on the genetic and functional diversity of yeast strains in alcoholic beverages, particularly wine. Her work encompasses the isolation and identification of autochthonous yeasts from natural environments, the technological and functional characterization of yeast strains, analyses of genetic polymorphism and population dynamics during fermentation, and the study of yeast gene expression under varying environmental conditions. Her work in the field includes publications on studies on reducing sulfur dioxide use in winemaking through selected yeast starters, lipid production by oleaginous yeasts using agri-food waste, the impact of non-Saccharomyces yeasts on mixed fermentations, microbial cross-over in fruit beer production, and chitosan-based strategies to control Brettanomyces bruxellensis in wine.

Development of biological-based approaches to reduce the external input and increase sustainability in the winemaking sector

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Background: Alongside the "traditional attributes" driving the consumer's choice of wine, such as region of production, grape variety, brand, price, vintage, sustainability-related elements and health concerns are increasingly influencing consumer perceptions and preferences when choosing wine. These trends in consumer preferences have strongly influenced wine producers, leading them to consider these factors as key elements for the competitive development of the sector. The chemical compounds traditional used during wine fermentation is sulphur dioxide (SO_2), for the control of undesirable microorganisms and the prevention of oxidative phenomena. To meet the recent consumer request for environmentally friendly and healthy production, the winemaking sector is addressed to find suitable methods for replacement or reducing SO_2 use.

Aims: This study will be addressed to discuss biological tools, such as the use of selected microorganisms, to satisfy these new tendencies. In particular, biotechnological strategies for production of low-suplhite wine will be described.

Methods: The first approach described is based on the "bioprotection", which means the use of microorganisms, usually non-*Saccharomyces* yeasts (i.e. *Metschnikowia pulcherrima*), added on grapes or must before fermentation to prevent the development of undesirable microorganisms without negatively changing wine sensory properties. The second approach is related to the use of chitosan as promising alternative to SO_2. In our research we tested an innovative and sustainable source of

chitosan, which is insect-based chitosan, for control of undesirable wine microorganisms, such non-*Saccharomyces* yeasts present in the first fermentation steps and *Brettanomyces bruxellensis* (the main wine-contaminant). The last approach proposed in this study for partial or total substitution of SO_2 will be the use of wine by-products, such as stems or grapevine shoots, grape seeds, or stems, because of their richness in antioxidant and antimicrobial compounds.

Results: the use of selected non-*Saccharomyces* yeasts as alternative to sulfites limits the development of natural microbiota present during the first steps of fermentation without negative effect on organoleptic quality of the wine. These results confirm that bioprotection can represent an interesting biological alternative to sulfites at the beginning of the winemaking process. As regards the use of insect-based chitosan, non-*Saccharomyces* yeasts showed medium/high resistance to this compound, while high efficacy against *B. bruxellensis* was found. These findings highlight insect-based chitosan as a promising, sustainable alternative for microbial control in wine production. Finally, the addition of grape marc extracts during laboratory-scale fermentations reduced the level of non-*Saccharomyces* yeasts, although at lesser extent than SO_2 addition.

Conclusions: Overall, these results indicate the need to address the future research activities toward the implementation of these biotechnological approaches, in particular during real winemaking conditions, in order to reduce the wine industry's environmental footprint and improve economic viability.



Prof. Stefan Dragoev is affiliated with the Technological Faculty, Department of Meat and Fish Technology at the University of Food Technology – Plovdiv. His research spans Food Science, Animal Science and Meat and Fish Technology, with a particular focus on muscle biochemistry, lipid peroxidation, natural antioxidants, and the development of functional meat and fish products. Selected publications include studies on lipid peroxidation in muscle foods and its implications for quality, safety, and human health; food waste management in the restaurant sector; valorization of agro-industrial by-products as feed phytonutrients; quality changes in poultry meat during frozen storage; and the use of natural plant extracts to enhance the quality and safety of traditional meat products.

Current research and innovations in foods of animal origin

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Background: The quality, safety, and functionality of animal-based foods remain prominent and widely debated topics in modern society.

Aims: This review synthesizes a range of contemporary scientific research and innovations within the sector, developed over the past decade.

Results: Specifically, this review explores several emerging areas of research and technological advancement:

- Inhibition of lipid peroxidation in sausages through the optimization of natural antioxidant mixtures and bioactive substances;
- Reduction of nitrite content in meat products and the formulation of new functional foods enriched with natural antioxidants;
- Minimization of added nitrites in traditional cooked and raw-dried sausages;
- Application of antioxidant phytonutrients as feed additives and the integration of alternative insect-based protein sources in livestock and poultry nutrition;
- Assessment of insects as alternative protein additives in processed meats and the utilization of male layers (egg-sector chicks) as a sustainable source of poultry meat;
- Development of edible coatings and films to extend the shelf life of fresh fish;
- Evaluation of advanced preservation techniques, including ultra-rapid supercooling, acoustically assisted freezing, and radiofrequency processing, to maintain the quality and safety of animal-derived foods;
- Novel technologies for the upcycling of egg white by-products for industrial applications;
- A comparative study and classification of Bulgarian linden honey.

Conclusions: In conclusion, this review highlights the critical role of technological innovation in addressing the evolving demands for food safety, nutritional functionality, and environmental sustainability. By integrating novel preservation techniques with the use of bioactive natural ingredients and alternative protein sources, the industry can significantly reduce its reliance on synthetic additives. Finally, current trends are synthesised to provide a roadmap for future scientific enquiry, emphasising the transition towards a circular bioeconomy and the development of high-value, clean-label animal-based foods.



Prof. Diego Garcia Gonzalo holds a Degree in Veterinary Medicine (2001) and a PhD in Food Technology (2005), both from the University of Zaragoza. His main research interests include microbial stress responses and resistant variants, food preservation technologies, antimicrobial resistance in foodborne pathogens, the application of molecular and omics tools (WGS, metagenomics, transcriptomics), and the dynamics of microbiota and the resistome in food processing environments. His work in the field includes studies on the microbiome and resistome of poultry processing lines, microbial resistance following exposure to plasma-activated water, genetic variants of Salmonella under essential oil treatments, and whole-genome analyses revealing microbial stress responses to essential oil constituents.

The hidden links between food preservation and antibiotic resistance

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Food preservation and antibiotic resistance are often considered separate challenges, one linked to food technology and the other to clinical practice and public health. However, our recent research shows that these boundaries may be less clear than traditionally assumed. Bacterial adaptation to antimicrobial stress can generate phenotypes with implications that extend well beyond the original selective pressure.

In this lecture, we will see how resistant variants have served as a valuable model in our research to investigate these hidden connections. We first focused on variants selected in the presence of natural antimicrobials, particularly individual constituents of essential oils, with the aim of gaining insight into their mechanisms of action. The underlying idea was that understanding how bacteria adapt to these compounds could also help explain how these antimicrobials exert their lethal effects.

Our results revealed that adaptation was often not restricted to the selecting compound. In *Escherichia coli*, *Salmonella enterica*, and *Listeria monocytogenes*, resistant variants obtained after exposure to compounds such as carvacrol, citral, limonene, or whole essential oils frequently showed cross-resistance to other food preservation hurdles, including heat, acid stress, preservatives, and other relevant control strategies. In some cases, these variants also displayed reduced susceptibility to antibiotics, highlighting a potential link between adaptation in food-related environments and traits of public health concern.

We then explored the problem from the opposite perspective by studying variants selected under antibiotic pressure. Some of these variants also showed cross-resistance to preservation treatments such as heat, lactic acid, carvacrol, and high hydrostatic pressure. Altogether, these findings support the idea that food preservation and antibiotic resistance are interconnected through common adaptive responses. Recognizing these links is essential for improving microbial control strategies and for anticipating unintended consequences in food safety and public health.



Prof. Watanabe earned his Doctor of Engineering degree from Waseda University in 1998, where he also completed his Master's and Bachelor's studies in Mechanical Engineering. His academic training and early research focused on two-phase flow distribution in multipass evaporators for high-performance air-conditioning systems. His research now centers on food refrigeration science and engineering, with expertise in food freezing and thawing, food quality evaluation, energy analysis, and the development and assessment of refrigeration equipment. He has contributed to numerous studies on advanced freezing technologies, supercooled freezing, food quality preservation, and environmental impact assessments of chilled and frozen food distribution systems. Selected publications include work on the effect of static electric fields on scallop freezing, suppression of ice recrystallization during storage, CO_2-equivalent emissions associated with chilled and frozen seafood transport, the impact of supercooled freezing on meat quality, and consumer perception of frozen–thawed sashimi.

Researches to achieve sustainable distribution of high-quality seafood

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Eating raw seafood, such as sushi, is an essential and unique feature of Japanese food culture. However, marine products deteriorate extremely quickly, so in order to eat them raw, they must be consumed immediately after being caught. But the demand for consuming raw Japanese seafood is increasing; one of the reasons would be the fact Japanese food was registered as a UNESCO Intangible Cultural Heritage, in 2013. For distributing a wide variety of raw marine products from Japan, air transportation is now in practical. However, this has huge environmental impact and possibly becomes difficult to use in the future society of net zero carbon. Freezing significantly extends the shelf life of raw marine products, making it possible to transport them by ship and greatly reducing the environmental impact. But frozen-thawed marine products have been generally thought to have a significant quality deterioration and were rarely eaten raw. In recent years, because the quality of frozen-thawed seafood has improved, frozen distribution of marine products for raw consumption is gradually becoming more widespread. This quality improvement is the result of long-standing research, and we must continue making efforts to achieve both good food quality and low environmental impact for the future. In this lecture, I will introduce research examples for sustaining the distribution of even higher quality marine products.

The research we have carried out so far is very wide-ranging. It is related to the fact that in order for frozen seafood to be of good quality, it is necessary to manage all four processes at a certain level: post-harvest processing, freezing, refrigerated preservation, and thawing. In the early days of frozen-preservation, it was

widely recognized that rapid freezing was extremely important and many studies were conducted on freezing, but the importance of other processes was not well understood. We have conducted research on the four processes, and in addition, we recognize that quality evaluation technology is also extremely important. This is because if quality evaluation is not performed properly, it is not possible to determine which freezing, storage, and thawing conditions are better. I will introduce research on post-harvest processing that investigated the effectiveness of high-freshness freezing, and research on thawing that examined the effect of thawing rate on fish meat quality after thawing. In these studies, impedance and microscopic observation are used as quality evaluation methods, so the effectiveness of these will also be explained.



Alain Le-Bail is a Professor in Food Process Engineering with the French Ministry of Agriculture, holding a PhD in Heat Transfer and Fluid Dynamics (1990) and a Habilitation (2000) from the University of Nantes, France. His main research areas include phase transitions in food systems, food refrigeration and freezing, baking processes, freezing under electric and electromagnetic fields, as well as thermal and non-thermal food processing technologies. He is also President of Commission C2 "Food Science & Engineering" of the International Institute of Refrigeration (IIR). His work in the field includes studies on subzero temperature storage regimes, the influence of temperature oscillations on the shelf life of frozen foods, cryogenic versus mechanical freezing, microwave-assisted freezing, and the effects of DC voltage on crystallization in food systems.

Innovation in baking: a focus on baking including the impact of a possible ban of PFAS based nonstick coatings

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Background: This presentation will propose a focus on innovation in baking process and technology applied to bakery products. The first focus will concern the case on microwave and ohmic heating, which yield in few industry applications. The second topic concerns baking surfaces (pans) and the project of PFAS ban in Europe as a global concern with PFAS pollution. An overview of the situation and key regulations and dates at EU level will be reminded. Results obtained in the case of domestic cookware and baking in industry will be presented with a discussion about alternatives.

Aims: This contribution proposes a state of the art of the two proposed focus based on different projects and on the global expertise of the presenter. The aim is to clarify the situation and to draw perspectives in terms of industry applications.

Methods: The presenter recently co-supervised PhD on MW baking of bread and biscuits as well as ohmic baking of cake and bread as references. MW baking of bread is applied to sliced breads in EU with two patents related to the depaning of the breads; these will be discussed. Ohmic baking was developed in the 50th and is applied in UK and US to produce breading; further application will discuss such as in flow baking applied to 3D printing (one patent from the presenter).

The project of PFAS ban in Europe is on the way with first measures taken in 2022 with the ban of PFAS for food packaging in particular. The PFAS represents a large group of molecules, of man-made organic compounds, resulting in a complex situation when one try to determine contamination. Examples in terms of contamination will be proposed showing that the migration to bread is very low during the early life time of a PFAS coating. The development of stickiness (adhesion) during usage of the coating is related to the increase

of the roughness resulting in a higher surface energy. Alternatives can be silicone coating, which address other risks. Coming back to metallic baking surface is doable but require the use of nonstick fluids address specific risks such as Glycidyl esters and 2-3 MCPD.

Conclusions: “Emerging” baking technologies are considered by several research groups nowadays; the presentation will show their potential and limits. Regarding the PFAS ban project, it seems that the EU commission progresses with a certain delay compared to the initial ban agenda: the impact of PFAS ban must be anticipated and discussed with the industry, since new risks may appear.

References from the author:

Prof LE-BAIL coordinated and was involved in several baking project using MW and ohmic baking. Also, Prof LE-BAIL was Coordinator of the “SATIN-BAKING” project ANR France-2014-2016 on PFAS in the baking industry. He was invited by the EHEDG for a plenary presentation in 2023 world congress (European Hygenic Equipment Design Group).

ORAL AND POSTER PRESENTATIONS

ID 001

Assessment of sour cherry pit shell fractions as additives for protein-based packaging

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Background: The ecological burden caused by plastic pollution has intensified the search for alternative materials with a lower environmental footprint. This problem also resonates within the food packaging industry, where environmental concerns regarding plastic materials are coupled with a series of serious health considerations.

Aims: The focus of this work was to develop sustainable food packaging materials that would provide functionalities comparable to those of commercial plastics. Whey proteins were used as the base material and their properties were improved by incorporating fractions obtained from sour cherry pit shells.

Methods: Whey protein-based films were prepared by casting using thermally treated whey proteins (90 °C, 20 min, pH 8), glycerol as a plasticizer, and lignin- and nanocellulose-containing fractions obtained by fractionation of sour cherry pit shells. The fractions were characterized by spectroscopy, while particle size distribution and ζ-potential were determined using a Zetasizer. The resulting films were evaluated in terms of mechanical properties.

Results: The incorporation of sour cherry pit shell fractions led to noticeable changes in the mechanical behaviour of whey protein-based films. The addition of the lignin-rich fraction resulted in increased tensile strength and elongation at break compared to the control films. On the other hand, the addition of the nanocellulose-containing fraction resulted in a decrease in both tensile strength and elongation at break. These differences can be associated with variations in the physicochemical characteristics of the fractions. Namely, the nanocellulose-containing fraction showed a high degree of particle size heterogeneity combined with a less negative ζ-potential, indicating limited colloidal stability and a higher tendency toward aggregation, which may have hindered effective incorporation into the protein matrix. On the other hand, the lignin-rich fraction exhibited a more negative surface charge, which, despite its high particle size heterogeneity, enabled better dispersion and interactions with whey proteins. This resulted in the formation of thinner films with a more compact structure and superior mechanical behaviour compared to the control. These findings suggest that differences in surface characteristics and dispersion behaviour of the fractions play an important role in determining the final structure and performance of the films.

Conclusions: Overall, these findings highlight the potential of sour cherry pit shell fractions as functional additives for tuning the properties of protein-based films and advancing the development of sustainable food packaging materials.

Funding: This research was supported by the European Union's Horizon Europe programme (HORIZON-MSCA-2023-SE-01; Grant No. 101179991, VERDEDRIVE).

ID 002

From plant proteins to health claims: Regulatory aspects

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Plant-based proteins are becoming an increasingly popular alternative and replacement for animal-based proteins due to their health benefits, sustainable development, potential economic viability, and cultural and nutritional needs. Sources of plant origin are mostly found in traditional foods, however, due to increased consumer demand, the food industry is increasingly turning to innovative products and ingredients that often fall into the category of novel foods or food with health claims.

According to the European Commission's definition, "novel food" refers to any food that was not consumed to a significant extent in the EU before 15 May 1997 and is produced using new technologies or comes from new sources, or if it meets the criteria and belongs to at least one of the categories prescribed in Regulation (EU) 2015/2283. Although consumers are cautious when purchasing and consuming novel foods, it must receive a positive opinion from EFSA on possible risks before being approved. In accordance with Commission Implementing Regulation (EU) 2017/2470, it must be included in the Union list of novel foods, which also prescribes additional specific labelling requirements, conditions under which the novel food may be used, such as a specified food category and maximum levels, as well as product specifications and other requirements compliant with European Union food policy, ensuring a high level of human health protection.

Regulation (EU) No. 1924/2006 and Regulation (EU) No. 432/2012 regulate the possibilities for the use of health claims. For proteins of plant origin in the EU, there are several approved health claims that can be indicated on the product in accordance with the applicable legal regulations. As the wishes and needs of modern consumers are moving towards the consumption of plant proteins, which very often fall into the category of novel foods, a considerable number of requests for the authorization of such products and accompanying health claims are currently in the evaluation process at EFSA.

ID 005

Monitoring aging processes and adulteration in Sherry vinegars using Raman spectroscopy and chemometrics

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Background: Sherry (Jerez) wine vinegar represents one of the most prestigious and high-quality categories among wine vinegars, originating exclusively from the Vinagre de Jerez Denomination of Origin in Cádiz, southern Spain. Its distinctiveness arises from a prolonged and carefully controlled traditional aging process, known as the “Soleras and Criaderas” system, conducted in oak barrels, during which complex oxidative and extraction phenomena occur. This long-term maturation imparts Jerez vinegar with an intense aromatic profile and enhanced sensory complexity.

Aims: The aim of this study was to develop and evaluate an emerging spectroscopic approach for monitoring the aging process and authenticity of vinegar samples. In addition, the study aims to explore the potential of Raman spectral fingerprints combined with chemometric analysis to enable rapid, nondestructive classification of vinegar samples according to aging stage and to support authenticity verification.

Methods: A total of 39 original Jerez-type vinegar samples produced using traditional aging within geographically indicated regions [unaged (Apto), Crianza (6–24 months), Reserva (24 months–10 years), and Gran Reserva (≥10 years)] were analyzed using Raman Microspectroscopy.

Results: Sample authentication and classification were evaluated by Principal Component Analysis (PCA), where Apto, Crianza, Reserva, and Gran Reserva samples were clearly discriminated along PC1 (45.14%) and PC2 (9.13%). To assess adulteration detection capability, Gran Reserva samples were intentionally mixed with less-aged Crianza samples at levels ranging from 0 to 100% (v/v) at 10% intervals. Partial Least Squares (PLS) and Artificial Neural Network (ANN) models were developed for adulteration quantification. The validation model of PLS achieved a coefficient of determination (R^2) of 0.964, while the ANN model applied to the test dataset yielded an R^2 value of 0.998.

Conclusions: Overall, Raman spectroscopy demonstrated strong potential for both classification of authentic Jerez vinegars and detection of adulteration in Gran Reserva samples. This approach offers a rapid and reliable method for monitoring authenticity, fermentation, and aging processes in analytical and biochemical applications, as well as in food quality control laboratories.

Acknowledgement: This work was funded by The Scientific and Technological Research Council of Turkey (TUBITAK) ARDEB 1002 (Grant No. 124O687).

ID 006

Effect of plant-based substrates on microbial dynamics and acidification during kombucha fermentation

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Background: Kombucha fermentation is a complex microbial process in which substrate composition plays a key role in shaping microbial growth and acidification behavior. The use of plant-based substrates offers opportunities to diversify fermented beverages and modulate their functional properties.

Aims: This study aimed to evaluate the effect of different traditionally consumed plant infusions on microbial dynamics and acidification during kombucha fermentation.

Methods: Ten plant infusions, including sage, rosemary, bay leaf, nettle, St. John's wort, French lavender, carob, thyme, lemon balm, and olive leaf, were used as fermentation substrates. Fermentation was carried out at room temperature for 30 days. Samples were analyzed for microbiological counts and pH values on days 1, 15, and 30. Correlation analysis was performed to assess relationships between microbial populations and pH.

Results: pH values ranged between 1.96 and 3.87 and decreased throughout fermentation for all substrates. The highest pH decrease was observed in lemon balm (ΔpH = -1.46), while the lowest was found in carob (ΔpH = -0.45). Acidification behavior was substrate-dependent, with most substrates showing rapid initial acid production, whereas French lavender required a longer adaptation period. Mean microbial counts (log CFU/mL) were 5.10 for TMAB, 5.14 for yeast and mould, 6.40 for acetic acid bacteria, 5.75 for *Lactobacillus* spp., and 5.78 for *Lactococcus* spp. Correlation analysis showed that only yeast and mould had a statistically significant relationship with pH ($r = -0.475$, $p < 0.01$), suggesting their association with acidification during fermentation. Microbial populations generally peaked on day 15, while yeast and mould reached maximum levels on day 30. Substrate-specific variations were observed, with the highest increases recorded in lemon balm, thyme, olive leaf, and French lavender for different microbial groups.

Conclusions: These findings indicate that substrate selection influences microbial dynamics and acidification behavior during kombucha fermentation. Therefore, plant-based substrates can be used to modulate fermentation performance and product characteristics, providing practical insights for the development of fermented beverages.

This study aligns with the objectives of COST Action CA24132 (Mic2Food) by contributing to the understanding of microbial dynamics in fermented food systems.

Acknowledgement: The attendance to this conference was supported by the COST Action CA24132 "Mic2Food – Accelerating Innovation and Development of European Microbial Foods," supported by COST (European Cooperation in Science and Technology).

ID 008

Valorization of Banana Waste in the Philippines: A Review of Scientific Studies on Food Application

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Background: The Philippines is a major banana producer generating large volumes of underutilized biomass (peels, pseudostems, stalks, leaves, blossoms, rejected fruits) that currently pose environmental burdens but contain valuable polysaccharides, starches, fibers, and bioactive compounds suitable for food and functional ingredient applications.

Aims: This review aims to synthesize Philippine-based scientific studies on the valorization of banana waste for food, nutraceutical, and antimicrobial applications, highlight methodological advances, and identify research gaps relevant to developing a circular banana bioeconomy.

Methods: A narrative literature review of national and international journal articles, theses, government reports, and institutional studies was conducted, focusing on Philippine research that characterizes banana waste components, optimizes extraction processes (e.g., acid, microwave-assisted, ultrasound-assisted), evaluates functional and bioactive properties, and assesses their performance in model and actual food systems.

Results: Studies demonstrate that Saba peel is a viable source of low-methoxy pectin with promising rheological and emulsifying functionality; green banana flour and resistant starch show potential as functional ingredients and partial wheat flour substitutes; peel and blossom fractions exhibit significant antioxidant, lipid-lowering, and dietary fiber properties; and peel-derived extracts and zinc oxide nanoparticles provide antibacterial effects suitable for food, packaging, and nutraceutical applications, while blossom- and flour-based products achieve acceptable sensory quality in various food prototypes.

Conclusions: Philippine research has established banana waste, particularly Saba peel, green fruit, and blossom, as multifunctional resources for value-added food, ingredient, and antimicrobial applications, but wider impact will require scale-up and techno-economic studies, broader variety coverage, nanotechnology development, and supportive policy frameworks to operationalize a circular banana bioeconomy.

ID 009

Nutritional and Biological Value of Fresh Probiotic Dairy Products Enriched with Royal Jelly – Yogurt and Fresh Cheese

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Background: In recent years, functional dairy products have attracted increased scientific and industrial interest due to their potential health-promoting properties. The incorporation of probiotic cultures and bioactive substances such as royal jelly (RJ) enhances the nutritional value and biological potential of fermented dairy matrices. RJ is a complex bee product rich in proteins, lipids (notably 10-hydroxy-2-decenoic acid), vitamins, and bioactive peptides, which may synergistically interact with probiotic cultures.

Aims: The present study aims to evaluate the nutritional and biological value of fresh probiotic yogurt and fresh cheese enriched with 2% royal jelly by analyzing using selected lipid quality parameters and determination the effects of enrichment with RJ.

Methods: The nutritional value and biological quality of yoghurt and fresh cheese enriched with a probiotic strain *Lacticaseibacillus casei* RC-1 and RJ were assessed through lipid content and fatty acid profile, while protein quality was evaluated based on amino acid composition. The atherogenic index (AI), thrombogenic index (TI), hypocholesterolemic/hypercholesterolemic ratio (H/H), and nutritional value index (NVI) were subsequently calculated.

Results: The enrichment of yogurt and fresh cheese with probiotic strain *Lacticaseibacillus casei* RC-1 and 2% RJ resulted in significant modifications of fatty acid and amino acid profiles. Samples containing RJ exhibited increased levels of medium-chain and unsaturated fatty acids, as well as the presence of characteristic RJ fatty acids (10-hydroxy-2-decenoic acid). Furthermore, these samples showed enhanced concentrations of essential amino acids (e.g., leucine, isoleucine, and lysine) compared to controls. During storage, a decrease in lactose content and dynamic changes in organic acids were observed, indicating intensified metabolic activity and improved biochemical maturation of the products.

Conclusions: The incorporation of probiotic strains and RJ significantly improves the nutritional value and biological potential of fresh dairy products by enhancing lipid quality and protein composition. These findings support the development of yogurt and fresh cheese as functional foods with potential health-promoting benefits.

ID 010

Nutritional and Biological Evaluation of Omega-3 Enriched Dairy Products

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Background: Omega-3 enrichment of dairy products has gained increasing interest as an approach to improve their nutritional functionality and health-promoting potential. While the fatty acid composition, trans fatty acids, and metabolite profiles of omega-3 enriched dairy products have been previously reported, limited information is available regarding their evaluation through nutritional and biological quality indices.

Aims: This study aimed to assess the nutritional and biological value of omega-3 enriched yogurt and fresh cheese through lipid health and protein quality indices and to determine the effect of enrichment on health-related nutritional parameters.

Methods: Omega-3 enriched yogurt and fresh cheese were evaluated using selected lipid quality indices, including atherogenicity index (AI), thrombogenicity index (TI), hypocholesterolemic/hypercholesterolemic ratio (H/H), and nutritive value index (NVI). Protein quality was assessed through indices calculated from amino acid composition. Previously published fatty acid composition data were used for index calculations, while the present study focused exclusively on the interpretation of nutritional and biological quality indicators.

Results: Omega-3 enrichment improved the nutritional quality of dairy lipids, as indicated by reduced AI and TI and improved H/H ratio compared with non-enriched controls. Protein quality indices confirmed the high biological value of the dairy matrices. Differences between yogurt and fresh cheese suggested matrix-dependent effects on lipid and protein quality indicators. The combined assessment demonstrated that omega-3 fortification enhanced the overall nutritional functionality of both dairy products.

Conclusions: Omega-3 enriched yogurt and fresh cheese showed improved nutritional and biological value based on lipid and protein quality indices, supporting their potential as functional dairy foods. These findings provide complementary evidence beyond compositional analysis and contribute to the health-related evaluation of omega-3 fortified dairy products.

ID 011

Metabolite and volatile profiling of the indigenous Bulgarian "Kossara" cherry cultivar by HS-SPME GC–MS

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Background: Cherry fruits belong to the genus Prunus (family Rosaceae), subgenus Cerasus. Among the numerous species within this group, sweet cherry (*Prunus avium* L.) and sour cherry (*Prunus cerasus* L.) are the two species primarily cultivated for human consumption. Sweet cherries are among the earliest-ripening temperate fruits and are widely appreciated for their bright color, firmness, sweetness–acidity balance, and aromatic profile, all of which strongly influence consumer acceptance. Traditional and indigenous cherry cultivars represent an important genetic resource, as they contribute to biodiversity preservation and may possess distinctive compositional and sensory traits not present in commercial varieties.

Aims: This study profiles polar, lipid, and volatile metabolites in the indigenous Bulgarian 'Kossara' sweet cherry cultivar, providing insight into its chemical and aroma composition.

Methods: Headspace solid-phase microextraction coupled with gas chromatography–mass spectrometry (HS-SPME GC–MS) is the analytical technique used for the extraction and identification of volatile and metabolite compounds in the studied extracts.

Results: Thirty-eight metabolites were identified, including eleven amino acids, six organic acids, four sugar alcohols, two phenolic acids, four fatty acids, and eleven mono- and di-saccharides, within the analyzed samples. Furthermore, using HS-SPME GC–MS, fifty-nine volatile organic compounds were characterized, spanning alcohols, aldehydes, esters, ketones, lactones, and terpenoids.

Conclusions: This work represents the first comprehensive metabolomic and volatile characterization of the indigenous Bulgarian 'Kossara' cherry cultivar and provides a scientific basis for its valorization, authentication, and preservation.

Influence of *Melissa officinalis* Flour on the Textural Characteristics of Chocolate Systems

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Background: Chocolate masses are primary semi-finished products whose rheological and structural properties largely determine the quality of the final chocolate products. In recent years, there has been increasing interest in incorporating functional plant-based ingredients, such as *Melissa officinalis* (lemon balm), to enhance both technological and nutritional characteristics. However, the influence of such additives on the rheological behavior and texture of different chocolate systems remains insufficiently studied.

Aims: The present study aims to investigate the influence of *Melissa officinalis* flour on the rheological properties and textural characteristics of various chocolate masses. The objective is to evaluate how different concentrations of the added flour affect flow behavior, shear stress, and plastic viscosity in dark, milk, and white chocolate systems.

Methods: The rheological properties were determined using a Rheotest (Germany). The plastic viscosity of the chocolate masses according to Casson was determined by the method of the International Cocoa and Chocolate Organization. The particle size of the solid phase of the chocolate masses (fineness) was determined using a microscope and Image Tools software. A total of nine samples were analyzed, containing 1%, 1.5%, and 2% *Melissa officinalis* flour incorporated into dark, milk, and white chocolate masses.

Results: All analyzed samples exhibited non-Newtonian flow behavior. An increase in the concentration of *Melissa officinalis* flour resulted in higher shear stress values across all types of chocolate systems. Additionally, a corresponding increase in Casson plastic viscosity was observed with increasing flour content. The presence of lemon balm flour influenced the structural characteristics of the chocolate masses, affecting their flow and consistency.

Conclusions: The incorporation of *Melissa officinalis* flour significantly affects the rheological properties of chocolate masses. The results suggest that it can be used as a functional ingredient.

ID 013

Molecular identification and characterization of three yeast strains for beer production

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Background: Yeasts represent a highly diverse group of microorganisms distributed across a wide range of ecological niches, including soils, plants, and aquatic environments. This diversity is reflected in their broad metabolic potential, which has stimulated increasing interest in their application in fermentation industries. In recent years, the brewing sector has focused on exploring unconventional yeast strains as a means to enhance fermentation performance and diversify the chemical composition of beer. This trend is further supported by advances in molecular identification techniques, enabling accurate characterization and differentiation of newly isolated strains. Consequently, the selection and evaluation of novel yeasts for brewing applications has become an important area of research.

Aim: This study aimed to identify three yeast strains (designated as strains 1, 7, and 13) and to evaluate their suitability for beer production under laboratory conditions, with a focus on their fermentation performance and metabolic activity.

Methods: The yeast strains were identified using molecular genetic techniques, including total DNA isolation, amplification of the intergenic spacer regions within the rRNA gene operon (ITS1, 5.8S rRNA gene and ITS2) or the 5' end of the Large-Subunit (26S) rRNA Gene, PCR product purification, and partial sequencing based on the Sanger method. Fermentation trials were conducted in both unhopped and hopped all-malt wort. Fermentation dynamics were monitored based on weight loss. In the final product, basic physicochemical parameters (original, real, and apparent extract, pH, and alcohol content) were determined, along with selected secondary metabolites, including higher alcohols, esters, and aldehydes.

Results: Molecular identification confirmed that strain 1 belongs to *Schizosaccharomyces pombe*, whereas strains 7 and 13 were identified as *Saccharomyces cerevisiae*. Fermentation trials demonstrated that the presence of hops exerted an inhibitory effect on yeast activity, resulting in extended fermentation times. Analytical data showed that all strains were capable of producing beers with an alcohol content exceeding 7% (v/v). Hop addition also influenced the formation of secondary metabolites: ester concentrations decreased significantly, while higher alcohol levels increased. Aldehyde concentrations showed strain-dependent variation.

Conclusions: The studied yeast strains demonstrated potential for application in brewing processes aimed at producing high-alcohol beers. The use of unconventional yeasts represents a promising approach for diversifying fermentation performance and expanding brewing applications.

Funding: This work was funded under the project "Synergic plant extracts (e.g. essential oils) - bioprotective microorganisms for development of functional fermented foods (SEO-MICRO-FOODS)" under the Competition for projects under bilateral cooperation programs 2026 - Bulgaria - France ("Rila" program, project BG-175467353-2025-05-0004 /FNI-2923 of 08.12.2025/ of the Bulgarian Scientific Research Fund). Cooperation

between University of Food Technologies Plovdiv (Bulgaria), BioDyMIA research unit (Université Claude Bernard Lyon 1 - ISARA Lyon, France), and Ecole d'Ingénieurs de Purpan (Université de Toulouse, France) was supported by Franco-Bulgarian cooperation Hubert Curien Programme (PHC Rila) The authors wish to express their gratitude for the supports of the Ministry of Education and Science (Bulgaria), the Embassy of France to Bulgaria in Sofia ("Ministère des Affaires Etrangères", France), Campus France and "Ministère de l'Enseignement Supérieur, de la Recherche et de l'Innovation" (France).

ID 014

Process parameters during corn semolina extrusion enriched with watermelon seed flour

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Background: The efficiency of extrusion processing is determined by product quality attributes, including minimal losses of proteins and vitamins, desirable physicomechanical properties, and acceptable techno-economic performance, such as mass flow rate and specific mechanical energy consumption.

Aims: The study aimed to evaluate the effects of watermelon seed flour content, feed moisture content, and die temperature on key process parameters during corn semolina extrusion.

Methods: Extrusion trials were conducted using a laboratory-scale single-screw extruder (Brabender 20 DN). The effects of watermelon seed flour content (3 % and 10 %), feed moisture content (14 % and 18 %), and die temperature (160 °C and 180 °C) on die pressure, mass flow rate, and specific mechanical energy were investigated. The mass flow rate was determined using a stopwatch and an analytical balance, while the specific mechanical energy was calculated based on the measured torque and screw speed. The die pressure in the matrix was measured using a Terwin 20UNF pressure sensor.

Results: Die pressure ranged from 4.49 MPa to 8.59 MPa, mass flow rate from 3.88 kg/h to 8.04 kg/h, and specific mechanical energy from 100.8 Wh/kg to 157.5 Wh/kg, respectively. Increasing die temperature resulted in a reduction in die pressure and mass flow rate, while no significant effect on specific mechanical energy was observed. Higher feed moisture content and increased watermelon seed flour content led to decreases in all evaluated process parameters.

Conclusions: Die temperature, feed moisture content, and watermelon seed flour content significantly influence the extrusion performance of corn semolina blends. These findings contribute to the optimization of extrusion conditions for producing nutritionally enhanced extruded products incorporating watermelon seed flour.

ID 015

Characterization of cyclodextrin glucanotransferase from *Bacillus megaterium* immobilized on DEAE-cellulose activated with glutaraldehyde

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Background: Immobilization of cyclodextrin glucanotransferase is a tool for change in the biochemical properties of the enzyme regarding its application for cyclodextrin production.

Aims: The aim of the research is investigation of the biochemical characteristics of cyclodextrin glucanotransferase from *Bacillus megaterium* immobilized on DEAE-cellulose activated with glutaraldehyde.

Methods: The main biochemical properties of cyclodextrin glucanotransferase immobilized on DEAE-cellulose activated with glutaraldehyde were investigated. The optimal temperature and pH value for enzyme action, thermal stability, kinetic constants, and reusability of the immobilized biocatalyst were determined and compared with the characteristics of the free enzyme.

Results: The immobilized cyclodextrin glucanotransferase showed high temperature optimum at 60˚C and its activity was higher than the activity of the free enzyme up to 70˚C. The immobilized enzyme displayed pH optimum at pH 5.0-6.0, and high activity above 80 % was found in a broad pH range from 5.0 to 9.0. The immobilized biocatalyst showed better thermal stability than the free one. When incubated at 60°C it retained its activity for up to 6 hours. At 70°C it showed above 50 % residual activity for up to 3 h, and the free enzyme lost 50 % of its activity for 1 h. Due to the immobilization, the kinetic constants of CGTase increased. The value of Km was determined to be 65.06 mg/ml and Vm value was 0.578 mg/(ml.min). This indicated that immobilized CGTase performed the reaction with higher activity, but it did not have better affinity for the substrate. The immobilized CGTase showed good reusability for up to 7 cycles. The enzyme retained about 70 % of its relative activity for 3 cycles and displayed over 60 % activity for up to 7 cycles.

Conclusions: The immobilized cyclodextrin glucanotransferase on DEAE-cellulose activated with glutaraldehyde showed characteristics, which are beneficial in regard to its application in a process for cyclodextrin production.

ID 016

Sorption characteristics of baobab fruit powder

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Background: Baobab powder is an exotic and nutritionally valuable product, combining functional ingredients and aligning with modern dietary trends focused on diversity and supplementation.

Aims: The objective of this research is to investigate the sorption behavior of baobab powder, which plays a key role in food processing, storage, and transport technologies.

Methods: The study employed a static gravimetric technique at 10 °C, 25 °C, and 40 °C, covering a relative humidity range from 0.11% to 0.87%. The BET model was used to calculate monolayer moisture content, while isotherms were fitted using modified Oswin, Henderson, Halsey, and Chung–Pfost models incorporating temperature effects.

Results: The resulting isotherms showed characteristic sigmoidal (*S*-shaped) curves, corresponding to type II in Brunauer's classification. An inverse relationship between temperature and equilibrium moisture was observed at constant relative humidity. Based on statistical indicators (mean relative error, standard deviation, and residual analysis), the modified model was found most suitable. Monolayer moisture values ranged between 9.11–9.53% (adsorption) and 14.68–15.55% (desorption).

Conclusions: The study establishes a fundamental database on the sorption characteristics of baobab powder, supporting predictions of its stability during storage and processing. As a superfood, it holds strong potential for the development of new and innovative food products, especially when combined with local ingredients.

ID 017

Effect of lactic acid bacteria strain on phenolic, antioxidant and sensory characteristics of lemongrass-enriched wort beverages

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Background: Lactic acid fermentation of cereal-based substrates is an emerging approach for the production of functional non-dairy beverages. The incorporation of plant ingredients such as essential oils can further enhance their bioactive properties. Previous studies have demonstrated that lemongrass essential oil can improve the phenolic content and sensory properties of fermented wort beverages; however, the extent to which these effects are strain-dependent remains unclear.

Aims: The aim of the present study was to evaluate the combined effect of lactic acid bacteria (LAB) strain and lemongrass essential oil concentration on the phenolic content, antioxidant activity and sensory profile of lactic acid wort-based beverages.

Methods: Wort supplemented with lemongrass essential oil at concentrations of 0.01%, 0.02%, and 0.03% (v/v) was subjected to lactic acid fermentation using two LAB strains (*Lactiplantibacillus plantarum* PX3 *Lacticaseibacillus casei* ssp. *rhamnosus* LBRC11) at 25 °C for 48 h. Samples were analyzed at the beginning and at the end of fermentation and compared to control beverages without lemongrass oil addition. Phenolic content was determined spectrophotometrically, while antioxidant activity was assessed using ABTS and CUPRAC assays. Sensory characteristics of the obtained beverages were also evaluated by a trained panel.

Results: The results revealed pronounced strain-dependent differences in both phenolic content and antioxidant activity. One of the strains exhibited a decrease in total phenolic content after fermentation under certain conditions, whereas the other maintained more stable phenolic levels. The effect of lemongrass oil concentration was not uniform, indicating a strong interaction between strain and oil. Furthermore, antioxidant activity did not always correlate with phenolic content, with divergent trends observed between ABTS and CUPRAC assays. These findings suggest that microbial metabolism plays a key role in determining both phenolic transformation and antioxidant potential. Sensory evaluation showed that the combination of lemongrass oil with *Lacticaseibacillus casei* ssp. *rhamnosus* LBRC11 resulted in lower acceptance compared to the control sample without oil addition.

Conclusions: The study demonstrates that the effect of lemongrass essential oil on lactic acid fermented wort beverages is strongly strain-dependent. The results highlight the importance of LAB strain selection for optimizing the functional properties of such beverages and indicate that phenolic content alone is not sufficient to predict antioxidant activity.

Funding: This work was funded under the project "Synergic plant extracts (e.g. essential oils) - bioprotective microorganisms for development of functional fermented foods (SEO-MICRO-FOODS)" under the Competition for projects under bilateral cooperation programs 2026 - Bulgaria - France ("Rila" program, project BG-

175467353-2025-05-0004 /FNI-2923 of 08.12.2025/ of the Bulgarian Scientific Research Fund). Cooperation between University of Food Technologies Plovdiv (Bulgaria), BioDyMIA research unit (Université Claude Bernard Lyon 1 - ISARA Lyon, France), and Ecole d'Ingénieurs de Purpan (Université de Toulouse, France) was supported by Franco-Bulgarian cooperation Hubert Curien Programme (PHC Rila) The authors wish to express their gratitude for the supports of the Ministry of Education and Science (Bulgaria), the Embassy of France to Bulgaria in Sofia ("Ministère des Affaires Etrangères", France), Campus France and "Ministère de l'Enseignement Supérieur, de la Recherche et de l'Innovation" (France).

ID 018

Optimization of Original Extract and Bilberry Addition Time in the Production of Beer with High Antioxidant Capacity

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Background: Previous studies have shown that the addition of bilberries during beer maturation can modify its phenolic profile, antioxidant capacity and sensory characteristics. However, the combined effect of original extract and bilberry addition time has not been systematically evaluated and optimized.

Aims: The aim of the present study was to optimize the combined effect of original beer extract and time of bilberry addition during maturation on the antioxidant capacity and total phenolic content (TPC) of beer.

Methods: A face-centered central composite design with 11 experimental runs, including three replicates at the center point, was used to study the effect of original beer extract (12 °P, 14 °P, 16 °P) and time of bilberry addition at the beginning and on days 3.5 and 7 of maturation on the antioxidant capacity and TPC. The antioxidant capacity was evaluated by ABTS, CUPRAC and FRAP assays, while TPC was determined using the Folin–Ciocalteu (FC) method. An optimal processing region was determined through multi-criteria graphical optimization using the constraints ABTS > 3500 µmol TE/L, CUPRAC > 8250 µmol TE/L, FRAP > 3800 µmol TE/L and FC > 920 mg GAE/L.

Results: The experimental data were fitted to quadratic polynomial models and analyzed using response surface methodology. The coefficients of determination (R^2) for the models were 99.43% for ABTS, 98.56% for CUPRAC, 99.99% for FRAP and 90.79% for FC, with no statistically significant lack-of-fit observed for any model at $\alpha = 0.05$. Bilberry addition time and the quadratic effect of original extract significantly affected all four responses, while a significant interaction between the two factors was observed for CUPRAC, FRAP and FC. The overall boundaries of the optimal processing region determined through multi-criteria optimization were approximately 12.8–15.3 °P for the original extract and 0–6 days for bilberry addition time, with the permissible combinations of the two factors being mutually dependent. The combination of 14 °P and bilberry addition at the beginning of maturation was identified as the preferred experimentally investigated technological regime within the optimal region.

Conclusions: The present study extends previous research on beers matured with bilberries by moving from the independent evaluation of original extract and bilberry addition time to their joint modelling and multi-criteria optimization. The identified optimal processing region provides a basis for selecting technological conditions that simultaneously ensure high antioxidant capacity and total phenolic content.

ID 019

Adsorption of copper (II) cations from aqueos solutions usinng tobacco by-products and wastes

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Background: Bioadsorption of pollutants is among the most explored method for decontamination of aqueous solutions. It relies often on utilization of wastes and by-products of the agro-industry (usually from plant origin) to eliminate hazardous compounds and heavy metal cations. Besides it could serve as an approach for concentration of these heavy metals, some of them considered as critical raw materials, such as copper, aluminum, nickel, etc. and also a method for valorization of the vast amounts of the agro-industrial by-products and wastes, i.e. tobacco industry.

Aims: The aim of the present study was to explore the possibilities to adsorb and concentrate copper (II) cations from aqueous solutions with industrial tobacco by-products and wastes.

Methods: The tobacco wastes and by-products were obtained from the experimental fields of Tobacco and Tobacco Products Institute, Markovo, Bulgaria. The spectrophotometric (LLG Labware, Germany; A=600 nm) determination of unabsorbed Cu^{2+} was performed with Spectroquant® Copper test (Supelco, Merck KGaA, Darmscdat, Germany) according to the instruction of the manufacturer.

Results: From the investigated 15 samples tobacco wastes and by-products the best adsorption ability showed industrial tobacco dust and washed cigarette butts: 18.68±0.11 mg/L and 18.32±0.11 mg/L adsorbed Cu^{2+}, respectively (initial concentration of Cu^{2+} = 20 mg/L). In all investigated residues the adsorption was higher than 75% adsorbed Cu^{2+}. The adsorption experiments performed at six different temperatures: 4, 20, 40, 60, 80 and 100 °C, revealed that the best results were obtained at room temperature (20 °C) and increase of the temperature lowered the absorption rate.

Conclusions: The data obtained for the impact of contact time and temperature on the adsorption of Cu^{2+} revealed the initial assumption that the tobacco residues from agro-industrial processing could be successfully valorized as cheap, renewable and nature friendly bioadsorbents for removal and concentration of Cu^{2+} from its' aqueous solutions.

Acknowledgments: This work has been carried out in the framework of the National Science Program "Critical and strategic raw materials for a green transition and sustainable development", approved by the Resolution of the Council of Ministers № 508/18.07.2024 and funded by the Ministry of Education and Science of Bulgaria. This work was supported by the Bulgarian National Science Fund, Ministry of Education and Science in Bulgaria (project КП-06-Н87/13 / 06.12.2024 Complex valorization of by-products and waste from the tobacco industry.

ID 020

Biological tools for microbial control: bacterial isolates from fermented cabbage brine as promising antibacterial and antifungal agents

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Background: Fermented cabbage represents a complex microbial ecosystem driven by dynamic physicochemical and microbiological changes. During spontaneous lactic acid fermentation, diverse microbial communities—including lactic acid bacteria and spore-forming bacteria—develop and produce bioactive compounds with antimicrobial potential. These systems are increasingly explored as sources of functional strains with applications in food safety, biocontrol, and probiotics.

Aims: This study aimed to characterize the microbial dynamics of fermented cabbage brine and to evaluate the antimicrobial, antifungal, and probiotic potential of selected bacterial isolates.

Methods: Fermentation was monitored over four weeks through pH, electrical conductivity, and microbial counts (CFU mL^{-1}). A total of 133 isolates were obtained and phenotypically characterized, followed by selection of 18 isolates based on antimicrobial activity. Antibacterial activity was assessed using agar-well diffusion against six reference pathogens, while antifungal activity was tested against six phytopathogenic fungi. Selected isolates were further evaluated for antibiotic susceptibility, tolerance to NaCl (6%), acidic conditions (pH 2–3), and bile salts (0.3%), as well as fermentative capacity and catalase activity. Molecular identification was performed using 16S rDNA sequencing.

Results: Fermentation showed typical trends, with an initial pH decrease (to 3.49) followed by an increase, reflecting microbial succession. High microbial loads (up to 10^{10} CFU mL^{-1}) confirmed active fermentation. Among 133 isolates, 18 exhibited antimicrobial activity, with strain-specific effects. Certain isolates (e.g., 2.18.1, 2.4.1, 2.4.2) demonstrated strong antibacterial activity against multiple pathogens, with inhibition zones up to 35 mm, while others showed minimal effects. Broad-spectrum antifungal activity was observed, particularly against *Penicillium spp.*, *Aspergillus ochraceus*, and *Calosphaeria pulchella*, with inhibition zones up to 45 mm. Physiological assays revealed high tolerance to salt, acidic pH, and bile salts in several isolates, indicating potential probiotic properties. Molecular identification indicated dominance of *Bacillus* spp. (including *Bacillus amyloliquefaciens* and *Bacillus subtilis*), with one isolate identified as *Lelliottia aquatilis*.

Conclusions: Fermented cabbage brine is a valuable source of functionally diverse bacteria with strong antimicrobial and antifungal potential. Selected isolates demonstrate promising characteristics for application as natural antimicrobial agents and biocontrol tools, with additional probiotic potential depending on strain-specific properties.

ID 021

Adsorption of methyl orange from aqueous solutions using agro-industrial by-products and wastes

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Background: Adsorption is widely recognized as an effective method for the purification of contaminated by pollutants (organic and inorganic) aqueous systems. For adsorption recently became popular utilization of agro-industrial by-products and wastes, mainly of plant origin, as low-cost adsorbents for the removal of hazardous pollutants, such as heavy metals, aromatic hydrocarbons and pigments (dyes). Among these, methyl orange (MO) is a commonly encountered synthetic azo dye released from textile and chemical industries, known for its persistence and potential environmental impact. The application of such waste-derived materials not only enhances pollutant removal but also contributes to the sustainable utilization of agro-industrial residues.

Aims: The aim of the present study was to investigate the potential of agro-industrial by-products and wastes for adsorption and removal of the azo dye methyl orange from aqueous solutions.

Methods: The investigated agro-industrial by-products and wastes were collected from various sources. Adsorption experiments were carried out using aqueous solutions of methyl orange (20 mg/L) at different contact times (3, 6, 12 min, etc.). The concentration of unadsorbed dye was determined spectrophotometrically at 465 nm using an UV–Vis spectrophotometer LLG Labware, Germany, according to standard analytical procedures.

Results: Thirteen samples tobacco waste were investigated as possible bioadsorbents and compared with activated carbon, Al_2O_3 and chromatographic silicagel. All tobacco samples were able to adsorb MO above 95% after 90 min contact time. In all experiments only the activated carbon was able to remove all the MO from model aqueous solutions. The industrial residues of *Helichrysum arenarium* (immortelle) and *Coriandrum sativum* (coriander) were washed with dH_2O, 0.1M H_2SO_4, and 0.05M NaOH and used for MO adsorption. It was found that the acid-washed residues were the most effective adsorbents.

Conclusions: The findings suggest that agro-industrial residues have significant potential as low-cost and environmentally sustainable bioadsorbents for methyl orange removal from aqueous solutions. Such utilization represents an efficient and sustainable pathway for both water purification and the valorization of agricultural waste materials.

Acknowledgments: This work has been carried out in the framework of the National Science Program "Critical and strategic raw materials for a green transition and sustainable development", approved by the Resolution of the Council of Ministers № 508/18.07.2024 and funded by the Ministry of Education and Science of Bulgaria. This work was supported by the Bulgarian National Science Fund, Ministry of Education and Science in Bulgaria (project КП-06-Н87/13 / 06.12.2024 Complex valorization of by-products and waste from the tobacco industry.

ID 022

Textural impact of sucrose and maltitol in sponge cake systems

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Background: Increasing consumer demand for sugar-free and lower glycemic impact bakery products has encouraged the use of effective sucrose substitutes that preserve key structural and textural properties. Sugar plays a critical role in sponge cake systems, influencing batter adhesion, sticness and overall textural quality of final product, including crust firmness and crumb softness. Maltitol (E 965) as a low-glycemic polyol, has emerged as a promising sugar substitute. However its impact on structural characteristics of sponge cake systems requires further investigation

Aims: The aim of current study was to evaluate the effects of sucrose and maltitol, applied in different concentration levels (25, 50, 75 and 100 % relative to the standard sugar content) on the elasticity and adhesion properties of cake batters. In addition their impact on textural characteristics of baked products, including crust firmness and crumb softness was investigated.

Methods: A TA.HD.plus texture analyzer (Stable Micro Systems) was used to determine the structural parameters. All measurements were performed in triplicate at 25 ^{o}C. For sponge cake layers both compression and penetration tests were performed with appropriate measuring attachments, depending on specific measured parameter. For batter samples analyses a penetration procedure was applied.

Results: At 50% concentration of both maltitol and sucrose, sponge cake batters exhibited significantly increased adhesiveness and stickiness compared to control sample and 25 % formulations. This tendency toward enhanced elasticity and stickiness persisted at higher concentrations (75% and 100%). Comparable structural-mechanical properties were observed between sucrose- and maltitol-based systems. Crust hardness analysis revealed that samples containing 25 % sucrose or maltitol developed a firm and brittle crust, with maltitol formulations demonstrating lower hardness relative to both the control and sucrose-containing samples. At elevated concentrations (75% and 100%) the products were characterized by softer and more elastic crust. Crumb softness evaluation after controlled compression indicated that maltitol-containing samples (75% and 100%) exhibited greater softness compared to sucrose samples. Nevertheless, in both cases, structural integrity was preserved, and both samples demonstrated good elastic recovery.

Conclusions: The use of maltitol as a sugar substitute in the composition of sponge cake formulations does not affect the stickiness and adhesion properties of the dough. Maltitol exhibits similar structure-forming properties to sugar in terms of the elasticity of the finished product. It was found that the cakes' crumb of maltitol samples had a relatively softer structure than that of the product prepared with sugar.

ID 023

The effects of apple extracts on blood cells depend on the type of the eco-friendly farming system

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Background: Apples are a traditional fruit in the Western diet. The aphorism "An apple a day keeps the doctor away" reflects the centuries-old aspiration of people towards healthy eating. Today, this approach is being developed by using foods from eco-friendly production. However, most analyses of the types of farming systems are focused on production efficiency. Comparative analyses of the impact of their products on human cells are limited.

Aims: The aim of the present work is to investigate the impact of apples produced through eco-friendly farming systems on mitochondrial activity and the hemolysis of human blood cells..

Methods: The apples cultivar "Florina" were collected from orchards with organic (certified), biodynamic, integrated and mechanized (anthropogenically influenced) farming systems. The water extracts of the apples at five doses at range from 100 µg/ml to 500 µg/ml were tested for modulation of mitochondrial activity of human blood cells and the ability to induced hemolysis of human red blood cells. Triton X-100 was used as positive control in hemolysis test.

Results: All extracts decreased mitochondrial activity in comparison with the untreated group. Only the highest dose of apple extract from anthropogenically influenced (mechanized) farming systems significantly increased mitochondrial activity. Apple extracts from eco-friendly farming systems reduce the proportion of blood cells that undergo hemolysis. The extracts from anthropogenically influenced apple orchard increase the proportion of blood cells in hemolysis.

Conclusions: Apple extracts from eco-friendly farming systems have a beneficial effect on the ability of blood cells to avoid hemolysis. They also reduce mitochondrial activity, which may be an expression of one of two processes in blood cells: a decrease in vitality or a decrease in stress levels. Further research is needed to determine the cause of the decreased mitochondrial activity.

Acknowledgements: This work was carried out with the support of BG05SFPR001-3.004-0004-C01 "Interdisciplinary training for the development of knowledge and competencies of doctoral students in various areas of modern research for healthy living and clean technologies (INTERDOC)", funded by the Education Programme 2021-2027, co-financed by the European Union and by the Bulgarian Ministry of Education and Science, and Grant No. RD-08-48/23.01.2026, funded by the Bulgarian Ministry of Education and Science.

ID 024

Low Temperature Nitrogen Assisted Dealcoholization During Must Fermentation – A New Approach for Wine Alcohol Content Management

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Background: Entirely closed and working in nitrogen atmosphere distillation system was used for dealcoholization of fermented grape must. The method offers gentle regime of treatment at must temperature not exceeding 30 ˚C.

Aims: The aim of the method is to study possibilities of producing low-alcohol wines and wines with reduced alcohol level during its fermentation and maximum preservation of their obtained characteristics.

Methods: The innovative InnoSolv llc device for low temperature evaporation in inert atmosphere was used for fermented wine treatment in two different stage of alcohol fermentation. The samples of fermented wine was treated and separated after treatment for individual completion of fermentation or mixing with non-treated wine.

Results: One of the examined operation mode allows for a reduction of the natural alcohol content by over 50 %. The volatiles such as esters, aldehydes, higher alcohols as well as some individual specific volatile compounds were determined in the treated and control wines. No increase in volatile acids was observed in the treated wines, and the processing temperature did not lead to inactivation of used Saccharomyces yeast culture.

Conclusions: The results show that the minimal impact of the method applied combined with using in a reductive stage such as the fermentation process is promising method for low-alcohol wines producing or just reducing alcohol content in the context of a hot wine region climate and problem of high sugar content resolving.

ID 025

Unlocking the potential of „*Cucumis melo* var. Galia“ seeds: sorption behavior, particle analysis, and nutritional profile

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Background: Melon seeds (*Cucumis melo* L.) represent a valuable yet still underutilized by-product of fruit processing. Contemporary trends related to sustainable development and food waste reduction encourage their efficient utilization as a source of nutritional and bioactive compounds.

Aims: The present study aims to obtain results from the analysis of the nutritional profile, particle size distribution, and sorption characteristics of ground “Galia” melon seeds. The findings provide valuable information for optimizing storage conditions and technological processing of the product.

Methods: Analytical procedures were conducted in accordance with standardized methodologies and regulatory frameworks, ensuring high levels of reliability and reproducibility.

Results: The investigated product demonstrates a balanced and relatively stable chemical profile. Its high nutritional and caloric value is largely attributed to lipids (29.01 g/100 g) and proteins (25.14 g/100 g). Particle size analysis reveals a heterogeneous distribution, with a distinct peak within the 355–450 μm fraction, characteristic of medium semolina. Sorption studies conducted at three temperatures and seven relative humidity levels confirm typical plant-material behavior, including temperature dependence, water activity influence, and adsorption–desorption hysteresis. Among the evaluated models, the modified Chung–Pfost equation exhibited superior performance ($R = 0.98$). Monolayer moisture content showed stability during adsorption but increased sensitivity to temperature during desorption.

Conclusions: Ground melon seeds (*Cucumis melo* L.) exhibit high nutritional and energy value, mainly due to their lipid and protein content. Particle distribution is uneven and predominantly semolina-like, indicating a relatively low and heterogeneous grinding degree. Sorption properties follow typical plant material patterns, with the Chung–Pfost model providing the most accurate description and a reliable basis for optimizing drying, storage, and processing conditions.

ID 026

Monitoring of keel bone demage in laying hens in enriched cages and aviary systems

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Background: The ban on keeping laying hens in conventional cages has been in place in the EU since 2012. Following the entry into force of Directive 1999/74/EC, modified housing systems for laying hens have been widely adopted in European Union countries. Although these systems were introduced to improve animal welfare, their implementation has also revealed new challenges, among which keel bone disease (KBD). Keel bone disease, which includes both keel deviations and fractures, is recognised as a significant welfare problem as it can cause pain and discomfort in hens (Harlander et al., 2015).

Aims: The aim of this study was to determine the presence of KBD in laying hens in two different housing systems during the early production cycle.

Methods: The research was carried out on 28 weeks old Lohmann brown laying hens. The hens from two production systems were used - enriched cages and aviary system. From each housing system 100 hens were randomly selected and were inspected for KBD- deviation or fracture. The prevalence of deviation and fracture was assessed by using the palpation technique of Wilkins et al. (2004). Palpation was performed by running fingers alongside and over the keel bone. It was only determined whether fracture present or not. Scoring system for Deviation of Keel bone were as following : 0: keel bone with no deformation; 1: keel bone was slightly deformed, the extent of deformation was less than 10%;2: keel bone was deformed, the extent of deformation was 10% to 50%; 3: keel bone was deformed, the extent of deformation was more 50%.

Results: Keel deviation was recorded in both housing systems observed, while fractures were observed only in the aviary housing system. The occurrence of deviations in enriched cages was recorded in 11.3% of birds, of which 9% had score 1 and 2.3% had score 2. In the aviary system, the occurrence of KBD was higher (18.6%), where 13.5% of hens had a deformity, 1% had fractures, and 4.1% had both deformity and fractures.

Conclusions: Hens raised in the aviary system had a higher incidence of KBD, probably because they were not adequately trained to use ramps for climbing and descending. Hens in enriched cages spend most of the day and all night on the perches and therefore press on the sternum while sitting. In general, it can be concluded that laying hens raised in enriched cages have fewer problems with KBD than laying hens from the aviary system during the early production cycle.

ID 027

Texture and consumer acceptance of hazelnut spreads with *Tenebrio molitor*

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Background: For the purposes of the study, hazelnut pastes containing a stabilizer in amounts of 3% and 3.5%, as well as an additive - Tenebrio molitor powder in three variants - 1%, 3% and 5%.

Aims: The aim of the present study was to investigate the textural profile and consumer preference of hazelnut spreads with Tenebrio molitor.

Methods: The textural parameters hardness, adhesion force, adhesion, springiness, cohesiveness, gumminess and chewiness were measured, using a texture analyzer TA.XT Plus Texture Analyser (Stable Micro Systems Ltd., England). A scoring system (ISO 6658) is used to conduct the sensory analysis. The samples are submitted to a 7-member committee, using a score from 1 to 5 (with a step of 0.25), which corresponds to the quality of the product according to the respective indicator.

Results: A linear relationship was established between the textural characteristics of the developed products and the added stabilizer. The highest values of most parameters (except elasticity and homogeneity) were recorded in the samples with 3% stabilizer and the addition of worm powder in amounts of 1% and 3%. The results of the sensory analysis show that the same samples receive the highest overall score (3,99–4,36), with the variant with 1% additive being the most preferred. Lower consumer acceptability was observed for the samples with 3,5% stabilizer, with the lowest rating being that with 5% insect powder.

Conclusions: The textural profile of the developed hazelnut spreads is significantly influenced by the addition of stabilizer PS 209, establishing a linear relationship between its concentration and the main textural indicators. The highest values of most parameters (except springiness and cohesiveness) were recorded in the samples with 3% stabilizer and the addition of worm powder in amounts of 1% and 3%. The same samples also received the highest sensory ratings, with a preference observed for smooth and homogeneous structures, as well as for lower worm powder content, in which the specific insect flavor was “masked” or harmoniously balanced in the overall flavor profile.

ID 028

Optimising ultrasound-assisted extraction of propolis

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Background: Propolis is a multi-component natural product, rich in bioactive substances such as phenolic acids, flavonoids, and other secondary metabolites with proven antioxidant and antimicrobial properties. Various methods for the extraction of these bioactive compounds have been discussed in the literature. The extraction efficiency of these constituents depends significantly on the processing parameters, particularly temperature and duration. Ultrasound-assisted extraction (UAE) serves as an effective method for enhancing mass transfer and increasing the overall efficiency of the extraction procedure compared to conventional approaches.

Aims: The objective of the present study is to optimise the ultrasound-assisted extraction parameters for propolis, specifically focusing on temperature, process duration and extractant component ratio.

Methods: A full factorial experimental design was employed, involving three factors: temperature, extraction duration, and the ratio of extractant components. The levels for each factor were as follows: temperature ranging from 20 to 80°C; extraction duration from 15 to 45 min; and extractant component ratio from 0:100 to 20:80%. To establish the interactions between these factors and determine the optimal extraction conditions, Response Surface Methodology (RSM) was applied using the Box–Wilson method. The resulting propolis extracts were characterised based on their physicochemical and functional properties, including total phenolic content, total flavonoid content, and antioxidant activity.

Results: Significant effects were observed for temperature and extraction duration, as well as for the ratio of extractant components. Furthermore, the interactions between these three factors were found to influence the extraction efficiency of bioactive substances from propolis. While increasing the temperature and extending the extraction duration improved the efficiency of the process, values approaching the upper limits of these two factors resulted in the degradation of thermolabile compounds present in the propolis.

Conclusions: A systematic, science-based approach is proposed for the evaluation of key ultrasound-assisted extraction (UAE) parameters for propolis. Furthermore, the propolis extraction processes have been successfully optimised.

ID 029

Comparison of classic descriptive analysis and flash CATA method in cheese evaluation

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Background: Sensory analysis, employing human perception, either via trained or untrained panels, is a substantial method used for the characterization of product attributes and consumer perception. Traditional methods such as Quantitative Descriptive Analysis (QDA) provide high-resolution, statistically robust data by leveraging expert panels capable of detecting subtle sensory differences. However, the implementation of such protocols demands high financial and labor/time costs, primarily due to the extensive temporal and operational resources required for panel training, calibration and maintenance.

Aims: Aim of this study is to compare the effectiveness and applicability of classis and flash methods of sensory evaluation for cheese profiling.

Methods: The Quantitative Descriptive Analysis (QDA) performed by a trained panel and Check-All-That-Apply (CATA) carried out by random assessors were applied to evaluate four distinct Spanish cheeses - Manchego, Pria, Rulo de cabra, and Gruyère. In QDA each cheese was evaluated independently by the two panels consisting of 7 trained panelists, using a shared lexicon of 26 descriptors, covering flavor, taste, aroma, and mouthfeel. The intensity of each attribute was ranked according to a 9-point unstructured scale in two replicate sessions. In CATA 84 untrained consumers evaluated all four samples using a binary checklist format.

Results: The results showed that both methods successfully discriminated the cheese along sensory axes, particularly for strong, salient attributes like “spicy,” “musty,” “goaty,” and “sour.” Principal Component Analysis of the CATA data confirmed reasonable congruence with expert assessments, particularly for samples with pronounced flavor notes. The study confirmed that untrained consumers can identify major sensory differences with reasonable consistency using CATA compared to trained panels, also suggesting that CATA can be functionally reliable under well-defined conditions. Revealed structural similarity between the QDA and CATA reinforces the growing acceptance of CATA as a viable alternative when analytical speed, cost, or consumer relevance are prioritized. Nonetheless, the reduced granularity and absence of intensity scaling in CATA remains a limitation, especially for detecting subtle attributes. The study confirms that QDA is the most precise method for establishing robust sensory lexicons and capturing textural or flavor nuances, particularly in such complex matrices like cheese. The comparative analysis demonstrated that while QDA yields detailed and reproducible results, CATA is better aligned with consumer language and perception.

Conclusions: Summing up, the performed study suggested that although CATA may lack the sensitivity of QDA for nuanced differentiation, it is a valid alternative for rapid screening and consumer driven product development.

ID 030

Optimization of extraction, кinetics, and evaluation of the effect of *Malva sylvestris* L. extract on a traditional vegetable preserve (Lyutenitsa)

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Background: Lyutenitsa is a traditional Balkan vegetable spread with high popularity but limited functional fortification. *Malva sylvestris* L. (common mallow) is a potent source of bioactive compounds, yet its application as a natural functional ingredient in complex vegetable matrices remains insufficiently explored.

Aims: The study aimed to optimize the functional and safety profile of Lyutenitsa by incorporating *Malva sylvestris* L. extract and to evaluate its impact on the phytochemical profile, extraction kinetics, and microbiological safety of fortified lyutenitsa.

Methods: Eight extraction systems (methanol, ethanol, and acetone at various concentrations) were screened to identify the optimal solvent. *M. sylvestris* extracts were incorporated into the product at three concentrations (0.5%, 0.9%, and 1.3%). The total phenolic content (TPC), pH, and antioxidant capacity (DPPH and FRAP) were determined. Extraction kinetics were modeled using Peleg's equation, and comprehensive microbiological testing (total viable count, yeasts, molds, and industrial sterility) was performed.

Results: Ethanol (70%) was identified as the superior extractant, yielding 40.36 ± 1.64 mg GAE/g DW. The addition of the extract significantly increased the antioxidant potential in a concentration-dependent manner. Kinetic modeling demonstrated a high correlation between experimental and theoretical data (R^2: 0.97–0.99), with equilibrium reached at 90 minutes. The pH remained stable (4.44–4.55), ensuring the physicochemical integrity of the matrix. All fortified samples exhibited high microbiological purity and successfully passed the industrial sterility test.

Conclusions: The incorporation of *M. sylvestris* extract effectively enhances the biological value of vegetable spreads without compromising their safety or stability. The study confirms that common mallow is a viable natural ingredient for developing functional plant-based foods with optimized antioxidant properties.

ID 031

Development of Probiotic Non-Alcoholic Beer: Stability of LAB Cultures and Impact on Flavor and Composition

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Background: Probiotic beer is an emerging functional beverage that contains live cells of probiotic yeasts and/or lactic acid bacteria. Challenges include maintaining the viability of probiotics despite the harsh conditions in beer—low pH, iso-α-hop acids, CO_2, oxygen exposure, and storage conditions—that can inhibit microbial survival.

Aims: The aim of the study was to determine the survival rate of three probiotic cultures of lactic acid bacteria - *Lb. plantarum*, *Lb. acidophilus* and *Lb. gasseri*, in non-alcoholic beers - light and sour, as well as their impact on the quality of the obtained non-alcoholic probiotic beers (NAPB).

Methods: The beers were inoculated under sterile conditions with a fresh LAB culture at 106 cells/mL. After one, three, and six months, samples were taken and analyzed for viable LAB cell content (MRS medium, anaerobic conditions, 37°C), pH, selected organic acids and sugars (HPLC), active volatile components (SPME-GC-MS, FID-GC-O), and sensory analysis (QDA).

Results: The viability guaranteeing a health-promoting effect (above 106 cells/mL) was characteristic for NAPB with the addition of *Lb. gasseri* throughout the entire period of analysis, with 5x10^6 cells/mL detected in light beers after 6 months of storage, and 2×106 cells/mL in sour beers. In all beers, a pH drop of approximately 0.4 units was observed. The increase in lactic and acetic acid content did not exceed 10% compared to the control. Almost complete decomposition of residual sugars (mostly glucose, fructose, and maltose) was observed in all beers. The addition of probiotic bacteria significantly affected the sensory characteristics of NAPB. In the case of the sour, a reduction in fruity and floral aromas were observed, and the taste, instead of sweet and fruity, was perceived as sour and slightly bitter. Non-alcoholic probiotic light beers received better scores than the controls, which was associated with more intense floral, fruity and herbal notes, and a more intense sourness and fruity aftertaste.

Conclusions: In non-alcoholic beer, it was significantly easier to maintain the viability of probiotic bacteria. They positively reduced residual sugar content. They also significantly changed the taste and aroma of the beers, making them more similar to alcoholic beers.

ID 032

Stability of microparticles based on sunflower fibres and polyphenols of tart cherry juice during storage

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Background: Sunflower meal is a by-product of oil production, rich in proteins; however, a significant amount of fiber remains after protein extraction, with over 60% fiber. This fiber matrix can be further utilized for the formulation of bioactive microparticles, since fibers can be used as carriers of polyphenols.

Aims: The aim of this research was to prepare microparticles with the potential to serve as functional food additives (FFA), as both fibers and polyphenols are well recognized for their health benefits. This FFA can be used to enrich foods with these components and to improvement the stability of foods.

Methods: Microparticles were prepared by complexing sunflower fibers with polyphenols from tart cherry juice, followed by freeze-drying to obtain stable systems, which were then stored for 12 months, exposed to light and in the dark. The resulting microparticles were evaluated for total polyphenols, proanthocyanidins, antioxidant activities, and color parameters.

Results: It was determined that, over 12 months of storage, retention of total polyphenols was around 15% regardless of storage conditions. Degradation of proanthocyanidins occurred after just 3 months of storage and continued thereafter. DPPH, ABTS, CUPRAC, and FRAP methods were used to evaluate antioxidant activity, and changes were observed, especially after 9 months of storage, showing a greater difference between samples stored in light and those stored in the dark. Changes in all color parameters (L*, a*, b*, °h, and C*) were also observed due to degradation of polyphenols.

Conclusions: This method of complexation and formulation of FFA represents a green approach and contributes to the sustainability concept, which has gained popularity in recent years as solution for food waste reduction.

Acknowledgement: This research was conducted as part of the IP-2025-02-3588 project financed by Croatian Science Foundation.

ID 033

Encapsulation of blackberry juice flavour compounds on protein matrices

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Background: Flavor compounds are quite unstable and can be easily lost; therefore, significant efforts are made to overcome this barrier through encapsulation on biopolymers. Proteins are valuable plant biopolymers that can be used to prepare stable encapsulates.

Aims: The aim of this research was to prepare encapsulates based on plant proteins enriched with blackberry juice flavor. We used pea and rice protein matrices containing 85% of proteins, and pumpkin and almond matrices containing 50% of proteins, in combination with blackberry juice, to investigate whether these matrices can serve as efficient biopolymers for adsorption of flavor compounds.

Methods: After complexation of the protein matrices with blackberry juice, stable encapsulates were obtained by freeze-drying. Flavor compounds of blackberry juice, protein matrices and obtained encapsulates were isolated by application of SPME technique and evaluated by GC-MS.

Results: In addition to blackberry juice, each protein matrix contains a certain amount of flavor compounds that contribute to the overall flavor profile. The identified compounds were divided into acids, alcohols, carbonyl compounds, and terpenes. Terpenes were the dominant compounds in blackberry juice. Almond and pumpkin protein matrices contained the highest amounts of carbonyl compounds, while terpenes prevailed in the corresponding encapsulates. Pea and rice protein matrices also had carbonyl compounds as the dominant group, but in the corresponding encapsulates, acids were also dominant alongside these compounds.

Conclusions: From the results, it can be concluded that blackberry juice altered the flavor profile to a greater extent in almond and pumpkin protein matrices, both of which contain lower amounts of proteins. This method of complexation and formulation of flavor-protein encapsulates represents a green approach to their production.

Acknowledgement: This research was conducted as part of the IP-2025-02-3588 project financed by Croatian Science Foundation.

ID 034

Selective Partitioning of Volatile Compounds from Tomato Leaves during Fractional Distillation

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Background: Tomato leaves are frequently discarded despite their richness in aroma-related volatile compounds. Understanding how these compounds partition into distinct fractions may facilitate targeted recovery of specific aromas and promote the use of tomato leaves in food applications.

Aims: This study aimed to determine the distribution of aroma compounds from tomato leaves during fractional distillation and to assess whether specific compounds accumulate in fractions under standard pressure conditions.

Methods: Tomato leaf material was subjected to fractional distillation under controlled pressure conditions representing low, medium, and high processing levels. Distillate fractions were collected sequentially during the process, and HS-GC-MS was used to analyze volatile compounds. The study focused on fraction-dependent occurrence patterns and changes in the representative distributions of key volatile compounds, rather than on full quantitative comparisons of concentrations.

Results: The aroma compounds were not evenly distributed across all fractions. For instance, trans-2-hexenal, which imparts a fresh green aroma, was most concentrated in the middle fractions, particularly in fraction 4. Hexanol was also predominantly present in fraction 4, whereas phenethyl alcohol was more abundant in the later fractions. Notably, 2-isobutylthiazole, responsible for the characteristic tomato scent, appeared only in certain, primarily later, fractions. These findings indicate that fractional distillation enables the selective separation of specific aroma compounds.

Conclusions: Fractional distillation enables the selective separation of valuable aroma compounds from tomato leaves. Understanding the distribution of these compounds among the various fractions may inform improved methods for recovering natural aromas and utilizing tomato leaves that are typically discarded.

ID 036

Wine Lees from Autochthonous Grape Varieties as a Source of Value-Added Ingredients: Initial Compositional and Antioxidant Characterisation

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Background: Wine lees are a substantial yet underexplored and underutilised by-product of the wine industry, particularly compared to grape pomace and seeds, which have well-established valorisation pathways. Within the circular bioeconomy framework, their utilisation as a source of proteins and bioactive compounds represents a promising strategy for waste reduction and the development of value-added ingredients. However, the nutritional and functional potential of wine lees, especially those derived from autochthonous grape varieties, remains insufficiently characterised.

Aims: This study aimed to assess the nutritional composition and antioxidant potential of wine lees obtained from autochthonous grape varieties of the Vojvodina region (Grašac and Probus), with emphasis on inter-varietal differences and their relevance for sustainable valorisation.

Methods: Wine lees from the autochthonous varieties Grašac and Probus were analysed for proximate composition, mineral content, and amino acid profile. Phenolic composition was evaluated through total phenolic content (TPC), total flavonoid content (TFC), and total anthocyanins, alongside detailed phenolic profiling. Antioxidant activity was assessed using DPPH and ABTS radical scavenging assays.

Results: Both samples exhibited notable nutritional potential, primarily due to their protein content and favourable amino acid composition. The lees were also rich in phenolic compounds, with distinct differences between Grašac (white) and Probus (red) in total phenolics, flavonoids, and anthocyanins. These compositional differences were reflected in antioxidant activity, with Probus demonstrating higher radical scavenging capacity. Overall, the findings highlight wine lees from autochthonous varieties as a promising source of bioactive compounds for functional food applications.

Conclusions: Wine lees from the autochthonous grape varieties Grašac and Probus represent a valuable yet underutilised resource, characterised by significant protein and phenolic content. Their valorisation is consistent with circular bioeconomy principles and supports the development of sustainable food systems through the production of value-added functional ingredients.

Acknowledgments: This research was funded by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (Contract No. 451-03-33/2026-03/200222) and by the Provincial Secretariat for Higher Education and Scientific Research (Contract No. 003863453 2025 09418 003 000 000 001 04 004).

ID 039

Development of a fiber-coupled LED-induced fluorescence source with an optimized diffuse reflector for excitation-emission matrix (EEM) spectroscopy of biologically active metabolites

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Background: Excitation-emission matrix (EEM) spectroscopy is a powerful tool for the analysis of complex biological matrices, but its implementation with compact LED sources is often hindered by significant optical losses. Previous research established the basic concept of using dye-induced fluorescence for this purpose, yet efficiency remained a challenge when dealing with low-quantum-yield fluorophores or turbid samples.

Aims: The primary aim of this study is to enhance the efficiency of a fiber-coupled LED-induced fluorescence source by optimizing the diffuse reflector system. A secondary aim is to shift the generated fluorescence into the ultraviolet (UV) region to expand the detection range for biologically active metabolites like mycotoxins and vitamins.

Methods: A fiber-optic experimental setup was developed using a glass capillary and a glass ferrule. Two high-power LEDs (365 nm and 275 nm) were used to excite organic dyes (Coumarin 1 and p-Terphenyl). A novel diffuse reflector, composed of barium sulfate and polyvinyl alcohol, was designed and implemented to maximize light collection. The system was tested with ochratoxin A, riboflavin, and yeast extract.

Results: The optimized diffuse reflector achieved a two-fold increase in the output fluorescent signal compared to previous designs. Successful spectral shifting into the UV region was demonstrated. While the concept was confirmed for direct fluorescence detection, the results also identified critical limitations when using a monochromator due to the inherent turbidity and inner filter effects of the biological samples, which significantly attenuated the signal.

Conclusions: The study demonstrates that an optimized diffuse reflector significantly improves the efficiency of LED-induced dye fluorescence sources. Although further structural optimizations (such as quartz components) are required to overcome the optical losses of monochromators for EEM applications, the current setup provides a viable foundation for developing compact, fiber-coupled analytical instruments for metabolite analysis.

ID 040

Bulgarian Chickpeas as a Sustainable Raw Material for Aquafaba Production: Composition and Evaluation

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Background: Aquafaba has emerged as a plant-based ingredient of increasing importance in the food industry, particularly as an egg substitute. Chickpeas are among the primary raw materials for its production due to their rich chemical composition. Variations in the components of different cultivars may influence the functional properties of the final product. Therefore, the investigation of local (Bulgarian) chickpea varieties as a sustainable resource is of considerable interest. Understanding their compositional characteristics is essential for evaluating their suitability in sustainable food production.

Aims: The present study aims to evaluate the potential of three Bulgarian chickpea cultivars for aquafaba production. Specifically, the study seeks to analyse their chemical composition and fatty acid profile. Additionally, it aims to assess how compositional differences affect functional properties, such as foaming capacity. The ultimate objective is to determine the suitability of these cultivars as a sustainable raw material.

Methods: The study involved the analysis of three Bulgarian chickpea cultivars. The content of key chemical components: dry matter, proteins, and carbohydrates, was determined. The saponin content was also analysed as a factor influencing functional properties. Furthermore, fatty acid profiling was conducted to characterise the lipid composition. The obtained data were comparatively evaluated across the samples to identify variations.

Results: The results demonstrated similar levels of dry matter (86–90%), protein (~24–25%), and carbohydrates (~54–57%) across all examined cultivars. These findings suggest favourable conditions for the extraction of soluble components required for aquafaba production. Differences in saponin content were observed, which may influence foaming properties. The fatty acid profile was characterised by a predominance of unsaturated fatty acids, with linoleic acid as a major component.

Conclusions: Bulgarian chickpea cultivars exhibit strong potential as raw materials for aquafaba production. Their consistent chemical composition supports efficient extraction processes. Variations in saponin content may be utilised for selecting cultivars with improved functional properties. The predominance of unsaturated fatty acids enhances their nutritional value. Overall, the study highlights the importance of local resources in the sustainable production of alternative food ingredients.

ID 041

Production of Aquafaba from Chickpeas: Influence of Cultivar and Processing Parameters on Functional Properties and Applications

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Background: Aquafaba, obtained as a by-product of the thermal processing of chickpeas (*Cicer arietinum* L.), has emerged as a promising plant-based functional ingredient due to its notable foaming and emulsifying properties. These functionalities are primarily attributed to its complex composition: soluble proteins, carbohydrates, and low-molecular-weight surface-active compounds, which collectively contribute to interfacial stabilisation. In the context of increasing demand for sustainable and vegan food alternatives, aquafaba has gained considerable attention as a substitute for egg-derived ingredients in various food systems.

Aims: The present study aims to identify the most suitable chickpea cultivar for aquafaba production and to conduct a comparative evaluation of key functional properties. It is emphasized to determine the cultivar with optimal foaming capacity, foam stability, and emulsifying performance, thereby to ensure its applicability in food formulations.

Methods: Three chickpea cultivars was subjected to standardised thermal processing to obtain aquafaba samples. Chemical composition analyses and assessment of functional characteristics such as foaming capacity, foam stability, emulsifying activity, and emulsion stability. Subsequently, the cultivar demonstrating superior performance was selected for further optimisation of technological parameters, including chickpea-to-water ratio, processing temperature, and duration. Statistical and comparative analyses were employed to establish correlations between processing conditions and functional attributes.

Results: The comparative analysis led to the identification of a chickpea cultivar exhibiting significantly enhanced foaming and emulsifying properties, likely attributable to its elevated content of soluble solids and surface-active compounds. Optimisation of processing parameters demonstrated that both temperature and extraction time exert a pronounced effect on aquafaba functionality, with specific conditions promoting improved protein solubilisation and structural performance. The applicability of the optimised aquafaba was confirmed in model food systems, including vegan mayonnaise and meringue, which displayed favourable textural, rheological, and stability characteristics comparable to those of conventional egg-based products.

Conclusions: The findings of this study underscore the importance of cultivar selection and process optimisation in maximising the functional potential of aquafaba. The results confirm its viability as a sustainable, plant-based alternative to egg ingredients, with broad applicability in contemporary food technologies. Furthermore, the study contributes to the advancement of knowledge regarding the relationship between raw material characteristics, processing conditions, and functional performance, supporting the development of innovative and environmentally responsible food products.

ID 042

Physicochemical, nutritional, and microbiological assessment of tobacco and pepper seed meals

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Background: Agriculture and related processing industries generate substantial amounts of by-products, which are often treated as waste through incineration or landfilling, resulting in adverse environmental and economic impacts. In this context, oilseed meals obtained from tobacco and pepper seeds after oil extraction represent a promising resource for valorization. Owing to their composition, rich in proteins, dietary fiber, and bioactive compounds, these materials exhibit significant potential for the development of value-added products.

Aims: The aim of the present study was to perform a physicochemical, nutritional, and microbiological evaluation of tobacco and pepper seeds meals with regard to their potential applications.

Methods: Five tobacco seed meal samples (NT1–NT5) and two pepper seed meal samples, including hot pepper (CLP6) and sweet pepper (CSP7), were analyzed using standardized analytical methods.

Results: The results showed that tobacco seed meals are characterized by a high protein content (31.43–36.92%), comparable to that of conventional oilseed crops. Carbohydrate content was more than twofold higher in pepper seed meals, with the highest value observed in sample CLP6 (7.69%). Free fat content varied within a relatively wide range, from 1.38% (CSP7) to 3.96% (NT5), with generally higher levels in tobacco seed meals. The highest total polyphenol content was determined in CLP6 (522 mg GAE/100 g), significantly exceeding the values observed in the other samples. Antioxidant activity did not fully follow the same trend, with the highest value recorded for NT4 (687 µmol TE/100 g), despite its lower polyphenol content (252 mg GAE/100 g) compared to CLP6. Significant differences in amino acid profiles were observed among the samples. Microbiological analysis indicated low contamination levels and good microbiological safety.

Conclusions: The obtained results confirm the considerable potential of the investigated seed meals as sources of bioactive compounds and value-added raw materials applicable in the development of food and biobased products.

ID 043

Sterile Hydroponic Systems for *In Vitro* Plants cultivation

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Background: Sterile hydroponic processes are emerging bioprocess engineering systems for *in vitro* plant cultivation, combining the aseptic control of tissue culture with the physiological advantages of hydroponics. They are able to solve key limiting factors of industrial implementation of plant *in vitro* technologies for both biomass and bioactive metabolites production: 1) high cost of bioreactors for cultivation of plant *in vitro* cultures; 2) high labor cost of *in vitro* plant propagation; 3) complexity of process control, especially in cultivation processes of differentiated *in vitro* plant cultures; 4) possibility of automation of cultivation, system design and cultivation conditions as well; 5) problems concerning malformation, hyperhydration, etc.

Aims: The aim of the presentation is to explore the design, operational principles, and applications of closed, contamination-free hydroponic platforms that enable plants to grow in a sterile, nutrient-rich liquid medium under controlled conditions and to outline the guidelines for the application of these systems for the large-scale cultivation of *in vitro* plant cultures.

Results: Sterile hydroponic systems improve nutrient availability and gas exchange while reducing labor, cost, and variability associated with other known cultivation systems, as well as gelled media. Key components discussed include vessel design, aeration strategies, sterilization protocols, nutrient formulation, and methods for maintaining asepsis over extended growth cycles. Comparative results demonstrate enhanced biomass accumulation and bioactive metabolites biosynthesis, faster growth rates, and improved acclimatization success, in micropropagation processes, when plantlets are transferred from sterile hydroponics to *ex vitro* conditions.

Applications span micropropagation, physiological studies, secondary metabolite production, and large-scale propagation of horticultural, medicinal, and forestry species. The presentation also addresses common challenges such as microbial contamination, oxygen limitation, and shear stress, offering practical solutions and design considerations for researchers and commercial laboratories.

Conclusions: By integrating principles from tissue culture and hydroponic engineering, sterile hydroponic systems offer a scalable, efficient, and cost-effective alternative to conventional *in vitro* methods, with significant implications for plant biotechnology and sustainable propagation practices. They allow precise process control and optimization to shorten the cultivation time, increase the yield and/or maintain consistent year-round production despite the environmental conditions. These types of bioengineering systems may also result in more complex metabolic pathways to occur *in vitro*.

ID 044

Polyphenols and antioxidant potential of instant chicory and spelt coffee substitutes

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Background: Recently, coffee substitutes have become more popular due to health reasons, such as reducing caffeine intake and increasing fiber consumption.

Aims: The aim of this research was to compare commercially available instant coffee substitutes on the Croatian market that are based on chicory and spelt. Two chicory samples, one spelt sample, and three blends of chicory and spelt in 80:20 ratio were analyzed.

Methods: Prepared coffee substitutes were analyzed for total polyphenols and antioxidant potential using the DPPH, ABTS, CUPRAC, and FRAP methods. Additionally, the browning index was determined, and color parameters (L*, a*, b*, °h and C*) were measured.

Results: Generally, both chicory coffee substitutes had the highest total polyphenol contents (40.71 and 36.31 mg/mL) and antioxidant potential as estimated by all applied methods, while spelt contained 15.05 mg/mL of total polyphenols with the lowest antioxidant potential. The browning index, as an indicator of roasting intensity, was also highest in the chicory samples, while the lowest values were determined in the two blends and spelt samples. Maillard reaction products, which are results of roasting, may also contribute to the antioxidant potential of the chicory samples. Recording of color parameters also revealed slight changes between examined samples of coffee substitutes.

Conclusions: Coffee substitutes are a good choice for consumers who enjoy the flavor of coffee but have some health issues that may be reinforced by caffeine intake.

Acknowledgement: This research was conducted as part of project ISKRA PK.1.1.12.0222, co-founded by the European Union under the “Competitiveness and Cohesion” programme for the 2021–2027 programming period.

ID 045

Comparative analysis of technological indicators of four wheat varieties and their flours ground in a stone mill

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Background: This study presents a comparative analysis of the technological characteristics of four wheat (*Triticum aestivum* L.) varieties and the flours obtained from them through stone milling. The wheat varieties Fermer, Sashets, Yaylzla, and Pobeda were supplied by the Institute of Plant Genetic Resources "K. Malkov" – Sadovo, Republic of Bulgaria (harvest year 2025).

Methods: The grain samples were evaluated for the following parameters: moisture content, hectoliter weight, vitreousness, hardness, specific weight, ash content, wet gluten yield, gluten deformation index, protein content, and falling number.

Flour samples were produced under industrial conditions using a stone mill, and flour yield was determined for each variety. The obtained flours were analyzed for moisture content, particle size distribution, ash content, color, wet gluten yield, gluten deformation index, protein content, water absorption capacity, and falling number.

Results: The results revealed significant variability among the studied varieties in both grain and flour characteristics. A clear relationship between the technological properties of the wheat and those of the corresponding flours was established. The varietal characteristics were found to exert a substantial influence on the quality attributes of the flour.

Conclusions: These findings emphasize the importance of appropriate wheat variety selection in stone-milled flour production and provide a basis for optimizing technological processes in milling practice.

ID 046

Evaluation of the Technological Potential of Wheat Varieties Based on the Quality Parameters of Flours Obtained by Different Milling Methods

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Background: The present study aims to evaluate the technological potential of three wheat varieties through the analysis of quality parameters of low-ash flours obtained using different milling methods. Soft wheat from three Bulgarian varieties – A59, Zebrets, and Fermer – cultivated in Bulgaria was analyzed.

Methods: The main grain quality parameters related to technological performance were determined, including moisture content, hectoliter weight, vitreousness, specific weight, ash content, wet gluten yield, and gluten deformation index.

The grain samples were processed using three technological milling approaches: a four-roll laboratory mill (TM), milling without intermediate sifting (WIS), and an extended milling process (EMP). The obtained flours were characterized in terms of their key physicochemical and technological properties.

Results: The results demonstrated that both varietal characteristics and the applied milling method have a significant influence on the quality of the final products. It was established that the application of an extended milling process allows for a more comprehensive expression of the technological potential of the studied varieties.

Conclusions: The obtained data confirm the importance of selecting an appropriate milling technology for the objective evaluation of the baking quality of wheat.

Antimicrobial and antioxidant potential of *Inonotus hispidus* culture liquids: a comparative study of submerged and surface cultivation

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Background: *Inonotus hispidus* is a medicinal mushroom characterized by a rich diversity of secondary metabolites, including polyphenols, triterpenoids, polysaccharides, and hispidin derivatives, associated with notable antioxidant, antimicrobial, and anticancer activities. However, optimizing their production through different cultivation strategies remains an important challenge. Fermentation methods like submerged and surface cultivation can strongly affect both yield and biological activity of metabolites in the culture liquids.

Aims: The present study aims to evaluate the influence of submerged and surface cultivation on the antimicrobial and antioxidant potential of *I. hispidus* culture liquids.

Methods: *I. hispidus* was cultivated under submerged and surface fermentation conditions, and the resulting culture liquids were collected and concentrated. Antimicrobial activity was evaluated using the disk diffusion method against a panel of pathogenic bacteria, yeasts, and filamentous fungi. The minimum inhibitory concentration (MIC) for each culture liquid was evaluated according to the CLSI method. Antioxidant potential was assessed by determining total phenolic content (TPC) and applying standard *in vitro* radical scavenging and reducing assays (DPPH, ABTS, FRAP, CUPRAC). Comparative analysis was performed between cultivation strategies.

Results: The results indicate pronounced bioactivity of the *I. hispidus* culture liquids. Surface cultivation produced an inhibition zone against *Listeria monocytogenes* comparable to that of clarithromycin, while both cultivation methods exhibited antimicrobial activity against *Klebsiella pneumoniae* ATCC 13883 comparable to bacitracin, indicating the production of effective bioactive compounds even against resistant pathogens. Both approaches also exhibited antifungal activity, particularly against the resilient phytopathogen *Alternaria alternata*. The MIC assay confirmed the antimicrobial activity of the culture liquids. Regarding antioxidant potential, submerged cultivation was more effective, increasing TPC by over 57 %, with a 3.4-fold higher reducing power (FRAP) and a four-fold increase in radical-scavenging activity (ABTS). A strong correlation was observed between phenolic content and antioxidant capacity across all assays, highlighting the efficiency of submerged cultivation in promoting the biosynthesis of antioxidant compounds. These results support the potential application of *I. hispidus* culture liquids as a cost-effective and technologically advantageous source of natural antioxidants.

Conclusions: The present study demonstrates that the cultivation strategy critically determines the bioactive profile of *I. hispidus* culture liquids. Surface cultivation was found to favor the production of compounds with broad-spectrum antimicrobial activity, whereas submerged cultivation significantly enhanced antioxidant biosynthesis and phenolic accumulation. Both approaches yield biologically active, non-purified culture liquids effective against resistant pathogens, highlighting their potential as cost-effective and environmentally friendly bioresources for agricultural and pharmaceutical applications.

Acknowledgements: This research was funded by the National Science Fund of Bulgaria: Contract No. КП-06-H86/7 from 06.12.2024, “Controlled *in vitro* cultivation of a wild medicinal mushroom *Inonotus hispidus* (*Basidiomycota*) and complete genomic characterization: promising approaches for bioprospecting and sustainable production of new therapeutically active biomolecules”

ID 048

Modeling and Analysis of the Drying Process of Solvent-Based Inks in Flexographic Printing on Multilayer Polyamide Packaging

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Background: Drying of the ink film in flexographic printing on flexible polyamide packaging is a critical stage that determines both print quality and the safety of the final product, particularly in packaging for meat products. The implementation of integrated convective hot-air drying systems within the printing line necessitates a quantitative description and control of the drying kinetics. This study proposes a systematic approach to process analysis by linking technological parameters with mass transfer and evaporation processes in the ink layer.

Aims: The aim of this study is to develop an experimentally validated model of ink film drying, to establish quantitative relationships between process parameters and drying rate, to define an optimal temperature profile, and to minimize the risk of migration of ink components into the packaging material.

Methods: A comprehensive analysis of key process parameters was conducted, including printing speed, web tension, anilox roller characteristics (line screen and cell volume), tonal value of the printing element, plate parameters, and the ratio of printed to non-printed areas. The transferred ink quantity was determined using a high-precision gravimetric method. Drying kinetics were investigated by monitoring the evaporation of volatile components under stepwise varying temperature profiles, while maintaining constant airflow rate and printing speed. Based on these data, a temperature-dependent process model was developed.

Results: Quantitative relationships were established between ink film thickness, process parameters, and evaporation rate. The developed temperature profile leads to accelerated drying and more complete removal of volatile components, significantly improving the mechanical resistance of the ink layer and reducing set-off effects. The results also indicate a potential reduction in migration risk through optimized thermal conditions.

Conclusions: The proposed approach provides a scientifically grounded framework for modeling and analysis of drying in flexographic printing on polyamide packaging. The results have direct industrial applicability, contributing to improved print quality, production efficiency, and safety of food packaging materials.

ID 049

Oxidative changes of chilled broiler meat influenced by low-fat yellow mealworm (*Tenebrio molitor*) meal inclusion in the feed

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Background: Effective broiler production requires high-quality protein sources in the feed, with soybean meal traditionally used. Due to environmental and nutritional risks associated with soybean production, there is increasing interest in alternatives. Yellow mealworm (*Tenebrio molitor*) larvae are considered a sustainable and promising protein source with the potential to improve the nutritional value and oxidative stability of chicken meat.

Aim: The aim of this study was to evaluate the influence of different levels of low-fat *Tenebrio molitor* meal supplementation in the finisher feed on the oxidative stability of chicken meat during refrigerated and frozen storage.

Methods: The effect of different concentrations of the additive on the hydrolytic and oxidative processes in the lipid and protein fractions of chilled chicken meat was investigated.

Results: The addition of 10% Tenebrio molitor meal resulted in a significant decrease in the acid value of lipids in the pectoral and thigh muscles after 5 days of storage at 0–4°C. In the thigh muscles, 5% supplementation showed an even stronger effect. The inclusion of 7.5% resulted in a small but statistically significant decrease in the peroxide value in the pectoral muscles, and in the thigh a similar effect was observed at 2.5% and 5%. The thiobarbituric acid value was not significantly affected by the supplementation. Free amine nitrogen levels decreased significantly at 7.5% and 10% supplementation, both in the pectoral and thigh muscles. The 7.5% supplementation also decreased the protein carbonyl content.

Conclusions: Inclusion of 2.5%–10% low-fat Tenebrio molitor meal in broiler feed has a varying but generally positive effect on the oxidative stability of chicken meat.

This research was funded by both Bulgarian National Science Fund, Ministry of Education and Science in Bulgaria (Grant number KP-06-N76/7, 5 December 2023) and by project BG16RFPR002-1.014-0012-C01 „Establishment and sustainable development of a Center of Competence „Agrifood Systems and Bioeconomy", financed by the European Regional Development Fund through the „Program for Research, Innovation and Digitalisation for Smart Transformation" (PRIDST).

ID 050

Green Valorization of Essential Oil Residues: Vacuum Microwave-Assisted Extraction of Phenolics from Lavender and Melissa by-products

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Background: Lavender (*Lavandula angustifolia*) and melissa (*Melissa officinalis*) are widely cultivated in Mediterranean regions, including Bulgaria, for essential oil production. The solid residues generated after distillation are largely underutilized, despite being rich in bioactive compounds such as polyphenols, aromatic constituents, and polysaccharides with potential applications in functional foods. Recently, green extraction technologies have gained attention for their ability to efficiently recover these compounds while reducing environmental impact. Compared to conventional methods, they offer higher extraction efficiency, shorter processing times, and better preservation of thermolabile compounds. In particular, vacuum microwave-assisted extraction enhances mass transfer and minimizes thermal and oxidative degradation.

Aims: This study aimed to valorize lavender and melissa residues by converting them into high-value functional ingredients through the recovery of phenolic compounds using vacuum microwave-assisted extraction (VMAE). Additionally, the study sought to determine the optimum extraction conditions using Response Surface Methodology (RSM) to maximize extraction efficiency and bioactive yield.

Methods: Solid residues obtained from lavender and melissa after essential oil extraction were subjected to VMAE. The extraction process was optimized using a 3-level Box–Behnken experimental design considering four independent variables: vacuum pressure, extraction time, ethanol concentration, and sample-to-solvent ratio. The obtained extracts were evaluated for total phenolic content (TPC), total flavonoid content (TFC), and antioxidant capacity using DPPH and CUPRAC assays.

Results: TPC values ranged from 12.76 to 19.76 mg GAE/g for lavender and from 38.2 to 67.9 mg GAE/g for melissa, indicating a higher phenolic content in melissa residues. Antioxidant activity followed a similar trend, with DPPH values ranging between 66.63–243.40 mM TE/kg for lavender and 325.9–857.8 mM TE/kg for melissa. CUPRAC values were substantially higher, reaching up to 1,087.50 mM TE/kg for lavender and 5,567.3 mM TE/kg for melissa. TFC values varied between 0.69–3.14 mg QE/g for lavender and 0.4–3.5 mg QE/g for melissa. Optimization using Design-Expert 13 indicated that the highest desirability was achieved at 7.5 min extraction time, 20% ethanol concentration, and a 1:20 sample-to-solvent ratio. The optimal vacuum pressures were determined as 450 mmHg for lavender and 350 mmHg for melissa.

Conclusions: VMAE is an efficient and sustainable method for recovering bioactive compounds from essential oil residues. It enables the conversion of low-value by-products into antioxidant-rich functional ingredients and supports scalable, sustainable valorization for food applications.

This study was supported by The Scientific and Technological Research Council of Turkey (Project no: 125N131 (№ IC-TR/19/2025-2027), TÜBİTAK-BAS, Turkey-Bulgaria Bilateral Collaboration Project).

ID 051

Evaluation of the textural, sensory, and physicochemical properties of yogurt supplemented with apple peel powder from the Starkrimson, Golden Delicious, and Jonathan varieties

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Background: Food waste represents a systemic inefficiency within the global agri-food chain, reflecting a significant imbalance between production, consumption, and resource management, with important implications for economic and environmental sustainability. In this context, apple peel, conventionally considered a byproduct, can be valorized by processing it into powder through a controlled drying and grinding process. The resulting powder is characterized by a high content of dietary fiber, polyphenols, and other bioactive compounds.

Aims: The objective of this study is to develop a functional dairy product by incorporating apple peel, a byproduct rich in bioactive compounds. The combination of yogurt and apple peel powder may result in a value-added functional product, offering a sustainable approach to the valorization of food byproducts. This approach contributes to waste reduction and promotes responsible consumption, which are critical considerations in the current environmental context.

Methods: Three distinct apple varieties cultivated in Romania were utilized in this study: Starkrimson, Jonathan, and Golden Delicious. The primary objective was to perform a comprehensive sensory, textural, and physicochemical evaluation of the novel product obtained by incorporating different concentrations of apple peel (1% and 2%) over three storage periods (days 1, 5, and 10). Sensory evaluation was conducted using a five-point hedonic scale, while textural properties were assessed by the reverse extrusion (pseudo-compression) method. Physicochemical analyses included the determination of pH, dry matter content, water activity, syneresis index, and L-lactic acid content (enzymatic method).

Results: The results were influenced by both powder concentration and storage period. Firmness increased in several samples, reaching values of up to 160.16 g on day 10, while consistency also showed an upward trend (up to 4216.94 g·s). Sensory evaluation scores decreased over the storage period, reaching mean values between 2.7 and 3.02 on day 10. Physicochemical characterization of apple peel powder highlights its potential as a sustainable ingredient capable of enhancing product quality and extending the shelf life of the final product.

Conclusions: This study demonstrates the beneficial effects of incorporating apple peel powder, a promising ingredient due to its health-promoting properties, into cow's milk yogurt, a widely consumed product with recognized nutritional value. The findings support the potential of apple peel powder as a functional ingredient in dairy products. Further research is recommended to investigate its antimicrobial and antioxidant properties, as well as to explore its application in the development of additional dairy products.

ID 052

Yellow mealworm (*Tenebrio molitor*) a novel feed ingredient in laying hens' diet: a review

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Background: Considering the environmental impacts of different livestock systems, unlike other farm animals, poultry meat and eggs require the least water and have the lowest carbon footprint per kg of protein produced. As egg consumption continues to increase, the expense of increasing the consumption especially since the consumers are positively oriented towards changing their diet to food obtained in an environmentally friendly way. In light of the above evidence, the study of alternative protein feeds on the quality of laying hen eggs would have a significant scientific value with a dual impact on environmental aspects on a global scale (on the one hand, replacing plant proteins with alternative insect sources and on the other hand, the lower carbon footprint of poultry farming compared to ruminants). Eggs are a unique product in terms of biological value of nutrients. A cheap source of complete, easily digestible proteins, optimal fatty acid composition, rich in mineral components and fat-soluble proteins, preferred by consumers of all age groups. On the other hand, raising laying hens has a number of major advantages over other farm animals - fast growth, low costs of raising and low price of poultry meat and eggs. Since the sector of alternative proteins, in particular insects as a source of protein for food and feed, is just beginning to develop, more in-depth research is needed, such as determining optimal inclusion levels for insect additives, studying the quality of meat and eggs. The use of insect meal has the potential to improve the growth and quality of meat and eggs of poultry species. Edible insects do require much less land than conventional livestock, but they also produce much less greenhouse gases, allowing them to mitigate the negative effects of climate change. Mealworms are the larvae of Tenebrio molitor and are one of the most promising species as a protein. The protein content of dried larvae usually ranges from 45% to 60%. This makes it a direct competitor to soybean meal (which is about 44%-48% protein). They are more caloric than soybeans, due to their high fat content (about 20%-40%). Moreover, mealworms are also rich in bioactive compounds such as functional polysaccharides and antimicrobial peptides. These components not only provide essential nutrients, but can also improve immune function and gut health in animals, positioning TM meal as a multifunctional feed additive.

This research was funded by Bulgarian National Science Fund, Ministry of Education and Science in Bulgaria (Grant number KP-06-N76/7, 5 December 2023).

CEFood 2026 CONGRESS

ID 053

Study of the influence of rootstocks SO4, 4453-M, 110 R and Fercal on the volatile fraction of wines from Kaylashki Rubin variety, three harvests (2021-2023)

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Background: The integration of rootstocks into viticulture became a critical necessity in the mid-19th century as a strategic defense against the devastating spread of phylloxera (*Philloxera vitifolii* Fitch. VITEUS VITIFOLIAE, HOMOPTERA: PHYLLOXERIDAE) across Europe, which threatened the survival of ungrafted vines. Beyond pest resistance, the selection of specific rootstocks and the resulting scion/rootstock interactions exert a profound influence on the physiological development of the vine plant and its adaptation to the environment, the quality and composition of grapes, the sensory characteristics and the content of volatile compounds in wines.

Aims: The aims of the study is to define the influence of four rootstocks - SO4, 4453-M, 110 R and Fercal on the content of esters, higher alcohols, aldehydes and terpenes in wines from different rootstock combinations on the Bulgarian variety Kaylashki Rubin, utilizing data across three consecutive harvests (2021–2023).

Methods: Red wines of Kaylashki Rubin variety grafted on the rootstocks Berlandieri x Riparia SO4, Berlandieri x Rupestris 110 Richter, 4-53 Malègue [Riparia grand glabre x 144 M (Cordifolia x Rupestris)], Fercal [BC1 (Berlandieri x Colombard No1) x Z33 EM (Berlandieri x Cabernet Sauvignon) were studied. Vinification was carried out according to the classical technology for red wines. Gas chromatographic analysis (GC-FID) was performed for identification and quantitative determination of the available esters, higher alcohols, aldehydes and terpene compounds. Descriptive statistics were applied for analysis of the results.

Results: The wines of the experimental variant Fercal demonstrated a significant accumulation of volatile compounds in the 2021 (2219.52 mg/dm^3) and 2023 (1185.00 mg/dm^3) harvests, and lower levels were found in the 2022 harvest (519.58 mg/dm^3), compared to all varieties studied. In all analyzed variants, the total content of higher alcohols increased in the order: harvest 2022 < harvest 2023 < harvest 2021. The wines of the Fercal variant accumulated the highest total ester content, varying in concentration between the harvests from 270.43 mg/dm^3 (2022) to 1068.39 mg/dm^3 (2021), as well as the highest levels of total terpenes, varying quantitatively from 0.16 mg/dm^3 (2023) to 1.14 mg/dm^3. In all studied samples of Kaylashki Rubin, 2-methyl-1-butanol and 3-methyl-1-butanol were identified as the primary compounds, with the latter consistently exhibiting quantitative dominance. Ethyl acetate was identified as the predominant ester in all samples, serving as the primary contributor to the ester fraction. Acetaldehyde was established as the major aldehyde, while the terpene fraction showed limited species diversity.

Conclusions: The results obtained characterize the complex aromatic profile and the distribution of diverse volatile compounds in the red wines studied, providing empirical evidence regarding the influence of four distinct rootstocks on the volatile composition of Kaylashki Rubin wines across a three-year period. Significant trends were identified, delineating the specific impact of each rootstock.

Quality attributes and sensorial profile of fried meatballs: Synergistic effects of radiofrequency treatment and modified atmosphere packaging

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Background: Radiofrequency (RF) heating is an advanced volumetric dielectric technology utilizing electromagnetic waves (3–300 MHz) to transfer energy directly to polar water molecules within food matrices. Despite its potential, there is currently a lack of empirical data regarding the application of RF treatment for the non-destructive pasteurization and decontamination of pre-packaged meat products.

Aims: This study evaluates the impact of various radiofrequency (RF) heating regimes on the quality attributes and sensory profiles of fried meatballs packaged under a modified atmosphere (MAP). The primary objective was to evaluate the physicochemical and organoleptic stability of the products during a 90-day storage period at 4–6 °C.

Methods: Packaged samples were treated using a Stalam RF 1 x 7 kW apparatus (Stalam S.p.A., Italy) operating at 27.12 ± 0.163 MHz, with an electrode gap of 180 mm and a 5000 V operating voltage. Treatment times were strictly regulated to preclude thermal damage. Samples were packaged under a modified atmosphere (MAP). Sensory evolution was monitored via descriptive analysis, while instrumental colour (L* and a*/b* ratio) was recorded for both external and cross-sectional surfaces using a Konica Minolta CR-410 colorimeter. Quality parameters included pH monitoring, proximate chemical composition, headspace gas stability, and microbiological safety (including *Listeria monocytogenes* and *Salmonella* spp. detection).

Results: Sensory scores remained consistent across all treatments until day 60, with acceptable profiles maintained up to day 90. Both RF mode and storage duration significantly influenced ($p<0.05$) lightness (L*) and the a*/b* ratio, particularly on cross-sectional surfaces. By day 60, samples 3 (3000 V) and 5 (4000 V) best-preserved external colour attributes relative to the control. Crucially, RF intensity and storage time had no significant effect ($p\geq0.05$) on pH or microbial proliferation; all samples remained pathogen-free. However, packaging barrier properties compromised after day 90, leading to depletion.

Conclusions: Microbiological data suggest a 90-day shelf life for RF-treated fried meatballs; however, optimal organoleptic and colour characteristics are restricted to a 60-day window. These findings demonstrate that RF treatment, specifically regime 5 (20 min at 3000 V); regime 4 (30 min at 4000 V), and regime 1 (10 min at 2000 V), effectively extends the shelf life of convenience meat products without compromising safety.

This research was funded by Bulgarian National Science Fund, Ministry of Education and Science in Bulgaria (Grant number KP-06-N96/10, 10 December 2025).

ID 055

Using The Mineral Profile In The Characterization Of Wines From Different Geographical Regions Of Romania

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Background: Determining the minerals in wine is very important for the quality of the wine, but also for the health of consumers. At the same time, it is a complementary tool for differentiating wines according to their geographical origin.

Aims: In this paper were considered twelve brands of wines from eight major wine-growing areas in Romania (Iasi, Babadag, Focsani, Cotnari, Silagiu, Dragasani, Stefanesti and Blaj). In this study were determined micro-minerals: 52Cr, 59Co, 64Cu, 59Ni, 75As, 112Cd, 201Hg, 208Pb, 7Li, 9Be, 79Se, 88Sr, 51V, 96Mo, 108Ag, 88Sr but also macro minerals: 25Mn, 65Zn, 56Fe, 27Al, 24Mg, 40Ca, 23Na, 19K, in order to differentiate wines by geographic areas. Elements ^{40}Ca, ^{25}Mn, ^{88}Sr, ^{79}Se, ^{7}Li, and ^{201}Hg have observed from research that they are predominantly of natural origin.

Methods: Analytical measurements were performed using an inductively coupled plasma mass spectrometer (ICP-MS Varian 820-MS de la Varian, Australia) equipped with an SPS-3 autosampler (Varian, Australia), operating in a quantitative analysis mode. Each sample was analyzed in duplicate. Argon gas with a purity of 6.0 was used to form the plasma in the ICP-MS. (Messer, Austria). Wine samples were prepared by microwave digestion, with a CEM – Mars 6 Teflon system.

Results: The results indicate variability among samples, both for white and red wines. Manganese concentrations ranged from 0.472 mg/L (FN_C) to 1.346 mg/L (Tr_Bj), with most values clustered around 0.6–1.3 mg/L, indicating relatively homogeneous distribution across samples. Zinc exhibited higher variability, with concentrations ranging between 2.182 mg/L (FR_St) and 10.102 mg/L (MO_Bj). Elevated Zn values were observed particularly in wines from Blaj and Focșani regions, suggesting possible influences related to vineyard treatments or technological processes. Compared to macroelements, trace elements exhibited significantly higher variability across samples. Chromium concentrations showed a wide range, from 5.405 µg/L (FN_C) to 476.580 µg/L (SB_F), indicating substantial differences between wine samples. Higher Cr values were observed particularly in wines from Focșani and Moldova regions. Nickel also exhibited pronounced variability, with concentrations ranging from 3.465 µg/L (FA_St) to 298.945 µg/L (CH_BG). Elevated Ni values were recorded in wines from Babadag and Moldova regions.

Conclusions: The statistical analysis of wines showed a strong coordination between the macro mineral compounds, as well as the micromineral ones, on the studied geographical areas. This can be used as a wine authentication system.

ID 056

High-nutritional-value extruded snack with sprouted oats: development and characterisation

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Background: The development of innovative foods from high-nutritional-value raw materials has attracted increasing attention due to their technological versatility and potential for added value. Oats are recognised for their nutritional composition and their ability to be modified by processes such as sprouting, which can influence their structural and functional properties. Furthermore, extrusion is widely used in the production of cereals with desirable textural characteristics. In this context, incorporating sprouted oats into extruded products represents a promising strategy for developing innovative cereal-based foods.

Aims: This study aimed to evaluate the effect of adding sprouted oats on the technological, nutritional, and sensory properties of extruded breakfast cereals.

Methods: Oat grains were sprouted by soaking for 16 hours, followed by incubation at 25 °C for 72 hours with periodic washings, followed by drying at 40 °C for 48 hours and grinding to obtain flour. Non-sprouted oat flour was prepared under the same conditions as a control. Three formulations were prepared using a corn-based matrix to ensure adequate expansion during extrusion: (i) control (without oat flour), (ii) 20% sprouted oat flour, and (iii) 20% non-sprouted oat flour, all adjusted to 14% moisture. The samples were processed by extrusion and dried at 45 °C for 2 hours. A sugar solution (10 mL/100 g) was applied as a coating, then dried at 70 °C. This step was repeated to increase crispness. Texture profile, radial expansion index, specific volume, apparent density, shrinkage index, proximate composition, amino acids profile by chromatography, and sensory acceptance analysis were performed to characterise the products.

Results: The main results indicated an increase in nutritional properties, with protein content rising from 6.5% to 9.2% and 9.3%, respectively, and an improved profile of essential amino acids, especially in the sprouted oats sample, while maintaining sensory acceptance. No significant differences were observed in the other nutritional parameters compared to the control.

Conclusions: Oat sprouting in the production of extruded snacks increased protein content and the amino acid profile, maintained sensory acceptance, and did not alter other parameters, indicating the product's viability for a consumer audience seeking a healthier diet. These findings support the use of sprouted oats as a value-added ingredient in cereal-based foods, contributing to current trends in food innovation and the development of future-oriented products.

ID 057

Sensory and nutritional impact of oat sprout time in plant-based beverages

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Background: Due to the growing number of consumers who, by choice (vegans) or due to health restrictions (intolerances or allergies), are seeking alternatives to dairy beverages, cereal-based beverages are among the options. However, their acceptance is usually lower than that of dairy-based beverages, particularly because of cereal-like flavours and reduced sugar content. In this context, the sprout process can be an alternative that simultaneously improves the acceptability and nutritional profile of cereal-based beverages.

Aims: The objective of this research was to evaluate the influence of sprout time on the sensory and nutritional characteristics of beverages made from sprouted oats.

Methods: The beverage was prepared from oats previously sprouted for 48 and 72 hours at 22 °C, and non-sprouted oats were used as a control. The sprouted oats were ground and mixed with water in a 1:7 (w/w) ratio, followed by a mashing process (45 °C for 10 min / 62 °C for 30 min / 68 °C for 40 min / 78 °C for 10 min), aiming to improve sensory characteristics due to the enzymatic breakdown of part of the starch. After mashing, sucrose and cocoa were added, and the mixture was boiled for 10 minutes. The beverage was then bottled and stored under refrigeration at 4 °C. For the nutritional and sensory evaluation of the beverages, analyses of proximate composition, bioactive profile, amino acid profile by chromatography, and sensory profile were performed.

Results: The main results showed no significant difference in the bioactive profile; however, the essential amino acid profile improved with longer sprouting time, while in the sensory profile, acceptance (9-point hedonic scale) was higher in the sample sprouted for 48 hours (5.15^{b} for the control sample, 5.08^{b} for the sample with oats sprouted for 72 hours, and 7.10^{a} for the sample sprouted for 48 hours). The results indicate that the oat sprouting process improved the amino acid profile and enhanced sensory quality. However, it is important to note that the balance between sensory and nutritional improvements was achieved at 48 hours of sprouting, when, despite not achieving the best amino acid profile, acceptance was significantly higher.

Conclusions: The results indicate that sprouting, followed by mashing, can simultaneously improve the nutritional and sensory characteristics of oat-based beverages.

ID 058

Validation of a 5-Log Reduction of Vegetative Pathogens in GDL-Acidified Sugar-Free Syrups to Meet FDA Regulatory Requirements

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Background: Ensuring the microbiological safety of acidified and acidified-equivalent foods requires validation of processes capable of achieving significant reductions of vegetative pathogens. While conventional acidulants are widely used, alternative approaches such as glucono-delta-lactone (GDL) must be evaluated in conjunction with controlled post-process conditions. Sugar-free (SF) syrups that are acidified but manufactured using a cold-fill process in a non-aseptic environment following pasteurization require specific validation to demonstrate a ≥5-log reduction of key pathogens to comply with U.S. FDA requirements under 21 CFR Part 114. In such systems, where no lethality step is applied after packaging, microbial inactivation depends on formulation (e.g., GDL-driven acidification) and intrinsic product factors. Variations in composition and processing conditions necessitate product-specific validation.

Aims: This study aimed to determine time-temperature-pH conditions required to achieve a ≥5-log reduction of *Escherichia coli*, *Salmonella enterica*, and *Listeria monocytogenes* in GDL-acidified sugar-free syrups, supporting validation under industrial cold-fill conditions.

Methods: A proprietary SF syrup (pH 3.9) was pasteurized at 90 °C for 10 min and cooled to 42 °C prior to cold filling. Three strains each of *S. enterica*, *L. monocytogenes*, and *E. coli* were evaluated. Due to regulatory constraints and strain availability differences between regions, *E. coli* 8785 was used as a surrogate for O157:H7. Strains were prepared individually and tested separately to assess species-specific inactivation kinetics. Inoculated samples were incubated at 40-45 °C to simulate industrial conditions. Microbial survival was monitored over five days using serial dilution and selective plating.

Results: The combined effect of GDL acidification and the preservatives resulted in a ≥5-log reduction of all target pathogens in the formulation at pH 3.9. Under the evaluated cold-fill conditions (40-45 °C), holding times of up to four days were sufficient to achieve the required reduction. These findings suggest that GDL acidification enhances the reduction of vegetative pathogens in low-pH systems.

Conclusions: GDL is an effective acidifying agent in sugar-free syrups when combined with pasteurization and validated cold-fill processes. The findings provide critical parameters for control of pH, time, and temperature in accordance with regulatory requirements. This validation ensures microbiological safety and product stability for sugar-free syrups without post-packaging thermal treatment.

ID 059

Plant-based coagulants in cheesemaking: sustainable alternatives for functional dairy products

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Background: In the context of functional food development and the transition toward sustainable technologies in the dairy industry, the use of plant-based enzymes in cheesemaking represents an innovative alternative to traditional coagulation. Conventional animal rennet, while widely used, raises concerns related to cost, availability, and ethical constraints, encouraging the exploration of vegetal and microbial substitutes. This study investigates the potential of enzymatic preparations derived from plant sources, including local resources and agri-food by-products, for application in cheese technology, with additional consideration of different milk types (cow, sheep, goat, and buffalo).

Aim: The research aims to evaluate the proteolytic activity, coagulation efficiency, and stability of plant-based enzymes compared to animal rennet, and to assess their impact on physicochemical, microbiological, and sensory characteristics of cheeses. A further objective is to explore their role in the formation of bioactive peptides with potential health benefits.

Methods: The methodology integrates advanced analytical and modeling techniques to optimize technological processes and assess enzymatic performance under practical conditions. Cheeses were produced using standardized protocols, employing different milk types and coagulants. Analyses included proteolytic activity assays, compositional evaluation (pH, moisture, fat, protein), microbiological profiling, and texture measurements. Sensory evaluation was conducted using trained panelists and interpreted through fuzzy logic-based agreement criteria. Statistical tools were applied to identify significant differences and correlations.

Results: The results highlight that plant-based enzymes exhibit variable but promising coagulation capacity, influenced by their origin and extraction method. Compared to animal rennet, they tend to induce more intense proteolysis, leading to softer textures and distinct flavor profiles. The degree of these effects varies depending on the milk type, with sheep and buffalo milk showing enhanced structural stability. Notably, increased proteolysis contributed to the release of bioactive peptides with potential antihypertensive and antioxidant effects. Microbiological quality remained within acceptable limits, confirming process safety.

Conclusions: The findings emphasize the opportunity to valorize alternative plant sources as sustainable coagulants in cheesemaking, supporting both product diversification and environmental responsibility. This approach aligns with circular economy principles and offers for developing functional cheeses with added health value and improved consumer appeal.

ID 060

Comparative study on cheeses obtained from different types of milk and various sustainable coagulant enzymes

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Background: Cheese quality is strongly influenced by both the type of milk and the coagulant used in the production process. Milk from cow, sheep, goat, and buffalo differs significantly in protein composition, fat content, and casein profile, which directly affect coagulation behavior and final product characteristics. Additionally, the increasing interest in sustainable and alternative coagulants has led to the use of animal, plant-based, and fungal enzymes, each contributing differently to proteolysis, texture, and flavor development.

Aims: This study aims to comparatively evaluate the physicochemical, textural, and sensory characteristics of cheeses obtained from four types of milk (cow, sheep, goat, and buffalo), each processed using three types of coagulants (animal, plant-based, and fungal enzymes), in order to identify optimal combinations for quality and consumer acceptability.

Methods: A factorial experimental design was applied, resulting in twelve cheese variants. Standardized cheesemaking procedures were used for all samples, with controlled processing parameters. Physicochemical analyses included pH, moisture, fat, protein, and salt content. Texture profile analysis (TPA) and rheological measurements were conducted to assess firmness and elasticity. Sensory evaluation was performed by a trained panel using a linguistic scale and agreement criteria based on fuzzy logic methods. Data were statistically analyzed to determine significant differences between samples.

Results: Results indicated that both milk type and enzyme source significantly influenced cheese characteristics. Sheep and buffalo milk cheeses showed higher fat and protein content, leading to firmer textures, while goat milk cheeses exhibited softer textures and distinct flavor profiles. Animal coagulants generally produced more consistent textures, whereas plant-based enzymes contributed to increased proteolysis and softer structures. Fungal enzymes showed intermediate behavior, with good coagulation efficiency and balanced sensory attributes. Sensory analysis revealed higher acceptability for combinations of sheep milk with animal rennet and buffalo milk with fungal enzymes.

Conclusions: The study demonstrates that the interaction between milk type and coagulant source plays a crucial role in defining cheese quality. Alternative coagulants represent viable options for diversifying cheese production, though their effects vary depending on the milk used. These findings support the development of tailored cheese products with specific functional and sensory properties.

ID 061

Designing Bioprocesses *In Silico*: Data-Driven Bioprocess Optimization of Molasses and Corn Steep Liquor for Yeast Protein Production

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Background: The transition toward sustainable and circular food systems requires resource-efficient strategies for the valorization of industrial by-products into high-value outputs. Molasses and corn steep liquor (CSL) represent abundant yet underutilized streams with significant potential for microbial protein production. In practice, their efficient use is constrained by complex nutrient interactions that are difficult to resolve through time consuming conventional experimental optimization.

Aims: This study aimed to develop a computationally guided framework for digital bioprocess design and optimization of molasses-CSL-based media for protein production by *Saccharomyces cerevisiae*, with a focus on identifying key process parameters governing metabolic trade-offs.

Methods: A genome-scale metabolic model based on yeast-GEM (Yeast9) was systematically analyzed using flux balance analysis (FBA) under physiologically relevant constraints, including non-growth associated maintenance. Molasses was represented as a mixed carbon source, while CSL was approximated as a complex nitrogen input. Sensitivity analysis and multi-objective optimization were applied to quantify metabolic trade-offs. A design-of-experiments (DOE) approach was implemented *in silico* to map the process design space across varying carbon-to-nitrogen (C/N) ratios and oxygen availability, generating a response surface for protein production.

Results: The model demonstrated robust and biologically predictive behavior corroborating expected trends in biomass formation under varying substrate conditions. Simulations indicated the presence of a transition region associated with changes in nutrient limitation, as well as a strong influence of oxygen availability on metabolic efficiency. The response surface analysis suggested the existence of an optimal operational window for protein production within intermediate carbon-to-nitrogen ratios and sufficiently aerated conditions. Overall, the results highlight consistent relationships between nutrient balance and protein synthesis, supporting the applicability of the model for process optimization.

Conclusions: This study highlights the potential of integrating computational modeling with biotechnological process design to improve the efficiency of protein production from complex substrates. By supporting systematic exploration of complex process spaces while reducing experimental burden, the proposed framework contributes to the development of digitally enabled, sustainable fermentation processes aligned with future food production and green transition priorities.

Compositional Evaluation of *Lemna minor* Biomass as a Novel Ingredient for Functional Food Applications

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Background: The growing demand for sustainable, nutrient-dense foods has increased interest in alternative high-value biomasses. *Lemna minor*, a fast-growing aquatic plant with a favorable protein composition and the ability to accumulate minerals and bioactive compounds, has emerged as a promising candidate for food applications. Its rich nutrient composition, combined with the presence of functional components such as fibers, phenolics, and photosynthetic pigments, positions this biomass as a potential multifunctional ingredient for the development of nutritionally enhanced and functional food systems.

Aims: This study aimed to provide a comprehensive characterization of *L. minor* biomass obtained under different cultivation conditions and evaluate its potential as a functional food ingredient through chemical and nutritional analyses.

Methods: Proximate chemical composition and total dietary fiber (soluble and insoluble fractions) were determined using standard methods. Mineral content was analyzed using atomic absorption spectrophotometry to assess nutritional value and potential safety constraints. Antinutritional factors were quantified to evaluate potential limitations for food applications. Bioactive compounds were investigated through food-grade extraction (aqueous and hydroethanolic systems), followed by spectrophotometric determination of total phenolics and flavonoids. Pigments (chlorophylls and carotenoids) were analyzed spectrophotometrically under controlled extraction conditions.

Results: Both samples exhibited a favorable nutritional profile, primarily due to their protein content (~25-30 %), along with a high total dietary fiber content (~50 %), dominated by insoluble fiber (~40-45 %) and a lower soluble fraction (~8 %). Iron content was notably high (~500 mg/kg), indicating potential as a plant-based iron source. Antinutritional factors were detected within ranges reported in the literature. Polyphenolic analysis indicated that the overall content of total polyphenols was moderate. The ethanolic extract contained a higher level of total polyphenols, with flavonoids identified as the dominant polyphenolic group. Pigment analysis revealed chlorophylls as the dominant pigments, consistent with the intense green coloration of the biomass.

Conclusions: Both samples of *Lemna minor* demonstrated a favorable nutritional profile, characterized by high protein and dietary fiber content and significant iron levels. Despite moderate polyphenolic content, the biomass shows strong potential as a multifunctional ingredient. The observed variability between samples highlights the influence of cultivation conditions and underscores the importance of controlled growth parameters to ensure consistent composition, safety, and functionality.

Acknowledgments: Research was funded by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (451-03-33/2026-03/200222) and IMPRESS project co-funded under the Horizon Europe programme (GA 101084437).

ID 063

A sustainable approach to valorizing by-products from the vegetable oil industry in the development of gluten-free bread

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Background: Most food production processes generate by-products alongside the main product, and their valorization represents a sustainable strategy for recovering valuable compounds and reintegrating them into the human diet.

Aims: This research aimed to diversify and improve a gluten-free bread recipe based on buckwheat flour, rice flour, and psyllium husk, previously studied by capitalizing on by-products resulting from the processing of pumpkin seeds, grape seeds, and flaxseed oils, processed into flours. These were included in the recipe at 10%, a percentage determined by sensory analysis.

Methods: In this study, the main characteristics of the flours (moisture, total ash content, color, water retention capacity, total polyphenol content and antioxidant activity) were investigated, as well as the characteristics of the dough (dough firmness, dough stickiness), but also of the gluten-free breads obtained (sensory characteristics, specific volume, porosity, moisture, texture, color, polyphenol content and antioxidant activity of the breads). Statistical analyses were performed using IBM SPSS 345 Statistics, and XLSTAT 2024 parameters were evaluated using two-way analysis of variance (ANOVA), followed by Duncan's multiple range test at a significance level of $p < 0.05$.

Results: The results show that although the bread sample containing grape seed flour achieved better values for humidity, crumb stickiness, polyphenol content, and antioxidant activity, it received a lower score from the tasters because it had a specific marc–fermented taste. The sample with flaxseed oil cake flour was the most appreciated in terms of sensory. It presented a slightly higher specific volume compared to the other samples, but also a higher crumb firmness. The pumpkin seed sample decreased the polyphenol content and antioxidant activity of the sample, and generally obtained values closer to the control sample.

Conclusions: In conclusion, oilseed cake flours significantly influence bread quality, with flaxseed flour offering the best balance between sensory and functional properties, while the other variants present acceptability or performance limitations.

ID 064

Effects of fermentation and aronia fruit juice supplementation on content of total phenolic compounds, total flavonoids, total anthocyanins and antioxidant activity of goat yoghurt

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Background: Enriching a diet with plant-based derivatives, abundant in polyphenolic compounds, is essential in prophylactic against lifestyle-related diseases and people's demand for foods, rich in natural antioxidants is showing a long-lasting rise. Regarding this, we prepared goat yoghurt supplemented with organic, cold-pressed aronia (Aronia melanocarpa) fruit juice in attempt to create a functional product that combines the abundant polyphenolic content in it with beneficial composition of fermented goat milk

Aims: The aim of the study is to determine effects of aronia juice supplementation and fermentation process on content of total phenolic compounds (TPC), total flavonoids (TF), total anthocyanins (TA) and antioxidant activity of goat yoghurt

Methods: The fermentation was carried on with traditional starters, containing *Lactobacillus delbruecki spp. bulgaricus* and *Streptococcus thermophilus*. The values of total phenolic compounds (TPC), total flavonoids (TF), total anthocyanins (TA) and antioxidant activity (AO) of raw goat milk, control and experimental yoghurt and added aronia juice were measured.

Results: The fermentation resulted in two times higher antioxidant activity in control yoghurt compared to the raw milk and increased levels of TFC with about 10%. Slight drop was observed in concentration of TF, while anthocyanins were not detected in both precursor milk and yoghurt.

Aronia juice turned out to be rich in phenolic compounds, expressed potent antioxidant activity and influenced greatly studied parameters in, even though only 3% of it was added. The TPC in experimental yoghurt increased more than twice compared to raw milk and with 90% to the control. TF demonstrated less prominent rise with about 12% and 20% compared to the raw milk and the control, while anthocyanins were detected only in aronia enriched samples. The significant boost in antioxidant activity was observed in experimental yoghurt – six and three times higher compared to the raw milk and control respectively.

Conclusions: Supplementation of goat yoghurt with aronia juice is a way to improve diversity and promote consumption of probiotic rich natural foods. The study determined promising potential of aronia juice to enrich goat yoghurt composition with wholesome antioxidants and to add extra functionality to its high nutritional and dietary value.

ID 065

Sustainable Fish By-product Transformation: Enzyme-Assisted Collagen Recovery and Zero-Waste Food Product Development

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Background: The global aquaculture industry produces 185.4 million tons per year and generates large volumes of waste streams. By-products from fish processing, including skin, scales, and bone, are rich in high-value Type I collagen, omega-3 fatty acids, and bioactive peptides. Conventional extraction techniques generate hazardous chemical waste. Dual valorization techniques, combining pharmaceutical collagen with functional food production, simultaneously represent innovative circular economy solutions aligned with the UN Sustainable Development Goals (SDGs).

Aims: (1) Develop an eco-friendly enzyme-assisted collagen extraction from fish by-products; (2) optimize yield, purity, and minimize chemical utilization; (3) produce zero-waste functional food from fish skins; and (4) design a scalable circular economy model.

Methods: Collagen Isolation: Acid pretreatment (0.5–2M acetic acid, 24h, 25°C) removed 70–90% minerals, while base pretreatment (0.1–1M NaOH, 12h) involved the removal of non-collagen proteins; enzyme-assisted hydrolysis using pepsin (pH 2–3) and collagenase; purification via dialysis, centrifugation, precipitation, freeze-drying. Functional food development: Cod skins were under brine treatment (2.5% NaCl), followed by drying and three cooking methods, namely deep-frying (180°C, 2–3 min), oven-baking with oil spray (180°C, 16 min), and oil-free oven-baking (180°C, 13 min). Evaluation was based on a variety of quality parameters, including energy value measured with a calorimeter, moisture content, sensory analysis of smell, taste, and texture, and consumer acceptability on a 0–5 scale. Collagen characterized via SDS-PAGE, DSC thermal analysis, and amino acid profiling.

Results: For collagen extraction, procedures retained the triple helix structure, and SDS-PAGE yielded the typical bands (α chain, ~130 kDa), with thermal denaturation occurring between 35–45°C. For fish skin chips, energy values were 584.3 kcal/100g for fried, 394.3 kcal/100g for oil-sprayed, and 364 kcal/100g for oil-free. Moisture contents are 5.84% for fried, 10.12% for oil-sprayed, and 9.20% for oil-free. Oil-free chips demonstrated the highest consumer preference, superior crispness, and 30–40% higher protein than potato chips. Both products demonstrated industrial scalability potential.

Conclusions: The integrated study provides two marketable products from fish waste: collagen for pharmaceutical applications and nutritional snacks. Enzyme-based extraction could reduce greenhouse gas emissions by up to 50–75%, reduce chemical contamination, and increase bioactivity. Fish oil-free chips provide nutritional benefits while retaining consumer attractiveness. The circular economy ensures 70% utilization of fish biomass and generates income from waste. Future strategies include expanding to other by-products and establishing industrial partnerships.

ID 066

Functional butter biscuits enriched with dandelion root flour and organic oil-bearing rose petals

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Background: Dandelion roots and rose petals are edible plant plants that present sources of polyphenols and dietary fibers. The roots of dandelion are used in food and beverages as inulin source, a polysaccharide with probiotic properties, while essential oil-bearing rose petals find application in tea, confectionary products.

Aims: The aim of this study was to design functional butter biscuits enriched with dandelion root flour and organic rose petals and to evaluate their nutritional potential, sensory properties and antioxidant activity.

Methods: The percentage of substitution of wheat flour with dandelion root flour in butter biscuits varied from 1 to 5 %. The moisture, ash content, lipids, protein, total carbohydrates (inulin and fructan content), total phenols and flavonoids and antioxidant activities of dandelion flour and prepared biscuits were also determined. Sensory evaluation was performed.

Results: The increased concentration of dandelion root flour reflected on some sensory properties: the darkening of the color, specific taste and decrease in crispness. The total polyphenol and flavonoids content, as well as the antioxidant activity of biscuits increased by the percentage increase of dried dandelion root and rose petals additions. Total fructan content also increased with the addition of dandelion roots as inulin content reached 1.6 % dry weight. It was found that dried dandelion root flour can be a recipe additive for butter biscuits with and without rose petals. However, due to their specific smell and bitter aftertaste, its content should not exceed 3 g per 100 g flour.

Conclusions: The sensory evaluation revealed that the most favorite biscuits were these prepared with 2% dandelion flour, followed by biscuits with 2.5% rose petals and 2% dandelion flour. The current research demonstrated designed of functional butter biscuits enriched with dietary fibers and polyphenols, due to the dandelion flour and organic oil-bearing petals incorporated in them.

Acknowledgments: This work was supportedby the Bulgarian Ministry of Education and Science under the National Research Programme “Healthy Foods for a Strong Bio-Economy and Quality of Life” approved by DCM # 577/17.08.2018”.

ID 067

Lawless land? Food regulation in the metaverse

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Background: The term metaverse is currently used to describe a plurality of virtual worlds that have not yet reached the complexity and potential of a metaverse stricto sensu, namely a world capable of evolving even when users are not connected, characterized by interoperability, an integrated economy, and the simultaneous presence of multiple users in the same virtual space. Nevertheless, when one refers to "virtual environments", these spaces raise regulatory issues that may affect areas seemingly unrelated to them, such as food, the most tangible good essential to human life and a subject of legal rights and protection. While legal systems are traditionally defined by territorial boundaries, laws, sanctions, and enforcement mechanisms, the question arises whether there is a body of law - and more specifically, food law -applicable to the metaverse or other parallel virtual worlds.

Aims: The contribution aims at emphasizing the function and issues that virtual environments present and which can affect the real world, when related to food and food business operators. It will try to answer several research questions, such as the identification of digital territoriality, the applicability of existing legal definitions and EU regulatory framework to the marketing and sale of real food by means of the virtual world space.

Methods: Despite such a new theme, the methodology is the traditional one used by law scholars. It is primarily based on doctrinal legal research, examining the issue through existing legal provisions and scholarly literature. At the same time, the technical nature of the subject requires engagement with technical sources, thus introducing an interdisciplinary dimension to the analysis.

Results: Being the contribution based on law research, the results will be theoretical but with immediate applicability in the context of virtual world management.

Conclusions: Although virtual environments challenge traditional assumptions of territoriality, jurisdiction, and regulatory enforcement, existing food law frameworks are not entirely inapplicable to such digital spaces. The main legal difficulty lies in adapting established concepts and regulatory categories to technologically mediated environments where real and virtual dimensions overlap. While food business operators may remain subject to existing obligations under EU food law, the peculiar features of virtual systems, such as transnationality, decentralization, and technological complexity generate enforcement and interpretative challenges that are beyond the current legal frameworks. In conclusion, further doctrinal and regulatory reflection is necessary to clarify the territorial and functional scope of food law in virtual environments.

ID 068

Mediterranean diet: food model and regulation in the industrial food era

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Background: The Mediterranean diet may be understood, from a historical perspective, as the product of a combination of climatic, geographical, and socio-economic factors. Since the 1970s, it has increasingly been regarded by nutritionists as a dietary model, while from a political and legal perspective it was referred to within first the European Economic Community and later the European Community primarily in connection with the promotion of agricultural products. Only in recent years has it been indirectly addressed in European Union policies as a tool contributing to the green transition towards sustainable food systems. In the era of industrialized food, the Mediterranean diet may still be regarded as a model worthy of institutional promotion.

Aims: The contribution aims to reconstruct the legal history of Mediterranean diet in the European Union framework, contextualizing it among several provisions, including agricultural rules, food safety law, consumer information law, nutrition and health claims regulation, and quality schemes. It frames it in the most recent EU strategies and policies, but it aims also to emphasize the limits that provisions on competition and information to consumers (such as front-of-labelling) might draw for products which are typical of the Mediterranean diet.

Methods: The traditional methods of law research are applied and integrate with each other. On the one hand, the legal historical approach, which allows to reconstruct the development of provisions which supported the adoption of the Mediterranean diet, mainly with reference to the Common Agricultural Policy; on the other hand, the doctrinal method, which analyzes acts, case law and relevant literature to identify the current applicable provisions. A comparative approach will be used to assess different acts that EU member states adopted and that can promote or, conversely, hinder Mediterranean diet.

Results: The research identifies a fragmented and largely indirect legal recognition of the Mediterranean diet within EU law. It highlights that promoting the Mediterranean diet through legal and policy instruments raises tensions with other fundamental principles of EU law, particularly those relating to competition, market neutrality, and freedom of enterprise. Measures aimed at encouraging Mediterranean dietary patterns may also produce unintended effects on consumer information and market access if not carefully designed.

Conclusions: The contribution argues that future EU and national initiatives should adopt a more coherent legal approach to the Mediterranean diet, recognizing its nutritional, cultural, and environmental dimensions while ensuring consistency with internal market principles and fair competition rules.

ID 069

Thermal resistance in trimethoprim-resistant *Salmonella* Typhimurium: phenotypic persistence and genomic insights

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Background: Antimicrobial resistance (AMR) is a major global public health challenge. *Salmonella* spp., a leading cause of foodborne outbreaks, has developed resistance to antibiotics used in human and veterinary medicine, including trimethoprim (TMP). Previous laboratory studies showed that TMP-resistant variants (RVs) of *Salmonella enterica* Typhimurium LT2 (SeT) exhibited increased tolerance to heat treatments (HTs). These findings raise concerns about whether this cross-protection, observed under controlled laboratory conditions, is maintained in real food systems, where matrix complexity may influence microbial behavior.

Aims: This study aimed to determine whether the increased thermal resistance prevously observed in TMP-resistant RVs under laboratory conditions is maintained when these strains are exposed to HTs in food matrices. In addition, the study sought to identify genetic determinants potentially involved in both antimicrobial resistance and thermal tolerance.

Methods: Four previously isolated TMP-resistant RVs, that had shown increased thermal tolerance in laboratory media, were selected for further analysis. These RVs were subjected to lethal HTs in two food matrices representative of different environmental conditions: a neutral matrix (skimmed milk, pH 6.73; 54 ºC, 30 min) and an acidic matrix (orange juice, pH 3.77; 50 ºC, 15 min). Their survival was compared to that of the parental strain under similar conditions. Whole-genome sequencing (WGS) was performed to identify mutations potentially associated with both antimicrobial resistance and thermal tolerance phenotypes.

Results: Consistent with previous observations in laboratory media, TMP-resistant RVs showed enhanced survival compared to the parental strain after exposure to HTs in food matrices. In skimmed milk, all RVs maintained increased thermal resistance that implied an increase in survival risk 10-1000 times higher than SeT, although this phenotype was slightly attenuated compared with that previously reported under laboratory conditions. In orange juice, three out of four RVs retained a survival advantage at the end of the treatment, with a 10–100-fold increase in survival risk when compared to SeT, indicating that the phenotype can persist under acidic conditions. WGS analysis revealed mutations in several genes potentially linked to AMR and stress response, particularly *ygdP*, which encodes a hydrolase involved in alarmone metabolism and could contribute to heat tolerance.

Conclusions: These results show that TMP-resistant *Salmonella* Typhimurium variants with increased thermal resistance in laboratory media, potentially linked with mutations in the *ygdP* gene, can partially maintain this phenotype in food matrices. These findings suggest that AMR-associated phenotypes may compromise the effectiveness of heat-based preservation strategies, with potential implications for food safety and public health.

ID 070

Influence of yeast type on the analytical characteristics of wine from the Negru de Drăgășani variety

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Background: This paper analyzes the impact of using different yeast strains on the chemical and sensory profile of wines obtained from the same grape variety, Negru de Drăgășani (an indigenous variety), in the context of highlighting the terroir character specific to indigenous wines from the Drăgășani vineyard.

Aims: To analyze the evolution of the bouquet complexity and the physicochemical composition of Negru de Drăgășani wine, depending on the technological characteristics of the yeasts used.

Methods: Determinations of the physicochemical composition of the studied musts and wines were performed using an enzymatic analysis system based on enzymatic reactions that produce a colored or fluorescent product, which is subsequently analyzed by spectrophotometry. These methods have a high degree of specificity and sensitivity. A statistical method was also used to interpret the results. The following types of yeasts were used for the experimental batches in the study: *Saccharomyces cerevisiae* var. *Bayanus*; Saccharomyces cerevisiae, *Saccharomyces cerevisiae* x *Saccharomyces bayanus*.

Results: Using the same grape processing and must fermentation technology, but with different fermentative material, it was found that yeast specificity managed to better highlight the terroir character of the wines and the specificity of the experimental batches. The terroir character emphasizes the particularity of the area, being the result of the interaction between natural factors (climate, soil) and local working techniques and tradition. The wine batches analyzed showed variations in chemical parameters, with anthocyanin content ranging between 568-679 mg/L and polyphenol content between 2005-2413 mg/L. Additionally, the glucose/fructose content varied between 0,34 and 1,52 g/L, and the pH values ranged between 3,63-3,72. The result of all analyzed parameters, including those from sensory analysis, was represented in response diagrams.

Conclusions: The obtained results highlighted differences between the three wines produced and analyzed, each variant having distinct characteristics in terms of chemical composition, aromas, structure, and tase balance. Thus, in this context, oenological interventions in the must fermentation process using different yeast strains can have a significant influence on the aromatic and gustatory expression of the wine as well as on its chemical composition.

ID 071

Brewers' Spent Grain and Apple Pomace as Sustainable Ingredients in Snack Bar Formulation

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Background: The food industry generates large quantities of by-products that remain underutilized despite their high nutritional and functional value. Brewers' spent grain (BSG), the main solid residue of the brewing process, and apple pomace, a by-product of juice production, are rich in dietary fiber, protein, and bioactive compounds such as polyphenols. Their improper management contributes to environmental burden, while their valorization aligns with circular economy principles. Increasing interest in sustainable food systems has led to the exploration of these materials as ingredients in value-added products, including functional snacks.

Aims: The aim of this study was to evaluate the feasibility of using brewers' spent grain and apple pomace as functional ingredients in the production of snack bars and to assess their physicochemical and antioxidant properties, as well as their overall product quality.

Methods: Brewers' spent grain and apple pomace were collected from local producers, dried at 60°C for 24 hours, and ground into fine powders. Three variants of snack bars were formulated: 100% BSG, 100% apple pomace, and a 1:1 mixture of both raw materials. Wheat flour and whole eggs were added as binding agents. The mixtures were homogenized, shaped, and baked at 220°C for 40 minutes. The resulting products were analyzed for moisture content, total protein (Kjeldahl method), total polyphenols (Folin–Ciocalteu method), and antioxidant activity using ABTS and DPPH assays. Additionally, a sensory evaluation was conducted using a structured scoring system.

Results: The results demonstrated that both by-products can be successfully incorporated into snack bar formulations. Bars containing BSG showed the highest protein content (up to ~26.8%), while those based on apple pomace exhibited higher polyphenol content (up to ~95.4 mg/100 g) and antioxidant activity. The combined variant provided a balanced profile, combining elevated protein levels with significant antioxidant potential. Sensory analysis indicated acceptable quality across all variants, with the mixed formulation achieving the most favorable overall evaluation.

Conclusions: Brewers' spent grain and apple pomace represent promising raw materials for the development of functional snack products. Their application enables the creation of nutritionally enhanced foods while contributing to waste reduction and sustainable resource management.

ID 072

From Clean Pollen to Real Honey Samples: A Scale-Preserving Deep Learning Pipeline for Pollen Recognition

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Background: Melissopalynological analysis is the widespread method for verifying the botanical origin and authenticity of honey through identification and quantification of pollen grains. Conventional analysis employs manual optical microscopy, which proves to be both resource-intensive and time-consuming. Convolutional neural networks (CNNs) achieve high accuracy on clean, flower-collected pollen images, but performance deteriorates substantially on pollen images taken from honey, due to background sediment, debris, and staining differences between domains.

Aims: This study evaluated whether combining a background-purification and scale-normalization preprocessing pipeline with joint flower- and honey-domain training data reduces this domain gap across five major botanical taxa (*Robinia pseudoacacia*, *Brassica napus*, *Lavandula angustifolia*, *Cirsium* spp., and *Tilia* spp.), and whether the effect is consistent across a custom CNN and six pretrained architectures.

Methods: Flower-domain samples were prepared by direct collection from the plant, fuchsin-fixed and mounted in glycerine-gelatine. Honey-domain samples were obtained by dissolving 10 g of honey in 20–40 cm^3 of warm distilled water and centrifuging at 2,500–3,000 rpm for 10–15 min, with the sediment fixed and mounted identically. Both domains were imaged under the same 40× light microscopy setup. Grains were localized via Otsu thresholding and contour detection, cropped, and manually reviewed. Crops were rescaled using one fixed factor across both domains to preserve relative grain size. The background content was removed via HSV-based alpha-matte masking tuned to the fuchsin stain. This pipeline was applied identically throughout; its contribution relative to training-data composition alone was not isolated. A custom seven-layer CNN and six pretrained architectures (MobileNetV2, ResNet50, ResNet152, InceptionResNetV2, Xception, VGG19) were trained under pure flower-domain and combined flower and honey conditions using 10-fold cross-validation, and evaluated on held-out flower-domain (n = 765) and honey-domain (n = 45) test sets.

Results: Flower-only training gave high in-domain accuracy (96.7–98.3%) but poor, architecture-dependent honey-domain accuracy (25.1–69.8%). Combined-domain training raised honey-domain accuracy to 90.9–99.6% across all seven architectures with flower-domain accuracy essentially unchanged (within ±0.7 points). Pretrained backbones converged to a narrow 95.8–99.6% band, while the custom CNN, despite the largest absolute gain (+65.8 points), trailed at 90.9%. With only 45 honey-domain test images, fold-level results near 100% should be read as indicative rather than precise.

Conclusions: Combining background purification, scale normalization, and joint-domain training substantially reduces the flower-to-honey domain gap, consistently across seven architectures, at negligible cost to flower-domain accuracy. Because preprocessing and data composition were varied together, this establishes

that the combined approach works, not which component drives it; isolating these factors and expanding the honey-domain test set are priorities for future work.

ID 073

In vitro screening of antimicrobial activity of cell-free supernatants from lactic acid bacteria of food and probiotic origin

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Background: Cell-free supernatants derived from lactic acid bacteria (LAB) contain a variety of metabolites such as organic acids, fatty acids, and peptides produced during microbial growth. These compounds may exhibit antimicrobial and other beneficial biological activities in the absence of viable cells. Due to the growing demand for natural alternatives to chemical preservatives and antibiotics, LAB-derived cell-free supernatants have gained attention as potential biopreservative and functional agents in food, pharmaceutical, and cosmetic applications. In particular, strains isolated from fermented foods and probiotic products are of interest due to their safety status and adaptation to complex microbial environments. However, antimicrobial activity of cell-free supernatants is highly strain-dependent, highlighting the need for *in vitro* screening to identify the most effective candidates.

Aims: The aim of the study was to evaluate the *in vitro* antimicrobial activity of cell-free supernatants from lactic acid bacteria isolated from fermented foods and probiotic preparations against indicator bacterial strains, and to investigate the influence of pH on this activity.

Methods: LAB strains isolated from sauerkraut and cheese, as well as from commercial probiotic products. Cell-free supernatants were obtained after cultivation in MRS broth, followed by centrifugation and filtration. Antimicrobial activity was evaluated using the agar well diffusion method against selected indicator bacterial strains. In addition, susceptibility of indicator strains to chloramphenicol was assessed. The pH of the obtained supernatants was measured to evaluate its potential influence on antimicrobial activity.

Results: Cell-free supernatants of LAB showed variable antimicrobial activity against the tested bacteria. Stronger inhibition was generally associated with their lower pH values. All tested bacteria were sensitive to chloramphenicol.

Conclusions: The tested supernatants showed measurable antimicrobial activity, which may be partly associated with the production of organic acids.

ID 074

Evaluation of the antibiofilm properties of treated micro-perforated moulds with Zn, compared with conventional cheese moulds

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Background: The formation of biofilms in the food industry poses a significant challenge to food safety. This is why the limitations of traditional anti-biofilm methods are driving the search for new alternative methods, which are being developed in this field, such as coatings containing antimicrobial agents or coatings designed to modify the surface topography or physicochemical composition, such as those containing silver, copper or zinc.

Aims: This study evaluates the ability of a commercial additive of Zn to the polypropylene (PP) during the mould-making process, to inhibit biofilm formation on micro-perforated PP moulds used in cheese production and had been made with, whose complex structure promotes bacterial adhesion and proliferation.

Methods: To investigate this phenomenon, experimental tests were carried out in which different strains of *Pseudomonas* spp. (*P. fluorescens, P. aeruginosa* and *P. aeruginosa* ATCC), that had been isolated from fresh cheeses and were cultured and inoculated onto PP fragments (2x2 cm) with Zn and without Zn. The bacteria were incubated for three days, after the colony-forming unit (CFU/ml) counts were performed; this experiment was repeated three times over a three-week period. Furthermore, based on the results obtained, a statistical analysis was carried out, and the bacteria were observed using a Field Emission Scanning Electron Microscope (FESEM).

Results: The results showed an initial reduction (1 log reduction) in bacterial growth in the Zinc-treated moulds during the first day of incubation. However, this trend declined in the following days, with higher bacterial counts even being observed in some of the Zinc-treated samples. Statistical analysis revealed no significant differences ($p>0.05$), which may be due to the small sample size ($n=3$), yielding exploratory but inconclusive results. Observations using electron microscopy confirmed the previous findings, showing a lower bacterial count in the treated moulds during the first days, but not on the following days (days 2 and 3).

Conclusions: Both tests confirm the biocidal and antibiofilm properties of the Zn used in the preparation of the PP moulds, but this inhibitory effect was only demonstrated during the first 24 hours. Given that cheese moulds have a service life of several years and undergo numerous wash cycles before being reused, we consider that, in this study, the incorporation of Zn into the polymer matrix does not yield the expected results in terms of bacterial growth.

ID 075

Effect of sonication pretreatment on carotenoid content and quality of purple carrot

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Background: Low-frequency ultrasounds are increasingly utilized in various food industry unit operations. Their application leads to pectin degradation and the loosening of cellulose structures, resulting in reduced plant tissue stiffness and the formation of microchannels. Therefore, they facilitate operations such as osmotic dehydration, drying, or freezing.However, tissue damage may also stimulate the synthesis of secondary metabolites as a defensive response to stress conditions.

Aims: Evaluation of the impact of ultrasound treatment duration and root storage time on carotenoid content and selected quality parameters of purple carrots.

Methods: The research material consisted of purple carrot roots of the 'Deep Purple' cultivar. The raw material was subjected to ultrasound treatment at a frequency of 35 kHz for 15 and 60 minutes. Analyses were performed after the process (0h) and after 48, 72, and 96 hours of storage at 8°C. Purple carrot roots not subjected to sonication, stored under the same conditions, used as the control. The scope of the study included the determination of texture parameters (TPA profile), dry matter content, and the electrical conductivity of the cortex and core. Carotenoid content was determined by HPLC according to the method of de Sá and Rodriguez-Amaya (2004).

Results: In the control sample and the material subjected to 60 minutes of ultrasonic pretreatment, the initial carotenoid content (at 0 h) was at a similar level, approximately 0.8 mg/100 g FW. After 48 hours of storage, a 25% increase in carotenoid content was recorded in the sonicated samples. This level was maintained in the 15-minute ultrasound-treated sample after 72 hours; however, after 96 hours, a decline in carotenoid content to 0.3–0.4 mg/100 g occurred across all variants. Consequently, it can be hypothesized that *de novo* synthesis of the analyzed compounds occurred as a result of sonication, as evidenced by the presence of phytoene—a key colorless precursor—in the sonicated samples after 48 hours of storage. Changes in ion leakage and texture were also determined to evaluate the impact of ultrasound on tissue structure. A statistically significant positive correlation (r=0.60) was observed between the electrical conductivity of the carrot cortex and the total content of unidentified carotenoids, suggesting that the induction of *de novo* synthesis was triggered by the disruption of tissue integrity.

Conclusions: The induction of *de novo* carotenoid synthesis and the presence of phytoene indicate a metabolic response to sonication-induced abiotic stress; nevertheless, during prolonged storage, degradative processes predominate over the biosynthesis of the target compounds.

The study was supported by the Faculty of Food Science and Nutrition, Poznań University of Life Sciences, as part of the funding for young researchers - Project No. 506.JOR.DC.00 "Evaluation of the impact of ultrasound as a pretreatment on the quality of purple carrots".

ID 076

Heavy metal levels in polyfloral, monofloral and honeydew honey: assessment of dietary exposure and health risk

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Background: Honey is a widely consumed natural product and an important component of the human diet. However, environmental contamination can lead to the presence of heavy metals in honey, posing potential risks to human health. As a bioindicator, honey reflects the quality of the surrounding environment and can provide valuable information on contaminant transfer into the food chain

Aims: This study aims to determine the levels of selected heavy metals (Pb, Cd, As,Hg) in different types of honey (polyfloral, monofloral, and honeydew) and to assess dietary exposure and potential health risks associated with their consumption.

Methods: Honey samples representing polyfloral, monofloral, and honeydew types were collected and analyzed for Pb, Cd, and Hg concentrations using ICP-OES. Dietary exposure was estimated through the calculation of Estimated Daily Intake (EDI) based on average honey consumption rates. Health risk assessment was performed using Hazard Quotient (HQ) and Hazard Index (HI), and results were compared with international safety guidelines.

Results: The concentrations of heavy metals varied among honey types, with noticeable differences depending on botanical origin. In general, metal levels were within permissible limits; however, variability in Pb, As and Hg concentrations was observed across samples. Estimated Daily Intake values indicated low exposure levels for the general population. Hazard Quotient values for individual metals were below the safety threshold (HQ < 1), suggesting no significant non-carcinogenic risk, while the cumulative Hazard Index remained within acceptable limits.

Conclusions: The results indicate that the analyzed honey samples are generally safe for consumption with respect to heavy metal contamination. Nevertheless, the observed variability highlights the importance of continuous monitoring to ensure food safety and protect consumer health.

ID 077

Digital nutrition education and its influence on food choices: Perceptions regarding online platforms and artificial intelligence in Romania

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Background: The rapid expansion of digital technologies has changed the way nutrition-related information is accessed, interpreted, and applied in everyday life. Online platforms, mobile applications, social media, and artificial intelligence-based tools have become increasingly relevant in shaping food-related knowledge and decision-making. Although these resources may improve access to nutrition education and support healthier behaviors, they also raise concerns regarding misinformation, credibility, personalization, and user trust.

Aims: This study aimed to explore the influence of digital nutrition education on food choices among Romanian adults, focusing on the use of online sources, perceived impact on dietary behavior, trust in nutrition information available online, and attitudes toward artificial intelligence as a nutrition education tool.

Methods: A cross-sectional descriptive study was conducted using an online questionnaire developed in Google Forms. The instrument included 34 items covering socio-demographic characteristics, digital behaviors, patterns of online nutrition information seeking, use of mobile nutrition applications and artificial intelligence, trust in digital content, and perceived changes in eating habits. Data were collected between 15 March and 15 April 2025 through social media platforms, university groups, and online communities in Romania. Of 259 initial responses, 246 valid questionnaires were retained after applying the inclusion and exclusion criteria. Data were descriptively analyzed using Microsoft Excel 365.

Results: Most respondents were women (80.5%) and had university-level education. Online nutrition information was accessed frequently, mainly through social media, official websites, and independent blogs. Participants reported positive dietary changes associated with online nutrition content, including reduced sugar intake, increased consumption of minimally processed foods, improved label reading, and higher fruit and vegetable intake. At the same time, 91.1% reported having encountered false or contradictory nutrition information online, highlighting the importance of critical evaluation of digital sources. Although artificial intelligence was perceived as having significant potential to improve digital nutrition education, its use remained limited. The main concerns related to AI were inaccurate information, lack of personalization, limited transparency of sources, and data privacy issues.

Conclusions: Digital nutrition education appears to play a meaningful role in shaping food choices and encouraging healthier dietary behaviors. However, its effectiveness depends on the credibility of online information, users' digital and nutrition literacy, and the ethical implementation of artificial intelligence tools. Expanding access to reliable, evidence-based, and user-centered digital nutrition resources may support more informed and sustainable food choices in Romania.

ID 078

Cascara and coffee silverskin as circular functional ingredients: From coffee by-products to consumer-accepted food innovation

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Background: The coffee industry generates large amounts of by-products, including cascara and coffee silverskin, which are increasingly investigated as potential sources of dietary fiber, phenolic compounds, and other bioactive constituents. In the context of circular food systems, these materials may represent valuable resources for the development of functional foods rather than waste streams. However, their successful integration into food products depends not only on nutritional and technological potential, but also on safety, sensory quality, food matrix compatibility, and consumer acceptance.

Aims: This narrative review aimed to analyze the potential of cascara and coffee silverskin as circular functional ingredients in food innovation. The review focused on their bioactive composition, potential health-related properties, food applications, safety considerations, sensory acceptance, and the role of sustainable communication in supporting consumer trust and acceptance.

Methods: A narrative literature review was conducted using scientific databases such as PubMed, ScienceDirect, MDPI, EFSA Journal, and Google Scholar. The search focused mainly on studies published in the last decade, using keywords such as “coffee by-products”, “cascara”, “coffee silverskin”, “functional foods”, “bioactive compounds”, “circular food systems”, “sensory acceptance”, and “consumer acceptance”. Studies were selected if they addressed at least one of the following dimensions: bioactive composition, food applications, safety assessment, sensory properties, consumer perception, or sustainable valorization of coffee by-products.

Results: The reviewed literature suggests that cascara and coffee silverskin have distinct but complementary potential as circular functional ingredients. Cascara appears particularly suitable for beverages, fermented products, and dairy matrices, such as kombucha and yogurt, due to its specific aromatic profile and phenolic content. Coffee silverskin seems more appropriate for solid food products, including biscuits, cakes, bakery products, and snacks, mainly because of its fiber content, antioxidant potential, and compatibility with cereal-based matrices. However, the transition from coffee by-product to accepted functional ingredient is influenced by dosage, sensory impact, safety validation, technological feasibility, and consumer-oriented communication. The evidence indicates that bioactive value alone is insufficient to ensure consumer acceptance.

Conclusions: Cascara and coffee silverskin should not be approached as interchangeable residues, but as distinct circular ingredients with different functional applications. Their successful integration into functional foods requires a balance between nutritional value, safety, sensory quality, technological feasibility, and consumer trust. Sustainable communication may play a key role in reframing coffee by-products from “waste” into safe, functional, and valuable ingredients. This integrative perspective may support both food waste reduction and the development of healthier, consumer-accepted circular food products.

ID 079

Identification and screening of yeasts for their ability to assimilate biodiesel-derived crude glycerol

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Background: The growing accumulation of glycerol as a by-product of biodiesel production has intensified interest in its sustainable valorization through biotechnological approaches. Owing to their metabolic versatility, yeasts can utilize a wide range of carbon sources and convert them into valuable biomass, making them promising candidates for glycerol-based bioprocess development. In this context, industrially impacted soils represent a valuable reservoir of naturally adapted microorganisms with the potential to efficiently metabolize glycerol.

Aims: The aim of the present study was to identify yeast strains isolated from soils around biodiesel production facilities and to evaluate their ability to assimilate crude glycerol.

Methods: Soil samples were collected from biodiesel production sites, and yeasts were isolated using standard microbiological techniques. The isolates were first characterized based on morphological features and subsequently identified through molecular methods as members of the genera *Naganishia*, *Rhodotorula*, *Trichosporon*, and *Cutaneotrichosporon*. Screening experiments were carried out in liquid media containing biodiesel-derived crude glycerol as the main carbon source. Yeast growth was monitored over a 24-hour cultivation period by measuring optical density, while changes in pH were simultaneously recorded. Growth profiles of the tested strains were then comparatively analyzed under varying concentrations of crude glycerol.

Results: Several yeast isolates were successfully recovered and identified from the examined soil samples, highlighting the microbial diversity of biodiesel-associated environments. Marked differences in growth dynamics, substrate utilization, and pH variation were observed among the tested strains. Certain isolates exhibited enhanced growth and greater tolerance to crude glycerol, suggesting physiological adaptation to the complex nature of this industrial substrate. Overall, the results demonstrate clear strain-dependent variability in the capacity to assimilate biodiesel-derived crude glycerol.

Conclusions: Soil-associated yeasts constitute a valuable biological resource for the valorization of biodiesel-derived crude glycerol. The integrated approach, combining taxonomic identification with biochemical screening, enabled the selection of strains exhibiting distinct growth performance and tolerance to this substrate. The observed variability among isolates underscores their differing adaptive capacities and highlights their potential for future biotechnological applications. These findings provide a basis for further research into biomass production, protein enrichment, and process optimization using industrial glycerol streams.

ID 080

Microbiological and Resistome Characterization of Meat by Integrated Metagenomic and Culture-Based Approaches

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Background: The microbiological quality and safety of pork-derived products depend on the composition of their surface-associated microbial communities, which may include both environmental and processing-related microorganisms, as well as bacteria of potential intestinal origin. Comprehensive characterization of these communities, including their associated resistome, is essential from a food safety and One Health perspective.

Aims: This study aimed to perform an in-depth characterization of the microbiota present in meat (bacon), focusing on (i) taxonomic profiling and (ii) the identification of antimicrobial resistance genes, complemented by the isolation and characterization of viable bacteria of interest.

Methods: Meat (bacon) samples were collected following ISO 17604:2015 guidelines. Particular attention was given to the optimization of microbial DNA extraction, involving concentration of bacterial biomass through centrifugation and the use of a dedicated kit for complex food matrices. Shotgun metagenomic sequencing (Illumina NextSeq) was performed to obtain taxonomic profiles and identify antimicrobial resistance genes. In parallel, culture-based analyses were conducted on TSA and chromogenic media to enumerate and isolate viable microorganisms. Selected isolates were identified by 16S rRNA gene sequencing and characterized using the VITEK®2 system for phenotypic antimicrobial resistance profiling.

Results: Taxonomic analysis revealed that the bacon microbiota was dominated primarily by *Anoxybacillus*, followed by *Clostridium*. In addition, the community exhibited a high taxonomic diversity, including a wide range of environmental and spore-forming genera. Metagenomic data also enabled the detection of bacterial groups relevant to food safety, including *Enterococcus*, *Staphylococcus*, and members of the *Enterobacteriaceae* family (e.g., *Escherichia* spp.), although at lower relative abundances. Resistome analysis identified the presence of antimicrobial resistance genes associated with major antibiotic classes, including tetracyclines, macrolides, and aminoglycosides, highlighting the potential role of meat products as carriers of resistance determinants. Culture-based approaches allowed for the isolation of diverse bacterial taxa (including *Staphylococcus spp.*, *Enterococcus spp.*, *Escherichia spp.*, *Citrobacter spp.*, and *Enterobacter spp.).* Antimicrobial susceptibility profiles showed overall high sensitivity among Gram-negative isolates, with resistance mainly to ampicillin and first-generation cephalosporins. In contrast, Gram-positive bacteria, particularly *Enterococcus faecium*, exhibited higher levels of resistance, especially to macrolides and tetracyclines.

Conclusions: The detection and successful isolation of bacterial taxa of clear microbiological and clinical relevance, coupled with the identification of antimicrobial resistance genes across multiple antibiotic classes, are potent tools to study the role of meat products as reservoirs and potential transmission vehicles of antimicrobial resistance. This study also emphasizes the advantages of applying multi-method monitoring strategies for the assessment of antimicrobial resistance risks in food products.

ID 081

Dynamics of Physicochemical Properties and Pigment Content of Quince Leaves (*Cydonia oblonga* Mill.) in Relation to Cultivar and Growth Stage

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Background: Quince (*Cydonia oblonga Mill.*) is a fruit-bearing tree cultivated primarily for its aromatic fruit, while its leaves are often frequently discarded as agricultural waste. Given the increasing emphasis on sustainability and waste reduction in agriculture, investigating the physicochemical properties and potential of these leaves represents an opportunity to utilize this underutilized resource.

Aims: The objective of this study is to evaluate the potential for utilizing the leaves of three Bulgarian quince cultivars as an agricultural by-product, transforming them from agricultural residues into a potential functional industrial resource. Through a comparative assessment of physicochemical and pigment characteristics at two critical phenological stages—peak vegetation (August) and the end of the growth cycle (October)—the research quantifies the dynamics of moisture, ash, water activity, color, and chlorophyll content. By integrating these parameters, the study seeks to determine the optimal time for recovery of the "waste" and the potential of quince leaves.

Methods: Comparative analyses were performed to evaluate the physicochemical properties of quince leaf samples, focusing on varietal differences and the influence of the growth period. The investigated parameters included moisture content, water activity, ash content, and color characteristics. Pigment profiles, including total chlorophyll and carotenoids, were quantified spectrophotometrically, while color coordinates were measured to assess chromatic variations across varieties and seasons.

Results: The data indicate that leaf characteristics are influenced by variety and growth period, particularly in relation to natural senescence, structural changes, and the accumulation of substances under the impact of climatic factors.

Conclusions: The findings highlight the potential for utilizing quince leaves as a viable functional resource, in sustainable practices rather than a waste product. By recognizing their physicochemical properties, these leaves can be valorized for applications in food, cosmetics, and pharmaceuticals, contributing to waste reduction and resource efficiency in agricultural systems.

Acknowledgement: The authors would like to express gratitude to the Fruit Growing Institute, Plovdiv, Bulgaria, for kindly providing the leaves, and the Bulgarian Science Fund, Grant № КП-06-Н97/3, for supporting this research.

ID 082

Nature-Driven Innovation: Natural Antioxidants in Food Processing

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Background: Rosemary (*Rosmarinus officinalis* L.) is a versatile plant that plays an important role in functional foods, being primarily used to extend their shelf life. Its extracts and essential oils are valued for their antioxidant, antibacterial, and anti-inflammatory properties. It is a prominent natural antioxidant in the food industry.

Aims: The objective of this study is to evaluate the polyphenolic content and antioxidant activity of 10 natural rosemary extracts in preventing food oxidation, as well as to analyze their impact on the long-term quality of food. The extracts demonstrating the highest antioxidant activity will be incorporated into a pork product characterized by a soft texture. This approach will enable the assessment of their antioxidant properties and the comparison of their efficacy in food applications, with the aim of better understanding their potential to replace chemical additives.

Methods: Spectrophotometric tests were used to determine the total polyphenol content and antioxidant activity, which was assessed using the following assays: the DPPH• radical scavenging assay (RSA), the ferric reducing antioxidant power assay (FRAP), and the $ABTS^{\bullet+}$ radical cation scavenging assay (ABTS). The analysis of pork products aims to detect lipid oxidation by determining the peroxide value and the degree of fat oxidation using the Kreiss reaction over a 30-day storage period.

Results: Antioxidant and polyphenol analyses revealed the high efficacy of two extracts: Rosemary Oleoresin Herbalox and Rosemary Oleoresin 11% Halal. The polyphenol content of these samples ranged from 1.842 to 3.468 mg GAE/mL of extract, and their antioxidant activity ranged from 98.043% to 99.600%. Regarding the meat product, the control sample showed the formation of peroxides, which subsequently degraded into aldehyde compounds. In contrast, samples containing rosemary extract exhibited oxidative stability, confirming the antioxidant efficacy of the extracts.

Conclusions: Research has demonstrated that the incorporation of rosemary extracts has a positive impact on the quality of pork products. This process reduces lipid oxidation, thereby preserving the freshness and sensory quality of the product. In addition, it decreases the formation of volatile compounds responsible for rancid taste. In the context of using rosemary extract as a substitute for conventional preservatives, further studies are needed to fully exploit the potential of this natural antioxidant. Future research should also prioritize sustainability by valorizing waste from rosemary processing and conducting a comparative analysis of the environmental impact of natural extracts versus synthetic preservatives.

ID 084

Evaluation of the combined effects of polyols and plant sterol esters on the microbiological and quality characteristics of no-added-sugar frozen yogurt

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Background: To develop no-added-sugar frozen yogurt enriched with phytosterol esters, three formulations were prepared by incorporating phytosterol esters at a level of 3 g per 250 g serving. One formulation containing 18% sucrose and two no-added-sugar formulations containing either 18% maltitol or a combination of maltitol, erythritol and steviol glycosides were developed. Control samples without phytosterol esters were designated as FY-1 with sucrose, FY-2 with maltitol, and FY-3 with a combination of maltitol, erythritol and steviol glycosides, while FY-4, FY-5 and FY-6 represented the corresponding formulations enriched with phytosterol esters.

Aims: The present study evaluates the combined effect of sucrose replacement and enrichment with soy phytosterol esters on lactic acid fermentation and the viability of *Lactobacillus acidophilus* LA-5, *Streptococcus thermophilus*, *Lactobacillus delbrueckii* subsp. *bulgaricus* and *Bifidobacterium animalis* subsp. *lactis* BB-12. Their influence on the physicochemical, textural and thermal characteristics of frozen yogurt was also investigated.

Methods: Microbiological analysis was performed according to BDS ISO 7889:2005 and ISO 29981. Sugar content was determined by HPLC. Identification of phytosterol esters in frozen yogurt samples was carried out using fluorescence spectroscopy in the range of 200–1200 nm. Thermal properties were evaluated by differential scanning calorimetry (DSC), while textural characteristics were determined by texture profile analysis (TPA).

Results: It was established that the addition of phytosterol esters during the production of probiotic frozen yogurt reduced the time required for lactic acid fermentation (pH = 4.6) at 37 °C compared to the control samples. After 60 days of storage at −18 °C, the viability of the microorganisms remained above 6 log CFU/g, with values of 8.05±0.01 log CFU/g for *Lactobacillus* spp. and 6.93±0.05 log CFU/g for *Bifidobacterium* spp. recorded in sample FY-6. The highest value for *S. thermophilus* (8.88±0.03 log CFU/g) was observed in FY-4. The addition of phytosterol esters led to a reduction in the amount of incorporated air, with the most pronounced effect observed in FY-6. Fluorescence analysis revealed the most distinct signal for phytosterols at 436 nm. Sensory analysis demonstrated good overall acceptability of all samples.

Conclusions: The obtained results demonstrate that soy phytosterol esters are suitable for the enrichment of frozen yogurt with probiotic potential. Their addition reduces the time required for lactic acid fermentation and supports the viability of microorganisms without adversely affecting the overall acceptability of the product.

ID 085

Sorption Properties of By-Products from Canning Industry

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Background: The processing of vegetables such as pepper and eggplant generates significant amounts of plant-based by-products. Their efficient valorization requires detailed investigation of their physicochemical and sorption properties.

Aims: The aim of the present study was to determine the sorption isotherms of pepper stalks (*Capsicum annuum* L.) and eggplant stalks (*Solanum melongena* L.), as well as to identify a suitable mathematical model for their description.

Methods: Equilibrium sorption isotherms were experimentally determined at 20 °C and water activity values ranging from 0.11 to 0.85 using a static gravimetric method. Experimental data were analyzed using the two-parameter Chung–Pfost, Oswin, Halsey, and Henderson models. The monolayer moisture content of the products was determined using the BET model.

Results: The obtained isotherms exhibited a characteristic sigmoidal shape and were classified as type II according to the Brunauer classification. Hysteresis between the adsorption and desorption processes was observed for both investigated products. Among the applied models, the Halsey model showed the best agreement with the experimental data, characterized by the lowest values of mean relative error and standard error of estimate. The monolayer moisture content of pepper stalks ranged from 7.23 to 7.70% d.b., while that of eggplant stalks was higher, varying from 7.81 to 9.38% d.b.

Conclusions: The obtained results provide useful information regarding drying, storage, and technological processing in the valorization of by-products generated during pepper and eggplant processing.

ID 087

Modernizing vocational education in food quality and safety through digital, green and industry-oriented competences

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Background: The rapid transformation of the food and beverage sector requires vocational education to respond more effectively to technological, regulatory and sustainability-related changes. Professionals involved in food quality and safety are increasingly expected to combine traditional technological knowledge with competences in digital traceability, automated process monitoring, analytical control, sustainability and communication in regulated production environments.

Aims: The aim of this study was to analyze the current State Educational Standard for the profession "Food and Beverage Quality Technician-Technologist" and to identify opportunities for updating its competence profile in line with the twin digital and green transition of the food industry.

Methods: A structured review of the educational standard was performed, focusing on entry requirements, occupational description, professional competences, units of learning outcomes, practical training, assessment criteria, material resources and opportunities for continuing education. The analysis was complemented by a critical evaluation of current challenges in vocational education, including laboratory capacity, teacher qualification, industry participation and the need for flexible upskilling formats.

Results: The standard provides a clear competence-based structure and includes important elements related to food quality, safety, hygiene, control procedures, communication and ICT. However, several gaps were identified, particularly regarding the practical implementation of modern analytical methods, digital documentation, process data management, automation, industrial traceability and sustainability-oriented production practices. Based on the analysis, a set of short training modules is proposed, including data use in food production, digital quality and traceability systems, automation for food technologists, green practices in the food industry, and soft skills for industrial environments.

Conclusions: Updating vocational education through modular, practice-oriented and industry-supported training can strengthen the preparedness of future food quality specialists. The proposed competence framework supports closer alignment between education and the evolving needs of the food and beverage sector, particularly in the context of digitalization, sustainability and lifelong learning.

Acknowledgement: This study was funded under the National Program "Development of Scientific Research and Innovation in the System of Bulgarian Preschool and School Education", implemented by the "Institute of Education" under the Ministry of Education and Science of the Republic of Bulgaria.

ID 090

Development of bacterial Toxin Certified Reference Materials

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Background: Bacterial toxins such as cereulide from *Bacillus cereus* and enterotoxins types SEA and SEB from *Staphylococcus aureus* play a crucial role in food-poisoning outbreaks. They are ranked top in the category of bacterial toxins according to the European Union One Health Zoonoses Reports in the past years published jointly by EFSA and ECDC. Certified reference materials (CRMs) are important tools for laboratories to produce and safeguard reliable measurement results. They are typically used for calibration, validation and/or quality control, and provide metrological traceability to an internationally recognized reference, ideally the International System of Units (SI). In addition, CRMs are one important pillar in analytical quality assurance and are crucial for standardization of laboratory results.

Aim: Our goal has been the development of the following CRMs: SEB in buffer, cereulide in cooked rice and SEA in cheese.

Methods: SEB was produced recombinantly and assessed for its purity. An aqueous buffer solution of SEB was aliquoted. For the matrix CRMs, pure cereulide and pure SEA were spiked into cooked rice and raw milk cheese, respectively. Both rice and cheese were converted into powders by means of freeze-drying, milling and mixing. Aliquots were filled into amber glass vials and zip-lock bags with alumina outer protection, respectively. For all CRMs, homogeneity and stability studies were conducted. For the SEB and cereulide CRMs, characterisation studies were performed. All measurements were obtained from laboratories with proven competence and validated methods, most of which were operated under ISO/IEC 17025 accreditation. A characterisation study will also be organised for the new batch of SEA in cheese CRM later this year.

Results: Three CRMs were processed in a large scale, aiming at long-year provision to customers. Suitable homogeneity of the CRMs could be confirmed. Additionally, short-term and long-term stability studies revealed material dispatch conditions and storage conditions, respectively. Characterisation studies allowed the acquisition of high-quality data, which enabled JRC to assign reference values to the SEB and cereulide materials. The certified values are traceable to the International System of Units (SI).

Conclusions: Two CRMs were developed and released for sale. The SEB CRM is mostly used for calibration of methods and assays, whereas the cereulide matrix CRM is used for method performance verification and/or method validation. Final measurements, value assignment and SEA CRM release are planned for 2027. All CRMs will help laboratories to establish and safeguard reliable measurements, which are a prerequisite for effective consumer protection.

ID 091

Medical potential of *Inonotus hispidus*: bioactive compounds and genomic features

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Background: *Inonotus hispidus* is a widely distributed medicinal mushroom traditionally valued in folk medicine for its strong anti-inflammatory and antimicrobial properties. Recent advances in chemical profiling and genome sequencing have renewed scientific interest in this species, revealing a complex range of bioactive compounds with significant therapeutic potential. However, current research findings remain scattered, highlighting the need for a clear synthesis of its bioactive compounds and genomic features.

Aims: This review evaluates the pharmacological activities and therapeutic potential of *Inonotus hispidus*. It highlights its mechanisms of action, explores clinical prospects, and outlines current research gaps for its medical application.

Methods: A structured literature review was conducted using major scientific databases, including PubMed, Scopus, and Web of Science, covering studies published up to 2025. Eligible studies were selected based on their relevance to pharmacological activity, therapeutic efficacy, and potential clinical applications of *Inonotus hispidus*, including *in vitro*, *in vivo*, and preclinical investigations. Data were critically analyzed to assess mechanisms of action, treatment outcomes, and the clinical relevance of these findings.

Results: *Inonotus hispidus* contains various bioactive compounds, including polyphenols, triterpenoids, and polysaccharides, associated with antioxidant, anticancer, antimicrobial, and hepatoprotective effects. These activities are supported by genomic evidence identifying biosynthetic gene clusters involved in secondary metabolite production. However, the available literature remains limited, with approximately 20–40 studies addressing its medicinal potential, bioactive profile, or genomic features. A minimal number of studies (approximately 2–4 studies) integrates these aspects, linking genomic insights with pharmacological effects such as anticancer and immunomodulatory activity. Notably, no study to date provides a unified analysis of its chemical, pharmacological, and genomic characteristics.

Conclusions: *Inonotus hispidus* is a pharmacologically promising but still insufficiently studied medicinal fungus with considerable potential for drug discovery and functional applications. Existing evidence supports its relevance as a source of bioactive compounds with therapeutic value, complemented by emerging genomic data. Nevertheless, research remains fragmented and key gaps persist. Future research should focus on standardizing extraction methods and validating active compounds through rigorous preclinical testing. Additionally, functional analysis of biosynthetic gene clusters and a deeper elucidation of molecular mechanisms will be essential to translate these findings into clinical applications.

Acknowledgements: This research was funded by the National Science Fund of Bulgaria: Contract No. КП-06-Н86/7 from 06.12.2024, “Controlled *in vitro* cultivation of a wild medicinal mushroom *Inonotus hispidus* (*Basidiomycota*) and complete genomic characterization: promising approaches for bioprospecting and sustainable production of new therapeutically active biomolecules”.

ID 092

Modern methods and techniques for monitoring acetic acid fermentation: Review

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Background: In the modern world, food quality is of utmost importance. Vinegar, as the main flavoring and sterilizing product that people use, must meet certain standards and requirements. The control that is carried out in the fermentation process is with the help of sensors and biosensors that monitor various parameters during the course of this biochemical process.

Aims: This article reviews the current methods and techniques for tracking and classifying the final product in acetic acid fermentation. The aim is to propose new fast, accurate and objective methods that replace traditional techniques, equipment and trained technologists.

Methods: Through an extensive literature review, a study of contemporary literary sources in this field has been conducted. A classification of the methods used has been made depending on the techniques used and depending on the field of application.

Results: The theoretical knowledge gained from the overview study provides a good basis for starting experimental work to monitor the acetic acid fermentation process with modern methods and techniques.

Conclusions: Monitoring and control of acetic acid fermentation are of utmost importance to ensure the quality and safety of the final product. The review of the literature shows that modern sensor and biosensor technologies used in the monitoring and control of fermentation processes offer significant advantages in terms of speed, accuracy and objectivity. It has been theoretically proven that the implementation of new technologies optimizes the production process and increases the quality of the final product.

ID 093

Multisensor computer technology for EEG-based neurogastronomic analysis

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Background: Neurogastronomy is an interdisciplinary field that combines neuroscience, sensory science, and food technology to investigate the complex neural mechanisms involved in food perception and sensory evaluation. Traditional sensory analysis methods are often subjective and depend on human interpretation, which limits reproducibility and objectivity. Recent advances in wearable electroencephalography (EEG), embedded systems, and real-time data processing provide new opportunities for objective monitoring of cognitive and emotional responses during tasting experiments.

Aims: The aim of this study is to develop a multisensor computer technology for EEG-based neurogastronomic analysis capable of acquiring, processing, and visualizing brain activity during food perception experiments in real time.

Methods: The proposed system integrates a lightweight Muse 2 EEG headband with a Raspberry Pi 5 embedded computing platform and a Python-based software environment. The communication between the hardware and software layers is established via Bluetooth and Lab Streaming Layer (LSL). EEG signals are collected and analyzed across the five main frequency bands (α, β, γ, δ, and θ). Real-time visualization and signal processing are implemented through an optimized Python script featuring a dynamic SVG graphical interface. The software automatically processes adapted, empirically derived neurophysiological indices for interpretation of the taster's sensory and cognitive responses.

Results: The developed computing platform enables stable, low-latency real-time acquisition and processing of EEG signals during active sensory experiments. Preliminary validation analyses demonstrate the capability of the system to distinguish changes in neural activity associated with different food perception phases and various tasting stimuli. The application of embedded computing provides a portable and non-invasive approach for neurogastronomic investigations. The EEG-based neurogastronomic analysis demonstrated that the proposed neurocognitive indices (FAA, SPI, CLI, and RI) successfully differentiated emotional valence, sensory integration, cognitive load, and relaxation responses during food perception experiments, indicating the potential of the system for objective assessment of consumer neurophysiological reactions to taste, aroma, and texture stimuli.

Conclusions: The proposed multisensor computer technology demonstrates the potential of EEG-based analysis for objective evaluation of sensory food perception. The system can support innovative applications across food science, consumer behavior research, neuromarketing, and intelligent FoodTech systems.

ID 094

Edge computing-based multisensor embedded system for real-time physicochemical analysis of liquid food

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Background: Conventional physicochemical analysis of food products is commonly based on laboratory procedures requiring specialized equipment, extended processing time, and expert interpretation. The increasing demand for rapid quality control and food traceability creates the need for portable and intelligent systems capable of real-time measurements and automated evaluation.

Aims: The aim of this work is to develop an edge computing-based multisensor computer system for food traceability real-time physicochemical analysis of liquid food products.

Methods: The developed system integrates sensors for temperature, pH, electrical conductivity, spectral analysis, and ultrasonic measurements using Raspberry Pi 5 and Raspberry Pi Pico 2W in an IoT-based architecture. A web application developed in Python and Dash enables real-time monitoring, visualization, and processing of acquired data. For the measurement of active acidity (pH), a DFRobot SEN0161-V2 sensor is integrated. For electrical conductivity (EC), a DFRobot DFR0300 sensor with a cell constant of K=1 is used. To investigate the molecular composition and optical properties of the samples, a multispectral sensor matrix from the AS7265x series and an AS7341 sensor from the Smart Spectral Sensor Family are implemented. To capture an ultrasonic transmission footprint, an ultrasonic module was synthesized for burst transmission and reception of ultrasonic waves at a frequency of 1 MHz.

Results: The implemented platform provides real-time acquisition and analysis of physicochemical parameters from liquid food samples. Preliminary experimental results indicate the capability of the system to generate objective multisensor profiles and support real-time food traceability. The proposed architecture allows portable deployment and remote monitoring through web technologies. Captured footprints obtained with the presented multispectral system are provided.

Conclusions: The edge computing-based multisensor system represents a promising approach for intelligent real-time physicochemical food analysis by combining edge embedded computing and IoT technologies. The system has potential applications in food quality control, traceability, and Industry 4.0 environments.

ID 095

The role of artificial intelligence in monitoring the production of meat products and determining their quality and safety - Review

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Background: In the meat processing industry, control methods are associated with periodic sampling and laboratory analyses, which are expensive and time-consuming. When determining the quality of final products, sensory analysis is often used, which carries risks of subjectivity in determining characteristics and is influenced by the experience and sensitive perception of specialists in the field. Modern AI-based methods create the possibility of automated and continuous monitoring of the quality and safety of meat products.

Aims: The purpose of this article is to review modern methods for monitoring meat product production and determining their quality and safety. Technologies such as machine learning, deep learning, computer vision, hyperspectral imaging, Internet of Things (IoT), and big data are considered, which provide real-time, objective, and accurate assessment of meat characteristics.

Methods: Based on a large volume of modern scientific articles in the field of determining the quality of meat products and tracking their production, a classification of current methods has been made.

Results: The article examines in detail Multisensor Systems, IoT Sensors, Hyperspectral and NIR Spectroscopy, Machine Vision and Computed Tomography, and Big Data. A comparative analysis is made between traditional laboratory approaches and modern systems based on artificial intelligence and the Internet of Things.

Conclusions: The reviewed modern methods for tracking meat production processes and determining their quality show that intelligent monitoring improves traceability, reduces waste and increases the quality of the final product. Advanced digital image processing systems, real-time data analysis and complex software models have a number of advantages over traditional sensory evaluation. The inclusion of artificial intelligence models reduces human error and leads to objectification of measurement results.

ID 096

Technological characteristics of sausages with plant proteins

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Background: Plant proteins are widely used as functional additives in the meat industry. Soy proteins remain the most common meat substitutes in sausage production due to their favorable technological properties. In recent years, pea and faba bean proteins have emerged as promising sustainable alternatives. However, scientific data regarding their effects on the technological and sensory characteristics of meat products are still limited.

Aims: The aim of the present study was to evaluate the influence of soy, pea, and faba bean proteins on the technological characteristics of sausages, including emulsion stability, color parameters (CIE L*ab*), pH, texture profile, and sensory properties.

Methods: Sausages formulated with different plant proteins were analyzed on the 1st and 5th day of refrigerated storage. Instrumental measurements included emulsion stability, color characteristics (CIE L*ab*), pH, and texture profile analysis. In addition, sensory evaluation was performed to assess the overall acceptability of the products.

Results: The incorporation of soy, pea, and faba bean proteins decreased the redness parameter (a*) of the sausages, while the yellowness component (b*) increased significantly compared to the control samples. On the first day of storage, sausages containing soy protein exhibited the highest lightness values (L*), whereas the lowest L* values were observed in samples with faba bean protein. Texture profile analysis demonstrated that sausages produced with soy protein and faba bean protein isolates showed higher values for all investigated texture parameters compared to the control group. In contrast, the use of pea protein flour containing 55% protein resulted in lower texture profile values across all measured parameters. The highest emulsion stability was recorded in sausages containing soy protein concentrate. Sensory evaluation indicated that the use of soy, pea, and faba bean protein isolates with protein content above 80% preserved the sensory quality and consumer acceptability of the sausages.

Conclusions: Pea and faba bean proteins, particularly when applied as high-protein isolates (>80% protein content), can successfully maintain the technological and sensory characteristics of sausages. These plant proteins represent promising alternatives to soy protein in the development of sustainable meat products.

This research was funded by project BG16RFPR002-1.014-0012-C01 "Establishment and sustainable development of a Center of competence „Agrifood systems and bioeconomy", financed by the European Regional Development Fund through the Bulgarian Operational Programme „Program for Research, Innovation and Digitalisation for Smart Transformation" (PRIDST).

ID 097

Impact of Plant Protein Inclusion on Lipid and Protein Oxidation in Hybrid Meat Matrices

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Background: Cooked short-shelf-life sausages are highly susceptible to lipid oxidation due to their elevated fat content. Oxidative deterioration negatively affects flavor, color, and overall product shelf life. Plant proteins may contribute to oxidative stability through free radical scavenging and antioxidant activity; however, the possible introduction of endogenous prooxidants requires careful evaluation of their effectiveness within meat systems. While soy proteins are well established in meat processing, pea and faba bean proteins have recently emerged as promising hypoallergenic and sustainable alternatives. Nevertheless, scientific evidence regarding their antioxidant potential and ability to inhibit rancidity in real meat matrices remains limited.

Aim: The present study aimed to investigate the effects of soy, pea, and faba bean proteins on the antioxidant activity and oxidative stability of cooked sausages during refrigerated storage.

Methods: Sausages formulated with different plant proteins were analyzed on the 1st and 5th day of refrigerated storage (0–4°C). Antioxidant activity was assessed by determining total phenolic content (TPC), DPPH radical-scavenging activity, and ferric reducing antioxidant power (FRAP). Oxidative stability was evaluated through acid value (AV), peroxide value (POV), and thiobarbituric acid (TBA) assays.

Results: The study evaluated the effects of novel pea protein formulations (P1, P2, P3, and P4) and faba bean protein (FB) on the oxidative stability and antioxidant capacity of cooked sausages. Compared to all protein-enriched formulations, the control sample without added plant proteins exhibited the highest degree of lipid hydrolysis, expressed by increased acid values, as well as the greatest accumulation of secondary lipid oxidation products after 5 days of refrigerated storage. The incorporation of plant proteins significantly reduced oxidative deterioration in the lipid fraction of the sausages throughout the storage period. Soy, pea, and faba bean proteins also enhanced the antioxidant activity of the products, as demonstrated by increased TPC, DPPH, and FRAP values. Among the tested formulations, plant protein isolates showed the strongest protective effects against oxidative degradation, contributing to improved physicochemical stability during storage.

Conclusions: Partial replacement of meat with pea and faba bean proteins improves the antioxidant capacity of cooked sausages and effectively suppresses lipid oxidation and hydrolytic processes during refrigerated storage. These novel plant-based protein alternatives demonstrate strong potential as natural and efficient

stabilizing ingredients for the meat industry, supporting the development of cleaner-label and more sustainable meat products.

This research was funded by project BG16RFPR002-1.014-0012-C01 "Establishment and sustainable development of a Center of competence „Agrifood systems and bioeconomy", financed by the European Regional Development Fund through the Bulgarian Operational Programme „Program for Research, Innovation and Digitalisation for Smart Transformation" (PRIDST).

ID 098

Assessment of Copper (Cu^{2+}) tolerance and biocapture efficiency of ascomycete fungi *Xylaria karsticola* and *Xylaria polymorpha* in controlled *in vitro* cultivation

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Background: Copper is an indispensable strategic metal, yet its industrial demand drives widespread environmental contamination. Traditional remediation is often costly and wasteful. Fungal-based biocapture offers a sustainable recovery alternative. This study explores the potential of two newly isolated strains, *Xylaria karsticola* and *Xylaria polymorpha*, uncharacterized in terms of metal valorization, to bridge the gap between waste management and circular metal recovery.

Aims: This study aims to evaluate the copper tolerance and biocapture efficiency of *X. karsticola* and *X. polymorpha*, providing new insights into their application for circular metal recovery and the sustainable valorization of industrial waste.

Methods: The copper tolerance and biosorption capabilities of *X. karsticola* and *X. polymorpha* were initially evaluated on potato-dextrose agar (PDA) supplemented with copper concentrations ranging from 0.1 to 1.0 g/L, with growth at 25°C measured daily for 15 days. The Gompertz model was utilized to calculate the maximum specific growth rate and the fungal adaptation phase duration. To define the relationship between copper concentration and growth, the Edwards, Haldane-Andrews, and Yano models were applied to identify the inhibition constant (Ki). Finally, copper biocapture efficiency was determined during submerged cultivation in potato-dextrose broth (PDB) at specific copper concentrations. Following cultivation, biomass was separated, and residual copper levels were determined spectrophotometrically using Spectroquant® Copper Test (Photometric) (Merck, Darmstadt, Germany) according to the instructions of the manufacturer to quantify the fungal metal uptake capacity.

Results: The Chrome Azurol S (CAS) assay confirmed siderophore production for both *X. karsticola* and *X. polymorpha*, visualized by the appearance of clear orange halos around the fungal colonies. Fungal tolerance to different copper (Cu^{2+}) concentrations showed that both strains exhibited copper tolerance up to 0.5 g/L. In submerged cultivation, *X. karsticola* achieved a high biocapture efficiency, reaching 78.1% at the copper concentration 0.5 g/L and 90.8% at 0.2 g/L concentration of Cu^{2+}. In comparison, *X. polymorpha* exhibited a slightly lower capacity for copper removal under the same conditions.

Conclusions: *X. karsticola* efficiently recovers copper from low-concentration effluents, proving to be a sustainable, cost-effective alternative to traditional chemical methods. Furthermore, these insights pave the way for future industrial applications in circular economy practices, particularly in the remediation of metal-rich industrial effluents.

Acknowledgements: This research was funded by the National Science Fund of Bulgaria under Contract No. КП-06-Н87/9 from 6 December 2024 "*Xylaria karsticola* (*Ascomycota*)—cell-based cultivation and *MULTI-OMICS* approach for bioprospecting and revealing the potential for obtaining new bioactive metabolites with therapeutic properties".

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ID 099

Evaluation of Food and Essential Oil Processing Residues as Potent Substrates for *Xylaria karsticola* Cultivation

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Background: The growth characteristics of *Xylaria karsticola* was investigated during solid-state cultivation on waste products from the food and essential oil industries, including tomato pomace, grape seeds, oil-bearing rose petals, and rose distillation wastewater. The effect of mineral salts supplementation on the development of the fungus was also examined. The growth dynamics of the mycelial mass were studied, and the suitability of the respective complex nutrient medium for the development of the strain was determined.

Aims: The aim of the present study is to investigate the possibility of utilizing waste products from the food and essential oil industries.

Methods: Complex nutrient media were prepared from the waste products, which were inoculated with agar plugs containing active fungal culture. The diameter increase of the mycelial mass was measured daily. These data were fitted to a logistic curve model to calculate the maximum specific growth rate (μ_{max}) and the growth inhibition coefficient (δ).

Results: The highest value of the maximum specific growth rate was observed during the cultivation of *Xylaria karsticola* on grape seeds and grape seeds supplemented with salts, for which μ_{max} was 0,310 ± 0,001 d^{-1} and 0,338 ± 0,001 d^{-1}, respectively. The next complex medium on which *Xylaria karsticola* developed with a similar growth rate was a mixture of all waste products supplemented with salts. For this medium, μ_{max} was 0,304 ± 0,002 d^{-1}. A relatively high maximum specific growth rate was observed for the nutrient media composed of rose petal waste, rose petals with salt supplementation, a mixture of waste products, rose water, and rose water with salt supplementation, for which the μ_{max} values 0,293 ± 0,001 d^{-1} , 0,255 ± 0,001 d^{-1}, 0,290 ± 0,001 d^{-1}, 0,255 ± 0,001 d^{-1} и 0,290 ± 0,002 d^{-1}, respectively. A lower, yet relatively high value of μ_{max} was determined for the complex medium containing tomato pomace and tomato pomace with salt supplementation — 0,167 ± 0,002 d^{-1} and 0,184 ± 0,004 d^{-1}. The utilization of all investigated waste products resulted in low values of the growth inhibition coefficient δ, varying in the range from 0,0020 ± 0,0000 to 0,0040 ± 0,0000 $mm.d^{-1}$.

Conclusions: The low value of the growth inhibition coefficient δ indicates that the investigated waste products are a suitable medium for the development of *Xylaria karsticola* and the production of bioactive substances.

Acknowledgements:This research was funded by the National Science Fund of Bulgaria under Contract No. КП-06-Н87/9 from 6 December 2024 "*Xylaria karsticola* (*Ascomycota*)—cell-based cultivation and *MULTI-OMICS* approach for bioprospecting and revealing the potential for obtaining new bioactive metabolites with therapeutic properties".

ID 100

Methods for objective non-destructive grading of common walnut (*Juglans regia* L.)

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Background: The significance of walnuts harvested from various cultivars of the common walnut (Juglans regia L.) for both domestic and European industries is continuously growing. This necessitates the implementation of non-invasive methods for objective walnut grading to guarantee compliance with strict European quality standards. Emerging technologies enable the introduction of methods capable of penetrating the shell and grading the internal kernel based on various parameters without compromising the fruit's integrity. This ensures economic efficiency during the processing, sorting, and storage of walnuts, allowing for an informed decision regarding further processing at an early stage of the production cycle.

Aims: The aim of this study is to review the various methods for the objective non-destructive grading of walnuts harvested from different common walnut (Juglans regia L.) cultivars, and to provide a rationale for selecting the most suitable methods to be integrated into a computerized grading system.

Methods: A scientific review and comparative analysis of existing specialized literature tracking the development of non-invasive control technologies were conducted. Modern approaches, such as classical computer vision, X-ray analysis, near-infrared spectroscopy (NIR), and acoustic methods, were subjected to comparison. The methodology includes evaluating parameters such as accuracy in detecting empty or spoiled kernels, real-time processing speed, and the potential for multi-sensor data fusion into a unified computer system.

Results: The comparative analysis indicates that the standalone application of individual technologies has certain limitations – X-ray methods are expensive and complex to operate, whereas computer vision only analyzes external defects. The multi-sensor solution, combining computer vision and acoustic analysis methods, stands out as the most effective and promising approach. While visual inspection captures surface imperfections on the shell, the acoustic signal (induced by a controlled impact or vibration) precisely identifies the internal condition and density of the kernel through the shell. This synergy ensures high detection accuracy, low cost, and excellent throughput, which justifies the selection of this technological combination for subsequent hardware and software integration.

Conclusions: The utilization of non-destructive testing methods is key to enhancing the competitiveness of walnut processors in Bulgaria and Europe. The study proves that combining acoustic methods with computer vision offers the highest objectivity and economic return on investment. The future integration of this combined technology into an automated computer system will enable precise, real-time sorting of produce, minimizing waste and ensuring strict compliance with European quality standards.

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ID 101

Evaluation of the antimicrobial properties of ethanol extracts obtained from tobacco residues

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Background: This study investigates the potential utilization of agricultural wastes through ethanol extraction and evaluates the antimicrobial potential of the obtained extracts. The plant-derived waste material was subjected to ethanolic extraction, and the resulting crude extracts were analyzed for antimicrobial activity using the agar well diffusion method and determination of the minimum inhibitory concentration (MIC). The observed biological activity is likely attributed to the presence of phenolic compounds, alkaloids, and other secondary metabolites characteristic of tobacco residues. The results indicate that tobacco waste contains bioactive compounds with antimicrobial properties, which may be of interest for further research and potential applications.

Aims: The aim of the present study was to investigate the potential of agricultural plant wastes from different botanical origins, including tobacco and other selected plant species, as a source of bioactive compounds by evaluating the antimicrobial activity of their ethanol extracts.

Methods: Five tobacco wastes were obtained from the experimental fields of Tobacco and Tobacco Products Institute, Markovo, Bulgaria. Two industrial by-products (*Daphne mezereum* (mezereon) and *Geranium macrorrhizum* (bigroot geranium)) were obtained from local distilleries. The inhibitory activity of the extracts was determined using the agar well diffusion method.

Results: Tobacco extracts exhibit limited and selective antimicrobial activity, with Gram-positive bacteria (*Bacillus subtilis*, *Bacillus cereus*, and *Staphylococcus aureus*) being the most sensitive, showing inhibition zones of 9–11 mm. Among the tested fungi, *Aspergillus niger*, *Penicillium chrysogenum*, and *Rhizopus* sp. were the most susceptible, and the effect increased with higher extract concentrations. In contrast, extracts from *Daphne mezereum* and *Geranium macrorrhizum* demonstrated strong antimicrobial activity against both pathogenic and saprophytic microorganisms, with *Geranium macrorrhizum* producing larger inhibition zones.

Conclusions: Tobacco extracts exhibited selective antimicrobial activity, mainly against Gram-positive bacteria and certain fungi. Extracts from *Daphne mezereum* and *Geranium macrorrhizum* demonstrated stronger and broader activity, indicating that all tested plant wastes are a promising source of bioactive compounds with antimicrobial potential.

Acknowledgments: This research was funded by project BG16RFPR002-1.014-0012-C01 "Establishment and sustainable development of a Center of competence „Agrifood systems and bioeconomy", financed by the European Regional Development Fund through the Bulgarian Operational Programme „Program for Research, Innovation and Digitalisation for Smart Transformation" (PRIDST). This work was supported by the Bulgarian National Science Fund, Ministry of Education and Science (project КП-06-Н87/13/06.12.2024 Complex valorization of by-products and waste from the tobacco industry).

ID 102

Microbiological Assessment of *Rapana venosa* Shell Meal and Shrimp By-Product Meal as Potential Poultry Feed Additives

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Background: It is evident that marine processing by-products have the potential to serve as a sustainable source of feed ingredients, owing to their nutritional value and the feasibility of their utilisation in animal nutrition.

Aims: The present study sought to evaluate the microbiological quality and safety of rapana shell meal and shrimp by-product meal, which were intended for use as poultry feed additives.

Methods: The following microbiological analyses were conducted: Plate Count Agar (PCA) was utilised for the enumeration of aerobic mesophilic bacteria; Violet Red Bile Dextrose Agar (VRBD) was employed for the detection of Enterobacteriaceae; Xylose Lysine Deoxycholate (XLD) agar was used for the selective isolation of Salmonella and Shigella species; and Thiosulfate Citrate Bile Salts Sucrose (TCBS) agar was used for the detection of halophilic marine-associated bacteria. Samples were subjected to serial dilution and plated in triplicate in accordance with standard microbiological procedures.

Results: The total bacterial load was determined on PCA, yielding a result of 2.37 ×10⁵ CFU/g for Rapana venosa shell meal and 1.56 ×10⁵ CFU/g for shrimp by-product meal. No bacterial growth was detected on VRBD and XLD media in either sample, suggesting the absence of detectable Enterobacteriaceae contamination and enteric pathogens. Furthermore, no observable growth was detected on TCBS agar in rapana shell meal, whereas shrimp meal exhibited a bacterial load of 5.11 ×104 CFU/g, indicating the presence of marine-associated microorganisms. The absence of growth on selective media for major pathogenic bacteria suggests a favourable microbiological profile, despite the measurable total bacterial counts.

Conclusions: These findings suggest that both rapana shell meal and shrimp by-product meal possess acceptable microbiological characteristics and may represent promising alternative feed ingredients for poultry nutrition. However, further analyses are recommended to focus on the identification of pathogens and the assessment of long-term storage stability, in order to confirm their suitability for practical feed applications.

Acknowledgements: The research was funded by the Scientific Research Fund through Scientific Project KP-06 PN76/38 Monitoring bone health indicators in laying hens during the early laying period. Possibilities to improve bone metabolism by using waste products from aquaculture.

ID 103

Comparative evaluation of biodegradable films enriched with artichoke leaf extract for potential food packaging applications

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Background: Agro-industrial by-products have attracted increasing attention as sustainable raw materials for biodegradable packaging applications. Artichoke processing generates considerable amounts of plant waste rich in phenolic compounds and other bioactive components. Incorporation of these compounds into biodegradable film systems may contribute to the development of environmentally friendly packaging materials as sustainable alternatives to conventional packaging within a circular economy approach.

Aims: This study aimed to comparatively evaluate the physical, mechanical, barrier, optical, and functional properties of carrageenan-, pectin-, and sodium alginate-based biodegradable films enriched with artichoke leaf extract for potential food packaging applications.

Methods: Artichoke leaves were dried, ground, and extracted to obtain bioactive compounds. The obtained extract was incorporated into carrageenan, pectin, and sodium alginate film formulations prepared by the solvent casting method. Film samples were characterized in terms of thickness, color, tensile strength, elongation at break, water vapor permeability (WVP), UV absorbance, antioxidant activity, antimicrobial activity, and surface morphology by SEM analysis.

Results: The type of biopolymer significantly affected film properties. Sodium alginate-based films exhibited the highest tensile strength and the lowest WVP values, indicating superior moisture barrier properties. Carrageenan-based films showed the strongest UV barrier properties and the highest antioxidant activity, while pectin-based films demonstrated the highest flexibility. SEM analyses indicated relatively smoother and more continuous surface morphologies in pectin- and sodium alginate-based films, whereas carrageenan-based films showed more pronounced local heterogeneity and particle-like structures. No clear antimicrobial activity against *Escherichia coli* and *Staphylococcus aureus* was detected.

Conclusions: The findings demonstrated that artichoke leaf extract could be successfully incorporated into biodegradable film systems and contribute to functional film properties. The developed films showed potential as sustainable biodegradable packaging materials and supported the valorization of agro-industrial by-products within a circular economy approach.

ID 105

Biotechnological Screening of Cu^{2+}-Tolerant Macromycetes for Copper Bioremediation and Critical Metal Recovery

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Background: Copper (Cu^{2+}) is a fundamental mineral resource, but current extraction and consumption patterns are rapidly depleting available global supplies. Furthermore, copper ions leaching into wastewater pose serious risks to human health. Bioremediation offers a sustainable alternative for heavy metal removal and recovery. In this context, macromycetes are increasingly recognized as promising agents for critical metal recovery. Their metal-binding cell wall functional groups and secretion of extracellular metabolites, including organic acids and siderophores, significantly enhance metal mobilization, uptake, and bioleaching efficiency.

Aims: This study aimed to screen and evaluate the Cu^{2+} tolerance of 11 macromycete strains (*Fomitopsis pinicola, Fomitopsis betulina, Lentinula edodes, Ganoderma resinaceum, Ganoderma lucidum, Cyclocybe cylindracea, Pleurotus ostreatus, Inonotus hispidus, Trametes versicolor, Xylaria karsticola and Xylaria polymorpha)* and to assess their potential for copper bioremediation and recovery.

Methods: A Chrome Azurol S (CAS) agar assay was used to screen siderophore production in the studied fungal strains. The Cu^{2+} tolerance was evaluated on Potato Dextrose Agar (PDA) supplemented with 0.1–2.2 g/L Cu^{2+} and incubated at 25 °C for 15 days. The Gompertz model determined the fungi's maximum specific growth rate and lag phase duration under copper exposure. To analyze growth inhibition, we applied the Edwards, Haldane-Andrews, and Yano models. These models identified the inhibition constant (Ki), representing the specific copper concentration at which fungal growth is suppressed. Copper biocapture of two basidiomycete strains was further evaluated in submerged cultures (100 mL PDB in 500 mL flasks) supplemented with Cu^{2+} concentrations derived from the kinetic analysis. Following cultivation, biomass was separated by filtration, and the remaining copper in the liquid phase was measured spectrophotometrically using Spectroquant® Copper Test (Photometric) (Merck, Darmstadt, Germany) according to the instructions of the manufacturer.

Results: The Chrome Azurol S (CAS) assay confirmed siderophore production in all tested strains, as visualized by the appearance of clear orange halos on the medium. Furthermore, the studied strains demonstrated tolerance to Cu^{2+} at concentrations of up to 2.0 g/L. In submerged cultivation, *Fomitopsis betulina* achieved the highest biocapture efficiency of 85% at 1.31 g/L and 86% at 1.25 g/L, followed by *Fomitopsis pinicola* with 86% at 1.00 g/L

Conclusions: The results confirm the strong biotechnological potential of *Fomitopsis pinicola* and *Fomitopsis betulina* for copper recovery. Both strains showed high Cu^{2+} tolerance and efficient biocapture under submerged conditions, involving biosorption and metabolite-mediated mechanisms. These findings support their use in sustainable bioremediation and metal recovery, warranting further process optimization and scale-up studies.

Acknowledgements: This work was supported by the National Science Program "Critical and strategic raw materials for a green transition and sustainable development" (Resolution № 508/18.07.2024), funded by the Ministry of Education and Science (MES), Bulgaria.

ID 106

Evaluating the growth kinetic characteristics of localy isolated *Xylaria* strains using lignocellulose-based media

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Background: *Xylaria karsticola* and *Xylaria polymorpha* (*Ascomycota)* were isolated from the region of Troyan, Bulgaria. The available data regarding the ability of these fungi to grow on lignocellulosic substrates is scarce due to limited amount research articles in this field. However, their application on the utilization and valorization of lignocellulosic wastes is crucial for the carbon footprint reductio and promoting a circular economy.

Aims: To evaluate and compare the growth performance and kinetic parameters of two *Xylaria* strains across a matrix of lignocellulosic substrates and temperature conditions.

Methods: The study was conducted by the cultivation of *Xylaria polymorpha* and *Xylaria karsticola* on six complex lignocellulose media at three temperature regimens. The media used were 4% sawdust, 4% wheat bran, 4% wheat straw, 2% wheat bran combined with 2% sawdust, 4% hexane-extracted rose flowers and 4% steam distilled lavender straw. The evaluation of the growth kinetics was performed by the employment of the logistic curve and reverse autocatalytic growth models.

Results: Experimental data clearly indicate that both fungal strains grew well at 21°C and 26°C, but higher temperatures were not suitable for the fungal development. *X. polymorpha* demonstrated comparative specific growth rate when cultivated on lavender (SDLS), wheat straw (WS) and wheat bran (WB) at 21°C, but at 26 °C a specific growth rate of 0.5711 was recorded on SDLS. In general, significantly lower growth rates were recorded *for X. karsticola*. At 21°C the fungus grew best on the mixed medium (wheat bran and sawdust; WBSD), whereas at 26°C the optimal growth rate was detected on WB medium.

Conclusions: *X. karsticola* demonstrated highest specific growth rate of 0.3218 when cultivated on WBSD at 21°C. The optimal growth for *X. polymorpha* was recorded on SDLS at 26°C with specific growth rate of 0.5711.

Acknowlegements: This research was funded by THE NATIONAL SCIENCE FUND OF BULGARIA under contract № КП-06-Н87/9, from 06.12.2024, "*Xylaria karsticola (Ascomycota)* - cell-based cultivation and MULTI-OMICS approach for bioprospecting and revealing the potential for obtaining new bioactive metabolites with therapeutic properties".

ID 107

Sprouting cereal grains as a tool to increase their nutritional value.

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Background: The germination of cereal grains is an effective biotechnological process that enhances their nutritional and functional value. During germination, endogenous enzymes are activated, leading to the degradation of complex macromolecules and the increased bioavailability of essential nutrients, including vitamins, minerals, amino acids, and bioactive compounds. In addition, germination can reduce antinutritional factors and improve the digestibility and antioxidant properties of cereal grains. Besides conventional cereals, unconventional cereal species such as tritordeum, as well as wheat varieties with coloured grains, represent promising raw materials for the development of value-added cereal products with enhanced nutritional and health-promoting properties for consumers.

Aims: The aim of the work was to evaluate the effect of germination on the selected nutritional properties of selected conventional and unconventional cereal grains, as potential raw materials for the development of functional foods. The experiment is funded by the Slovak Research and Development Agency (APVV-23-0375).

Methods: In addition to conventionally grown traditional cereals such as wheat, oat, and barley, we also used organically grown samples in our work, wheat grains with a non-traditional colour, tritordeum as an innovative biological species, and barley grains germinated with the application of essential oils (1, 5, 10 ppm of rosemary essential oil). The grains were germinated for 24 to 120 hours and selected nutritional parameters such as protein, starch, total dietary fibre, lipids and beta-glucans were analysed. Selected secondary metabolites such as yellow pigments and activities of selected enzymes such as alpha- and beta-amylase, sucrase and lipase were also analysed.

Results: In general, we can state that non-traditional cereal grains are characterized by, for example, a higher content of anthocyanins (unconventionally colored wheat grains) or yellow pigments (tritordeum), which are metabolites with biological value for the consumer, compared to conventional grains. We also observed that there were no statistically significant differences in the content of monitored metabolites and enzyme activity due to germination between conventionally grown cereals and organically grown cereals. During germination, we observed significantly increased activities of selected hydrolytic enzymes depending on the germination time. We observed also a decrease in the content of starch and lipids as storage substances in cereal grains due to the germination process. The essential oil was responsible for changes in the content of selected metabolites and enzyme activity; in principle, its effect was not significantly inhibitory but slightly stimulating.

Conclusions: Based on the results determined, we can consider the process of sprouting cereal grains as a simple biotechnological path that increases the activity of hydrolytic enzymes and the decomposition of larger polymeric and storage substances in the grain, which is a prerequisite for their increased digestibility by the consumer and higher biological value. Very promising in terms of cereal grains with added value for the purpose of creating innovative functional foods are grains with an unconventional color.

ID 108

Somaclonal variations in callus and suspension cultures of *Aronia melanocarpa* induced by light

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Background: Somaclonal variation represents a source of genetic and epigenetic diversity in plant *in vitro* systems. Light is a key environmental regulator that can influence morphogenesis and cellular metabolism. *Aronia melanocarpa is* known for its high phenolic content, therefore maintaining genetic fidelity during *in vitro* culture is essential, while controlled variation may provide a selection of improved genotype lines.

Aims: The study aims to investigate the occurrence of light-induced somaclonal genetic variation in callus cultures and cell suspensions of *Aronia melanocarpa*.

Methods: Callus cultures were maintained for 28 days under darkness and on photoperiod of 16 h light and 8 h dark for more than 3 months. Cell suspension cultures were initiated by transferring callus culture into liquid medium Woody Plant (WP) with 0.5 mg/L kinetin and 2.0mg/L picloram. Cell suspension cultures were maintained on orbital shaker at 26 °C for more than three mounts under dark condition and on photoperiod (16h light and 8h dark). Subcultivation was performed for a 7 day period. At the end of the cultivation period, genetic stability was evaluated using five Inter-Simple Sequence Repeats (ISSR) markers (UBC-808, UBC-807, UBC-811, UBC-827, and UBC-856).

Results: With the UBC-807 marker, genetic variability was detected between callus cultures and cell suspension cultures independently from photoregime applied throughout the cultivation period. With the UBC-856 marker, genetic variability was detected both within callus cultures, cultivated under different illumination conditions and between callus cultures and cell suspension cultures. With the UBC-827 marker, genetic variability was observed between callus cultures cultivated under darkness and those maintained under photoperiod.

Conclusions: The results demonstrated that somaclonal variation was detected between callus cultures and cell suspension cultures (2 out of 5 ISSR markers). Cell suspension cultures demonstrated no detectable somaclonal variability under either dark or illuminated condition, while callus cultures demonstrated genetic variability dependent on the light regime applied, detected by 2 out of 5 markers (UBC-827, UBC–856). These results demonstrated that genetic stability is influenced not only by in vitro culture platform used (callus, cell suspension), but also by presence or absence of light during prolonged cultivation period in calli.

ID 109

Kefir grain fermentation of enzyme-assisted sea buckthorn leaves extracts

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Background: Sea buckthorn leaves and kefir grains are rich sources of bioactive compounds and mixed-culture microorganisms with potential applications in functional foods and beverages. The symbiotic microbial community of kefir grains, mainly lactic and acetic acid bacteria, can synergistically interact with enzyme-assisted sea buckthorn leaves extracts to enhance the release and biotransformation of phenolic compounds. Evaluation of kefir grain microbial diversity is important for understanding variability in these conversional processes and the release of bioactive compounds. However, efficient recovery of these compounds depends on the interactions between substrate characteristics, microbial metabolism, and raw material composition.

Aims: To evaluate the effect of enzyme-assisted extraction (EAE) and kefir grain fermentation on the release of phenolic compounds and antioxidant activity of sea buckthorn leaves.

Methods: Dried and milled sea buckthorn leaves were prepared for enzyme-assisted extraction under optimized conditions: 45 °C, pH 4.9, and an extraction time of 195 min, using a substrate-to-water ratio of 1:10 (w/w) For the EAE 1% of Viscozyme L was used. The supernatant was subsequently mixed with kefir grain water (prepared by fermenting a 5% sugar solution with 10% kefir grains for 72 h at 30 °C) at ratios of 80:20, 50:50, and 20:80 (extract : kefir water), respectively, and fermented for 48 hours 30°C. Total phenolic compounds in the fermented samples were determined using the Folin–Ciocalteu method. For the antioxidant activities in vitro $ABTS^{\bullet+}$ and $DPPH^{\bullet}$ antioxidant activities were performed. Additionaly, shotgun sequencing of kefir grain bacteriome and analysis was performed.

Results: Kefir grain water media were predominantly dominated by *Lactobacillus kefiranofaciens*, followed by *Acetobacter fabarum*, *Acetobacter persici*, *Lacticaseibacillus paracasei*, *Lentilactobacillus kefiri*, *Leuconostoc pseudomesenteroides*, *Leuconostoc citreum*, *Ewingella americana*, and *Gluconobacter cerinus*. Total phenolic content in fermented sea buckthorn leaves extracts ranged from 0.5 to 2.5 mg GAE/g. Furthermore, $ABTS^{\bullet+}$ and DPPH• antioxidant activity assays showed antioxidant capacities ranging from 20 to 120 mM TE/g and 10 to 34 mM TE/g, respectively.

Conclusions: Our study demonstrated that fermented sea buckthorn leaves extracts exhibited varying phenolic compound contents and antioxidant activities depending on the extract concentration. The combination of EAE and kefir grain fermentation enhanced the recovery of bioactive compounds and contributed to increased antioxidant activity. These findings highlight the potential of combining enzymatic pretreatment with microbial fermentation for the development of functional ingredients from sea buckthorn leaves.

Acknowledgement: This project has received funding from the Research Council of Lithuania (LMTLT), agreement No. S-MIP-24-75.

ID 110

Optimization of xylanase production by *Trichoderma viride* SL-45 in solid-state fermentation of lavender distillation waste

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Background: The valorization of agro-industrial residues through microbial bioconversion represents a sustainable approach for the production of value-added products, such as enzymes. Lavender distillation waste is generated in large quantities and remains underutilized despite its lignocellulosic composition. Solid-state fermentation (SSF) using filamentous fungi offers an effective strategy for enzyme production from such substrates.

Aims: The aim of this study was to optimize the production of xylanase by *Trichoderma viride* SL-45 during solid-state fermentation of lavender distillation waste through evaluation of process parameters and medium composition.

Methods: The effects of cultivation temperature, substrate moisture content, and incubation time were investigated using a response surface methodology approach. In addition, a screening experimental design based on a linear model was used to evaluate the influence of selected medium components.

Results: The results demonstrated that temperature and incubation time significantly influenced xylanase production, while substrate moisture content showed a modulating effect. Response surface analysis revealed non-linear interactions between the investigated factors. Screening of medium components identified $MgSO_4$ as a statistically significant factor affecting xylanase activity. Optimization of process parameters led to enhanced enzyme production, confirming the suitability of lavender distillation waste as a fermentation substrate.

Conclusions: The study demonstrates that lavender distillation waste can be effectively utilized for xylanase production via solid-state fermentation. The application of experimental design and mathematical modeling provides a reliable approach for process optimization and supports the development of sustainable biotechnological processes.

Acknowledgements: This work was supported by SU-project 80-10-203 / 22.04.2026. The support of the Centre of Competence "Sustainable Utilization of Bio-resources and Waste of Medicinal and Aromatic Plants for Innovative Bioactive Products" (BIORESOURCES BG), project BG16RFPR002-1.014-0001, funded by the Program "Research, Innovation and Digitization for Smart Transformation" 2021-2027, co-funded by the EU, is greatly acknowledged.

ID 111

Phytochemical profile of *in vitro* plants from the genus Hypericum

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Background: The genus Hypericum includes over 450 species of herbaceous plants and shrubs with the most popular is the St. John's wort (*Hypericum perforatum*). It contains a number of active ingredients, including hyperforin, hypericin, and flavonoids, which are thought to be responsible for its numerous health benefits. Extracts from the plant are often used as an anti-inflammatory agent for various skin conditions, including seborrheic dermatitis, eczema, acne. They also have anti-allergic, wound healing and antiseptic properties effects. When consumed, the extracts can calm the nervous system and improve the sleep.

Aims: The aim of this study was to analyze the phytochemical profiles and antioxidant activities of *in vitro* grown plants from 4 widely distributed in Bulgaria Hypericum species: *Hypericum montbretii*, *Hypericum perforatum*, *Hypericum maculatum* and *Hypericum tetrapterum*.

Methods: Seeds of the plants were collected from the natural habitats in Rila, Pirin, Vitosha and Rhodopa Mountains in Bulgaria in 2023. The plants were identified by associate professor, Ina Aneva, Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences. Seeds were sterilized and transferred on full strength MS medium with addition of 30g/l sugar for germination. The cultivation was performed at 26°C, on darkness. The first seedlings appeared after 30 days and the plants were transferred to grow under illumination with photoperiod 16 h light and 8 h darkness. The sub-cultivation period of 28 days was applied, for more than 6 months before the collection of biomass for analyses. The collected *in vitro* plants were freeze-dried and extracted for analysis of total phenolic content and antioxidant activities (DPPH, TEAC, FRAP and CUPRAC).

Results: The results showed that the *Hypericum tetrapterum* extract had the highest total phenolic content (142.81 ± 4.01 μM GAE/g DW) followed by extracts from *Hypericum montbretia* (115.04 ± 3.47 μM GAE/g DW), *Hypericum perforatum* (76.08±1.99 μM GAE/g DW) and *Hypericum maculatum* (68.75±3.99 μM GAE/g DW). The results for antioxidant activities followed the trend of the results obtained from the analysis of total phenolic contents.

Conclusions: *In vitro* plants of investigated Hypericum species showed high potential for production of phenolics with antioxidant activities. This study could pave the way for development biotechnological process for of *in vitro* production of valuable antioxidants from the Hypericum.

ID 112

Somoclonal variation and biological activity of suspension cultures of *Passiflora careluea*

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Background: *Passiflora caerulea* is a medicinal plant known for its rich content of biologically active secondary metabolites with pharmacological potential. Plant suspension cultures represent a promising biotechnological approach for the production of valuable metabolites. However, during cultivation in controlled *in vitro* conditions, plant cells can undergo changes in their metabolite profiles and productivities due to appearance of somaclonal variations.

Aims: The present study aimed to evaluate the influence of three different culture media on the biological activities and the frequence of somoclonal variability in suspension culture of *Passiflora caerulea*.

Methods: Suspension culture of *Passiflora caerulea* was established from callus line by transfer it on liquid medium for submerged cultivation. After initiation of cell suspension, the culture was transferred for cultivation three different liquid culture media, composed with different concentrations of growth regulators: A3 (MS, sucrose, NAA, KIN), A7 (MS, sucrose, NAA, KIN), and WP15 (WP, sucrose, KIN, PIC). The cultures were cultivated with a sub-cultivation period of 7 days on a laboratory shaker (110 rpm) at 26°C in the darkness for a period of more than six months. Six inter-simple sequence repeat (ISSR) markers (UBC-808, UBC-809, UBC-807, UBC-811, UBC-827, UBC 856) were used to determine the appearance of somoclonal variations among the obtained cultures. In addition, several analyses were conducted, including determination of the antioxidant activity, total phenolic content, tyrosinase inhibitory activity and HPLC profiling of the metabolites.

Results: Results have shown that different composition of culture media lead to differences in content of total phenolics, biological activities (antioxidant activity, tyrosinase inhibitory activity) and HPLC profiles. 5 from 6 of the used ISSR markers were able to detect genetic variability in *Passiflora caerulea* cell suspension, cultivated on different culture media.

Conclusions: The results showed that culture medium composition significantly influences both genetic stability and secondary metabolite production in *Passiflora caerulea* suspension cultures. The study demonstrates the potential of *in vitro* suspension cultures as a source of biologically active compounds and highlights the importance of monitoring somoclonal variation during long-term cultivation.

Acknowledgements: This work was supported by the Bulgarian National Science Fund, Bulgarian Ministry of Education and Science, under the contract No. KP-06-M86/3; BG-175467353-2024-10-0027-C01.

ID 113

Effect of carbon source on growth and antioxidant activity of suspension culture of *Passiflora caerulea* L.

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Background: Plants are the largest source of valuable secondary metabolites with unique structures and remarkable biological activities. The advance in plant cell culture technology now made it possible to produce plant-derived active ingredients by culturing callus and suspension cultures in a controlled environment. However, the optimization of cultivation conditions, as well as the composition of culture medium are crucial for improvement of economic feasibility of such biotechnological process. *Passiflora caerulea* L. is popular in traditional medicine and its extracts are widely used as a sedative, anti-inflammatory, anxiolytic, antispasmodic, antihypertensive, antimicrobial and diuretic remedy.

Aims: The aim of this study was to evaluate the effects of different carbon sources (sucrose, glucose, fructose and lactose) on the accumulated biomass and antioxidants production by cell suspension culture of *Passiflora caerulea* L.

Methods: For the experiment, the suspension was cultivated on a liquid MS (Murashige & Scoog) nutrient medium, supplemented with growth regulators NAA and KIN and different carbon sources - sucrose (A7), glucose (B1), fructose (B2) and lactose (B3) – in concentrations of 30 g/l. The cultivation was carried out on orbital shaker, operated at 110 rpm on temperature of 24±1°C, in darkness. The flasks were cultured for 16 days, then the biomass was separated and used to evaluate the growth and to prepare the extracts for phytochemical characterization and analyses of biological activities.

Results: The *Passiflora caerulea* L. cell suspension culture showed intensive in all investigated variants of nutrient medium - A7, B1, B2, and B3. The maximal amount of accumulated dry biomass (ADB = 7.4±1.2 g/L; GI = 2.03±0.33) were reached when the cells were cultivated on medium supplemented with lactose, whereas the lowest biomass was recorded on medium with glucose (ADB = 4.33±0.56 g/L; GI = 0.93±0.12). However, the highest total phenolic content and antioxidant activities were observed when the cells were grown on medium with sucrose as carbon source.

Conclusions: The *Passiflora caerulea* L. cell suspension culture could use sucrose, fructose and lactose as a carbon source which is important finding because of the possibilities to utilize different and cheaper carbohydrate, even for waste products, for *in vitro* production of valuable antioxidants.

Acknowledgements: This work was supported by the Bulgarian National Science Fund, Bulgarian Ministry of Education and Science, under the contract No. KP-06-M86/3; BG-175467353-2024-10-0027-C01.

ID 114

Dynamics of growth of *Passiflora caerulea* L. *in vitro* suspension cultures

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Background: Cellular agriculture is an emerging field of science that reveals wide opportunities for both fundamental and applied researches in agricultural science. Large scale cultivation of plant cells and tissue cultures under controlled conditions is an innovative technology that could provide an renewable and sustainable supply of targeted biologically active plant-derived metabolites with possible application as food additives, pharmaceuticals, cosmetic ingredients and raw biomass.

Passiflora caerulea L., also known as "blue passionflower", has been widely recognized for its therapeutic properties and used to improve human health from a long time. Compared to numerous studies of other species from the Passifloraceae family, those, performed with *Passiflora caerulea* L. *in vitro* cultures have been scare.

Aims: The aim of this study was to initiate cell suspension cultures from *Passiflora caerulea* L. and to evaluate their growth dynamics and biosynthetic potential for production of phenolic compounds with antioxidant activities.

Methods: Two lines of *Passiflora caerulea* L. cell suspensions were initiated by cultivation of calli on liquid MS (Murashige & Scoog, 1962) nutrient medium (A3 and A7), supplemented with 30 g/l, sucrose and different concentrations of plant regulators NAA and KIN. The cultivation was carried out for 26 days on an orbital shaker with a rotation speed of 110 rpm at temperature of 24±1°C, in dark conditions. The dynamics of accumulated dry biomass, changes in conductivity and pH of the culture medium, dynamics of consumption of phosphates, ammonium and nitrate ions, as well as the changes in antioxidant activities (DPPH, TEAC, CUPRAC and FRAP) have been analyzed.

Results: The data showed a significant difference in growth and secondary metabolite production between the *Passiflora caerulea* L. cell lines, cultivated on A3 and A7 liquid media. The maximum in accumulated dry biomass was reached on day 10 from the beginning of cultivation, whereas, the maximal accumulated biomass by cell line A7 was reached at day 14. However, the cell line A7 accumulates a significantly higher amount of biomass and showed higher antioxidant activities in comparison with the cell line A3. The targeted high-performance liquid chromatography analyses revealed that (-)-epicatechin, ferulic acid, rosmarinic acid and rutin were the major phenolic compounds in both *Passiflora caerulea* L. cell suspension cultures.

Acknowledgements: This work was supported by the Bulgarian National Science Fund, Bulgarian Ministry of Education and Science, under the contract No. KP-06-M86/3; BG-175467353-2024-10-0027-C01.

ID 115

Socio-economic barriers and capacity-building needs in sustainable post-harvest practices: A conceptual review

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Background: The transition towards sustainable and circular food systems is increasingly recognized as a critical priority. Within this context, post-harvest practices—encompassing storage, sorting, processing, and distribution—play a pivotal role in minimizing food loss and improving resource efficiency. However, while large-scale food operators often have the infrastructure to adapt, small and medium-sized enterprises (SMEs), local producers, and socially vulnerable groups frequently encounter significant structural, financial, and educational obstacles. These constraints prevent them from fully integrating sustainable approaches, thus creating a persistent gap between macro-level sustainability policies and micro-level practical implementation within local food supply chains.

Aims: This conceptual review aims to systematically identify and categorize the primary socio-economic barriers and specific training needs that hinder SMEs and vulnerable groups in the post-harvest phase. Furthermore, the study seeks to propose an inclusive capacity-building framework designed to bridge the existing discrepancy between theoretical awareness of circular economy principles and the actual organizational capacity required for their practical application in the food sector.

Methods: The research employs an analytical approach based on a comprehensive review of current scientific literature, European strategic policy documents, and the methodological framework of the TrueFoodS project. A conceptual synthesis was conducted to categorize existing constraints into financial, administrative, technological, and educational deficits. This desk-based approach is appropriate for the early stage of the project, where the main objective is to establish a conceptual and methodological basis for subsequent empirical work.

Results: The analysis delineates distinct categories of barriers impeding the ecological transformation of small food businesses. Financially, the burden of new technology acquisition and complex administrative regulations severely limits adaptive capacity. Educationally, the review indicates that traditional, standardized academic training models –may be insufficient when they are not adapted to the operational realities, time constraints and practical needs of SMEs and vulnerable actors. In response, the conceptual synthesis supports the necessity for a paradigm shift in capacity building. We propose a new conceptual model emphasizing short-

term, practically oriented training formats, direct on-site mentorship, and the co-creation of inclusive business strategies.

Conclusions: Overcoming the systemic barriers in food supply chains necessitates a transition from generic educational frameworks to targeted, field-based interventions. The proposed conceptual model provides a robust theoretical foundation for developing practical, accessible resources tailored to SMEs. Furthermore, it establishes a comprehensive preparatory groundwork for subsequent empirical investigations during the implementation phases of the TrueFoodS project.

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Valorization of sea buckthorn (*Hippophae rhamnoides* L.) oil: compositional quality and complementary characterization by GC, FTIR and NMR

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Background: Sea buckthorn (*Hippophae rhamnoides* L.) oil is a rich source of bioactive lipids and a promising ingredient for food and nutraceutical applications. Its composition depends on the anatomical fraction (pulp, seeds, press-cake by-products), which can differ markedly in fatty acid profile and quality indices. Comparative characterization of these fractions is therefore important for efficient valorization and for developing reliable tools for quality assessment.

Aims: This study aimed to determine oil content and fatty acid composition of sea buckthorn samples from Romanian plant material and commercial products, focusing on differences between pulp-, press-cake- and seed-derived oils. A further objective was to evaluate quality parameters calculated from fatty acid data (iodine and saponification values, nutraceutic indices) and to explore the complementary use of FTIR and NMR spectroscopy for rapid characterization and future authenticity and quality control.

Methods: Thirteen samples from the 2017-2021 harvests and two commercial sea buckthorn oils were analyzed, including pulp, press-cake, seeds and commercial formulations. Oil was obtained by continuous Soxhlet extraction with petroleum ether, transesterified to fatty acid methyl esters and analyzed by gas chromatography using a commercial FAME standard. Quality indices were calculated from the chromatographic results, while FTIR and proton NMR are envisaged for additional molecular fingerprinting.

Results: All samples contained minimum 3.5 g oil/100 g material, with maximum values around 9.2 g/100 g for selected pulp samples and 7.8 g/100 g for press-cake. Sea buckthorn oils were rich in unsaturated fatty acids, especially linoleic and linolenic acids, whereas palmitic and palmitoleic acids varied between fractions. Pulp oils showed the highest polyunsaturated fraction (above 64 mol%), while press-cake and seed oils had relatively higher palmitic and palmitoleic contents. Iodine and saponification values confirmed distinct compositional and quality patterns across fractions and commercial oils.

Conclusions: Sea buckthorn oils from different anatomical fractions are valuable lipid sources with distinct profiles in terms of saturated *vs* polyunsaturated fatty acids. The results support the valorization of pulp, seeds and processing by-products for food and nutraceutical uses, highlighting the potential of combining GC with FTIR/NMR for rapid screening, authenticity and quality control.

Acknowledgement: APC was funded by the National University of Science and Technology POLITEHNICA Bucharest through the PubArt program.

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ID 117

FTIR and ^{1}H-NMR Spectroscopic Evidence for the Presence of Non-Dairy Fats in Romanian Commercial Butter and Fat Spread Products

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Background: Butter is a high-value dairy product, frequently exposed to adulteration/partial substitution with cheaper non-dairy fats, creating the need for rapid reliable authentication methods. Conventional chromatographic methods are useful but require longer analysis time and more laborious sample preparation, whereas spectroscopic techniques can provide fast structural information for food quality control.

Aims: This study aimed to perform a preliminary comparative investigation of authentic butter samples and commercial spreadable fat products with/without added milk fat, identifying spectral characteristics that may serve as indicators of the presence of non-dairy fats.

Methods: A sample bank including authentic butter samples from recognized producers and commercial blended spreads [1] was created, and information regarding producer, ingredients, and labeling was recorded. Fat was extracted with dichloromethane to obtain anhydrous fat. The isolated fats were characterized by FTIR and ^{1}H-NMR spectroscopy after dissolution in $CDCl_3$. Transesterification into fatty acid methyl esters was also performed in preparation for gas chromatographic analysis.[2]

Results: FTIR spectra displayed typical lipid profile, including intense bands assigned to $C=O_{ester}$ vibrations $\approx$1700 cm^{-1}, methylene and methyl vibrations (2800-3000 cm^{-1} region), and a fingerprint region (1500-800 cm^{-1}) useful for authentication studies. The analyzed fats showed similar general ^{1}H-NMR patterns, but important differences were observed in signal intensities and integrals. Authentic butter showed a characteristic triplet at approximately 0.95 ppm, assigned to the terminal methyl group of butyric acid, a specific marker of milk fat. In commercial blended spreads, major differences were observed for signals assigned to polyunsaturated fatty acids, unsaturated fatty acids, and unsaturated protons. In products containing vegetable fats and a low proportion of butter, the butyric acid signal was reduced, while signals associated with unsaturated fatty acids, including *bis*-allylic protons, became more pronounced.

Conclusions: The results point out the combined use of FTIR and ^{1}H-NMR spectroscopy as a rapid and informative approach for butter authentication and for highlighting the addition of non-dairy fats in commercial blended spreadable products. The butyric acid signal at about 0.95 ppm appears to be a particularly useful authenticity marker for distinguishing genuine butter fat from blended spreads.

Acknowledgement: This work was supported by a grant of the Ministry of Research, Innovation and Digitalization, CNCS-UEFISCDI, project number PN-IV-P2-2.1-TE-2023-0756, within PNCDI IV. APC was funded by the National University of Science and Technology POLITEHNICA Bucharest through the PubArt program.

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ID 118

Optimization of the Extraction Method and Characterization of Bioactive Compounds from Fruit By-Products Valorization

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Background: The fruit processing industry produces a significant amount of waste annually, and its disposal is becoming increasingly costly, both financially and environmentally. Therefore, new possibilities for reducing the amount of waste in the fruit juice industry by their superior valorization in the form of biologically active compounds and their incorporation into new products are currently in the spotlight [1-2].

Aims: This study aimed to determine the total polyphenol content and antioxidant activity by optimizing the extraction parameters, thus leading to a higher utilization of the amount of vegetable waste resulting from the fruit processing industry (plums, apples, cherry plums and grapes). A further objective was the compositional characterization and comparison of different extracts by evaluating the biologically active compounds of different varieties (white *vs*. red) from different fruits and exploring their complementary use in new products with improved nutraceutical properties.

Methods: Extracts obtained from fruit skins harvested from the Romania were analyzed. The extracts were obtained after establishing the optimal parameters regarding: extraction method (magnetic stirring *vs* ultrasound), extraction time (ranging from 1 to 60 minutes), type of solvents used in different ratios (water or water: ethanol in 1:2, 1:1 or 2:1 ratio). In order to characterize the biologically active compounds of the resulting extracts, they were analyzed by the Folin-Ciocalteu method to determine the total polyphenol content and by the TEAC method to determine their antioxidant capacity. At the same time, the resulting extracts were quantified by dry evaporation of the solvents.

Results: The optimal extraction parameters are: the ratio of solvents H_2O:EtOH 2:1, magnetic stirring, for 30 minutes. The amount of total polyphenols of the samples ranged between 177.86-241.22 mg GAE/100g dry skin in the case of the white varieties, and between 298.11-311.03 mg GAE /100g dry skins in the case of the red varieties. The antioxidant capacity of fruit skin extracts varied between 13.43-24.29 mM Trolox/L, being favorable in the case of red varieties. The amounts of solid extracts resulting from vacuum evaporation fall within the range of 1.88-3.38 g S.U./100mL hydroalcoholic extract.

Conclusions: Hydroalcoholic extracts from different fruit peels are valuable sources of biologically active compounds, with distinct profiles in terms of total polyphenols and antioxidant capacity. The results support the

valorization of by-products from the fruit for food processing industry for new food, nutraceutical or cosmetic applications, highlighting the potential for the development of new products with superior properties.

Acknowledgement: APC was funded by the National University of Science and Technology POLITEHNICA Bucharest through the PubArt program. This work was supported by a grant of the Ministry of Research, Innovation and Digitalization, CNCS-UEFISCDI, project number PN-IV-P2-2.1-TE-2023-0756, within PNCDI IV.

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ID 119

Comparative Metabolomic Profiling of *Colchicum autumnale* and *Colchicum bivonae* in Temporary Immersion Systems Under Variable Regimes

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Background: Temporary immersion systems (TIS) represent an efficient platform for the in vitro cultivation of medicinal geophytes and can significantly influence the accumulation of primary and secondary metabolites. Among these metabolites, colchicine, predominantly produced by *Colchicum* species, is of considerable pharmaceutical importance. In our previous study, the immersion regime consisting of 15 min immersion every 4 h (4/15) proved to be the most effective for maximising colchicine production. However, the broader metabolic adjustments and species-specific biochemical responses under less frequent immersion regimes remain insufficiently understood.

Aims: This study investigated alterations in the metabolite profiles of *Colchicum autumnale* (Ca) and *Colchicum bivonae* (Cb) cultivated in automated TIS bioreactors under different immersion regimes.

Methods: Shoots of both species were cultured in TIS bioreactors with three biological replicates per treatment under two immersion regimes: 15 min immersion followed by either an 8 h (8/15) or a 12 h (12/15) stand-by period. Metabolite profiling was performed using GC–MS analysis.

Results: A total of 45 metabolites were identified and quantified, including amino acids, organic acids, sugars, sugar alcohols, fatty acids, and phenolic acids, revealing pronounced species- and treatment-dependent metabolic responses. The predominant metabolites detected in both species were sugars and amino acids. Overall, the 8/15 regime promoted greater metabolite accumulation than the 12/15 regime in both species. *Colchicum bivonae* showed enhanced accumulation of glucose-6-phosphate, fatty acids, and long-chain alcohol derivatives. In contrast, *C. autumnale* exhibited elevated levels of glutaric acid, arabitol, pyroglutamic acid, fructose, and galactose under the 8/15 regime, whereas increased levels of valine, and maltose were observed under the 12/15 regime.

Conclusions: The observed metabolic variations indicate that immersion frequency strongly influences carbon metabolism and the biosynthesis of storage- and stress-related compounds in *Colchicum* cultures. Although the 8/15 regime enhanced overall metabolite accumulation and stimulated specific biosynthetic pathways, neither extended immersion treatment surpassed the colchicine yields previously achieved under the 4/15 regime. These findings provide an important basis for the further optimisation of TIS-based biotechnological strategies aimed at the controlled production of high-value phytochemicals.

Funding: This research was funded by the Bulgarian National Science Fund (BNSF), grant number KP-06-H66/5.

ID 120

Effects of plant extract on quality and stability of mashed strawberries during storage

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Background: Strawberries are widely consumed fruits, valued for their nutrients, vitamins and phenolic compounds. Due to a relatively short shelf life, strawberries must be consumed fresh rapidly or processed. Commercially produced berry purees and jams often contain synthetic preservatives to prevent mold, yeast, and bacterial growth, thus extending shelf-life. However, possible negative sides to human health of such components are discussed, especially with wide use in many daily products, and synthetic preservatives ends as undesired by consumers. Meanwhile plant-based alternatives are extensively investigated for their preservation possibilities including quality maintenance. Clove extract is known for antimicrobial, antioxidant activities and has high potential for application of processed berry products shelf-life extension.

Aims: This study aimed to investigate the clove (*S. aromaticum*) extract effect on unpasteurized strawberry puree quality and stability parameters during storage.

Methods: Clove extract was emulsified with water using ultrasonic processor at 0.5% and 1% concentrations (v/v). Fresh, uniform-looking strawberries were surface sterilized and mashed to puree. Purees were supplemented with 5 ml per kg clove extract mixtures, and puree without extract served as control. Purees were stored at 4°C and measured for quality ant stability parameters at days 0, 3 and 7. Total soluble sugars (TSS) content and pH were observed as general parameters of stability. Biochemical quality was expressed in total phenolic content (TPC), which was measured using Folin-Ciocalteu method. Microbiological quality was investigated by plating serialy diluted samples on sterile medium and calculating microorganisms' colony forming units (CFU/ml).

Results: Results revealed increased TPC values at 3 and 7 days of storage, where the most preserved release of phenolic compounds was observed in puree with 0.5% of clove extract mixture (from 188.63 mg/100 g to 197.45 mg/100 g), while in puree with 1% TPC increased from 171.30 mg/100 g to 196.63 mg/100 g and from 186.25 mg/100 g to 212.67 mg/100 g in puree without extract. No significant differences in total soluble sugars and pH values were found between purees during storage. Microbiological quality evaluations showed reduced CFU values in both purees with clove extract: $7,8 \times 10^3$ and $2,3 \times 10^3$ CFU/ml in 0.5% and 1% respectively, compared to control ($1,1 \times 10^5$ CFU/ml).

Conclusions: Supplementing fresh strawberry purees with different concentrations of clove extract demonstrated maintained quality and stability parameters and observed promising microbiological quality extension possibilities.

ID 121

Bioactive postbiotic fractions produced by probiotic lactic acid bacteria and their functional properties

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Background: Postbiotics are non-viable products of microorganism cultivation, including cell-free supernatants, cell wall components, and intracellular metabolites released by probiotic bacteria. They have attracted attention as a novel class of bioactive compounds because they retain the beneficial effects of probiotics without the risks associated with live microorganisms. Due to their stability, safety, and ease of standardization, postbiotics are promising candidates for applications in food, pharmaceutical, and biomedical fields.

Aims: This study aimed to evaluate methods for obtaining postbiotic fractions from lactic acid bacteria, as no optimal method has been established to date.

Methods: Two methods were used to obtain postbiotic fractions from probiotic lactic acid bacteria culture of *Limosilactobacillus fermentum* TC 3-11: heat treatment (75 °C and 95°C for varying time intervals) and repeated freeze–thaw cycles using liquid nitrogen. Effectiveness was evaluated by viable cell counts (CFU/mL) and pH monitoring. DPPH assay was used to assess antioxidant activity, and protein concentration was measured using the Bradford assay.

Results: No significant reduction of the viability was observed after 15–30 s of heat treatment at both temperatures. After prolonged exposure, counts decreased by 6 logs after 20 min at 75°C and by 7 logs after 10 min at 95°C. Freeze–thaw treatment reduced the viability by 4 logs after five cycles. A slight pH decrease accompanied the increase in cell inactivation in all types of treatment. Protein concentration decreased by 5–10 µg/mL after 20 min at 75°C and 10–15 µg/mL after 10 min at 95°C, while freeze–thawing caused an increase by 5–10 µg/mL. DPPH activity increased by 21% after 20 min at 75°C and by 20% after 10 min at 95°C, while freeze–thawing produced only a slight increase of 3% after the five cycles of treatment.

Conclusions: Both methods resulted in a significant reduction in cell viability following treatment, and postbiotic fractions were successfully produced using both approaches. Heat treatment at 75 and 95°C ensured higher inactivation and the highest antioxidant increase, but may involve key protein loss through denaturation and unpredictable cell inactivation kinetics. Freeze–thawing using liquid nitrogen provided milder, gradual inactivation and increases in protein and antioxidant activity, likely due to the intended cell lysis and release of intracellular components.

Acknowledgements: This work was supported by SU-project 80-10-185/22.04.2026. The support of the Centre of Competence "Sustainable Utilization of Bio-resources and Waste of Medicinal and Aromatic Plants for

Innovative Bioactive Products" (BIORESOURCES BG), project BG16RFPR002-1.014-0001, funded by PRIDST 2021-2027, co-funded by the EU, is greatly acknowledged.

ID 122

Antioxidant Activity of Combinations of Fermented Plant Milk Supernatants and Green Tea Extracts: *In Vitro* and *In Vivo* Evaluation for Cosmeceutical Applications

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Background: Natural antioxidants have emerged as promising candidates for cosmeceutical applications due to their potential to mitigate oxidative stress-related skin damage. Lactic acid bacteria-fermented plant-based milks and green tea extracts represent valuable sources of antioxidant bioactive compounds for the development of novel cosmeceutical formulations.

Aims: The aim of this study was to evaluate the *in vitro* and *in vivo* antioxidant activity of supernatants obtained from lactic acid bacteria-fermented soy and almond milk, as well as their combinations with green tea extracts, and to assess their potential for cosmeceutical applications.

Methods: Cell-free supernatants obtained from soy and almond milk fermented with *Lactobacillus delbrueckii* subsp. *lactis* VG2 and *Limosilactobacillus fermentum* TC3-11 were collected immediately after fermentation and after 24h of refrigerated storage, while the resulting products were microbiologically and physicochemically characterized. Aqueous and ethanolic green tea extracts were evaluated for total polyphenol and flavonoid content. The antioxidant activity of both extracts and supernatants was assessed by the DPPH radical scavenging assay and growth curve analysis using *Saccharomyces cerevisiae* as a model system under oxidative stress conditions. Supernatant–extract combinations were additionally tested to investigate potential synergistic effects.

Results: In the DPPH assay, supernatants collected after 24 h of refrigerated storage exhibited higher antioxidant activity than those obtained immediately after fermentation and were therefore selected for subsequent analyses. Among them, soy milk-derived supernatants showed stronger radical scavenging activity (>50% inhibition) than almond milk-derived samples. The ethanolic green tea extract exhibited higher total polyphenol and flavonoid contents (179 µg GAE/mL and 110 µg QE/mL, respectively) than the aqueous extract (62 µg GAE/mL and 54 µg QE/mL), which was consistent with its lower IC_{50} antioxidant value (approximately 17.5 µg dry weight/mL compared to 75 µg dry weight/mL for the aqueous extract). In the *S. cerevisiae* oxidative stress model, however, aqueous extracts and their combinations with fermented milk supernatants promoted stronger growth recovery, approaching the positive control and suggesting potential synergistic interactions.

Conclusions: The observed antioxidant effects of fermented plant milk supernatants, particularly in combination with green tea extracts, support their potential use as bioactive ingredients for cosmeceutical applications.

Acknowledgements: This work was supported by SU-project 80-10-202/22.04.2026. The support of the Centre of Competence "Sustainable Utilization of Bio-resources and Waste of Medicinal and Aromatic Plants for

Innovative Bioactive Products" (BIORESOURCES BG), project BG16RFPR002-1.014-0001, funded by the PRIDST 2021-2027, co-funded by the EU, is greatly acknowledged.

ID 124

Antioxidant Activity of Hops for 10 Genotypes with Increasing Alpha-Acid Content and Nutraceutical Potential

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Background: Scientific Hops are a perennial climbing plant from which hop cones are harvested. They contain three groups of chemical compounds of great interest due to their biological and nutraceutical activity: essential oils and their terpenic compounds; bitter resins; and prenylflavonoids. There are currently around 300 varieties of hops; 10 varieties from 6 countries with progressive alpha-acid percentages were selected.

Aims: To determine whether the % of alpha acids influences total antioxidant capacity,

To identify, from the 10 hops studied, which genotypes exhibit greater antioxidant activity.

To ascertain whether greater heat treatment influences the antioxidant response.

To understand the differences between craft beer and aqueous hop extracts in terms of antioxidant capacity.

Methods: An experimental flowchart was used to determine total antioxidant activity, based on the method of measuring the decrease in absorbance using the radical generated from 2,2'-azino-bis-(3-ethylbenzothiazoline-6-sulfonic acid), known as ABTS

Results:

- The samples showed a lower absorbance, that is, a lower oxidation:
  1. M11 = Citra hop < Tº (70 a 80 ºC)
  2. M4 = Motueka hop Tº (80 a 90 ºC)
  3. M2 = Saaz hop (80 a 90 ºC)
- Ascorbic acid was (mM):
  1. M11 = 3,145 Ac. ASC
  2. M4 = 2,603 Ac. ASC
  3. M2 = 2,142 Ac. ASC
- Interpreting the decrease in absorbance as a reduction in the colour of the blue chromophore, i.e. less oxidation, starting from the maximum oxidation obtained with the standard = 0.625 *absorbance*.

We have that: There is antioxidant activity in all samples and the % of AAT in M11, M4 and M2 is higher than in the rest. Results from M1 to M12 samples, ATT %:

Hallertau	Saaz	Zappa	Motueka	Centennial	Sorachi	Mosaic	Citra	Vic Secret	Topaz	T.T.citra	CAcitra
1	2	3	4	5	6	7	8	9	10	11	12
33,31%	47,71%	18,11%	58,69%	27,52%	23,07%	29,70%	38,11%	35,94%	32,51%	71,70%	

Conclusions: There is no direct correlation between the % of alpha acids in hops and AAT

• All 10 hop genotypes studied express AAT.

• Two hop varieties stand out: MOTUEKA hops with 58.69% and SAAZ hops with 47.71% AAT.

• The heat treatment applied during extraction influences AAT, as can be seen by comparing the M8 sample (38.11%) with the M12 sample (71.70% AAT); both contain the same CITRA hops and the same concentration of 3 g/L, but differ by 10 °C in the heat treatment applied. This results in 34% more AAT in M11 with 10 °C less heat.

• The craft beer was brewed with CITRA hops = M12, which have antioxidant capacity, with an AAT of 26.85%.

ID 125

Staphylococcus aureus in the Food Chain: Assessing Contamination Pathways and Public Health

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Background: *Staphylococcus aureus* remains a premier global public health threat, acting as a major cause of foodborne illnesses. This bacterium thrives in diverse environments and contaminates food systems during processing, storage, and handling. The ingestion of preformed staphylococcal enterotoxins (SEs) in food leads to rapid-onset staphylococcal food poisoning (SFP).

Aims: This literature review synthesizes recent scientific data regarding the prevalence, enterotoxin diversity, and antimicrobial resistance (AMR) profiles of *S. aureus* within the global food supply chain.

Methods: A comprehensive search of peer-reviewed literature from the past decade was conducted across databases including PubMed, Science Direct, and Google Scholar. The review focused on studies evaluating *S. aureus* contamination in raw and processed foods, including dairy, meat, and ready-to-eat products. Data on enterotoxin gene distribution and phenotypic antibiotic resistance patterns were extracted, categorized, and analyzed to identify global trends.

Results: The literature confirms a high prevalence of *S. aureus* in artisanal dairy products and poultry. While classic enterotoxins (SEA to SEE) remain responsible for most SFP outbreaks, recent studies highlight a rising prevalence of newer enterotoxins (SEG to SEIU) in food isolates. Alarmingly, the data reveals a significant increase in multidrug-resistant (MDR) *S. aureus* strains within the food chain. Methicillin-resistant *S. aureus* (MRSA) is increasingly isolated from livestock and retail meats, posing a zoonotic risk to consumers and food handlers. Furthermore, biofilm formation on food processing surfaces emerged as a critical factor driving persistence and sanitization failure.

Conclusion: *Staphylococcus aureus* contamination in the food sector is an evolving challenge characterized by complex enterotoxin profiles and escalating antimicrobial resistance. Traditional preservation methods are often insufficient against heat-stable enterotoxins and biofilm-associated cells. The findings emphasize the urgent need for stricter hygiene protocols, improved cold-chain management, and routine surveillance of AMR strains from farm to fork. Implementing molecular screening for novel enterotoxins is essential to accurately assess food safety risks and protect public health.

ID 126

Foodborne Toxoplasmosis: Assessing Transmission Pathways, Risk Factors, and Prevention Strategies in the Modern Food Chain

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Background: *T. gondii* is a cosmopolitan protozoan parasite that infects approximately one-third of the global human population. While traditionally associated with feline contact, contemporary epidemiological data indicate that foodborne transmission is a primary driver of human infections.

Aims and methods: This abstract reviews the current landscape of foodborne toxoplasmosis, focusing on transmission vectors, high-risk dietary habits, and emerging control strategies within the global food supply chain. A comprehensive search of peer-reviewed literature from the past decade was conducted across databases, including PubMed, Science Direct, and Google Scholar.

Results: Humans acquire foodborne toxoplasmosis primarily through two routes: the ingestion of tissue cysts in undercooked or raw meat from infected animals, and the consumption of infective oocysts contaminating fresh produce, soil, or drinking water. Among meats, pork, lamb, and wild game represent the highest risk categories due to extensive livestock exposure to outdoor environments where wild or domestic felines shed oocysts. Concurrently, the rising consumer demand for organic, free-range meat elevates the prevalence of *T. gondii* cysts in livestock, challenging standard intensive farming biosecurity protocols. In addition to meat, fresh produce has emerged as a significant vehicle for outbreaks. Ready-to-eat salads and berries are frequently contaminated via irrigated water or agricultural runoff containing robust oocysts, which resist standard chemical sanitization. Clinical manifestations of foodborne infection range from asymptomatic presentations to severe ocular or neurological damage in immunocompromised individuals. Furthermore, primary gestational infection poses severe congenital risks, including miscarriage, stillbirth, or permanent fetal neurological deficits. Mitigating this public health threat requires a multidisciplinary One Health approach integrating veterinary medicine, food science, and consumer education. Traditional meat inspection methods, such as visual inspection and palpation, are entirely ineffective for detecting microscopic tissue cysts. Consequently, industrial mitigation relies on freezing techniques (at least -12°C for three days) or thermal processing (internal temperatures reaching 67°C) to reliably inactivate cysts. Emerging technologies like high-pressure processing (HPP) and gamma irradiation offer promising, non-thermal alternatives that preserve food quality while ensuring safety.

Conclusions: Reducing the global burden of foodborne toxoplasmosis necessitates stricter pre-harvest biosecurity, optimized post-harvest processing, and targeted public health campaigns. Educating vulnerable populations—specifically pregnant individuals and immunocompromised patients—on safe food handling, thorough meat cooking, and rigorous produce washing remains the cornerstone of immediate prevention. Continued research into standardized diagnostic tools for food matrices is vital to establishing robust regulatory frameworks.

ID 127

Occurrence and method optimization for quantification of PFAS in wild-foraged *Rubus fruticosus* near an industrial point source

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Background: The 3M fluorochemical plant (FCP) near Antwerp (Belgium) is a well-documented PFAS point source, with elevated PFAS levels reported in soil and homegrown crops (vegetables and fruits) in nearby areas. Yet, wild fruit plants common to the area, such as *Rubus fruticosus* (common blackberry), represent a poorly characterized dietary exposure pathway for both humans and terrestrial wildlife. Hence, investigation of PFAS accumulation in these species is a matter of food safety concern.

Aims: This study aimed to (i) develop and optimize an analytical method for quantification of PFAS in *R. fruticosus* collected near the 3M FCP, and (ii) determine PFAS levels and profiles to assess uptake and implications for human dietary exposure.

Methods: For method optimization, six treatment combinations were assessed through composite desirability scores, based on spiked (native PFAS) recoveries, repeatability (relative standard deviations; RSD), and internal standard (IS) recoveries. Homogenized fruits (50 mg) were extracted with either 1% ammonium hydroxide (NH_4OH) in 4:1 methanol (MeOH)/ethyl acetate (EtAc) or 1% NH_4OH in MeOH, followed by vortex mixing (1 min), sonication (30 min), and centrifugation (4,000 rpm, 10 min). Sequential clean-up used Envicarb (25 mg) or solid-phase extraction (SPE; GCB-WAX or OASIS-WAX). PFAS quantification employed UHPLC-MS/MS (Agilent 1290/6495) in ESI(-)/MRM mode.

Results: Extraction with 1% NH_4OH in 4:1 MeOH/EtAc, Envicarb clean-up) ranked highest (composite score: 1.0; mean spike recovery: 87.7%; RSD: 1.95%; IS recovery: 64.1%). EtAc addition improved recoveries for ether-PFAS, perfluoroalkyl sulfonamides (FASAs), and perfluoroalkyl sulfonamidoacetic acids (FASAAs), while WAX-based clean-up reduced the recoveries for long-chain perfluoroalkyl sulfonic acids (PFSAs) and precursors. Using the optimized method for the subsequent analysis of nine berries, total PFAS (detected 10 out of the 39 target analytes) ranged from 16 to 150 ng/g (mean: 58 ng/g). Short-chain perfluoroalkyl carboxylic acids (PFCAs) dominated (max: PFBA: 144 ng/g; PFPeA: 45 ng/g), followed by PFOA. PFOS was ubiquitous (detection frequency=100%) but at lower concentrations (0.2–3.5 ng/g). Precursors, such as FASAs (FBSA, FOSA), Et-FOSAA, and diSAmPAP, previously identified in soil samples from the same area, were also detected. Hierarchical clustering (Bray-Curtis) showed spatially coherent PFAS profiles among geographically proximate samples.

Conclusions: PFAS concentrations measured in *R. fruticosus* were significantly higher than in other fruits and vegetables previously collected from nearby sites. This confirms non-negligible soil-to-plant transfer under highly contaminated conditions, which may contribute to cumulative dietary exposure, particularly among frequent foragers. However, these findings are context-specific, as PFAS uptake may differ outside heavily contaminated zones.

ID 129

Creating a virtual laboratory for food image analysis - Review

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Background: Modern training methods include online training in synchronous and asynchronous form. For this purpose, it is necessary to create special platforms to provide an attractive theoretical module, combined with a precise practical course. An electronic laboratory includes virtual tools, prepared assignments, work instructions, solved examples, chatbots for communication, etc.

Aims: This article examines modern methods for creating virtual laboratories in various fields of science. The goal is to create and adapt modules for equipping a virtual laboratory for technical vision and food image processing.

Methods: A literature review of contemporary scientific developments and publications on virtual laboratories in various disciplines is conducted. The methods used for equipment and work with software laboratory platforms are described..

Results: The survey study is about creating a modern, functional and promising laboratory for conducting objective, non-contact, non-destructive experiments for food analysis based on their images..

Conclusions: The main advantages of using a virtual laboratory are that it does not set a time frame for conducting experiments. Everyone works at their own pace at a time convenient for them. The learner can analyze food images an unlimited number of times. They can store, check and analyze the results obtained. Creating a virtual laboratory in image processing training significantly increases the interest and engagement of the learners.

ID 130

Development of fermented industrial hemp leaf extracts using kefir grains and assessment of their antioxidant activity

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Background: Industrial hemp (*Cannabis sativa* L.) leaves are a valuable source of bioactive compounds with potential applications in functional foods. Enzyme-assisted extraction (EAE) is an effective approach for improving the release of phenolic compounds from the plant cell wall matrix. Tibetan kefir grains contain a complex microbial consortium, dominated by *Lactobacillus kefiranofaciens*, *Acetobacter fabarum*, *Acetobacter persici*, *Lacticaseibacillus paracasei*, *Lentilactobacillus kefiri*, *Leuconostoc pseudomesenteroides*, *Leuconostoc citreum*, *Ewingella americana*, and *Gluconobacter cerinus*, capable of further releasing and transforming phenolic compounds through fermentation. However, the efficiency of this process depends on fermentation conditions and substrate characteristics.

Methods: Industrial hemp leaves were dried at 40 °C and milled to a particle size of >0.5 mm. EAE was performed under previously optimized conditions (45 °C, pH 4.9, 195 min, solid-to-liquid ratio 1:10, w/v) using Viscozyme L (≥100 FBGU/g) cellulolytic enzyme mixture. The extracts obtained were separated into supernatant and residue-containing fractions. Tibetan kefir grain water was prepared by fermenting a 5% (w/v) sucrose solution with 10% (w/v) Tibetan kefir grains for 72 h at 30 °C. Extract fractions were mixed with kefir grain water at extract-to-kefir water ratios of 80:20, 50:50, and 20:80 (v/v) and subsequently fermented for 48 h at 30 °C. Following fermentation, samples were filtered and stored at −20 °C until analysis. Total phenolic content (TPC) was determined using the Folin–Ciocalteu method, while antioxidant activity was evaluated using $ABTS^{\bullet+}$ and $DPPH^{\bullet}$ radical scavenging assays.

Results: Fermentation significantly affected the phenolic composition and antioxidant properties of industrial hemp leaf extracts. The highest total phenolic compound content was detected in the non-fermented enzyme-assisted extract. The highest antioxidant activity was observed in extracts fermented with an 80:20 (v/v) extract-to-kefir grain water mixture, showing 1.3 times higher $ABTS^{\bullet+}$ activity and 2.8 times higher $DPPH^{\bullet}$ activity compared to the non-fermented EAE extract.

Conclusions: Overall, fermentation conditions significantly influenced the recovery of phenolic compounds and antioxidant properties of industrial hemp leaf extracts. The 80:20 (v/v) extract-to-kefir grain water mixture showed the most favorable results, indicating its potential for producing antioxidant-rich functional ingredients.

Acknowledgement: This project has received funding from the Research Council of Lithuania (LMTLT), agreement No. S-MIP-24-75.

ID 131

Resistant Starch Formation and Prebiotic Potential of Selected Plant-Based Raw Materials Subjected to Single and Repeated Retrogradation Cycles

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Background: Resistant starch (RS) has gained increasing attention in recent years due to its physiological benefits and prebiotic properties. Unlike digestible starch, resistant starch resists enzymatic digestion, and reaches the colon, where it is fermented by beneficial microbiota. Starch's thermal treatment followed by cooling promotes retrogradation results in the formation of RS3-type resistant starch, while lipid-containing matrices may facilitate the formation of amylose–lipid complexes (RS5). As plant-based raw materials vary considerably in their composition, understanding the influence of their major components on RS generation is essential. Moreover, versatile processing conditions may largely affect the potential for functional food development.

Aims: The aim of this study was to compare the RS-forming potential of seven plant-based flours (black rice, potato starch, chickpea, tapioca starch, purple corn, green banana, tiger nut). Particular attention was paid to monitor the effects of (repeated) retrogradation on RS formation, and the change in prebiotic potential.

Methods: Aqueous solutions were subjected to gelatinization at 65, 95, 140 °C for 5, 15, 30 minutes. Native samples, single-retrograded samples, and double-retrograded samples were prepared. Retrogradation was induced by storage at 4 °C for 24 h following thermal treatments. Total starch, digestible starch, and RS fractions were determined using enzymatic hydrolysis with pancreatic α-amylase and amyloglucosidase. Retrogradation indices and resistance ratios were calculated based on glucose-contents and starch-fractions. Prebiotic potential of samples was assessed using Ipreb and PAS indices involving probiotic and pathogenic indicator strains.

Results: Green banana flour exhibited the highest native RS content, whose RS levels were increased substantially following retrogradation treatments. Potato starch and tapioca starch also demonstrated considerable RS-formation capabilities, particularly after repeated retrogradation cycles. Higher processing temperatures (95 and 140 °C) generally promoted fortified RS-generation, compared to milder treatments. Double retrogradation resulted in further increase in RS content, indicating enhanced molecular reorganization and recrystallization of starch chains. Complex matrices containing diverse bioactive compounds, such as chickpea, black rice, and purple corn flours, showed moderate resistant starch formation, suggesting matrix-related limitations in starch transformability.

Conclusions: Raw materials' quality, as well as thermal processing conditions strongly influence RS formation. Green banana flour proved to be the most promising source of RS, while potato and tapioca starch also showed excellent retrogradation potential. Higher temperatures and repeated retrogradations significantly enhance RS content. These findings support the potential of the examined materials for development of functional food with improved prebiotic properties.

ID 132

Assessment of the prebiotic potential of enzyme-modified plant components using selected *Lactobacillus* strains

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Background: Plant-derived raw materials contain substantial amounts of non-digestible polysaccharides that can be converted into prebiotic oligosaccharides through enzymatic hydrolysis. The application of cellulase and xylanase may increase the concentration of fermentable carbohydrates promoting the growth of beneficial Lactobacillus strains, leading to enhanced prebiotic capabilitties. Previous studies demonstrated the oligosaccharide-forming potential of enzymatic treatments, however prebiotic features of the degradates haven't been revealed. In the present study, prebiotic activities of enzymatic degratdates are evaluated using multiple Lactobacillus species.

Aims: We aimed to evaluate the prebiotic potential of enzymatically generated hydrolysates obtained from various plant-derived raw materials following cellulase and xylanase treatments. The growth-promoting effects of the resulting hydrolysates were assessed using *Lactobacillus rhamnosus*, *Lactobacillus pentosus*, and *Lactobacillus casei*, with particular emphasis on strain-specific responses to the modified carbohydrate profiles.

Methods: The prebiotic potential of hydrolysates obtained from oat, amaranth, buckwheat, rye, and chickpea by means of cellulase- and xylanase-treatments was investigated. Following enzymatic degradation, the hydrolysates were applied in MRS broth and inoculated with overnight cultures of *Lactobacillus rhamnosus*, *Lactobacillus pentosus*, and *Lactobacillus casei*. After incubation at 37 °C for 6 hours, bacterial growth was quantified by plate count analysis and expressed as colony-forming units (CFU/mL).

Results: It was demonstrated that enzyme-induced modifications of carbohydrate profiles influenced the growth of all the investigated Lactobacillus strains. In general, cellulase-generated hydrolysates exhibited stronger growth-promoting effect than those obtained by xylanase treatment. Among the tested substrates, cellulase-treated rye produced the most favorable growth responses in Lactobacillus pentosus and Lactobacillus casei, whereas the growth of Lactobacillus rhamnosus was stimulated most effectively by cellulase-treated buckwheat. Hydrolysates obtained by xylanase treatment also supported bacterial proliferation, however, their stimulatory effects were generally less pronounced. Significant differences were observed among both the applied enzymes and the investigated plant-derived substrates. Furthermore, the examined Lactobacillus strains utilized the carbohydrate fractions generated during enzymatic hydrolysis with varying efficiencies, highlighting the strain-specific nature of the observed prebiotic activities. All the treatments resulted in significantly higher bacterial counts than the controls.

Conclusions: Our results confirmed that enzymatic hydrolysis of plant-derived polysaccharides can generate carbohydrate fractions capable of selective stimulation of beneficial *Lactobacillus* strains. The observed prebiotic effects highlight the importance of microbiome composition, as well as substrates' quality and

way of enzymatic treatment. Our findings in terms of establishment of specific treatments of raw materials therefore may lay the foundation for plausible functional food applications and prebiotic product developments.

ID 134

Protective potential of a wheat sourdough-derived *Lactiplantibacillus plantarum* strain against foodborne pathogens

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Background: Fermented cereal products are a valuable source of lactic acid bacteria with possible application as starter, adjunct or protective cultures. Among them, *Lactiplantibacillus plantarum* strains are of particular interest because of their adaptability to different food substrates and their ability to produce metabolites that suppress undesirable pathogenic or spoilage microorganisms. In this context, wheat sourdough isolates represent a promising but still insufficiently explored resource for the development of starters for safer functional cereal-based and non-cereal based foods.

Aims: The aim of the present study was to assess the inhibitory activity of *Lactiplantibacillus plantarum* LBRRPP2, isolated from wheat sourdough, against selected foodborne and opportunistic pathogenic bacteria. The study focused on the relationship between the growth of the lactic acid bacteria strain, acidification of the medium and reduction of pathogen viability.

Methods: The antimicrobial effect of *L. plantarum* LBRRPP2 was studied by co-cultivation with each of the selected pathogens: *Escherichia coli* ATCC 25922, *E. coli* ATCC 8739, *Staphylococcus aureus* ATCC 25293, *S. aureus* ATCC 6538P, *Salmonella enteritidis* ATCC 13076, *Salmonella abony* NTCC 6017 and *Enterococcus faecalis* ATCC 29219. The microorganisms were cultivated at 37±1°C for up to 60 h, both separately and in mixed cultures of *L. plantarum* LBRRPP2 and each of the pathogens. Every 12 hours viable cell counts of the lactic acid bacteria strain and the test microorganisms were determined by serial dilution and surface plating. Titratable acidity was measured by the Thorner method. All experiments were carried out in triplicate, and the results were statistically processed.

Results: *L. plantarum* LBRRPP2 grew well in the mixed cultures and clearly affected the survival of all tested microorganisms. A complete reduction of viable cells of all pathogens during co-cultivation at the 60th hour was observed. The decrease in the pathogen counts coincided with a considerable increase in titratable acidity, suggesting that the accumulation of organic acids played an important role in the inhibitory effect. However, the broad spectrum of activity also indicated that other antimicrobial metabolites produced by the strain may have contributed to the observed suppression.

Conclusions: The wheat sourdough isolate *Lactiplantibacillus plantarum* LBRRPP2 showed strong antagonistic activity against *Escherichia coli*, *Staphylococcus aureus*, *Salmonella enteritidis*, *Salmonella abony* and *Enterococcus faecalis*. The results support its potential use as a protective culture or adjunct culture in

fermented foods, especially where natural preservation and improved microbial safety are desired. Further studies should evaluate its technological performance and antimicrobial activity in real food matrices.

Acknowledgement: This research was funded by project BG16RFPR002-1.014-0012-C01 "Establishment and sustainable development of a Center of competence „Agrifood systems and bioeconomy", financed by the European Regional Development Fund through the Bulgarian Operational Programme „Program for Research, Innovation and Digitalisation for Smart Transformation" (PRIDST).

ID 135

Consumption and perception of coffee substitutes – is there market potential?

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Background: Coffee consumption is decreasing slowly while alternative options are making their way into the mainstream. Coffee substitutes are designed to replicate the taste and experience of traditional coffee without caffeine, based on a variety of plant-based alternatives such as chicory root, barley, dandelion, and roasted grains. The mean annual growth of coffee substitutes is projected at 5.7%, with wellness-oriented lifestyle being the main driver behind this change.

Aims: The aim was to get insight into consumption frequency, awareness and perception of coffee substitutes available on the Croatian market.

Methods: An observational study based on the study-specific questionnaire included 105 adults (age 20-75 years), 85.5% women and 14.3% men, regardless of their health status (50.5% had no health issues). The questionnaire was developed based on the existing literature in an open-source application, and was completely anonymous. The recruitment of study participants was done through social media channels.

Results: The majority of study participants do not consume coffee substitutes (56.2%), while 19.0% are regular consumers. Those who are not consumers said that the main reason for that is that they forget about it (45.0%), 21.7% said they dislike the taste and 33.3% said they never tried coffee substitute. Among consumers, the majority (52.4%) stated they prefer instant option. After asked whether they would buy a new coffee substitute product on the market 26.0% said they would, 55.8% maybe and 18.3% said no.

Conclusions: Consumption of coffee substitutes is low, but the reasons behind non-consumption clearly show the potential for market development and producers who, in addition to product development, should also work on awareness/informing consumers about available products and their health benefits.

Acknowledgement: This research was conducted as part of project ISKRA PK.1.1.12.0222, co-founded by the European Union under the “Competitiveness and Cohesion” programme for the 2021–2027 programming period.

ID 137

Innovative approaches to obtain tested products with functional plant components

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Background: Driven by global market trends toward functional foods and alternative proteins, this study investigates the development of novel protein blends. Specifically, formulations and processing technologies were established for three distinct ratios of a composite blend featuring almond protein, hemp protein, collagen, and chia seeds.

Aims: The study aims to developan innovative technology for sponge cakes enriched with a functional component, based on the determined biological activity, physicochemical characteristics, amino acid composition, CIE-lab color spectra, water and oil retention capacities, total phenolic compounds, in vitro antioxidant activity and Vitamin C content (titrimetric) of protein blends.

Methods: An innovative technology was used to create new products, which are sponge cakes enriched with functional protein blends with almond and hemp protein, collagen and chia in different ratios. A comparative method of the new products with the sponge cake control (dough control) was used.

Results: Experimental results were obtained for physicochemical properties, antioxidant activity, amino acid composition, textural, sensory and microbiological characteristics of sponge cakes containing different concentrations of protein blends.

Conclusions: Physicochemical and quality evaluations revealed that the incorporation of the functional protein blends (almond, hemp, collagen, and chia) significantly increased both the specific gravity and volume of the sponge cakes. A dose-dependent increase in total mineral content was observed at higher blend incorporation levels. Regarding hydration properties, the water absorption capacity of the cakes decreased with increasing concentrations of chia-free protein blends, whereas formulations dominated by hemp protein exhibited the highest water retention. Sensory profiling demonstrated that formulations excluding hemp protein achieved the highest consumer acceptability, maintaining color, aroma, taste, and shape scores closest to the control sample.

Acknowledgement: This work was supported and funded by the Science Fund of the University of Food Technologies, project no. 06/25H.

ID 138

Maltitol as potential plasticizer in pectin and sodium caseinate biopolymer films for edible and active packaging applications

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Background: Biodegradable and edible biopolymer films have attracted increasing attention as sustainable alternatives to conventional plastic packaging materials. Glycerol widely used as a plasticizer in edible films, however its high hygroscopicity may compromise film stability under humid conditions. Maltitol, a food-grade sugar alcohol approved for human consumption could possibly serve as alternative plasticizer for both edible and biopolymer packaging systems.

Aims: The aim of current study was to evaluate maltitol as substitute for glycerol in edible pectin and sodium-based films and to assess its influence on physicochemical and mechanical properties of films as well as the antimicrobial performance of natamycin-containing active packaging materials.

Methods: Film-forming solutions containing 6 % sodium caseinate or 2 % pectin were prepared with maltitol or glycerol at concentrations ranging from 0 to 50 % (w/w, based on polymer content). Films were cast and dried at 30˚C for 20 h. Moisture content, moisture sorption behavior and elasticity were determined under controlled conditions. Active films containing natamycin (90 mg/dm^3) and 30 % plasticizer were additionally prepared, and their antimicrobial activity against *Saccharomyces cerevisiae* was evaluated using agar diffusion method.

Results: Films plasticized with maltitol exhibited significantly lower moisture content and moisture sorption capacity than those containing glycerol. In sodium caseinate films, moisture content remained below 9 % across the investigated maltitol concentrations, whereas glycerol increased moisture content up to 34 %. Similar trends were observed in pectin films. At 100 % relative humidity, pectin films containing maltitol reached a moisture content of 81 %, compared with 92 % for glycerol-containing films. Elasticity increased with increasing plasticizer concentration in all formulations. However glycerol produced more elastic films than maltitol. Antimicrobial testing demonstrated that maltitol did not adversely affect natamycin diffusion or antifungal activity, yielding inhibition zones comparable to those obtained with glycerol-plasticized films.

Conclusions: Maltitol demonstrated potential as an alternative food-grade plasticizer for pectin and sodium caseinate based polymer films. Compared with glycerol, maltitol was associated with lower moisture uptake and improved stability under conditions of increased relative humidity, although it resulted in reduced elasticity of the films. In addition, the incorporation of maltitol did not adversely affect the antimicrobial activity of natamycin in active packaging formulations.

ID 139

Sensory Evaluation of Gluten-Free Cookies Enriched with Brazil Nut Oil Processing By-Products

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Background: The increasing demand for gluten-free products and more sustainable food systems has created interest in using food-processing by-products as functional ingredients. Brazil nut flour produced after oil extraction is rich in nutrients and represents a promising ingredient for gluten-free cookies, with the added benefit of reducing food waste.

Aims: This study aimed to evaluate the sensory acceptance of gluten-free cookies enriched with Brazil nut flour obtained as an oil extraction by-product and to determine how different incorporation levels affect consumer preference.

Methods: Six cookie formulations were prepared by replacing part of the flour mixture with Brazil nut flour at 0% (control), 2%, 4%, 6%, 8%, and 10%. Sensory evaluation was carried out by 20 semi-trained panelists. Overall liking was measured using a 9-point hedonic scale (1 = “dislike extremely”, 9 = “like extremely”). A Just-About-Right (JAR) test was also used to assess whether key sensory attributes were perceived as too weak, too strong, or optimal. The results were compared across formulations to identify the most acceptable level of Brazil nut flour addition.

Results: Incorporation of Brazil nut flour generally improved sensory acceptance. Hedonic ratings increased as the substitution level increased, with the 10% formulation receiving the highest scores for appearance (6.80), aroma (6.96), flavor (6.84), texture (7.00), and shape (7.32). JAR analysis indicated that most sensory attributes were perceived as close to optimal, particularly in the 8% and 10% formulations. Although some panelists considered the Brazil nut aroma slightly too pronounced in the 10% sample, this formulation still achieved the highest overall acceptance.

Conclusions: Brazil nut flour obtained as an oil extraction by-product can be successfully used in gluten-free cookies to enhance sensory quality and consumer acceptance. Among the tested formulations, cookies containing 10% Brazil nut flour were the most preferred, achieving the highest ratings across all evaluated sensory attributes. These findings highlight the potential of Brazil nut flour as a sustainable ingredient for developing value-added gluten-free bakery products while promoting the valorization of food processing by-products.

Acknowledgement: This work was supported by the Bulgarian Ministry of Education and Science, National Research Fund, under contract number КП-06-КОСТ/18.

ID 140

Growth and activity of lactic acid bacteria in fermented milk fortified with coffee extract during refrigerated storage

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Background: The development of functional fermented dairy products enriched with natural bioactive compounds has attracted considerable scientific interest. Coffee is a rich source of polyphenols, caffeine, and other antioxidant compounds that may influence the growth and metabolic activity of yoghurt starter cultures. While these compounds can enhance the functional value of fermented milk products, their effects on acidification processes and bacterial viability during storage are not yet fully understood. Therefore, evaluating the impact of coffee extract supplementation on the physicochemical characteristics and survival of *Lactobacillus delbrueckii* subsp. *bulgaricus* and *Streptococcus thermophilus* is important for the development of novel functional dairy foods with desirable quality and stability.

Aims: The aim of this study was to investigate the effect of different concentrations of coffee extract (0.5%, 1.0%, and 1.5%) on the acidification kinetics, lactose utilization, and viability of *Lactobacillus delbrueckii* subsp. *bulgaricus* and *Streptococcus thermophilus* in fermented milk during refrigerated storage at 4 ± 1°C for 21 days.

Methods: Viable cell counts of *S. thermophilus* S13 and *L. delbrueckii* subsp. *bulgaricus* S19 were determined according to Ivanov and Dimitrova (2019). Selective media M17 and MRS (Merck, Darmstadt, Germany) were used for enumeration of lactic acid bacteria. The procedure followed the standard EN ISO 7889:2003 (IDF 117:2003) for yogurt microorganisms using the colony-count technique at 37 °C. Sample preparation, including initial suspensions and decimal dilutions, was performed in accordance with ISO 8261:2001 (IDF 122:2001).

Results: The analyzed Instant coffee sample demonstrated high antioxidant capacity and high polyphenol content. The incorporation of instant coffee into yogurt significantly improved its functional properties by increasing the content of bioactive compounds and antioxidant activity. The present study demonstrated that the incorporation of instant coffee into yogurt systems influences the metabolic activity and viability of the starter cultures (*Lactobacillus delbrueckii subsp. bulgaricus* and *Streptococcus thermophilus*) as well as the evolution of key biochemical parameters during refrigerated storage (21 days at 4 °C). Overall, all formulations supported successful fermentation and maintained high microbial viability throughout storage. However, coffee fortification induced a concentration-dependent modulation of microbial growth, characterized by slightly reduced initial proliferation and lower maximum viable cell counts compared to the control, while still ensuring adequate survival levels (>10^7–10^8 CFU/mL). In coffee-enriched samples, both lactose utilization and acid development were moderately attenuated, suggesting a partial inhibitory effect of coffee-derived bioactive compounds, particularly polyphenols and caffeine. Despite these effects, no adverse impact on product stability or microbial viability was observed. On the contrary, coffee addition contributes to a more controlled post-acidification process, which may be beneficial for maintaining physicochemical stability during shelf life.

Conclusions: In conclusion, instant coffee can be considered a functional ingredient in fermented dairy products, as it modulates microbial activity and fermentation dynamics without compromising probiotic viability or product stability.

ID 141

Research Of Advanced Lines And Varieties Of Winter Wheat From A Representative Collection With High Quality Potential

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Background: During the period 2024–2025, a competitive variety trial was conducted in the experimental field of the IRGR - Sadovo with 110 genotypes of common winter wheat (*Triticum aestivum L.*), from which 47 breeding lines and the standard variety Sadovo 1 were selected.

Objectives: The entire study was based on a recognized collection of genotypes presenting high quality potential.

Methods: In the technological laboratory of the Institute of Plant Genetic Resources (IPGR) – Sadovo, the main parameters related to the quality of the protein–gluten complex and the technological properties of flour and dough were analysed using standard methods: sedimentation value, fermentation number, wet gluten yield, gluten weakening, bread-making strength value, and dry gluten content.

Results: The results of the analysis of variance showed that sedimentation value, fermentation number, and dry gluten content exhibited higher stability in response to environmental conditions and can be used as reliable selection criteria for evaluating the quality of genotypes. The best combination of parameters related to gluten complex quality and bread-making properties was established in the genotypes MV-Karej and MV-Uncia, which was also confirmed by PCA analysis. Good technological characteristics were also demonstrated by MV-Dandar, MV-Mente, MV-Kaplar, MX 270/3461, MX 286/1759, and RU 47/3504.

Conclusion: The obtained results demonstrate the presence of significant genetic diversity among the studied material. Genotypes showing a complex expression of high values for the evaluated parameters represent promising breeding material for use in programs aimed at improving the technological quality and bread-making value of wheat grain.

ID 142

Isolation and Characterization of Wild Yeasts with Potential Brewing Applications

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Background: The growing consumer demand for low-alcohol, non-alcoholic, and functional beers has intensified interest in the discovery of new yeast strains with desirable technological and sensory attributes. Natural ecosystems represent an under explored reservoir of yeast diversity and offer significant potential for the isolation of strains suitable for brewing applications.

Aims: This study aimed to isolate, identify and characterize yeast strains from natural habitats in Bulgaria and to evaluate their potential for brewing applications.

Methods: Samples were collected from Strandja National Park in Bulgaria, from *Rubus fruticosus* (blackberry) and *Prunus spinosa* (blackthorn). Following the assessment of cellular morphology and colony characteristics, 5 yeast isolates were selected for further analysis. Species identification was performed by sequencing the ITS1 region, while metabolic characteristics were determined using API 20 C AUX carbohydrate assimilation tests. The ability of the isolates to ferment different carbohydrates was assessed using Durham tube assays, while their fermentation performance was evaluated in laboratory-scale fermentations conducted at 20°C in glass bottles fitted with air locks.

Results: Microorganisms isolated from blackberry were identified as *Dothiora phillyreae* and *Aureobasidium bupleuri*, while blackthorn samples yielded *Cyberlindnera saturnus* and two strains of *Saccharomyces cerevisiae*. Following the literature review, which indicated the need for strain-specific safety assessment before food or beverage application, *D. phillyreae* and *A. bupleuri* were not included in subsequent lab-scale fermentation experiments. The remaining isolates were classified into two groups according to their ability to ferment maltose, the predominant fermentable sugar in brewer's wort, using the API 20 C AUX system and Durham tube fermentation tests. Strains capable of maltose fermentation were considered suitable for the production of conventional beer styles, whereas strains unable to utilize maltose were regarded as potential candidates for non-alcoholic beer production. Fermentation assays demonstrated that *C. saturnus* was unable to ferment maltose, highlighting its suitability for the production of low- and non-alcoholic beers. Among the two *S. cerevisiae* isolates, strain SC8.5 failed to complete wort fermentation and produced beer with a suboptimal pH value. In contrast, strain SC8.7 exhibited satisfactory fermentation performance, achieving an attenuation rate of 75% and producing beer with an optimal pH for lager beer production. Consequently, SC8.7 was selected for further beer development.

Conclusions: The results demonstrate that natural habitats are a valuable source of yeast strains with potential brewing applications. Among the isolates, *Cyberlindnera saturnus* and one *Saccharomyces cerevisiae* strain showed promising technological properties for the production of low-alcohol and novel beers.

Funding: This work was funded under the project "Synergic plant extracts (e.g. essential oils) - bioprotective microorganisms for development of functional fermented foods (SEO-MICRO-FOODS)" under the Competition for projects under bilateral cooperation programs 2026 - Bulgaria - France ("Rila" program, project BG-175467353-2025-05-0004 /FNI-2923 of 08.12.2025/ of the Bulgarian Scientific Research Fund). Cooperation between University of Food Technologies Plovdiv (Bulgaria), BioDyMIA research unit (Université Claude Bernard Lyon 1 - ISARA Lyon, France), and Ecole d'Ingénieurs de Purpan (Université de Toulouse, France) was supported by Franco-Bulgarian cooperation Hubert Curien Programme (PHC Rila) The authors wish to express their gratitude for the supports of the Ministry of Education and Science (Bulgaria), the Embassy of France to Bulgaria in Sofia ("Ministère des Affaires Etrangères", France), Campus France and "Ministère de l'Enseignement Supérieur, de la Recherche et de l'Innovation" (France).

ID 143

Effect of Enzymatic Maceration Pre-Treatments on Chokeberry Juice Quality

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Background: Chokeberry (*Aronia melanocarpa*) is a polyphenol-rich functional fruit, but its bioactive anthocyanins and phenolics are largely retained within the cell-wall matrix and the resistant skin tissue, which limits their extraction during juice production. Enzymatic maceration is a widely used pre-treatment to overcome this barrier, yet the choice of commercial enzyme preparation strongly affects both juice yield and functional quality.

Aims: This study aimed to evaluate the effect of two commercial enzyme preparations, Pectinex Ultra Color and Pectinex XXL, on the juice yield, physicochemical properties, colour, total phenolic content (TPC) and total antioxidant activity (TAA) of chokeberry juice, and to identify the most suitable maceration strategy for functional juice production.

Methods: Chokeberry fruits grown in Edirne (Turkey) were crushed and divided into four batches: a control (25 °C), an enzyme-free control (50 °C), and two enzyme treatments (Pectinex Ultra Color and Pectinex XXL; 200 mL/ton, 50 °C, 1 h). After enzyme inactivation and pressing, juice yield, pH and Brix were measured; colour was assessed by CIELAB parameters (L*, a*, b*, C, ΔE); TPC was determined by the Folin–Ciocalteu method and TAA by the ABTS (TEAC) assay. Data were analysed by one-way ANOVA with Duncan's test ($p < 0.05$).

Results: Pectinex Ultra Color showed the best overall performance, achieving the highest juice yield (64.12%) and soluble solids content (28.20 °Brix). In addition, P. Ultra Color increased total phenolic content (TPC) by approximately 53% (33,296.2 mg GAE/L) and total antioxidant activity (TAA) by approximately 90% (345.9 mM TE/L) compared with the control, outperforming Pectinex XXL, and produced the deepest purple-black colour (L* = 0.71; highest ΔE = 8.36). Its superiority was attributed to its hemicellulase side-activities and the absence of anthocyanin-degrading beta-glucosidase.

Conclusions: Enzymatic maceration with Pectinex Ultra Color at 50 °C for 1 h is an effective industrial strategy for chokeberry juice production, maximising yield while preserving polyphenols, anthocyanins and antioxidant capacity. The results provide a basis for optimising enzymatic maceration in high-polyphenol berries to deliver functional juices of high quality.

ID 144

Machine Learning with Synthetic Data Augmentation For Predicting Protein Fouling in Microfiltration and Ultrafiltration

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Background: Microfiltration (MF) and ultrafiltration (UF) are cornerstone unit operations in dairy and whey processing, enabling the concentration, fractionation and recovery of high-value milk proteins. However, protein-induced membrane fouling lowers permeate flux, raises energy and cleaning costs and shortens membrane life, directly reducing product yield and process economics. Hermia and resistance-in-series models struggle to capture the nonlinear, multivariate nature of fouling, whereas data-driven models offer higher accuracy yet experimental datasets in food membrane processing remain scarce.

Aims: This work aimed to improve the prediction of permeate flux and protein rejection in dairy MF/UF systems by combining synthetic data augmentation with modern tabular learning models, and to identify the most suitable model and learning strategy under the limited-data conditions typical of food-processing research.

Methods: A compiled single-protein fouling dataset (399 records, 10 process and membrane descriptors) was augmented using Conditional Tabular GAN (CTGAN) and Variational Autoencoder (VAE) generators, each producing 399 synthetic records. Three transformer architectures (TabNet, TabTransformer, FT-Transformer) and three established models (Bayesian Neural Network, CatBoost, LightGBM) were trained to predict steady-state flux and protein rejection in both single-output and multi-output configurations. Performance was assessed with the coefficient of determination (R^2) and normalized RMSE against a one-dimensional CNN (ODCNN) reference.

Results: VAE-based augmentation produced the most consistent gains. The multi-output VAE-TabTransformer achieved the best flux prediction (R^2 = 0.965; NRMSE = 0.017), surpassing the ODCNN reference (R^2 = 0.833). For protein rejection, VAE-CatBoost performed best (R^2 = 0.806; NRMSE = 0.123), exceeding the reference (R^2 = 0.723). Gradient boosting models delivered reliable baselines even on the original data, while CTGAN better preserved the statistical distribution of the food dataset.

Conclusions: Synthetic data augmentation, particularly the low-variance VAE approach, markedly enhances model generalization for predicting protein fouling in dairy membrane filtration under limited experimental data. Such tools can support membrane selection, process optimization and fouling control in whey and milk protein processing, contributing to more efficient and sustainable food manufacturing.

ID 145

Assessment of the dual colorimetric loop-mediated isothermal amplification (LAMP) assay accuracy for pork detection

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Background: Accurate content specification for pork products is highly important, and because of the limitations of current protein and DNA-based methods, a specific method is necessary. The loop-mediated isothermal amplification (LAMP) assay is fast and sensitive compared with other DNA detection methods, and research on LAMP is increasing due to its advantages. Previously, it was shown that the developed dual colorimetric direct LAMP assay can detect unprocessed and processed pork samples.

Aims: This study aims to validate the sensitivity and effectiveness of the previously developed dual-colorimetric direct LAMP assay by testing mixtures of processed pork samples, verified DNA, and meat samples. The study also aims to increase the assay accuracy by adding an internal control design. Additionally, the study aims to optimize storage conditions for the reaction mixture.

Methods: 0.1%, 0.05%, and 0.01% processed pork mixtures are prepared and tested using the optimized dualcolorimetric direct LAMP assay. Animal-specific primers were tested with optimized conditions as an internal control. Assay accuracy was tested using a verified DNA sample containing different species and verified meat samples obtained from the Ministry of Agriculture and Forestry, Turkey. Storage conditions for the master mix were also tested periodically at different temperatures and durations. Master mixes were kept at -20°C for 6 months, at +4°C for a month, and at room temperature for 14 days.

Results: The limit of detection for processed meat products was determined to be 0.1%. Designed internal control primers have been shown to work under optimized conditions with similar sensitivity. Verified samples provided positive results with the LAMP method. Also, selected temperatures and times were effective for storing the reaction mixture.

Conclusions: It has been shown that the sensitivity of the developed assay is the same for the processed food mixtures, and the assay's results are comparable with qPCR results. Additionally, storage at +4°C and at room temperature can increase the assay's applicability for on-site detection.

Acknowledgment: The study was funded by METU (BAP-11395) and Baskent University (BAP- 228582) Scientific Research Projects.

ID 146

Synergistic plant extracts and bioprotective microorganisms for the development of fermented functional foods – SEO-MICRO-FOODS scientific cooperation project

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Background: The demand for minimally processed and clean-label foods is stimulating the development of biopreservation strategies based on natural antimicrobial systems. Fermented foods are particularly suitable for this purpose because selected microorganisms can simultaneously contribute to safety, shelf-life, sensory quality and functional value. In parallel, plant extracts and essential oils provide complex mixtures of antimicrobial and antioxidant compounds. Their combined use with bioprotective microorganisms may create complementary or synergistic effects, allowing lower effective concentrations of plant-derived antimicrobials while preserving the technological and sensory characteristics of the food matrix.

Aims: The SEO-MICRO-FOODS Bulgarian–French scientific cooperation project aims to establish an integrated bioprotection concept based on the synergy between selected plant extracts/essential oils and bioprotective microorganisms for the development of fermented functional foods. The project further seeks to exploit microbial and plant biodiversity associated with traditional foods and raw materials from Bulgaria and France and to identify combinations suitable for transfer to different food matrices.

Methods: The project integrates microbiological, molecular-genetic, analytical, technological and mathematical-statistical approaches. Lactic acid bacteria and non-conventional yeasts will be isolated, identified, characterized and selected from traditional fermented foods and beverages. Plant materials, including selected side streams, will be used to obtain extracts and essential oils that will be chemically characterized and evaluated for antioxidant and antimicrobial activity. Compatibility and survival of selected microorganisms in the presence of plant-derived preparations will be assessed, followed by in vitro screening of combinations against pathogenic and spoilage microorganisms. Promising combinations will subsequently be evaluated in model and real food matrices using hurdle-technology principles and controlled fermentation.

Results: The project is expected to generate a characterized collection of bioprotective microorganisms and plant-derived preparations and to identify microorganism–extract combinations with enhanced antimicrobial performance. The central scientific outcome will be the clarification of conditions under which microbial fermentation and plant-derived antimicrobials act synergistically without compromising starter viability or product quality. The resulting data will support selection criteria, predictive databases and proof-of-concept fermented foods with improved microbial stability and functional potential.

Conclusions: SEO-MICRO-FOODS positions synergy as the link between bioprotection and functional fermentation. By combining microbial biodiversity, plant bioactive compounds and hurdle technology within a bilateral research framework, the project is expected to provide a scientific basis for sustainable clean-label fermented foods and transferable strategies for food biotechnology in Bulgaria and France.

Funding: This work was funded under the project "Synergic plant extracts (e.g. essential oils) - bioprotective microorganisms for development of functional fermented foods (SEO-MICRO-FOODS)" under the Competition for projects under bilateral cooperation programs 2026 - Bulgaria - France ("Rila" program, project BG-175467353-2025-05-0004 /FNI-2923 of 08.12.2025/ of the Bulgarian Scientific Research Fund). Cooperation between University of Food Technologies Plovdiv (Bulgaria), BioDyMIA research unit (Université Claude Bernard Lyon 1 - ISARA Lyon, France), and Ecole d'Ingénieurs de Purpan (Université de Toulouse, France) was supported by Franco-Bulgarian cooperation Hubert Curien Programme (PHC Rila) The authors wish to express their gratitude for the supports of the Ministry of Education and Science (Bulgaria), the Embassy of France to Bulgaria in Sofia ("Ministère des Affaires Etrangères", France), Campus France and "Ministère de l'Enseignement Supérieur, de la Recherche et de l'Innovation" (France).

ID 147

Sustainable practices in craft brewing

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Background: The rapid development of the craft brewing sector has increased interest in production models that combine product quality, technological flexibility, and environmental responsibility. Although craft breweries operate at a smaller scale than large industrial plants, brewing remains resource-intensive due to water and energy consumption, generation of organic by-products and wastewater, packaging requirements, and impacts associated with raw material supply and distribution. At the same time, the flexibility and local orientation of craft production create opportunities for sustainability strategies based on resource efficiency and circular-economy principles.

Aims: This study aims to evaluate sustainable practices applicable to craft brewing and to identify approaches capable of reducing environmental impact while maintaining technological performance, beer quality, and economic feasibility.

Methods: A structured analysis of current scientific literature and reported brewing practices was performed, focusing on sustainability measures suitable for small- and medium-scale breweries. The investigated approaches were classified according to the main stages of beer production and their potential contribution to circular economy and improved process efficiency.

Results: The analysis indicates that sustainability in craft brewing is most effectively achieved through the integration of complementary measures rather than through a single technological intervention. Major opportunities include optimization of cleaning and rinsing operations, water reuse where technically and hygienically appropriate, recovery and efficient utilization of thermal energy, use of renewable energy sources, and improved control of refrigeration and fermentation. Further environmental benefits can be obtained through local and responsibly sourced raw materials, reduction of packaging impacts, and valorization of spent grain, surplus yeast, hops, and other brewing residues as food ingredients, feed, fermentation substrates, or sources of value-added compounds. Digital monitoring of water, energy, temperature, and fermentation parameters can additionally support efficient resource management, particularly in breweries with variable production schedules.

Conclusions: Sustainable craft brewing requires an integrated approach combining technological optimization, circular resource use, digital tools, and responsible management of raw materials and packaging. The most suitable solutions depend on brewery scale, production portfolio, existing infrastructure, and local opportunities for resource recovery. Sustainability strategies should therefore prioritize technically feasible measures that simultaneously improve environmental performance, operational efficiency, and long-term economic resilience.

ID 148

The Gastronomy of the Visegrád Group Countries as an Element of Regional Identity and Cultural Diversity as an Analysis of Data from TripAdvisor

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Background: Gastronomy has evolved from a supplementary tourism service into a key component of destination identity and cultural heritage. Contemporary research identifies food as an important marker of regional identity, cultural diversity, and tourism attractiveness. In the Visegrád Group (V4) countries, the Czech Republic, Slovakia, Poland, and Hungary, gastronomy reflects a shared Central European heritage while maintaining distinctive national and regional characteristics. Concepts such as food heritagization, destination identity, and cultural diversity provide a useful framework for understanding the role of gastronomy in regional development and tourism competitiveness.

Aims: This study examines the relationship between gastronomy, regional identity, and cultural diversity in the capitals of the V4 countries. It aims to identify common gastronomic features and national specificities, analyse the representation of local and international cuisines, and propose a comparative framework for evaluating gastronomic tourism in Central Europe.

Methods: The research employs a qualitative, descriptive-analytical approach, based on a literature synthesis and secondary data analysis. The theoretical framework combines food heritagization with gastronomy as a marker of destination identity. Empirical data were collected from the TripAdvisor platform using the Apify web-scraping tool and focused on restaurant offerings in Prague, Bratislava, Warsaw, and Budapest. Restaurant datasets were analysed to identify the frequency of cuisine categories and dishes. Linguistic Inquiry and Word Count (LIWC) software was used to analyse culinary word frequencies, while Microsoft Copilot and Google NotebookLM supported comparative interpretation and visualization.

Results: The findings show that the gastronomic landscapes of the V4 capitals form a culturally cohesive yet internally diverse Central European culinary region. Traditional cuisines and local dishes remain strongly represented, particularly in Prague and Budapest, where Czech and Hungarian culinary identities are highly visible. Warsaw demonstrates the greatest international diversity, especially through Italian and Asian culinary influences, while Bratislava retains a more traditional profile characterized by dairy-based specialties and local dining formats. TripAdvisor data reveal differences in the representation of “Local Eats” restaurants, with Budapest (28%) and Warsaw (15.7%) showing higher levels of visible locality than Prague (11%) and Bratislava (4.3%).

Conclusions: Gastronomy represents an important expression of regional identity and cultural diversity in the V4 countries. While the four capitals share common Central European culinary foundations, each maintains distinctive gastronomic characteristics. The coexistence of culinary heritage and international cuisines highlights the dynamic nature of contemporary urban gastronomy. The study demonstrates the value of digital platform data for analysing gastronomic identity and provides a framework for future research on culinary tourism and cultural heritage.

ID 149

Ultrasound-Assisted Delivery of Natural Antioxidants Enhances the Oxidative Stability of Hempseed Oil

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Background: Hempseed oil is highly valued nutritionally for its rich content of polyunsaturated fatty acids, but this same composition renders it highly susceptible to lipid oxidation, a process further accelerated by chlorophyll-mediated photo-oxidation. Natural phenolic antioxidants such as quercetin and ferulic acid offer a potential solution given their potent radical-scavenging activity, yet their limited oil solubility constrains practical application. Ultrasound-assisted incorporation may overcome this barrier by improving antioxidant dispersion and, consequently, leading to a better inhibition of lipid oxidation.

Aims: This study aimed to optimize the incorporation of quercetin and ferulic acid into hempseed oil using ultrasound treatment and to investigate their individual and combined antioxidant effects for improving the oxidative stability of the oil.

Methods: The antioxidant capacities of quercetin and ferulic acid were assessed via DPPH and ABTS radical-scavenging assays. Ultrasound-assisted incorporation into hempseed oil was optimized by varying sonication amplitude and duration, with oxidative stability evaluated by the Rancimat method. The effects of antioxidant concentration and combination were then examined, and response surface methodology based on a central composite design was applied to optimize the formulation of antioxidants.

Results: Quercetin showed the strongest radical-scavenging activity, followed by ferulic acid, with both natural antioxidants yielding substantially lower IC_{50} values than the synthetic antioxidant BHT in both assays. Sonication at 20% amplitude for 5 min effectively dispersed the antioxidants without compromising the oil's oxidative stability. Both compounds increased the induction period of hempseed oil in a concentration-dependent manner, though quercetin achieved equivalent protection at 200 ppm to that requiring roughly tenfold higher concentrations of ferulic acid. Response surface methodology yielded a highly significant predictive model ($R^2 = 0.995$; $p < 0.0001$), confirming significant individual contributions of both antioxidants and enabling optimization of their combined formulation.

Conclusions: Ultrasound-assisted incorporation of quercetin and ferulic acid is an effective strategy for enhancing the oxidative stability of hempseed oil. The optimized process offers a promising natural alternative to synthetic antioxidants for stabilizing polyunsaturated edible oils, supporting the development of clean-label, lipid-based food products.

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ID 151

Comparative characterization of the chemical composition of essential oils from juniper berries (*Juniperus* ssp.) from Bulgaria

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Background: The genus *Juniperus* (сем. Cupressaceae) includes about 75 species, most of which have high ecological plasticity. Of these, ten juniper species are found in the European flora. Six of these are naturally occurring in the territory of Bulgaria: *J. oxycedrus* L. (red juniper), *J. communis* L. (common juniper), *J. pygmaea* C. Koch (small juniper), *J. sibirica* Burgs. (Siberian juniper), *J. sabina* L. (Cossack Juniper), and *J. excelsa* M.B. (tree juniper). In this work, the chemical composition of essential oils obtained in laboratory conditions from the fruits of two juniper species - *J. communis* and *J. oxycedrus* - was investigated. The two essential oils differ both in yield and in the content of the aromatic components identified in them.

Aims: The aim of the study is a comparative analysis of essential oils obtained from fruits of two species of juniper - *J. communis* and *J. oxycedrus*, harvested in the Pirin Mountain region, Bulgaria (with emphasis on major terpene constituents, yields of essential oil, and influence of climatic condition in the region on the chemcal composition of oil).

Methods: The chemical composition of the essential oils was determined by:

GC analysis. It was carried out with an Agilent 7890A apparatus (Agilent Technologies Inc., Santa Clara, CA, USA) under the following conditions: column HP-5 ms, 30 m x 250 mm x 0.25 m; temperature 35°C/3 min, 5°C/min to 250°C/3 min, total 49 min; carrier- helium, constant flow rate of 1 mL/min; split 30:1.

GC-MS analysis. An Agilent 5975 C apparatus was used (Agilent Technologies Inc., Santa Clara, CA, USA), carrier gas helium, column and temperature conditions as in the GC analysis; detectors: FID, 280°C, MSD, 280°C transfer line. The identification of aromatic substances was performed by comparison with the witness retention index.

Results: The fruits of both junipers were processed by water distillation under laboratory conditions, with the yield of essential oil for *J. communis* being 1.37% and for *J. oxycedrus* being 1.10%. Both essential oils are easily mobile liquids with a light yellow color, with a characteristic odor and aroma. By GC/MS analysis, 39 components were identified in the essential oil obtained from the fruits of *J. communis*, the main ones (over 2%) being α-pinene (51.56%), β-myrcene (16.68%), germacrene D (11.10%), sabinene (3.84%), limonene (2.73%), β-caryophyllene (2.73%) and α-caryophyllene (2.01%). In the essential oil obtained from the fruits of the species *J. oxycedrus*, 34 components were identified, the main ones (over 2%) being α-pinene (46.35%), β-myrcene (14.52%), germacrene D (13.76%), sabinene (4.34%), β-caryophyllene (3.39%), α-caryophyllene (2.49%) and limonene (2.38%). In both analyzed essential oils, monoterpene hydrocarbons predominate, as for the species J. communis they are 74.54%, and for the species J. oxycedrus 69.71%, followed by sesquiterpene hydrocarbons, respectively 21.44% and 27.3%. The oxygen derivatives of the terpene hydrocarbons in both oils are in very small quantities.

Conclusions: The comparative analysis of essential oils obtained from the fruits of two types of juniper originating in Bulgaria shows a difference not only in their yield, but also in the content of the main groups of components - mono and sesquiterpene compounds. These results contribute to the characterization of juniper berry essential oils and highlight their potential applications in the beverage, food, pharmaceutical, cosmetic, and fragrance industries.

ID 152

From Commodity to Functional Niche: Honey-Based Functional Foods as a Strategic Repositioning Pathway for Small Producers

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Background: The EU honey sector faces a structural challenge: despite producing approximately 286,000 t/year and ranking second globally, producers remain locked in low-margin bulk export channels. Bulgarian beekeepers export 10–11 million kg annually at €3–4/kg, capturing only a small fraction of final retail value. Simultaneously, global functional food markets are growing at 8.0% CAGR, driven by health consciousness, clean-label demand, and preventive nutrition trends. Honey's compositional and bioactive properties align well with these consumer trends, yet its penetration into structured functional food segments remains limited relative to its potential.

Aims: This article aims to: (1) examine honey's compositional and functional characteristics relevant to functional product development; (2) map relevant functional food market segments and consumer drivers; and (3) identify strategic considerations and barriers for small producers seeking to transition from bulk commodity sale to differentiated functional niche products.

Methods: The study is conceptual and analytical in nature, synthesizing EU and Bulgarian honey sector data, functional food market trends, regulatory frameworks (Regulation EC No 1924/2006), and product development literature. Secondary sources include Eurostat, FAO, European Commission market reports, UN Comtrade, and peer-reviewed literature on honey's compositional and bioactive properties.

Results: Honey possesses distinctive compositional and bioactive properties—natural sugars, antioxidants, antimicrobial compounds, and prebiotic potential—that support functional product development across multiple consumer segments: sports nutrition, children's health, immune and gut wellness, and premium lifestyle. The price asymmetry between bulk honey (€2–3/kg) and functionally positioned products (€33–50/kg equivalent) quantifies the margin expansion potential. Critical success factors identified include product-market fit for a defined niche, regulatory-compliant positioning under EU health claim regulation, leveraging of origin and traceability assets, and entrepreneurial knowledge transfer from outside the traditional beekeeping sector.

Conclusions: Honey-based functional foods represent a structurally accessible—though strategically demanding—pathway for small producers to escape commodity dependence and capture higher value. Success requires deliberate strategic positioning, regulatory navigation, and competencies beyond traditional production. Small producers' unique assets—raw material control, flexibility, authenticity, and local identity—are competitive advantages precisely in niche markets. Policy interventions (technical assistance, certification subsidies, innovation grants) can reduce barriers, but entrepreneurial initiative and market fit remain essential for sustainable differentiation and margin expansion.

ID 153

SymbioBurst: An interdisciplinary case study on synbiotic yogurt innovation, sustainability, and digital food education within the E-Food project

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Background: The growing interest in functional foods, plant-based alternatives, and sustainable nutrition has created new opportunities for innovation in the sectors of fermented dairy and non-dairy foods. Simultaneously, digital learning environments are increasingly influencing the way future food products are conceptualized and developed. Within the framework of the E-learning tools for food technology and development education (E-Food) project, an interdisciplinary multinational student-led initiative was undertaken to design innovative yogurt products combining tradition, innovation, nutritional functionality, sustainability, and interactive consumer communication and digital education.

Aims: The present case study aimed at developing two SymbioBurst yogurt concepts — a dairy-based and a plant-based formulation — integrating synbiotic ingredients, sustainable design strategies, and digital educational tools, developed within the E-Food project. The case study further investigated consumer target groups, market potential, and creative and effective communication strategies related to the development of the two synbiotic yogurt products. In parallel, the case study development explored how virtual collaboration, educational technologies, and consumer-centered communication tools can support modern food product development and science education.

Methods: Product development involved literature review, innovative ingredient selection, formulation planning, consumer-oriented concept design, and sustainability assessment. The dairy-based formulation incorporated yogurt starters, multi-strain probiotics, prebiotics, Chaga mushroom flour, and fruit juice spheres obtained through reverse spherification. The plant-based alternative included rice or hemp substrates and encapsulated avocado oil. Consumer feedback questionnaires and digital communication tools, including a multilingual QR-linked website with educational materials and interactive content, were integrated into the development process. Sustainability considerations focused on local sourcing, recyclable packaging, and reduction of environmental impact throughout the product lifecycle.

Results: The SymbioBurst concepts demonstrated strong potential as innovative functional foods combining health-oriented innovative ingredients with sensory attractiveness and multi-channel creative and transparent

communication. Consumer responses indicated interest in low-sugar formulations, high-protein options, localized flavors, and scientifically supported health information and educational transparency. The developed digital platform enhanced accessibility through multilingual educational resources, recipes, comics, and feedback tools designed to support consumer engagement and future product optimization. Internationalization strategies involving cultural flavor adaptation, sustainability certification, and localized communication further strengthened the market potential of SymbioBurst. The project further demonstrated the value of interdisciplinary student-led innovation in combining food science, sustainability, and digital technologies within a practical learning environment.

Conclusions: The study demonstrates the potential of combining food innovation, sustainability, and digital education within a collaborative academic environment. SymbioBurst development stands out as an example of how functional yogurt products can integrate scientific knowledge, consumer-centered design, interactive communication, and environmentally responsible strategies to address emerging trends in the global food sector and support future-oriented food technology education.

Acknowledgements: This research and educational activity were carried out within the framework of the Erasmus+ Project E-FOOD – E-learning Tools for Food Technology and Development Education, Project No. 2022-1-BG01-KA220-HED-000085089, co-funded by the European Commission.

Disclamer: The European Commission's support for the production of this publication does not constitute an endorsement of the contents, which reflect the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein. Project №: 2022-1-BG01-KA220-HED-000085089.

ID 154

Database Management and Integration of Diverse Information for the Digital Documentation of Plant Genetic Resources: A Case Study from Bulgaria

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Background: The long-term preservation of plant genetic resources depends on accurate documentation and efficient management of diverse passport and conservation data. The National Genebank at the Institute of Plant Genetic Resources "Konstantin Malkov", Sadovo, conserves more than 60,000 seed accessions of valuable germplasm representing Bulgaria's agricultural biodiversity and crop wild relatives. Effective management of these collections requires reliable digital tools that support documentation, conservation, data exchange and open access to plant gene pool.

Aims: To present the development and implementation of an integrated database management system supporting the digital documentation and conservation of plant genetic resources in Bulgaria.

Methods: Through several publicly funded projects, the genebank has been undergoing digital transformation aimed at integrating its databases and aligning data management with international FAO/Bioversity standards and the FAIR principles. The system combines an existing MS Access database, a newly developed information system, and the Bulgarian National Inventory published through European Search Catalogue for Plant Genetic Resources EURISCO. It integrates passport, taxonomic, conservation, regeneration, seed viability, characterization, and evaluation data into a unified digital environment.

Results: The integrated system improves data integrity, accessibility, scalability, and long-term information management while reducing data redundancy and facilitating standardized documentation. It supports efficient management of seed accessions, quality control, regeneration planning, scientific research, and interoperability with international plant genetic resources information systems.

Conclusions: The experience of the Institute in Sadovo demonstrates that integrated database management significantly strengthens *ex situ* conservation, promotes the sustainable use of plant genetic resources in Bulgaria, and contributes to the digital transformation of genebank operations.

Keywords: plant genetic resources; genebank; seed accessions; ex situ conservation; database management; information system; digital documentation; EURISCO.

Acknowledgements: This research was supported by Project BG16RFPR002-1.014-0012-C01, Establishment and Sustainable Development of a Center of Competence "Agrifood Systems and Bioeconomy", funded by the European Regional Development Fund under the Programme for Research, Innovation and Digitalisation for Smart Transformation (PRIDST).

ID 155

Comparative biometric characteristics of pea (*Pisum sativum* L.) genotypes in open field conditions

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Background: Proteins are components that play a fundamental role in maintaining human health and, due to their vital functional properties, they are key ingredients in many food systems. Pea (*Pisum sativum* L.) is an important protein crop with a wide cultivation area. Pea protein is considered a high-quality protein and a functional ingredient in the global industry due to its low allergenicity, high protein content, availability, affordability, and deriving from a sustainable crop. Moreover, pea protein has excellent functional properties such as solubility, water, and oil holding capacity, emulsion ability, gelation, and viscosity. Growing garden peas for greens is an excellent choice, as the crop is high-yielding, cold-resistant, and improves soil quality. Green peas are a cold-resistant crop rich in vitamins (C, K), minerals and fiber. Therefore, these properties and qualities make it a promising and perspective crop for the food industry.

Aims: The aim of the present study is to morphologically characterize pea genotypes in order to identify suitable sources for creating varieties with good economic qualities.

Methods: The experiments were conducted at the *Maritsa* Vegetable Crops Research Institute-Plovdiv. The study included 40 pea genotypes grown in the field. The following plant indicators were recorded: plant height; number of productive nodes; number and weight of pods; number and weight of green grain; average number of grains in a pods.

Results: The studies included 40 genotypes, which were divided into 7 groups according to the morphological characteristics of the plants. Of the materials included in the study, genotypes 29, 26, 38, 5 and 28 stand out as promising for breeding. These breeding materials have good biometric indicators and yield.

Conclusions: The inclusion in breeding programs of genotypes with good biometric indicators and good yield will provide the opportunity to create pea varieties that provide quality production for consumers of this valuable protein crop. In the comparative evaluation of 40 pea genotypes with good indicators, 29, 26, 38, 5 and 28.

Acknowledgements: This research was supported by Project BG16RFPR002-1.014-0012-C01, Establishment and Sustainable Development of a Center of Competence "Agrifood Systems and Bioeconomy", funded by the European Regional Development Fund under the Programme for Research, Innovation and Digitalisation for Smart Transformation (PRIDST).

ID 156

Exploration of the strenghts and weaknesses of specialty beers as fucntional beverages: IPA and Stout styles

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Background: The relevance and interest of functional food products is increasing worldwide. Thus, there is an innovation opportunity within the beer market. Specialty beers such as the IPA and Stout styles can be modified to be considered functional. However, there is not a clear landscape for that endeavor.

Aims: This study's main aim is the exploration of the composition of some massively commercialized beer products to determine their weaknesses and strengths as potential base products for the development of functional beverages. The viability of the development of functional beer products as well as a selection of the most suitable production technique are also presented and discussed.

Methods: Samples of IPA and Stout styles were obtained from five different producers and analyzed. The ethanol content, density and real extract of beer samples were quantified using an Alcolyzer Beer ME device. Polyphenol levels were determined using the Folin-Ciocalteu method, gallic acid was used as a standard. The antioxidant capacity was quantified using the TRAP (Total Reactive Antioxidant Potential) assay, ascorbic acid was used as standard. The reaction between flavonoids and + p-dimethylaminocinnamaldehyde (DMACA) in acidic medium was used for their quantification, (+)-catechin was used as standard.

Results: Results show that Stout beer samples present 61.37% more real extract, 68.19% more polyphenols, 37.26% more antioxidant capacity and 60.12% more flavonoids. Another relevant result is that the amount of ethanol and density do not present any statistically significant difference between the IPA and Stout beer samples ($p>0.05$). As it stands, the most viable way to achieve a functional beer product derived from IPA and Stout styles is to produce alcohol-free versions of them. The Stout style is more suitable to be the base of a functional beer product as its polyphenols, flavonoids and antioxidant levels are higher than those of the IPA style. Theoretically, a process of nano filtration would be the most fitting to the production of a functional alcohol-free beer. Filtration methods provide several advantages in comparison to other techniques like arrested fermentation or vacuum distillation.

Conclusions: Despite the obvious shortcoming of having considerable ethanol content, beer products, such as IPA and Stout beer styles possess relatively high levels of some compounds relevant for being considered as functional beverages. Stout style beers are more suitable to produce a functional beverage. A filtration technique would maximize the functionality of the alcohol-free beer produced.

ID 158

Bioactive polyphenols and volatile compounds in nectar plants as functional ingredients: bioactivity and applications in future food and non-food products

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Background: Nectar-producing plants are a valuable source of bioactive compounds, particularly polyphenols and volatile constituents involved in plant defence and ecological interactions. These compounds exhibit antioxidant, antimicrobial and antiparasitic activities and are increasingly recognised as functional ingredients. Plant-derived essential oils and phenolic fractions offer sustainable alternatives to synthetic chemicals due to their biodegradability and lower environmental impact.

Aims: This study aimed to evaluate the composition, antioxidant capacity and bioactivity of polyphenols and volatile compounds in selected nectar plants and to assess their potential applications in functional food and non-food products.

Methods: Medicinal and nectar-producing plant species were collected, dried and extracted using ethanol–water mixtures (25:75, v/v). Total polyphenol content (TPC) was determined spectrophotometrically using the Folin–Ciocalteu method. Antiradical activity was evaluated using DPPH and ABTS assays. Volatile compounds were characterised by gas chromatography–mass spectrometry (GC–MS).

Results: High TPC was observed in *Verbascum thapsus*, *Centaurea cyanus* L. flowers, *Melissa officinalis*, *Mentha piperita* and *Primula veris* flowers. The highest DPPH activity was recorded in *Verbascum thapsus*, *Centaurea cyanus* L., *Lavandula angustifolia*, *Achillea millefolium* and *Calendula officinalis*, while ABTS activity was highest in *Filipendula ulmaria*, *Mentha piperita*, *Melissa officinalis*, *Verbascum thapsus* and *Centaurea cyanus* L. Leaves and stems of *Salvia officinalis* exhibited higher TPC than flowers. Major phenolic compounds included catechin, quercitrin and kaempferol, and volatile fractions contained α-pinene, limonene, thymol, carvacrol and borneol.

Conclusions: Nectar-producing plants are rich sources of phenolic compounds and volatile terpenoids with notable antioxidant, antimicrobial and acaricidal properties. Species such as *Verbascum thapsus*, *Centaurea* cyanus, *Melissa officinalis* and *Mentha piperita* exhibit particularly high bioactivity. These findings support their use as sustainable natural ingredients in functional foods and environmentally friendly bioactive products.

ID 159

Growth properties of traditional yogurt starter cultures in experimental plant based milk analogues produced by combination of almond, walnut, soy and hemp

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Background: Yogurt produced with classic starters *Lactobacillus delbrueckii* subsp. *bulgaricus* and *Streptococcus thermophilus* is well known as a product with a beneficial effect on the human intestinal microbiome. Plant-based milk alternatives are increasing their market size by 9-10% per year as the main reasons for this being lactose and casein intolerance, ethical issues with dairy cows rearing in closed barns without pasture, climate fingerprint of dairy farming, preferences for lifestyle without foods of animal origin. Plant-based milk alternatives are nuts based liquid products, as there is a challenge in fermentation by classical yoghurt starters and beneficial concentration of more than 10^6 CFU/g in the final product. Insufficient fermentation and off-flavour are commonly detected by consumers.

Aims: The aim of this study was evaluation of fermentation process and quality indicators of experimental plant based milk analogues produced by a combination of almond, walnut, soy and hemp and starters *Lactobacillus delbrueckii* subsp. *bulgaricus* and *Streptococcus thermophilus*.

Methods: Experimental plant based milk analogues were produced in four combination of almond, walnut, soy and hemp with additive of inulin, glucose and hydrocolloid xsantan. After fermentation process with classical yoghurt starters L. delbrueckii subsp. bulgaricus and Str. thermophilus at 43°C and chilling to 6°C the samples were subjected to quality evaluation based on: organoleptic properties, laboratory indicators pH, titratable acidity, water-holding capacity (WHC), percentage of fat, proteins, ash content. LAB enumeration was on MRS and M17 agar. Samples were tested in duplicate and results were statistically evaluated.

Results: The combination of almond, walnut, soy and hemp for laboratory prepared plant based milk analogues was balanced to 3,4.% fat and 4,4 % protein. The addition of 0,075% inulin and 0,5% glucose ensures sufficient fermentation process, only after incubation at 43°C for 12 hours. Enumeration of LAB resulted in at least 8,91 Log10 of L. delbrueckii subsp. bulgaricus and 9,51 Log10 of Str. thermophiles. After storage at 6°C we detect 4,55 pH and 69 to 91 titratable acidity. Water-holding capacity (WHC) was significantly influenced by hydrocolloid xsantan. All the experimental samples were compared with control sample of fermented cow yoghurt.

Conclusions: Development of an experimental composition of plant-based milk alternatives requires balancing by fats, proteins through an optimal ratio of combination of almond, walnut, soy and hemp. For the fermentation process with 0.2% classic yogurt starter require addition of inulin and glucose. The fermentation process of 12 hours provides a beneficial concentration of more than 10^7 CFU/g LAB. Storage at 6°C for 18 days does not change the quality indicators and does not lead to unwanted off-flavours.

ID 160

Heat-flux-driven two-node ODE model for predicting moisture loss during biscuit baking

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Background: Industrial biscuit baking is a complex heat and mass transfer process in which final product quality is strongly influenced by the oven thermal profile, residence time, product geometry, and moisture dynamics. In industrial tunnel ovens, direct measurement of product temperature and internal moisture evolution is challenging due to harsh operating conditions and limited sensor accessibility. Reduced-order mathematical models can therefore provide valuable insight into the baking process by linking measurable oven conditions to predicted product responses. In this context, a simplified two-node model, representing the biscuit as surface and core regions, may provide a practical compromise between detailed physical modelling and the limited measurements typically available under industrial conditions.

Aim: This study aimed to develop a heat-flux-driven two-node ordinary differential equation (ODE) model for biscuit baking, capable of predicting biscuit surface temperature, core temperature, and moisture loss from time-resolved oven measurements. The long-term objective is to calibrate and validate the model using repeated electric convective oven trials and to support process optimization based on measurable oven operating conditions.

Methods: A preliminary model was developed using data collected during an industrial gas-fired tunnel oven trial for laminated biscuits. Time-resolved measurements of total heat flux, air temperature, relative humidity, air velocity, belt speed, residence time, and product properties were organized into a structured MATLAB input dataset. The model consists of an energy balance for the surface node, an energy balance for the core node, and a moisture balance. The surface node is assumed to be directly exposed to the measured total heat flux, while internal heat transfer between surface and core is described using a lumped thermal conductance.. Moisture loss is described using a first-order drying model that incorporates an equilibrium moisture content and a temperature-dependent drying coefficient. The latent heat of evaporation is accounted for as a sink term in the surface energy balance.

Results: For the preliminary trial, the model predicted a final moisture content of 1.86% wet basis, closely matching the experimental value of 1.85% wet basis. The predicted final mass of biscuit was 5.46 g compared with the measured experimental value of 5.37 g. Local sensitivity analysis showed that the drying coefficient and heat-flux scaling factor had the strongest influence on final moisture prediction, whereas the internal thermal conductance primarily affected the surface–core temperature gradient.

Conclusions: The proposed two-node ODE model provides a practical reduced-order framework for linking industrial oven measurements with biscuit moisture and thermal evolution. Future work will focus on calibration and validation using repeated electric convection oven experiments, followed by model extension toward

comprehensive quality prediction, including moisture content, mass loss, colour development, texture, and image-based product descriptors.

ID 161

Bigel formulations as alternatives to conventional solid fats for food applications

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Background: Bigels are hybrid semi-solid systems obtained by combining oleogel (OG) and hydrogel (HG) phases, integrating the mechanical strength of oleogels with the viscoelastic properties of hydrogels. Their structural stability and functional performance are strongly influenced by the type and concentration of both oleogelators and hydrogelators. Natural waxes, such as rice bran wax (RBW) and carnauba wax (CW), are widely used as safe and effective oleogelators, whereas hydrogels consist of three-dimensional, water-retaining networks structured by hydrocolloids, primarily polysaccharides and proteins.

Aims: This study aimed to develop bigels by combining binary wax-based oleogels formulated with rice bran wax and carnauba wax with polysaccharide-based hydrogels composed of xanthan gum (XG) and κ-carrageenan (κ-C), as a sustainable alternative to conventional solid fats for food applications.

Methods: OGs were formulated using canola oil added with 5 concentrations (5, 8, 10, 12, and 15% w/w) of a mixture of RBW and CW, prepared at 5 different ratios, ranging 100:0 to 0:100 of RBW and CW, respectively. HGs were formulated by adding different amounts of XG and κ-C to water, ranging from 1.5 to 3% by weight. To identify the optimal formulations for bigel production, OGs and HGs were characterized by Fourier-transform infrared spectroscopy (FTIR), differential scanning calorimetry (DSC), texture profile analysis (TPA), oil binding capacity (OBC) and water holding capacity (WHC). Furthermore, all samples were visually evaluated for gel formation and structural integrity using the inverted-container test after 24 h of storage at 4 °C.

Results: OGs showed no oil leakage or flow, while HGs exhibited no water release. The inverted-container test confirmed the formation of stable gel networks, except for the HG sample prepared adding only XG, which completely collapsed. OGs formulated with canola oil and binary mixtures of RBW and CW showed a significant increase in OBC (77.72–98.26%) as the wax level increased, indicating enhanced crystal network formation and oil immobilization. FTIR analysis confirmed that OG formation was driven by physical interactions and wax crystallization without changes in the structure. DCS data indicated that all OGs formulated with an RBW/CW ratio of 25/75 showed the highest thermal stability. HGs prepared with κ-C and XG exhibited excellent WHC (99.6–99.9%), due to the formation of stable three-dimensional polymeric networks. HGs containing 1.5% κ-C combined with either 1.0 or 1.5% XG gum showed the most favorable balance between mechanical strength and flexibility, suggesting a positive interaction between the polysaccharides. FTIR analysis further confirmed that HG formation resulted from physical interactions, with no evidence of new covalent bond formation.

Conclusions: The optimized OG and HG formulations exhibited good thermal stability and desirable rheological characteristics, highlighting their potential as building blocks for the development of stable structured vegetable fats. The optimized bigel formulation will be incorporated into a model food system, such as salad dressing, and subsequently evaluated for its physicochemical, thermal, rheological, and structural properties.

Overall, this strategy offers a promising platform for replacing conventional solid fats with clean-label, structured lipid systems tailored for next-generation food products.

ID 162

Prevalence study of newly described staphylococcal enterotoxins isolated from food-borne outbreaks

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Background: Staphylococcal enterotoxins (SEs) are a major cause of foodborne intoxications due to bacterial toxins, and their notification has been mandatory in France since 2005. Among the 37 SEs reported in the literature, only five can be detected using commercially available immunoassays: SEA to SEE. Due to the lack of appropriate analytical tools, no validated method is currently available for to detecte newly described SEs. Several foodborne outbreaks in Europe have shown typical symptoms of staphylococcal food poisoning, although no classical SEs (SEA to SEE) were detected. However, genes encoding newly described SEs were identified by whole-genome sequencing (WGS), suggesting their presence in the implicated foods.

Aim: To investigate the occurrence and detection of newly described SEs in coagulase-positive staphylococci (CPS) strains isolated in the context of official controls and foodborne outbreak investigations.

Methods: Genomes obtained from approximately 700 CPS strains isolated from official controls and foodborne outbreaks were analysed for their *se* gene content using the NAuRA tool (D. Merda et al., 2020). A toolbox of validated in-house ELISA methods targeting SEG, SEH, SEI, SEK, SEQ and SEL, was implemented to detect newly described SEs in foods involved in foodborne outbreaks.

Results: *S. aureus* represented the majority of the strains studied, although a few *S. argenteus* was also identified. WGS data showed the presence of genes encoding classical SEs (SEA to SEE) in a significant proportion of *S. aureus* strains. SEA was the most frequently detected (45%), whereas SEE was rarely detected (1%). Newly described SEs represented a substantial proportion of all *se* genes detected among CPS strains. Genes located in the *egc* operon (*seg*, *sei*, *sen*, *sem*, *seo* and *seu*) were identified in approximately one-third of the investigated CPS strains. Other newly described SE types, such as SEH, SEK and SEQ, were detected in 22% of strains. Detection of SE produced by CPS strains in culture medium showed expression of all *se* genes, although at different concentration levels. Some newly described SEs (SEH, SEK, SEQ and SEL) were produced at concentrations comparable to those observed for classical SEs. Finally, analysis of several foods involved in foodborne outbreaks that occurred in France between 2018 and 2022 showed the presence of newly described SEs (SEH, SEK, SEQ and SEL) in the consumed foods, including ham, fish and cheese.

Conclusions: Newly described SEs remain insufficiently studied and may be completely overlooked during foodborne outbreak investigations due to the lack of suitable and validated methods targeting these enterotoxins.

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ID 163

Effect of herbal supplement and probiotic Zoovit LL on amino acids, organic acids and sugars in milk of sheep from the Synthetic Bulgarian Dairy Population

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Background: In recent years, with the increasing prevalence of antimicrobial resistance (AMR), researchers have focused their attention on the potential use of probiotics and medicinal plants in the nutrition of farm animals as an alternative strategy to reduce the use of antibiotics. Numerous studies have reported beneficial effects of biologically active substances on animal productivity, health status, and milk quality. However, information regarding their effects on the amino acid profile and the content of organic acids in sheep milk remains relatively limited.

Aims: The present study aimed to evaluate the effects of the probiotic Zoovit LL and an herbal complex consisting of chamomile and nettle on the amino acid profile, organic acid content, and lactose concentration in the milk of Synthetic Population Bulgarian Milk sheep.

Methods: The experiment included 45 ewes allocated into three groups of 15 animals each. The groups were balanced using the analogue method according to lactation number and daily milk yield. The control group received a standard concentrate mixture. The first experimental group was fed the same concentrate supplemented with 15 g of chamomile (*Matricaria chamomilla*) and 5 g of nettle (*Urtica dioica*) per animal per day. The second experimental group received the standard concentrate supplemented with 70 mL of the probiotic Zoovit LL per animal per day. The experimental period lasted 90 days. The amino acid profile, organic acid content, and lactose concentration in milk were determined at the beginning and at the end of the experimental period using a standardized gas chromatographic analytical method.

Results: A 13.58% higher concentration of total amino acids was observed in the group of ewes supplemented with the herbal mixture of nettle and chamomile compared with the group receiving the probiotic Zoovit LL. At the end of the experimental period, the herbal-supplemented group exhibited a significantly lower concentration of valine ($p = 0.021$) and a significantly higher concentration of proline ($p = 0.009$) compared with the beginning of the experiment. In the second experimental group, which received the probiotic supplement, no statistically significant differences were detected between the beginning and the end of the experimental period for any of the analyzed parameters. Regarding the organic acid profile of the milk, no statistically significant differences were found between the two experimental groups. However, the milk lactose concentration was significantly lower ($p < 0.001$) in the group supplemented with the probiotic Zoovit LL than in the group receiving the herbal complex.

Conclusions: The observed changes in the total amino acid concentration, particularly in the levels of valine and proline, in the milk of Synthetic Population Bulgarian Milk sheep indicate the need for further and more in-

depth investigations into the potential of the biologically active substances used in this study. Natural feed additives may represent promising alternatives to antibiotics in sheep production, with the potential to improve milk productivity and enhance milk quality.

ID 164

Recent Advances in the Assessment of Nutritional and Functional Quality of Oat (Avena sativa L.) Grain

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Background: The growing consumer demand for healthy and functional foods has drawn attention to deepening research on the nutritional qualities of cereals. Oat (*Avena sativa* L.) is an important cereal crop valued for their nutritional composition and bioactive compounds. Advanced analytical technologies have improved the quality assessment of oat grain, allowing reliable quantification of important bioactive compounds, making it an integral part of the development of varieties with improved nutritional and functional qualities and potential benefits for human health.

Aims: This review summarizes recent advances in the assessment of oat grain nutritional quality, with a focus on modern analytical techniques that support breeding efforts aimed at developing oat varieties with improved grain quality. It also identifies major challenges and future perspectives in oat grain quality improvement.

Methods: Peer-reviewed publications from the last decade were critically evaluated and synthesized to provide an overview of current knowledge on the nutritional composition of oats, phytochemical characterization and bioactive compounds, modern grain quality assessment techniques, as well as breeding strategies for improving grain quality.

Results: Recent studies have shown that chromatographic, hyperspectral imaging, and spectroscopic techniques have significantly improved the characterization of oat grain composition and bioactive compounds. The integration of machine learning with spectroscopic and imaging data has further improved the prediction of grain quality traits lowering the time and cost required for analysis. These approaches facilitate rapid screening of large numbers of genotypes and accelerate the identification of lines with superior nutritional profiles. However, the strong genotype by environment interaction for most of grain composition traits and the need for reliable calibration models remain major challenges for the routine application of high-throughput phenotyping in oat breeding.

Conclusions: Modern analytical technologies have significantly improved the nutritional evaluation of oat grain and facilitated the selection of functional oat varieties. The integration of high-throughput phenotyping is essential to accelerate the development of genotypes with superior nutritional content that meet the nutritional needs of consumers.

ID 166

Oxidative stability of maize oil during deep frying of potatoes

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Background: Deep frying is one of the most widely used methods for preparing fried foods because it produces desirable sensory characteristics such as a crispy texture, golden color, and distinctive flavor. However, exposure of the oil to high frying temperatures accelerates various chemical reactions, including oxidation, hydrolysis, and polymerization. These reactions lead to the formation of primary and secondary oxidation products that can affect oil quality, nutritional value, and consumer acceptability.

Aims: The aim of the research is investigation of the oxidative stability of maize oil during deep frying of potatoes and determination of the conditions for maximal stability of the oil.

Methods: The oxidative stability of the oil during deep frying was evaluated by determination of peroxide value, acid value, iodine value, and refractive index. Response surface methodology was applied for determination of the conditions for maximal oil stability.

Results: The influence of frying temperature and time during deep frying of potatoes was investigated. A mathematical model was developed to describe the effects of these factors on the peroxide value of maize oil. The optimum frying conditions for achieving maximum oxidative stability of the oil were determined. The minimum peroxide value of 7.12 meq O_2/kg oil was obtained when potatoes were fried at 190°C for 7 min. Under these frying conditions, the oil was characterized by an acid value of 0.67 mg KOH/g, an iodine value of 127 g I_2/100 g oil, and a refractive index of 1.4729. The fried potatoes produced under the optimized conditions exhibited good nutritional quality, with 61.8 % moisture, 29.4 % total carbohydrates, 24.6 % starch, 1.1 % sugars, 7.2 % fat, 2.1% protein, and an energy value of 188 kcal/100 g.

Conclusions: Deep frying of potatoes in maize oil at 190°C for 7 min provided the best compromise between oil oxidative stability and the nutritional quality of the fried potatoes. The developed mathematical model can be used as a useful tool for optimizing frying conditions in both laboratory studies and industrial food processing.

ID 167

Production of newly described staphylococcal enterotoxins in dairy products

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Background: According to the European food safety agency (EFSA) and the European center for diseases prevention and control (ECDC), staphylococcal enterotoxins (SEs) are the second leading cause of bacterial toxin-mediated foodborne outbreaks in the European Union (EU). Among the 37 SEs types, only five (SEA to SEE, "classical" SEs) are routinely detected in food using immunological commercial kits (EN ISO 19020:2017). ANSES, EU and national reference laboratory for coagulase positive staphylococci (EURL and NRL for CPS), gathered a large collection of CPS strains isolated from staphylococcal food poisoning outbreaks (SFPOs), official controls and own checks operated by dairy food manufacturers. Since several years, it was observed that the presence of SE in own checked cheese samples could not always be demonstrated, even when high levels of S. aureus were present. Two hypotheses could explain this observation: (i) SE were not produced because conditions for toxin production were not met, (ii) the strain produced newly described SE not covered by routine detection methods.

Aim: To assess the ability of *S. aureus* to grow in a milk-like medium and to produce and quantify both classical and newly described SEs.

Methods: Ten *S. aureus* strains carrying classical and newly described enterotoxins genes, isolated from SFPOs, official controls and own checks, were selected from the ANSES collection. Strains were grown in BHI (positive control) and MB10, an in-house medium prepared from milk ultrafiltration filtrate, to mimic milk conditions. Kinetics of S. aureus growth and SE production were monitored at 3, 4, 6, 9 and 24 hours of incubation in both media. SEs were detected using multiplex LC-MS/MS method (Lefebvre et al. 2022). Furthermore, genomic and transcriptional analyses were conducted to obtain a complete overview of SE production.

Results: Biological and analytical replicates were very satisfactory (standard deviation < 20%). S. aureus strains simultaneously produced both classical and new SEs in the milk-like medium, but the concentration varied depending on the type of SE. Classical and new SE amounts produced in MB10 were much lower than those measured in BHI, highlighting the influence of the nature of matrix on SE expression. S. aureus growth and SE production kinetics were also strain-dependent.

Conclusions: Classical and new SE production were medium- and strain-dependent. Moreover, some new SEs were produced at same concentration levels as classical SEs regardless of the medium, underlining their potential threat in SFPOs. This study highlights the urge to develop fast and reliable tools for detecting newly described SEs in food to ensure consumer safety.

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ID 168

Valorization of tilapia scales (*Oreochromis niloticus*) for bioactive peptide production with antioxidant and antihypertensive potential

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Background: The valorization of fish processing by-products has emerged as a sustainable strategy for developing high-value ingredients with applications in functional foods and nutraceuticals. In this context, tilapia scales (*Oreochromis niloticus*), commonly considered low-value waste, represent a promising protein source for the production of bioactive peptides with potential health-promoting properties. However, limited information is available regarding the impact of gastrointestinal digestion on the bioactivity and intestinal effects of peptides derived from tilapia scales

Aims: This study aimed to obtain protein hydrolysates from tilapia scales through enzymatic hydrolysis using Esperase® and to evaluate the effect of simulated gastrointestinal digestion on their biofunctional properties, with special emphasis on antihypertensive activity and cellular antioxidant potential in an intestinal cell model.

Methods: Demineralized tilapia scales were subjected to enzymatic hydrolysis using Esperase®. The degree of hydrolysis was determined by the pH-stat method, and molecular weight distribution was analyzed by high-performance liquid chromatography (HPLC). The stability of bioactivity after simulated gastrointestinal digestion was assessed by measuring inhibitory activity against angiotensin-converting enzyme (ACE), dipeptidyl peptidase IV (DPP-IV), and prolyl endopeptidase (PEP). Cellular antioxidant activity and cytotoxicity were evaluated in STC-1 enteroendocrine cells under oxidative stress induced by H_2O_2.

Results: The hydrolysate showed a degree of hydrolysis of 6.2%, with peptides ranging from 2 kDa to 985 Da. Prior to simulated digestion, the hydrolysate exhibited inhibitory activity against ACE (IC_{50}: 14.5 µg/mL), DPP-IV (IC_{50}: 0.69 mg/mL), and PEP (IC_{50}: 0.63 mg/mL). After simulated gastrointestinal digestion, antihypertensive activity significantly improved, with ACE inhibition reaching an IC_{50} of 4.6 µg/mL, suggesting the generation of more bioactive peptides. In STC-1 cells, the digested hydrolysate showed no cytotoxic effects at the tested concentrations. Furthermore, it demonstrated cellular antioxidant activity against H_2O_2-induced oxidative stress, reducing reactive oxygen species (ROS) production by approximately 50%.

Conclusions: Tilapia scales represent a sustainable source of bioactive peptides with antioxidant and antihypertensive properties. Simulated gastrointestinal digestion enhanced ACE inhibitory activity, indicating improved bioactivity after digestion. These findings support the potential application of tilapia scale-derived peptides in nutraceutical development for intestinal and metabolic health, contributing to by-product valorization and circular economy strategies.

ID 169

From Isolation of Bioprotective LAB Strains to their Application for Perishable Food Preservation: Case Studies in a Franco-Bulgarian Cooperation Perspective.

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Background: Lactic acid bacteria (LAB) play a key role in many traditional fermented products safety by inhibiting the growth of unwanted microorganisms by different mechanisms. These mechanisms include acidification resulting from lactic acid production and production of other antimicrobial metabolites such as bacteriocins. Isolation of LAB strains exerting an antagonistic activity against unwanted microorganisms has stimulated research regarding biopreservation of perishable foods by such LAB strains.

Aims: Development of innovative perishable foods biopreservation systems requires (i) the isolation and characterization of LAB strains with a high antagonistic activity against food-spoiling or foodborne pathogenic microorganisms, (ii) the development of innovative systems maintaining the viability and promoting the antagonistic activity of bioprotective LAB strains against unwanted microorganisms, such as biopolymeric systems entrapping LAB. The goal of the present contribution is to illustrate the complementarity of the skills of a Franco-Bulgarian consortium built to develop innovative LAB-based smart systems for perishable foods biopreservation.

Methods: Antagonistic activity of different LAB strains against foodborne pathogenic bacteria (e. g. *Listeria monocytogenes*) or surrogates (e. g. *Listeria innocua*) was estimated by the agar well diffusion method. Isolated commercial bioprotective LAB were incorporated in biopolymeric systems such as alginate or aqueous two-phase alginate-caseinate systems. The potential of such biopolymeric systems to preserve its viability and its antagonistic activity against unwanted bacteria was evaluated during storage for up to 12 days at temperatures ranging from 4°C to 30°C to mimick refrigeration temperature and cold chain break, respectively. Finally, challenge tests with chocolate mousse supplemented with a bioprotective LAB strain were performed.

Results: Bioprotective lactobacilli and lactococci strains were isolated in Bulgaria from yogurts (*Lactobacillus bulgaricus* strains) and from the rose blossom of *Rosa damascena* Mill L. (*Lb. helveticus* 2/20 probiotic strain) and in France from dairy products (*Lactococcus lactis* strains). Some of these strains exerted a high antagonistic activity against *L. monocytogenes*, *Staphylococcus aureus* and *Escherichia coli*. Alginate-caseinate aqueous two-phase systems better preserved viability and anti-*Listeria* activity of commercial bioprotective *Lc. lactis* strain than alginate alone whatever the storage temperature. Free and entrapped in alginate *Lb. helveticus* 2/20 cells

were added to chocolate mousse: they both effectively inhibited the growth of *E. coli* and *S. aureus* artificially contaminating chocolate mousse.

Conclusions: Challenge tests with pathogenic bacteria in chocolate mousse supplemented with a bioprotective LAB strain demonstrated its capacity to protect it from contamination. This proof of concept underlines the promises of bioprotective LAB strains for perishable foods safety.

Funding: This work was funded under the project "Synergic plant extracts (e.g. essential oils) - bioprotective microorganisms for development of functional fermented foods (SEO-MICRO-FOODS)" under the Competition for projects under bilateral cooperation programs 2026 - Bulgaria - France ("Rila" program, project BG-175467353-2025-05-0004 /FNI-2923 of 08.12.2025/ of the Bulgarian Scientific Research Fund). Cooperation between University of Food Technologies Plovdiv (Bulgaria), BioDyMIA research unit (Université Claude Bernard Lyon 1 - ISARA Lyon, France), and Ecole d'Ingénieurs de Purpan (Université de Toulouse, France) was supported by Franco-Bulgarian cooperation Hubert Curien Programme (PHC Rila) The authors wish to express their gratitude for the supports of the Ministry of Education and Science (Bulgaria), the Embassy of France to Bulgaria in Sofia ("Ministère des Affaires Etrangères", France), Campus France and "Ministère de l'Enseignement Supérieur, de la Recherche et de l'Innovation" (France).

ID 170

Evolution of the Microbiota During Long-Term Storage of Bulgarian White Brined Cheese Studied with Amplicon-Based Metagenomics

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Bulgaria has a reputation for strong traditions in animal husbandry, especially in breeding cows, sheep and goats. Because of the largely seasonal nature of milk production, cheesemaking has gained importance as a means of preserving milk's nutritional value. Bulgarian white brined cheese is probably the most consumed cheese in the country, and its production traditions date back centuries. Unfortunately, most studies on Bulgarian white brined cheese were focused on its physicochemical, rheological and nutritional characteristics, while the microbiota has been studied mainly using classical microbiological approaches, which cannot provide complete information on its composition and the functional roles of the different species. The main goal of this research was to study the composition of the microbiotas of cheeses made from cow, ewe, goat and buffalo milk at the fully ripened stage, as well as their evolution during long-term storage. All samples were obtained from industrially produced cheese batches in accordance with the Bulgarian State Standard BDS 15:2010 "Bulgarian white brined cheese". To achieve the study's goals, total DNA from the cheese samples was isolated and subjected to an amplicon-based metagenomic approach targeting the bacterial V3-V4 region of rRNA genes, with sequencing performed on the DNBSEQ platform. The raw sequencing data were processed using bioinformatics to obtain clean tags and OTUs, which were then annotated taxonomically. Based on this information, alpha diversity indices were calculated to assess richness and evenness in the microbiotas of the different samples. Finally, beta-diversity among cheeses prepared from different types of milk was studied, as well as their evolution during long-term storage. Based on the analyses performed, it can be concluded that the Bulgarian white brined cheese exhibits distinctive traits in its core microbiota, despite differences observed between cheese samples prepared from different types of milk and between those stored for different periods.

This research was funded by BULGARIAN NATIONAL SCIENCE FUND, grant number КП-06-66/6 from 13.12.2022 (BG-175467353-2022-04-0022-C01).

ID 171

The impact of sustainable agriculture on the agrochemical characteristics of arable soils

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Background: The intensive agricultural practices applied to satisfy the growing global food demand are the main cause of soil degradation and environmental pollution. For these reasons, sustainable agricultural production is increasingly relevant worldwide and in our country, based on Good Agricultural Practices.

Aims: To assess the influence of different fertilization treatments on agrochemical soil parameters and the content of the main macroelements in the soil solution.

Methods: The study was conducted under different climatic conditions on two soils with contrasting characteristics: Alluvial-meadow soil (Fluvisol) at the Tsalapitsa experimental field and Leached Smolnitsa (Haplic Vertisol) at the Bozhurishte experimental field. Maize (Zea mays L.) for grain production was grown after a peas–rye mixture used as a green manure crop. In 2025, maize was cultivated at both experimental sites. Four fertilization variants were applied: T0: N_0P_0 (control), T1: $N_{11}P_8$ + 30 kg/da organic fertilizer of plant origin, T2: $N_{11}P_8$ + 30 kg/da organic fertilizer of animal origin, T3: $N_{16}P_{12}$ (mineral fertilization).

Results: Mineral nitrogen content in the Alluvial-meadow soil remained close to background values, whereas significantly higher concentrations were recorded in the surface layer of the Leached Smolnitsa, followed by a decrease in the subsoil layer. Nitrate was the dominant form of nitrogen in the soil solution, with approximately threefold higher average nitrate concentrations in the Haplic Vertisol than in the Fluvisol after maize harvest. Both soils were well supplied with available potassium, with higher levels observed in the Haplic Vertisol.

Conclusions: The obtained results for the content of the main macroelements and humus in the soil and in its liquid phase - the soil solution, demonstrate the influence of both fertilization and soil-climatic conditions on the studied soil types Soil type had a stronger influence on mineral nitrogen distribution and nitrate concentrations in the soil solution than the fertilization treatments. The Haplic Vertisol exhibited greater nitrogen accumulation and potassium availability than the Fluvisol. Organo-mineral fertilization contributed to modest increases in humus content, but its effects on the evaluated agrochemical indicators were not consistently expressed.

ID 172

Predicting Barley Quality Traits via NIR Spectroscopy and Machine Learning

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Background: Improving the grain quality of barley (Hordeum vulgare L.) is one of the most important breeding objectives, whether the grain is used for the malting industry, for human consumption or for feed production. Classical laboratory methods are accurate and reliable, but many of them are slow, laborious and/or expensive. Near-infrared spectroscopy (NIR) is a fast, non-destructive and high-throughput technology that allows the assessment of grain composition without chemical analysis. This makes the approach particularly suitable in the initial stages of breeding programs, when working with a large number of genotypes and a limited amount of grain. The combination of this approach with machine learning increases its potential for predicting quality traits and for genotype selection.

Aims: This study provides a review of recent research on the application of NIR spectroscopy combined with machine learning approaches for the evaluation of barley grain quality traits and for supporting selection in breeding programs. The review focuses on model development, data processing strategies, and factors influencing predictive performance.

Methods: This study provides a review of recent research on the application of NIR spectroscopy combined with machine learning approaches for the evaluation of barley grain quality traits and for supporting selection in breeding programs. The review focuses on model development, data processing strategies, and factors influencing predictive performance.

Results: The reviewed studies have demonstrated that NIR spectroscopy, when integrated with machine learning algorithms provides reliable predictions of important barley grain quality traits. Reported model performances vary across studies, with prediction accuracy strongly influenced by spectral preprocessing techniques, wavelength selection, sample size, and genotype X environment interactions. Ensemble and nonlinear machine learning approaches generally outperform linear methods. High prediction accuracies have been reported for protein and moisture content, while satisfactory performance has also been achieved for starch, β-glucan, and kernel hardness. Overall, the combined use of NIR spectroscopy and machine learning has demonstrated significant potential for high-throughput, non-destructive phenotyping and for enhancing selection efficiency in barley breeding programs.

Conclusions: NIR spectroscopy combined with machine learning represents a promising approach for predicting important barley grain quality traits and improving breeding efficiency. Future advances should focus on developing robust, transferable prediction models across diverse genotypes and environments, enabling the routine integration of NIR-based phenotyping into modern barley breeding programs.

ID 174

Classification of dairy products with wavelet synthesis of recognition features

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Background: The quality of milk and dairy products can be determined using various methods that take into account its chemical, physical, microbiological and nutritional characteristics. For this purpose, various contact and non-contact methods can be used, allowing for the automated execution of these activities. The scientifically applied idea underlying in the present research consists of using primary information obtained through ultrasonic non-contact method, processing through the usage of discrete wavelet transform and identification using pattern recognition methods to determine the characteristics of quality characteristics of yogurt.

Aims: The main objective of the proposed research and applied contribution is the development and verification of an effective, mathematically based method for classifying dairy products through wavelet feature synthesis. The conducted research is about the applicability of a non-contact ultrasonic method for automatic classification of yogurt from traditional producers on the Bulgarian market.

Methods: The experimental setup, which consists of the following components: **ESP32**- microcontroller **with system-on-chip architecture (SoC)**, developed by the company Espressif Systems; Ultrasonic sensor - HC-SR04; PC configuration with Windows 10 and Arduino IDE software; Oscilloscope – UNI-T, UTD2052CL+. An emitter generates a packet of ultrasonic pulses in the working environment. When they reach the recognition medium, they are reflected from it in the form of an echo signal. The latter returns back to the receiver and is detected by it. The signal reflected from the object is amplified, detected and fed to the input of an oscilloscope, through which it is transmitted for processing to the PC.

Results: The conducted research prove that the application of discrete wavelet transform (DWT) on dairy product ultrasonic signals allows identification on yogurts by fat content. The used model demonstrates that through using methods with artificial intelligence for classification and formation of the signs with discrete wavelet transform (DWT) is received very high accuracy of its classification.

Conclusions: The report presents an approach for dairy product classification based on wavelet synthesis of recognition features. The developed mathematical apparatus successfully solves the problem of high computational complexity and heterogeneity of the studied objects by optimizing the feature space for classification algorithms.The achieved results outline a clear perspective for the implementation of the method in automated computer systems and food quality systems industry.

ID 175

Development of Functional Bread Intended for Individuals with Gallstone Disease

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Background: Gallstone disease is among the most common disorders of the hepatobiliary system and is associated with impaired bile secretion, digestive discomfort and reduced quality of life. The development of functional bakery products enriched with dietary fibre and plant bioactive compounds may contribute to dietary management and support of digestive health.

Aims: The aim of the present study was to develop a functional enriched bread intended for individuals suffering from gallstone disease by incorporating wholegrain flours and selected plant-based ingredients with proven health-promoting properties, and to evaluate their influence on the technological, nutritional and sensory characteristics of the final product.

Methods: Experimental bread samples were produced using wholegrain flours supplemented with dandelion (*Taraxacum officinale*), milk thistle (*Silybum marianum*), inulin and psyllium. Coriander was incorporated as a flavour-enhancing ingredient. The breads were evaluated for their physicochemical, rheological and sensory properties. Parameters including dough behaviour, loaf characteristics, nutritional value and consumer acceptability were assessed and compared.

Results: The incorporation of dandelion, milk thistle, inulin and psyllium improved both the nutritional value and rheological properties of the dough. The use of these functional ingredients increased dietary fibre content and enhanced the biological value of the product. Coriander contributed to improved flavour and aroma characteristics, resulting in higher consumer acceptance. An optimized production technology for “Herbal Health” bread was developed. The final product exhibited favourable physicochemical and sensory properties, good technological performance and high nutritional quality.

Conclusions: The developed functional bread “Herbal Health” represents a promising bakery product for dietary nutrition of individuals with gallstone disease. Its combination of wholegrain flours, dietary fibre and plant-derived bioactive compounds provides potential health benefits while maintaining desirable quality characteristics. The product may also be suitable for consumers seeking preventive and healthy nutrition.

ID 177

Protein Nutrition and Human Health: Evidence, Challenges, and Opportunities

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The role of proteins in human nutrition is of paramount importance, as they constitute the vital building blocks of the human body. Unlike carbohydrates and lipids, proteins possess nitrogen in their chemical structure and serve as a source of energy, distinguishing them structurally from other macronutrients. Dietary proteins are macromolecules formed by the linkage of amino acids. The human body requires these amino acids, the fundamental components of proteins, to sustain growth, development, and cellular functions. Although there are 20 amino acids present within protein molecules, 9 of them cannot be synthesized by the human body and must be obtained through dietary intake; therefore, they are classified as "indispensable amino acids" (IAAs). The physiological roles of these molecules are vital for human health, encompassing growth, homeostatic stabilization of vital functions, tissue repair and maintenance of epithelial integrity,, muscle and bone development, immune system enhancement, and energy provision. When an adequate amount of protein is digested, the organism is supplied with sufficient nitrogen and amino acids, thereby obtaining high-quality and adequate protein.

Since the human body cannot autonomously synthesize proteins, they must be acquired from external sources. The necessary protein for the human body is derived from both animal and plant-based sources. Although the protein content obtained from animal-based foods generally appears higher than that of plant-based foods, this situation may vary depending on individual physiological status and factors such as the saturated fat content within the product. The quality of dietary protein is an indisputable reality, and investigating the quality of protein sources remains a highly meritorious subject for human health. This study holistically examines the effects of various protein sources on individuals across different age groups and physical activity levels. It aims to investigate protein sources and demonstrate how proteins function in diverse individuals. Within the scope of this study, it is intended to reach a comprehensive conclusion by synthesizing recent scientific research.

ID 178

Research on the isolation and selection of *Bacillus* sp. strains from animal gut with strong inhibitory activity against certain food poisoning bacteria in Hanoi, Viet Nam

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Background: The discovery of multifunctional probiotic bacteria with both antimicrobial and extracellular enzyme-producing capacities is essential for developing effective alternatives to antibiotics in livestock and aquaculture. Indigenous bacterial strains adapted to local environments may provide superior biological performance and practical application.

Aims: This study aimed to isolate, screen, identify, and characterize bacterial strains with strong antibacterial and extracellular enzyme-producing activities from animal intestinal samples and to optimize fermentation conditions for enhanced metabolite production.

Methods: A total of 79 bacterial isolates were obtained from pig intestines, clam intestines, and brackish water shrimp intestines collected in suburban Hanoi, Vietnam. Antibacterial activity against *Escherichia coli* ATCC 25922, *Salmonella typhimurium* ATCC 14028, *Vibrio parahaemolyticus* VTCC 910192, *Clostridium perfringens* ATCC 13124, and *Staphylococcus aureus* VTCCB-0658 was evaluated using the agar diffusion method. Extracellular enzyme production was assessed by substrate hydrolysis assays. The selected isolate was identified by 16S rRNA gene sequencing, and fermentation conditions were optimized by varying medium composition and culture parameters.

Results: Among the 79 isolates, strain T10, isolated from brackish water shrimp intestine, exhibited the strongest and most stable antibacterial activity, producing inhibition zones of 8.9, 23.50, 21.8, 22.9, and 16.50 mm against the tested pathogens of *Escherichia coli* ATCC 25922, *Salmonella typhimurium* ATCC 14028, *Vibrio parahaemolyticus* VTCC 910192, *Clostridium perfringens* ATCC 13124, and *Staphylococcus aureus* VTCCB-0658, respectively. The strain also produced amylase, cellulase, protease, lipase, and phytase, with hydrolysis zones of 32.0, 23.0, 32.0, 36.0, and 34.0 mm, respectively. Based on 16S rRNA gene sequence analysis, strain T10 was identified as *Bacillus amyloliquefaciens*. Optimal production of antimicrobial compounds and extracellular enzymes was achieved in LB medium supplemented with 1% maltodextrin and 1% NH_4NO_3 at pH 7, using a 5% (v/v) inoculum (1-day-old culture), incubation at 37°C for 36 h.

Conclusions: *Bacillus amyloliquefaciens* T10 possesses broad-spectrum antibacterial activity and strong extracellular enzyme-producing ability. Its optimized fermentation process supports its potential application as a multifunctional probiotic for animal feed and aquaculture.

ID 179

Probiotic Potential and Encapsulation of Yeasts Isolated from Traditional Turkish Fermented Foods

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Background: The increasing consumer demand for functional foods and health concern has accelerated the search for novel probiotic microorganisms. Traditional fermented foods represent different yeast strains with potential probiotic properties; however, only a limited number of yeast species successfully isolated from traditional Turkish fermented foods. Furthermore, maintaining the viability and functional stability of probiotic yeasts during food processing and digestion limits their integration into food formulations. Encapsulation has emerged as an effective strategy to enhance their stability. Despite the increasing interest in probiotic yeasts, studies combining the isolation, probiotic characterization, and encapsulation of yeast strains from traditional Turkish fermented foods are still limited.

Aims: This study aimed to isolate and identify probiotic yeast strains from traditional Turkish fermented foods and comprehensively evaluate their probiotic and functional characteristics. Furthermore, the selected yeast strains were encapsulated to enhance their stability and viability for potential application in functional probiotic food products.

Methods: Yeasts were isolated from traditional Turkish fermented foods, including kefir, hardaliye, tulum cheese, mother of vinegar, various pickles, shalgam, and fresh tarhana. Based on their biochemical and functional properties, 13 isolates were selected for further analysis. Survival of the isolates under acidic conditions (pH 2.0 and 4.0) and in the presence of 0.3% bile salts, antimicrobial susceptibility, cell surface hydrophobicity, auto-aggregation and co-aggregation with pathogens were evaluated. Finally, the cytotoxicity of the selected yeast isolates and their cell-free metabolites was assessed on Caco-2 cells for 24 h and 48 h. The selected probiotic yeast isolate was encapsulated using freeze-drying with maltodextrin and inulin as carrier materials and the viability of the encapsulated cells was evaluated before and after *in vitro* gastrointestinal digestion.

Results: The purified yeast isolates were identified as belonging to the genera *Pichia*, *Kluyveromyces*, *Metschnikowia*, and *Nakaseomyces*. The isolates exhibited higher resistance at pH 4 (100–41.62%) compared to pH 2 (1.76–39.69%), while increasing incubation time generally had a adverse effect on cell viability. The highest auto-aggregation capacity was observed in *Kluyveromyces marxianus* GYTM14 (41.82%). Cytotoxicity assays indicated that none of the isolates showed toxic effects on Caco-2 cells, and the highest cell viability was also observed with the cell-free supernatant of *K. marxianus* GYTM14. In adhesion assays performed on Caco-2 cells, *K. marxianus* GYTM14 demonstrated a high adhesion capacity (74.25 ± 6.01%), and therefore this strain was selected for encapsulation studies.

Conclusions: Traditional Turkish fermented foods were confirmed as a source of probiotic yeasts. *K. marxianus* GYTM14 showed the most favorable probiotic characteristics, and its encapsulation improved stability under *in vitro* gastrointestinal conditions for potential functional food application.

ID 180

Differences in microbiota composition between industrially and home-made white brined cheeses

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According to the Bulgarian State Standard BDS 15:2010 "Bulgarian white brined cheese" is a fermented dairy product which can be prepared with the use of selected lactic acid bacteria (LAB) strains isolated in Bulgaria as additive starter cultures. However, the use of starter cultures is more typical for industrial production, while starter cultures are not used to produce homemade white brined cheese, which relies on environmental microorganisms. Homemade cheese microbiota composition is additionally impacted by the limited standardization in the production facilities. The main goal of the study was to assess and compare the microbiotas of homemade and industrially produced cheeses with the tools of amplicon-based metagenomics, as well as to perform comparative functional prediction profiling of the metabolic pathways by performing KEGG, COG and MetaCyc function prediction for the bacterial microbiomes. Additionally, a Correlation analysis was performed to investigate the important patterns and relationships among dominant species in both types of cheese.

This research was funded by the BULGARIAN NATIONAL SCIENCE FUND, grant number КП-06-66/6 from 13.12.2022 (BG-175467353-2022-04-0022-C01).

ID 181

Physicochemical characteristics of meat in native bulgarian Sakar lambs slaughtered at weaning in 60-days of age

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Background: Traditional sheep farming in favors the production of light lamb carcasses from native breeds slaughtered early at weaning, meeting consumer demands for low fat content and high-quality dietary meat. The Sakar sheep is an endangered native Bulgarian breed adapted to semi-mountainous conditions, but data regarding the physicochemical and qualitative traits of meat from its unweaned light lambs are currently non-existent.

Aims: This contribution aimed to perform a detailed investigation into the slaughter parameters, chemical composition, color stability, myoglobin forms, and fatty acid profiles of meat from light Sakar lambs slaughtered immediately at weaning at 60 days of age to assess its dietary and taste qualities**.**

Methodology: Six singleborn male Sakar lambs reared under traditional grazing and suckling conditions were slaughtered at 60 days of age. Slaughter traits and dressing percentage were determined after 24 hours of chilling at 4°C. Physicochemical evaluations were performed on m. Longissimus thoracis, monitoring pH, instrumental color characteristics (L*, a*, b*, C), and myoglobin redox forms (MetMb, DeoMb, OxyMb) at 24 hours post-mortem and after 7 days of refrigerated storage. Proximate chemical composition (moisture, fat, protein, ash) and the full fatty acid profile were quantified using standardized AOAC, Kjeldahl, Soxhlet, and gas chromatography methods**.**

Results: The lambs reached a pre-slaughter live weight of 19.58 kg, yielding a chilled carcass weight of 10.13 kg and a high dressing percentage of 51.17%. Muscle pH remained stable within the ideal tenderness range, changing from 5.49 (24 h) to 5.45 (7 days). The meat featured high moisture (72.29%) and exceptionally high protein content (25.03%), alongside a low fat content of 3.37%. Instrumental color metrics demonstrated strong stability under refrigeration (L* = 45.38, a* = 17.10, b* = 4.65), C = 17.30), backed by a constant metmyoglobin fraction (0.44 to 0.43). The dominant fatty acids were monounsaturated oleic (35.08%), saturated palmitic (26.20%), and stearic acid (13.99%), establishing a high total of "desirable fatty acids" at 60.62%. Furthermore, low concentrations of caprylic (0.39%) and capric (0.36%) acids successfully prevented any intense, species-specific off-odor.

Conclusions: This first study validates that light Sakar lambs yield high-quality, lean meat with excellent color stability during storage. Its superior protein levels and premium fatty acid profile confirm outstanding nutritional and dietary potential for commercial utilization.

ID 182

Effect of Different Microgreens on the Physical, Colour, and Sensory Properties of Cookies

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Background: Microgreens are natural source rich in bioactive compounds, vitamins, minerals, and antioxidants, and therefore, their use in the development of functional foods has been increasing. Their incorporation into bakery products may improve nutritional value, but it may also affect the physical and sensory characteristics of the final product.

Aims: The aim of this study was to evaluate the effect of different types of microgreens (beetroot microgreens, pea microgreens, and cabbage microgreens) on the physical properties (colour, diameter, thickness, spread factor, and volume) and sensory properties of cookies, in order to assess their potential as functional ingredients in the bakery industry.

Methods: The cookies were prepared with the addition powder of beetroot microgreens, pea microgreens, and cabbage microgreens, while the control samples were prepared without microgreens. The physical characteristics were determined according to AACC Method 10-50.05, while the colour was measured using the CIE L*, a* and b* colour system with Chroma Meter CR-400. Sensory analysis was conducted using a nine-point hedonic scale, evaluating colour, shape, texture, taste, aroma, and overall acceptability. The data were statistically analysed using one-way ANOVA and Fisher's LSD test at a level of $p < 0.05$.

Results: The addition of microgreens powder had a statistically significant effect on the physical and sensory characteristics of the cookies (ANOVA, $p < 0.05$). Significant changes were observed in the colour parameters (L*, a*, and b*), with the cookies containing cabbage microgreens exhibiting the lowest L* value, indicating the darkest surface. The highest spread factor was observed in the cookies containing pea microgreens, while the samples containing beetroot and cabbage microgreens showed greater diameter and volume compared with the control. Sensory analysis showed significant differences among the samples, with the cookies containing pea microgreens receiving the highest scores for all evaluated parameters, whereas the cookies containing cabbage microgreens had the lowest overall acceptability.

Conclusions: Adding microgreens significantly altered the physical and sensory properties of the cookies, with the effect depending on the type of microgreens used. Pea microgreens showed the most favourable combination of technological properties and the highest sensory acceptability, making them a promising functional ingredient for the development of innovative bakery products with improved quality characteristics.

Acknowledgement: This work was supported by the Bulgarian Ministry of Education and Science, National Research Fund, under contract number КП-06-КОСТ/18.

ID 183

A factor decomposition framework for forecasting food waste emissions

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Background: Food waste is a major source of greenhouse gas emissions and represents a significant challenge for sustainable food system management. Although numerous studies assess the environmental impacts of food waste using life cycle assessment and other static approaches, relatively limited attention has been paid to forecasting emission dynamics and identifying the structural factors driving future changes. Decomposition-based forecasting provides an opportunity to improve the interpretation of food waste emissions by modelling their underlying components separately.

Aims: This study proposes a decomposition-based forecasting framework that separately models food losses and emission intensity per unit of food loss in order to improve the interpretation of food waste emission dynamics and support sustainability-oriented decision-making.

Methods: Food waste emissions are decomposed into two components: food losses as an extensive factor and emission intensity per unit of food loss as an intensive factor. Each component is forecast independently using Holt's exponential smoothing method and subsequently combined to estimate total emissions. A scenario-based forecasting framework is developed by combining confidence intervals of the independently forecast components to construct realistic, optimistic, and pessimistic emission trajectories. The methodology is applied to FAO data for Bulgaria covering the period 2010–2023, with forecasts generated for 2024–2027.

Results: The forecasts indicate a gradual increase in food losses, whereas emission intensity per unit of food loss is projected to decline throughout the forecast period. The combined effect of these opposing trends results in relatively stable or slightly decreasing total food waste emissions. Compared with direct forecasting of total emissions, the proposed decomposition framework produces higher emission estimates, demonstrating that separate modelling of extensive and intensive drivers reveals structural dynamics that remain hidden when emissions are analysed as a single aggregated variable.

Conclusions: The proposed decomposition-based framework provides a more informative approach to forecasting food waste emissions by explicitly accounting for their structural drivers. The methodology enhances the interpretation of emission dynamics and offers a useful analytical tool for sustainability assessment and evidence-based environmental policy. Future research should extend the framework to disaggregated supply-chain data in order to evaluate differences between conventional and short food supply chains more comprehensively.

ID 184

Frost resistance of winter common wheat under climate instability – a laboratory evaluation of production efficiency

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Background: The present study is focused on the necessity of maintaining a high level of frost resistance in winter common wheat (*Triticum aestivum* L.) against the backdrop of a trend towards warmer winters and climate unpredictability. For this purpose, the level of frost resistance in 55 wheat varieties alongside an agrometeorological analysis were performed to determine the impact of climate factors during individual years on the dynamics of hardening and plants' frost resistance.

Aims: The study aims to characterize current climate instability in the Dobrudzha region for the period 1996–2025 and to determine the degree of frost damage risk that limits production efficiency.

Methods: The level of frost resistance was evaluated by the field-laboratory method under controlled freezing. For the quantitative assessment of the production risk and genotype differentiation, the following methods were applied: local linear interpolation to determine the critical temperature point (LT50); principal component analysis (PCA) to evaluate the annual impact of climate factors; and hierarchical cluster analysis (HCPC) to group accessions based on their level of frost resistance.

Results: The agrometeorological analysis of the 30-year period identified the main risks for agricultural production as fluctuating conditions during the plants' hardening stage, increased frequency of snowless winters, winter warming events leading to plant dehardening, and more occurrences of late spring frosts. The conducted ANOVA revealed a significant impact of annual weather conditions, strong genetic differences among the studied samples ($p < 0.001$), and a significant genotype-by-environment interaction. The applied PCA and its corresponding biplot grouped the 55 wheat genotypes into four distinct clusters based on frost resistance: high and stable, moderate, unstable with specific response, and highly susceptible. While frost events in November stimulated hardening, recent warming events above 10°C in December compromised frost resistance.

Conclusions: Climate unpredictability and frequent winter warming trends present a serious risk to winter wheat production by disrupting the plants' hardening dynamics. To mitigate this production risk in the Dobrudzha region, it is critical to cultivate genotypes with high trait stability. The cultivars Pchelina, Zara, Lazarka, Merilin, Chudomira, and Fedora demonstrated superior stability and are highly recommended to guarantee reliable frost protection and plant survival under changing climate conditions.

ID 185

Assessment of the adaptability of winter barley genotypes to abiotic stress under variable climatic conditions

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Background: Cereal production is increasingly challenged by climate variability, which increases the frequency and severity of abiotic stresses. Fluctuating temperatures, uneven distribution of precipitation, and the increasing occurrence of extreme weather events create a need for the development of varieties combining high productivity, stability, and adaptability to changing environmental conditions. The genotype determines the ability of plants to respond to adverse environmental conditions, making its evaluation essential for identifying adaptive forms. The adaptability of genotypes is determined not only by their ability to tolerate stress, but also by their capacity to maintain normal development and productive potential under unfavorable climatic conditions.

Aims: The aim of the present study was to evaluate the adaptability of winter barley genotypes to abiotic stress under field conditions.

Methods: The field experiment was carried out at the breeding field of Dobrudzha Agricultural Institute – General Toshevo during the 2025–2026 growing season. Forty genotypes of winter malting and forage barley of diverse eco-geographical origin were evaluated. The adaptability of the genotypes was assessed through a combined evaluation of morphological and phenological traits.

Results: Among the malting barley group, Asparuh, Ahat, Vanessa, and Brilyant were characterized by the highest productivity under the specific conditions of the year, while among the forage forms, Skiptar, Larimar, and Tyurkoaz showed the highest productivity. Regarding the response to adverse winter conditions, Heliodor, Fanagoriya, Tsitrin, Sayra, Monro, Violeta, and Henriette received the highest ranking.

Conclusions: The obtained results provide valuable information on the potential for integrating individual genotypes into breeding programs, expanding genetic diversity, and refining variety management technologies for sustainable production.

This research was funded by project BG16RFPR002-1.014-0012-C01 "Establishment and sustainable development of a Center of competence „Agrifood systems and bioeconomy", financed by the European Regional Development Fund through the Bulgarian Operational Programme „Program for Research, Innovation and Digitalisation for Smart Transformation" (PRIDST).

ID 186

Soil prokaryotic microbiome responses to green manure legacy and sustainable fertilisation under sorghum cultivation

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Background: Previous soil management practices, including green manure application, can leave persistent microbial legacies that modify the response of subsequent crops to fertilisation. Understanding these effects is important for designing soil-health-based strategies for resilient sorghum production.

Aims: This study evaluated the relative influence of previous field management and current fertilisation on the diversity, taxonomic composition and predicted functions of the soil prokaryotic microbiome under *Sorghum bicolor* (L.) Moench cultivation.

Methods: A 2025 field experiment compared two adjacent fields: Field 1, previously amended with green manure, and Field 2, previously used for conventional sorghum cultivation. Each field included an untreated control, beneficial microorganisms (BM), mineral fertilisation (MF), vermicompost (VC), VC+MF and biochar. Soil communities were analysed by 16S rRNA gene amplicon sequencing, taxonomically assigned using SILVA and functionally inferred with FAPROTAX.

Results: Management history was the main source of microbiome differentiation. Field 1 showed markedly higher richness and diversity (Chao1 1644.3–1973.4; Shannon 9.66–10.04) than Field 2 (Chao1 49.0–117.0; Shannon 2.05–3.70). The shared core comprised 360 ASVs in Field 1 but only 12 ASVs in Field 2. Taxonomic and predicted functional profiles separated clearly by field, whereas within-field fertilisation effects were smaller. BM produced the highest diversity in Field 1 and the largest displacement in predicted functional profiles within both fields.

Conclusions: Previous management exerted a stronger influence on the soil prokaryotic microbiome than the fertilisation treatments applied during sorghum cultivation. The green-manure legacy was associated with substantially greater prokaryotic richness, diversity and predicted functional breadth. These findings support green manure as a promising soil-management practice and demonstrate that management history should be considered when designing and interpreting sustainable fertilisation strategies.

Acknowledgements: This study was supported by the Bulgarian National Science Fund through Grant No. KP-06-N76/11. Additional support was provided by Project BG16RFPR002-1.014-0012-C01, "Establishment and Sustainable Development of the AgriFood Systems and Bioeconomy Centre of Competence", co-financed by the European Regional Development Fund under the Programme "Research, Innovation and Digitalisation for Smart Transformation" (PRIDST).

ID 187

Plant growth-promoting bacteria enhance the growth and nutritional status of sweet pepper (*Capsicum annuum* L.)

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Background: Plant growth-promoting bacteria (PGPB) offer a sustainable alternative to synthetic fertilisers by improving nutrient availability and plant performance through complementary biological mechanisms.

Aims: This study evaluated the plant growth-promoting potential of two indigenous bacterial isolates, T1 and TR3, and their effects on sweet pepper (*Capsicum annuum* L. cv. Plovdivska Kapia) grown under greenhouse conditions.

Methods: The isolates were characterised for phosphate and zinc solubilisation and indole-3-acetic acid production. Pepper plants were inoculated individually with T1 or TR3 or with a combination of both isolates. Plant responses were assessed based on stem height, leaf number, root length, chlorophyll-related index, and an integrated Plant Growth Index (PGI).

Results: Both isolates exhibited multiple plant growth-promoting traits. Compared with the untreated control, T1 produced the greatest overall improvement, increasing stem height by 60.4%, leaf number by 93.0%, root length by 25.2%, chlorophyll-related index by 39.9%, and PGI by 59.5%. Combined inoculation with T1 and TR3 increased stem height by 54.2%, leaf number by 95.3%, root length by 25.2%, and PGI by 58.3%. Although variability among the biological replicates limited the statistical significance of the differences observed for individual parameters, all evaluated traits showed a consistent positive response to bacterial inoculation.

Conclusions: T1 showed the most consistent positive effect and represents a promising candidate for the development of a microbial biofertiliser. The combined T1 + TR3 treatment promoted plant growth but provided no clear advantage over T1 alone. Further field studies involving a larger number of biological replicates are required to confirm the efficacy of T1 and assess its potential for sustainable sweet pepper production.

Acknowledgements: This work was supported by the Bulgarian National Science Fund under Grant No. KP-06-COST/21. Additional support was provided by Project BG16RFPR002-1.014-0012-C01, “Establishment and Sustainable Development of the AgriFood Systems and Bioeconomy Centre of Competence”, co-financed by the European Regional Development Fund through the Programme “Research, Innovation and Digitalisation for Smart Transformation” (PRIDST).

MAEPs&WASTE 3

Medicinal, Aromatic and Edible Plants (MAEPs) and their by-products: Utilization and valorization for a sustainable and circular economy

Dear Colleagues,

Time is running and one year had passed from the 2nd edition of the **MAEPs&WASTE** conference. We are dedicated and delighted to continue with sharing the knowledge and believe this initiative should be further developed. On behalf of the Organizing Committee, I am honoured to invite you to joining the 3rd International Applied Scientific Conference **Medicinal, Aromatic and Edible Plants (MAEPs) and their by-products: Utilization and valorization for a sustainable and circular economy**, which will take place on **28-29 May 2027** in Plovdiv, BULGARIA. The conference aims to bring together the best practices in the field of MAEPs utilization as a foundation of the circular economy and to serve as a forum for exchange and share of high-value knowledge between the science and business. The conference covers different aspects of plants application with special emphasis on production and marketing of high value added products, MAEPs as source of biologically active substances, utilization as functional foods, technologies for treatment of MAEPs, waste minimization and valorization of MAEPs processing, etc. In addition, the conference will cover all aspects of the vast and intriguing world of fungi: mushrooms, molds, and yeasts.

More information you can find here: http://conference2020.bnaeopc.com/

In addition to the scientific program, the Organizers hope that the participants will have the opportunity to enjoy the visit and the possibility to feel the atmosphere of the beautiful ancient city of Plovdiv, the 2019 European Capital of Culture!

We look forward to meeting you at the conference!

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The congress is organized with the financial support of the National Science Fund of the Republic of Bulgaria under Contract No. KP-06-MNF/4 of 15 May 2026. The National Science Fund of the Republic of Bulgaria bears no responsibility for the content of the papers presented at the scientific forum, nor for the content of any advertising or other materials related thereto.

ISBN 978-954-24-0394-4

CEFOOD 2026 **Book of abstracts**

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Академично издателство на УХТ - Пловдив
UFT Academic Publishing House, Plovdiv
2000

Formatting: Georgi Atanasov Kostov, Rositsa Denkova-Kostova

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