BOOK OF ABSTRACTS

11th International Congress of Food Technologists, Biotechnologists and Nutritionists

Unlocking Science and Technology for a Healthier and Sustainable World

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PREFACE

The 11th International Congress of Food Technologists, Biotechnologists and Nutritionists takes place from 9th to 11th December 2025 at the Westin Hotel in Zagreb, Croatia. The Congress is organized by the University of Zagreb Faculty of Food Technology and Biotechnology and the Croatian Society of Food Technologists, Biotechnologists and Nutritionists, in cooperation with distinguished international and national partners: ISEKI-Food Association, EFFoST, EHEDG Croatia, and the Croatian Academy of Engineering.

This year's event is held under the motto "Unlocking Science and Technology for a Healthier and Sustainable World" and is supported by high-level patrons: the President of the Republic of Croatia, the Ministry of Agriculture, Forestry and Fisheries, the Ministry of Science, Education and Youth, the City of Zagreb, the University of Zagreb, and the Zagreb Tourist Board.

Gathering more than 350 participants – prominent scientists, experts and industry representatives from Croatia and abroad – the Congress provides a multidisciplinary platform for presenting the latest scientific and technological achievements in food technology, biotechnology and nutrition. The program includes plenary and invited lectures, oral presentations and poster sessions. Multiple parallel sessions complement the main program: Satellite Symposium Biotechnology in Croatia "Vera Johanides"; panel discussion "Towards Sustainable Food Management: Synergy of Science, Industry and Consumers"; round table "Tradition, Innovation, and Sustainability – State, Potential, and Perspectives of the Food Industry in the Republic of Croatia"; workshops INTACTBioPack and EVOLVEPACK "How to Reduce Food Loss and Enhance Health Benefits by Using Innovative Packaging Solutions"; and MedDietMenus4Campus "MedDietMenus4Campus: A Case Study from Croatia".

The themes covered by the Congress include Advancements in Food Technology and Biotechnology; Nutrition Consumer Behavior and Global Health Challenges, and Food and Water Safety and Quality.

Thank you for joining us and contributing to this international scientific event.

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Keynote Lectures

AI driven Biotechnology for a Healthier and more Sustainable World

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Artificial intelligence (AI) is reshaping the life sciences, offering unprecedented opportunities to accelerate discovery and translation in biotechnology, nutrition, and food systems. Yet, its integration into academia faces significant challenges — from methodological skepticism and data quality concerns to gaps in reproducibility, education, and industry adoption. In this plenary lecture, I will explore how advanced computational approaches, particularly those inspired by natural language processing, are transforming our ability to interpret genomes, metagenomes, and proteomes, enabling the discovery of novel bioactive compounds, functional ingredients, and sustainable biotechnological solutions. Drawing on experiences from both academic research and technology transfer, I will highlight how AI can bridge the gap between “big data” and practical applications in health, nutrition, and sustainable food production. At the same time, I will reflect on the cultural and structural hurdles of introducing AI in academic environments and how fostering collaboration between academia, industry, and policymakers can help to unlock Science and Technology for a Healthier and Sustainable World.

Keywords:
Artificial Intelligence, Precision Medicine, Regenerative Medicine, Predictive Modeling, Multi-omics, Metagenomics, Epigenetics, Sustainable Food Systems, Cellular Therapies, Interpretable AI

Obesity & Nutrition: The Health Promotion View

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In Croatia 36% of school-aged children and 65% of adults have overweight or obesity. Estimates show that only 3% of children and 10% of adults eat the recommended 5 portions of fruit and vegetables per day, while 26% of children and 17% of adults drink sugar-sweetened soft drinks more than 3 times per week. In the obesogenic environment we live in, nutritional interventions are essential for facilitating healthy nutrition choices, improving nutritional habits and promoting health. In Croatia interventions like these are being implemented on multiple levels with a life-course perspective. Especially significant is the National health promotion programme Healthy Living that includes interventions in different settings, such as the educational & workplace settings, as well as front-of pack-labelling. These interventions are in line with other governmental & fiscal measures that shape the nutritional environment in Croatia. Many nutritional activities planned for the near future are also part of the national Action plan for obesity prevention 2024-2027. Our experience shows that only systemic and coordinated nutritional interventions, based on the participation of individuals, communities, institutions and policymakers, can change nutritional habits in the long term, lower the risk for overweight and obesity, and improve the health of the population.

Keywords:
Obesity, Nutrition, Health promotion, Epidemiology

Will 3D Food Printing Re-Shape the Food Industry?

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Additive manufacturing, also known as 3D-printing, is an upcoming production technique based on layer-by-layer deposition of material to reproduce a computer generated 3D design. In many industries, 3D printing revolutionized the manufacturing process, offered innovative products as well as revisited the distribution chain. In this presentation, we will discuss the state of the art in food printing. An overview of the different technologies will be given, in particular extrusion printing, selective laser sintering and powder bed printing. For each technology the ingredient and material requirements are presented and the opportunities for food structuring and processing are discussed. The examples illustrate how 3D food printing offers the food industry possibilities for flexible, decentralized, on-demand food manufacturing, and empowers the consumer to participate in this process. Furthermore, the opportunities of 3D printing to enable manufacturing of innovative products, since the technology allows to create food products with innovative structures, textures and other functionalities, which are not possible with conventional processes. 3D printing is a technological means to manufacture healthy, sustainable food products, as well as foods which are personalized towards the specific needs and requirements of individual consumers.

Keywords:
3D printing, Processing, Manufacturing, Personalized nutrition

Translating Research into Innovation: Biopharmaceutical, Biocosmetic, and Biobased Product Development from University to Market

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The development of innovative biotechnological products represents an important link between academic research and market applications. This presentation will highlight three representative case studies from our laboratories. First, we will discuss the development of the antileukemic biopharmaceutical L-asparaginase, an enzyme widely used in the treatment of acute lymphoblastic leukemia, with emphasis on upstream (microbial cell cultivation), downstream purification (low and high resolution processes), and preclinical studies. Second, we will present advances in the production of the biocosmetic hyaluronic acid, using a genetically modified *Kluyveromyces lactis*, and highlight upstream and downstream bioprocess strategies designed to optimize yield and quality for dermatological and aesthetic applications. Finally, we will address the development of agricultural bioinputs (biofertilizers and biopesticides), through cultivation at small, pilot, and industrial scales based on *Bacillus* sp., aimed at enhancing growth and resilience in soybean, corn, rice, and lettuce crops, thereby contributing to sustainable agricultural practices. Importantly, these three bioproducts are currently produced by two startups (Biobreyer Ltda and Bioinsumos Brasil Ltda) founded in collaboration with former graduate students and postdoctoral researchers from the University of São Paulo. Together, these examples illustrate the translation of biotechnology research into the creation of high-impact products for health, cosmetics, and agriculture.

Keywords:
Bioprocess, Asparaginase, Hyaluronic acid, Bioinput, Industrial microbiology, Enzymes

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Insights into Black Boxes and Traveling Back in Time – Computer-inspired Protein Engineering for the Synthesis of Natural Products and Fragrance Molecules

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The on-going digitalization of biotechnology changes the way how enzymes can be approved for biocatalytic application. Two examples illustrate the enormous impact of bioinformatics and machine learning on the engineering of powerful biocatalysts. A first example deals with an artificial pathway for the synthesis of Tulipalin A, a very promising polymer precursor. While Tulipalin A can be isolated from the flowers of tulips and alstroemerias, its biosynthesis remains unknown. We propose a synthesis from isoprenyl acetate, which itself can be produced via the microbial hemiterpenoid metabolism. The crucial reaction step is catalyzed by a membrane-bound monooxygenase. The difficulty to obtain accurate structure information has been a serious obstacle for their optimization by enzyme engineering. Here we show how *de novo* structure prediction tools and molecular modeling can guide the generation of tailor-made enzyme variants. In a second example, we investigate the evolutionary emergence of enantioselectivity in plant borneol dehydrogenases (BDHs) in the synthesis of optically pure dibornane type monoterpenols that find application as fragrances and in Chinese traditional medicine. Goal is to elucidate how stereoselective enzymes were formed from unselective ancestors, and whether active-site or indirect peripheral mutations drive this process. Comparison of selective and unselective ancestral proteins and site-directed mutagenesis revealed a potential natural evolutionary pathway that shapes enantioselectivity, and provide guidance for future enzyme engineering campaigns.

Keywords:
Fragrance molecule, alpha-methylene lactone, Alkane monooxygenase, Rational design

FemTech Innovations: Prebiotics and the Path to Microbiome Rebalance

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Vulvovaginal candidiasis (VVC) and bacterial vaginosis (BV) are the most prevalent vaginal infections, affecting millions of women worldwide. Disruption of the lactobacilli-dominated vaginal microbiome increases susceptibility, with recurrence rates of approximately 45% for VVC and 30% for BV within three months. These infections impose significant physical, emotional, and economic burdens, increasing the risk of sexually transmitted infections, pregnancy complications, and healthcare utilization. In the UK alone, over 2.5 million family doctor consultations for symptomatic and recurrent VVC/BV occur annually, costing the public healthcare system an estimated £375 million. To address this unmet clinical need, a university spin-out - BiotaLife Healthcare Ltd, has developed DUO Balance™, a patented mucoadhesive hydrogel designed to restore vaginal microbiome homeostasis. Preclinical studies demonstrate that DUO Balance™ promotes lactobacilli regrowth, likely reduces recurrence risk, and is associated with minimal side effects, all without the use of antibiotics, antifungals, or exogenous acids. The path to market will be described which now involves clinical validation of DUO Balance™ by comparative study against standard-of-care therapies in women with recurrent VVC or BV, advancing its technology readiness level (TRL) from TRL 4 to TRL 9. Key objectives include confirming safety and efficacy in real-world settings, establishing regulatory compliance, evaluating health economic impact, and defining a sustainable commercialization pathway. Patient and clinician engagement will ensure alignment with real-world needs and preferences. Post-study plans include a UK market launch of DUO Balance™ as an over the counter (OTC) medical device, and exploration of FDA approval of DUO Balance™ as a non-prescription OTC combination product. DUO Balance™ represents a promising, non-antimicrobial strategy for the prevention of recurrent vaginal infections, with the potential to improve women's health, reduce recurrence, and alleviate the global healthcare burden associated with VVC and BV.

Keywords:
Vaginal microbiome, Recurrent vaginal infections, *Lactobacilli* restoration, Non-antimicrobial therapy, Mucoadhesive hydrogel

From Niche to Notable: Food Science and Nutritional Perspectives on the Unique *Asimina* Fruit in Europe

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Asimina triloba is an underutilized fruit tree that is native to North America and only recently has been introduced into European horticulture for its unique flavor, nutrition, natural pest-resistance, and impact on biodiversity. *Asimina* is the only genus of the tropical *Annonacaea* family that grows in temperate climates, making it well-suited for cultivation in parts of Europe. The fruit has a creamy texture and is notable for its tropical flavor profile that is often described as a combination of banana and mango. This presentation explores geographical distribution of pawpaw in Europe and provides an overview of its composition, food science challenges, and potential applications. The integration of *Asimina* into regional European agriculture supports biodiversity and also aligns with growing consumer demand for novel, health-promoting fruits.

Keywords:
Fruit, *Asimina*, Pawpaw, Biodiversity

Reflections on an Academic Career in Cereal Science in the Age of GAI

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Universities serve society by producing educated graduates, creating new knowledge and nurturing scholars – with the latter purpose often neglected and undervalued from outside the university and within, relative to the more tangible rewards of teaching and research. Meanwhile, cereal science connects with profound realities of human existence beyond the merely nutritional, touching on culture, society, religion, technology, politics, economics and international relations. Scholarship in cereal science has the power to give perspectives on the world that enlighten, inform and guide. But the rise of generative artificial intelligence brings threats to education, to research and to scholarship, and hence to the crucial and unique *raison d'être* of universities and academics. Scholarship can be defined as *"the interaction between a scholar and their scholarly outputs that nurtures their intellect and hence their capacity to produce work of ever greater intellectual merit and value"* – an ever upwards virtual spiral of intellectual struggle and perseverance. Thus the purpose of scholarship is not just *outputs* – research papers written or classes taught – but *outcomes* – people who are more educated and capable as a result of the struggle of writing. Writing is thinking, but in tempting outsourcing of the writing process, GAI threatens the very nature and process of developing scholarly thinking. Writing with GAI is like going to the gym and have a machine lift the weights for you, like going to a restaurant and have the chef eat the food for you, like swimming in the sea of knowledge and coming out dry. The challenge for the current generation of cereal scientists is to resist the seductive efficiencies and sinister lies of GAI, in order to maintain genuine mastery and curation of our discipline's body of knowledge that uniquely underpins the security and flourishing of the world.

Keywords:
Education, Scholarship, Writing, Thinking, Generative artificial intelligence

Liquid-Liquid Phase Separation in Food Systems

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Liquid–liquid phase separation (LLPS) offers a coherent framework for engineering food structures while interpreting long-standing microstructural observations. It is both a feature of classic foods and a structuring tool for biomimetic ones. This presentation distinguishes segregative LLPS (aqueous two-phase systems of unlike polymers) from associative LLPS (coacervation: simple *vs.* complex) and begins with phase-diagram rules, using LLPS-formed cellular organelles as design cues. Evidence from classic foods (starch–gluten segregation in breads; protein–EPS partitioning in fermented dairy) is synthesized to show LLPS-like organization under realistic processing histories. Associative LLPS is positioned primarily as a process intermediate for encapsulation or as a precursor to gels, given its sensitivity to thermal and ionic conditions. Segregative LLPS is developed as a structuring route under flow: viscosity ratio and imposed shear guide transitions from droplets to threads to bicontinuous morphologies, which are subsequently fixed by gelation or vitrification. The discussion employs standard metrics and equations to provide a consistent, quantitative description.

Keywords:
Liquid-liquid phase separation, Water-in-water emulsions, Coacervate-derived hydrogels, Flow-templating, Biomimetic foods

The Benefice of Biodegradable Packaging for More Sustainability in the Food Chain

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The packaging of our everyday products accounts for 40% of the total plastic production, with two thirds of this being used for food packaging alone. This consumption has grown continuously until the 1950s. As it cannot reintegrate any biogeochemical cycles (e.g. the carbon cycle) that prevail on Earth within a timescale compatible with human life, plastic persists in the environment for centuries and even millennia in the ultimate form of persistent micro- and nanoparticles, causing unprecedented pollution. Despite all the scientific evidence proving the impact of plastic pollution on the health of living beings, the plastic footprint of our Western countries is growing exponentially, in direct proportion to a country's GDP. Meanwhile, food waste and loss remain significant, accounting for around one-third of all biological production lost or wasted annually, resulting in a substantial environmental impact (high carbon footprint of biological production). In this case, packaging could be an effective means of mitigating food waste and loss. Reducing the environmental impact of food packaging relies thus on two key pillars: minimizing the direct effect of the packaging itself has on the environment and optimizing its usage benefice which is decreasing food loss throughout the supply chain. This presentation will demonstrate, using key results obtained in diverse national and European projects (e.g., h2020 GLOPACK project ...), how packaging materials that are biodegradable under a wide range of conditions prevailing on the Earth could reduce the plastic footprint of packaged food and food loss, thereby reducing the carbon footprint. Such benefits could be achieved by adding active functionality to biodegradable materials, as illustrated by the preliminary findings of the ongoing IntactBioPack PRIMA project.

Keywords:
Biodegradable food packaging, Plastic particle footprint, Food waste and loss mitigation, Active functionality, Direct environmental impacts, Indirect environmental impacts

Microbial Innovation for a Sustainable Food Future: *Lactiplantibacillus plantarum* as Model

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The transition to sustainable and resilient food systems requires innovative strategies that promote food safety and quality, environmental protection, and human health. Microbial biotechnology and fermentation are receiving growing interest as key players in the design of a bio-inspired food future. The development of models among lactic acid bacteria for these types of applications supports the development of knowledge that is useful for promoting innovation processes and the green transition of production systems, particularly in the plant-based sector. The lactobacillus species *Lactiplantibacillus plantarum* stands out as an exemplary model in the field of microbial biotechnology applied to agri-food due to its genomic versatility, ecological adaptability, and metabolic diversity. It has a broad range of applications, combining traditional valorisation in fermentations with the most cutting-edge biotechnological advances in the sector. This lactic acid bacterium, considered a "nomad" due to its widespread lifestyle in agroecosystems, fermented foods, and the human gut, exhibits a remarkable ability to positively modulate various aspects of quality, including safety, sensory, nutritional, and functional properties. Its large genome encodes a range of functions that enable the conversion of substrates into bioactive compounds, the biosynthesis of certain B vitamins, the generation of 'antioxidant' 'metabolites, and the degradation of antinutrients improving food safety and shelf life, through acidification and the production of bacteriocins. In addition to its functional ingredients, *L. plantarum* contributes to human well-being through a series of strains with probiotic and postbiotic effects, modulating the intestinal microbiota, immune response, and global health. The integration in packaging solutions, the use of 'omics' tools, the implementation of precision fermentation solutions, and the relationship with the microbiomes with which the species is associated in production systems represent the frontier for the selection of lactic acid bacteria (starter, protective, and probiotic cultures) with tailored functionalities, paving the way for next-generation sustainable foods and personalised nutrition.

Keywords:
Lactic acid bacteria, Quality, Safety, Food, Beverage, Innovation

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Beyond the Food: Functional Food for Infants

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Breast milk represents the gold standard of nutrition for newborns, with a complex and dynamic composition that extends beyond its nutritional value. Compared with its nutritive components, breast milk contains a significantly richer functional component that plays a key role in the development of the child's immune, metabolic, and neurocognitive systems. In addition to essential nutrients, breast milk contains more than 200 human milk oligosaccharides (HMOs), live bacteria, bioactive lipids, and immune factors that together constitute a unique "living food" that changes according to the infant's needs throughout the day, week, and month. Research confirms that breastfeeding significantly reduces the risk of infections, allergies, metabolic disorders, and later development of chronic non-communicable diseases, while also benefiting maternal mental health. Infants who are not breastfed, as well as infants delivered by Caesarean section, have an altered gut microbiota with lower levels of *Bifidobacterium* spp., which is associated with an increased risk of infections and allergic diseases. The food and pharmaceutical industries are increasingly working on improving infant formula from a functional perspective, aiming to produce and incorporate functional components of breast milk into infant formula composition. In recent years, the greatest emphasis has been placed on probiotics, prebiotics, and HMOs (such as 2'-fucosyllactose, 2'-FL). These combinations of functional components have demonstrated a strong effect in restoring healthy microbiota and reducing clinical manifestations of dysbiosis.
Functional nutrition for infants, which includes such bioactive compounds, represents an important step toward approximating the functional properties of breast milk in infants who are not breastfed, and may contribute to the preservation of health and reduction of disease risk later in life.

Keywords:
Breastfeeding, Breast milk, HMOs, Microbiota, Synbiotics, Function

EU Food & Beverage Sector: Impacts, Risks, and Opportunities Reported in 2025

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The year 2025 marked a pivotal shift in corporate accountability across the European Union, as large companies—including many in the Food & Beverage sector—began mandatory sustainability reporting under the Corporate Sustainability Reporting Directive (CSRD). This new regulatory landscape requires organizations to identify and disclose their environmental, social, and governance (ESG) impacts, risks, and opportunities, and to explain how these are managed and integrated into their business strategies. This lecture will explore the emerging ESG themes within the Food & Beverage industry, drawing on the first wave of sustainability reports submitted in 2025. We will see how companies are responding to climate-related risks, biodiversity loss, water scarcity, packaging waste, and shifting consumer expectations. Social dimensions such as labor practices, supply chain transparency, and community engagement will also be examined, alongside governance issues like board oversight and ethical sourcing.
The lecture will give insights into how leading firms are leveraging ESG opportunities to drive innovation, improve operational efficiency, and enhance brand value. It will also discuss the challenges companies face in aligning with evolving EU regulations, data collection and assurance, and stakeholder engagement. By analyzing sector-wide trends and company-level disclosures, the lecture will offer a forward-looking perspective on how sustainability is reshaping the Food & Beverage landscape. Participants will gain a clearer understanding of what to expect from industry leaders in the years ahead, and how ESG performance is becoming a key differentiator in a competitive and increasingly regulated market.

Keywords:
Corporate Sustainability Reporting Directive (CSRD), ESG (environmental, social, governance), Impacts, risks and opportunities, Food & Beverage industry, 2025 Reporting, Emerging themes, Industry challenges, Sector-wide trends

Advancements in Food Technology and Biotechnology

Coupling Residence Time Distribution and Heat Transfer Phenomena with Kinetics of β-lg/κ-Casein Interactions during UHT Processing of Skim Milk

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When milk is heated to above 70 °C, the major whey protein β-lactoglobulin (β-lg) denatures and interacts with κ-casein, leading to functional change. Laboratory kinetic models for these interactions often fail to predict outcomes in industrial UHT processing because complex thermal and velocity gradients are not captured. This study integrates residence time distribution (RTD) and heat transfer effects from a Tetra Pak® indirect UHT heat exchanger (300 L/h) with existing β-lg/κ-casein kinetic models. A numerical 2D model incorporating RTD and local temperature fields was developed and validated using reconstitued skim milk. Including industrial RTD and heat-transfer effects improved prediction accuracy by 5-20% compared with lab-based models, reducing discrepancies with experimental data. Enhanced predictive capability supports better process tuning to minimise undesirable protein interactions and improve product stability.

Keywords:
UHT Processing, Dairy, Kinetics, Milk proteins, Industrial Processes

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Impact of Drying Conditions on the Physicochemical Properties of Wheat Bran Protein

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The growing global demand for sustainable and nutritious food sources has intensified the search for novel protein alternatives, with plant-based proteins receiving particular attention. Despite their potential, the efficient isolation of high-quality proteins from plant materials remains challenging, primarily due to the presence of dietary fiber and various antinutritional compounds. Each step in an improperly designed isolation process can lead to significant changes in protein characteristics, affecting not only their functional but also their nutritional properties. One of the most critical yet potentially harsh steps in protein isolation is drying. The impact of drying conditions on protein properties was investigated using wheat bran protein isolated via the pH-shift method. The protein fraction was extracted using 0.05 M NaOH (1:10 w/v) for 1 h. After centrifugation, the supernatant was collected and acidified to pH 4 using 1 M H_2SO_4 to induce protein precipitation. The resulting suspension was centrifuged again, and the obtained protein sediment was subsequently spray-dried under varying inlet (180–200 °C) and outlet temperature (70–90 °C) conditions. The characteristics (protein content, water and oil holding capacity, solubility, SDS-PAGE etc.) of the spray-dried wheat bran protein isolate (WBPI) samples were then compared to those of similarly prepared freeze-dried samples. Statistical analysis confirmed that the drying method significantly influenced the properties of WBPI. Freeze-drying was found to be a gentler technique, better preserving the native protein structure. However, with optimized process parameters, especially outlet temperature, the limitations of spray-drying can be mitigated. With the correct spray drying temperature settings, the protein content in the isolated material can be increased by up to 5%. Furthermore, spray-drying may beneficially alter certain functional properties of proteins. For the spray-dried WBPI samples, a decrease in oil-binding capacity of more than 50% was observed compared to the lyophilized WBPI (2.931 ± 0.146 g g^{-1}). The water-binding capacity of the spray-dried WBPI decreased by approximately 25% (2.180 ± 0.077 g g^{-1}). However, the improvement of WBPI solubility was observed after spray-drying.

Keywords:
Wheat bran protein, Protein isolation, Spray drying, Freeze-drying

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Dry Fractionation of Tucumã Oil (*Astrocaryum vulgare* Mart.) to Use in Food Industry

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Tucumã, a palm fruit native to the Amazon, is rich in lipids and represents a promising resource for developing functional fat systems. This study investigated the application of dry fractionation (solvent-free crystallization) to oils extracted from the mesocarp (pulp) and endosperm (kernel) with the aim of producing structured lipid fractions. The fractionation of pulp oil was carried out by gradually decreasing the temperature from 35 to 15 °C, leading to the formation of two distinct fractions, olein and stearin, with distinct physicochemical characteristics, including differences in fatty acid and triacylglycerol composition, melting and crystallization behavior, and polymorphic profiles. The stearin fraction was enriched in palmitic acid, exhibited higher oxidative stability, and showed predominance of the β-polymorph with a melting point of ~37 °C, indicating its potential as a structuring fat for high-solid applications. Despite these modifications, tucumã stearin retained a high proportion of unsaturated fatty acids (~63%) and substantial carotenoid levels (~1500 μg g^{-1}), suggesting its ability to stabilize highly unsaturated vegetable oils. Furthermore, the olein preserved the fatty acid composition of the original pulp oil and exhibited Newtonian flow behavior, in contrast to the pseudoplastic properties of the stearin and unfractionated oils. Binary blends of pulp olein with kernel fat enhanced carotenoid content, improved nutritional quality indices, and exhibited rheological and textural properties comparable to commercial palm oil, while also presenting a lower saturated fat content and higher n-3 fatty acid levels. Overall, the modification of tucumã pulp oil by dry fractionation, combined with blending strategies using kernel fat, represents a cost-effective approach of producing functional fats with desirable nutritional and technological properties, supporting their potential application in the development of value-added food products.

Keywords:
Amazonian fruit, Edible oil, Functional fat, Tucumã oil

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Importance of Fruit Surface Biophysical Characteristics

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During fruit ripening, numerous physiological changes occur, the most important of which include an increase in ethylene and CO_2 production, a change in colour from green to yellow or red, a decrease in firmness and starch content and an increase in volatile organic compounds. The parameters of soluble solids content, firmness and starch index change are used to determine the harvest date. Beside these changes, there are also biophysical changes of the fruit cuticle. The biophysical properties of the fruit cuticle are decisive for the storage and shelf life of fruit. The surface roughness was determined with an optical profilometer, the hydrophobicity with a tensiometer and the zeta potential with an electrokinetic analyser. All three biophysical parameters changed during storage and shelf life. The surfaces of apples and pears were hydrophilic with contact angles of 60 to 80°. During ripening, the contact angle tends to increase, i.e. fruit surface becomes less hydrophilic. The roughness of the fruit surface was around 0.7 µm for apples and between 0.8 and 3.5 µm for pears. The change in roughness during pear ripening depends on the cultivar and can increase or decrease. The surface charge of the fruit is the actual charge on the solid surface or the surface charge expressed as a zeta potential. The surface of pears had a zeta potential of -40 mV to –105 mV at a pH of 5.5. As the fruit ripens, the zeta potential tends to increase. The first step of microbial colonization to the surface is called adhesion, when microorganisms adhere to the fruit surface. All three parameters play an important role in the adhesion process of various microorganisms. Roughness is considered to be the most important parameter in microbial adhesion, as greater roughness favors microbial adhesion. Contact angle and zeta potential are of lesser importance.

Keywords:
Fruit, Surface biophysical characteristics, Contact angle, Roughness, Zeta potential

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Calcium Citrate Malate as Source of Soluble Calcium for Food Supplements and Fortified Beverages: A Narrative Review

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Calcium supplementation is indicated in individuals with inadequate dietary calcium intake, often due to low consumption of milk or fortified beverages. In patients after gastric resection or those taking proton pump inhibitors, calcium salts that are bioavailable without gastric acid, such as calcium citrate, are essential. This review aims to summarize the technological properties of calcium salts, focusing on their solubility and bioavailability. A literature review of scientific articles and patents was conducted. Compliance with calcium supplementation is low due to several factors: (1) there are no immediate effects of supplementation, and the long latency of osteoporosis reduces perceived urgency; (2) large daily doses are required, more than 2.5 g of calcium carbonate or more than 4.7 g of calcium citrate to achieve 1000 mg of elemental calcium; (3) most calcium salts have low solubility and unpleasant taste (chalky or bitter); (4) when effervescent tablets are used, users often discard sediment containing the majority of calcium. Similarly, calcium added to beverages often settles, and unshaken fortified soy beverages may contain less than one-third of the labeled calcium. These issues can be largely mitigated by using calcium citrate-malate (CCM), a metastable calcium salt described in European patent 0533724 B1 and approved for food use by EFSA in 2007. Calcium citrate has a solubility of 0.96 mg mL^{-1} H_2O at 25 °C, whereas CCM (6:2:3) reaches 11 mg mL^{-1} H_2O at 25 °C, with even higher solubility in low-pH beverages. The bioavailability of CCM is 8 to 15% higher than that of calcium citrate. CCM can be incorporated into food products using commercial CCM powders, or blending calcium citrate with calcium malate, or combining calcium carbonate with citric and malic acids in specific ratios. Conclusions: CCM can improve the solubility and bioavailability of calcium in food.

Keywords:
Calcium supplementation, Calcium citrate malate, Solubility, Food fortification, Compliance

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Conflict of interest: I declare that my past employer was Jata Emona d.o.o, a company manufacturing products containing calcium. No funding was received for this article.

Evaluation of Rosemary and Sea Fennel Extracts for the Biopreservation of Gilthead Sea Bream (*Sparus aurata*)

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The rapid microbial and biochemical deterioration of fresh fish such as gilthead seabream (*Sparus aurata*) significantly limits its shelf life and marketability. In the search for natural and sustainable preservation strategies, plant-derived extracts have emerged as promising clean-label alternatives to synthetic additives. Among them, rosemary (*Rosmarinus officinalis* L.) and sea fennel (*Crithmum maritimum* L.) are particularly noteworthy due to their high content of phenolic compounds, flavonoids, and essential oils exhibiting strong antimicrobial and antioxidant activities. This study aimed to evaluate the antimicrobial potential of rosemary and sea fennel water extracts against selected fish spoilage microorganisms and pathogenic bacteria and to assess their effectiveness in extending the shelf life of whole gilthead seabream. *In vitro* assays revealed significant inhibitory effects for both extracts, with rosemary showing greater antimicrobial activity, presumably associated with its higher concentration of rosmarinic and carnosic acids. Subsequently, the extracts were applied to whole fish (sea bream), which were stored under refrigerated conditions and monitored by microbiological analyses throughout storage. Treated samples exhibited delayed microbial growth and reduced spoilage compared to untreated controls, indicating a clear preservative effect. Overall, the results confirm that rosemary and sea fennel extracts can be effectively employed as natural bio-preservatives to enhance the microbial stability and prolong the freshness of gilthead seabream during refrigerated storage. These findings support their potential application in the development of sustainable preservation approaches for seafood products.

Keywords:
Plant extracts, Biopreservation, Antimicrobial activity, Shelf life

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Designing Healthier Indulgence: Exploring Dietary Fibers for Next-Generation Low-Fat Ice Cream

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The growing consumer demand for healthier indulgent foods has intensified research into effective fat replacers for frozen desserts. This study examined the role of four dietary fibers— inulin, acacia, oat, and apple— in improving the textural, thermal, and sensory qualities of low-fat vanilla ice cream. The objective was to identify fiber types capable of replicating the desirable properties of full-fat formulations while enhancing nutritional value. The incorporation of dietary fibers significantly ($p < 0.05$) increased mix viscosity, reflecting improved water-binding and network stability. Differential scanning calorimetry revealed lower glass transition and melting temperatures in all low-fat samples compared with the full-fat control, particularly in those containing acacia and apple fibers. Crystallization behavior was also influenced by fiber type, with oat and apple fibers inducing earlier ice nucleation and firmer textures. Sensory evaluation demonstrated that fiber addition affected creaminess, smoothness, and overall acceptability ($p < 0.05$). Among the formulations, those containing inulin and acacia fibers most closely resembled the full-fat control in sensory and physical characteristics, delivering a creamy texture and pleasant mouthfeel without undesirable graininess. Conversely, ice creams enriched with oat or apple fibers exhibited increased firmness and a slightly sandy texture, attributed to their higher insoluble content. Overall, these findings highlight inulin and acacia as the most promising natural fat replacers for developing nutritionally improved, low-fat ice creams. The study supports the advancement of fiber-based fat substitution strategies to create next-generation frozen desserts that balance health, texture, and consumer appeal.

Keywords:
Soluble/insoluble fiber, Fat replacer, Differential scanning calorimetry, Quantitative descriptive analysis

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No More Guesses: AI-Enhanced Adaptive Design of Experiments for Smarter Process Optimization

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Design of Experiments (DoE) is a well-established methodology for enhancing product quality and process performance in food manufacturing. It helps producers understand how changes in processing conditions like temperature, mixing time, or ingredient ratios influence key quality attributes like texture, yield, and stability. Traditional DoE approaches, based on statistical design principles, rely on fixed experiment plans to explore factor effects and interactions. While effective in simple and controlled scenarios, they can become inefficient when facing high-dimensionality, nonlinear behavior, or complex system interactions, often resulting in high experimental costs and long development timelines. This work introduces an adaptive, AI-assisted DoE framework to accelerate food process optimization. By combining statistical design principles with intelligent modeling, this approach enables continuous learning from experimental results and informed decision-making. In practical terms, it helps identify optimal process conditions more efficiently, reducing trials and minimizing development time and cost. The workflow begins with identifying relevant process parameters and measurable responses. When the number of variables is high, redundancy is reduced through feature selection and dimensionality reduction, preserving only the most informative variables and quality indicators. The core of the framework employs adaptive optimization strategies which balance exploration and learning, such as Bayesian modeling, to iteratively propose new experiments based on prior outcomes. The model continuously refines its understanding of the process space through automatic relevance detection by targeting unexplored regions of high uncertainty or potential improvement. This results in a streamlined sequence of targeted experiments rather than an exhaustive exploration. The process stops when model predictions converge, yielding an interpretable and reliable process model with actionable recommendations. By integrating classical DoE with adaptive, data-driven modeling, this approach reduces unnecessary trials, enhances reproducibility, and accelerates decision-making. It offers a scalable, cost-efficient strategy for manufacturers seeking to improve product quality and streamline development in dynamic food production environments.

Keywords:
Design of Experiments, Food processing optimization, Bayesian modeling, Product development, Operational cost reduction

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Investigating the Impact of GOX, PGA, TG, and DATEM on Prefermented Frozen Dough and Bread Quality

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Prefermented frozen dough (PFFD) is baked directly from frozen. This offers significant benefits to the bakery industry in terms of production flexibility and efficiency. However, freezing and frozen storage result in ice crystal formation and ice recrystallisation, which can damage dough structure, reduce dough strength and bread volume. The incorporation of functional ingredients may help mitigate these effects, yet their roles in preserving dough and bread quality require further investigation. This study investigated the impact of glucose oxidase (GOX), transglutaminase (TG), diacetyl tartaric acid esters of monoglycerides (DATEM), and propylene glycol alginate (PGA) on PFFD quality during 30 days of frozen storage. PFFD baguettes containing 0.001% GOX, 0.003% TG, 0.3% DATEM, and 0.75% PGA based on flour weight were prepared, stored at –18 °C, and analyzed on days 1 and 30. Structural evaluations included cryo-scanning electron microscopy to assess ice crystal morphology, differential scanning calorimetry to quantify frozen water, and confocal laser scanning microscopy to visualize gluten-starch distribution. Physical performance was assessed through dough uniaxial extensibility, bread specific volume, and texture properties of bread. After 30 days of frozen storage, TG-treated dough preserved the highest bread volume with lowest hardness, consistent with smaller ice crystals and a continuous gluten network. GOX increased dough resistance to extension, while DATEM increased dough extensibility initially but declined over time. PGA was the least effective in maintaining dough and bread quality. TG showed lower frozen water content on day 1, while GOX was lower by day 30. Ice crystal growth was observed in control, PGA, and TG samples, with largest crystals in control, while gluten network thinning was evident across all treatments over the storage period. Overall, TG was most effective in preserving dough structure and bread quality, highlighting the importance of ingredient selection in PFFD stability during frozen storage.

Keywords:
Prefermented frozen dough, Frozen storage stability, Ice recrystallisation, Dough strength, Cryo-Scanning electron microscopy, Bread quality

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Ultrasound, Proteases, and Aging on Lees affect Protein Stability and Nitrogenous Flavor-Related Compounds in Malvazija Istarska Wine

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The aim of this study was to evaluate the impact of different technological interventions on protein stability, pathogen-related (PR) protein concentrations, and the levels of amino acids and oligopeptides associated with umami flavor and the kokumi effect in Malvazija istarska wine. Grape juice was treated with ultrasound (US), Aspergillopepsin I enzyme (E), or their combination (US+E), with untreated juice as a control (C). After fermentation, produced wines were aged on fine lees with bâtonnage for 3.5 months. Protein stability was assessed by determining bentonite requirements using the standard heat test, with additional evaluation via quick heat and cold tannin tests. High-performance liquid chromatography (HPLC-DAD) was used to carry out PR protein analysis, while amino acids and oligopeptides were analyzed by ultra-high-performance liquid chromatography/mass spectrometry (UHPLC-MS/MS). Wines fermented with Aspergillopepsin I (E and US+E) required significantly lower bentonite doses for stabilization compared with C and US wines. Aging on lees further reduced bentonite requirements in C, E, and US wines. PR protein concentrations, particularly those of the chitinase family, showed a parallel decline, mirroring the reduced bentonite needs. E and US+E treatments yielded the highest concentrations of most amino acids and oligopeptides. In particular, E treatment significantly increased L-glutamic acid, a key contributor to umami taste, compared with C and US, and also elevated total kokumi oligopeptides relative to C. Aging on lees altered amino compound profiles in E and US+E wines, including a reduction in total tripeptides and kokumi oligopeptides, though γ-Glu-Val-Gly, the most potent kokumi compound, remained unaffected.

Keywords:
Bentonite, Pathogen-related proteins, Aspergillopepsin I, Umami flavor, Kokumi effect, Malvazija istarska

Acknowledgements
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Influence of Ultrasound Treatments on the Concentrations of Vitamins in Malvazija Istarska Wines

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Vitamins increase antioxidant activity and support metabolism in wine. Their concentrations mainly depend on the winemaking technique, so the aim of this research was to determine the influence of pre-fermentative ultrasound treatments of different amplitudes and durations on the concentrations of vitamins in Malvazija istarska wines. During the 2024 harvest, six different vinification treatments were carried out. Four treatments were based on the application of a pre-fermentative ultrasound technique on cooled cryomacerated mash (10 °C) as follows: ultrasound treatments of 70% amplitude for 80 min (US80-70%) and 160 min (US160-70%) and ultrasound treatments of 100% amplitude for the same durations as the previous ones (US80-100% and US160-100%). In addition to these treatments, the research also included a control treatment – C (wine produced using standard white winemaking technology) and a cryomaceration treatment lasting one day at 10 °C (CRIO). The research was conducted using an industrial ultrasonic processor, UIP2000hdT-230 (20 kHz, 2000 W). Seven vitamins (B1, B2, B3-niacin, B3-nicotinamide, B5, B6 and C) were analyzed in wine using LC-ESI-QqQ. Among B-group vitamins, niacin (B3) showed the highest values in all wines, with the significantly highest concentration found in the US160-100% treatment and the significantly lowest in the control treatment. Concentrations of nicotinamide (B3) were significantly the highest in the US80-100% and CRIO treatments, and lowest in both 70% amplitude treatments. Ascorbic acid (vitamin C), was found in all wines, with the highest value in US160-70%, and significantly lowest in the CRIO treatment. Similar results can be observed in total vitamin concentrations, with the highest value in the US160-70% treatment and significantly lowest in the US160-100%, CRIO and control treatments. The results indicate that the use of ultrasound can increase the concentrations of vitamins in wine, thus enhancing the health benefits of the wine.

Keywords:
Ultrasound treatments, Pre-fermentative treatments, Vitamins, Malvazija istarska wines

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Hydrogen-Driven Whole-Cell Biocatalysis using *Cupriavidus necator* for Sustainable Production of Aldehydes and Alcohols

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Aromatic aldehydes and alcohols are valuable compounds extensively used in the food industry as flavor and aroma ingredients. Biocatalysis provides sustainable routes for the synthesis of such compounds using enzymes. Carboxylic acid reductases (CARs) are an important enzyme class that reduces carboxylic acids to aldehydes using NAD(P)H and ATP. Expression of CARs in whole cells offers the advantage of in situ cofactor regeneration. Interestingly, while in vitro CAR mediated biotransformations lead to the formation of aldehydes, in whole-cell biocatalysts, alcohol dehydrogenases (ADH) of the host cell tend to reduce the aldehyde further to the corresponding alcohol. Herein we report the coupling of CAR catalyzed biotransformations to hydrogen-driven cofactor-recycling in recombinant cells of the hydrogen-oxidizing bacterium *Cupriavidus necator*. The organism's soluble [NiFe]-hydrogenase provides reduced NADH, which is subsequently transformed by the transhydrogenase to NADPH. On the other hand, the membrane-bound hydrogenase contributes to the proton gradient across the inner cell membrane, which is used for ATP synthesis. Thus, molecular hydrogen, as a clean and renewable electron source, fuels the supply of both cofactors required for the carboxylic acid reduction, leading to the corresponding aldehyde or alcohol, respectively. Production of the CAR from *Neurospora crassa* together with its maturation factor phosphopantetheinyl transferase in *C. necator*, enabled efficient whole cell reduction of different aromatic carboxylic acids under a $H_2/O_2/CO_2$ atmosphere, achieving conversions up to 89%. This work demonstrates the feasibility of direct reduction of carboxylic acids with readily available hydrogen as the electron source, providing a promising basis for green synthesis of aldehydes and alcohols relevant to the food and fragrance industries.

Keywords:
Aldehydes and alcohols, Hydrogen driven biocatalysis, Carboxylic acid reductases, *Cupriavidus necator*

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Comparative Analysis of Buckwheat Fermentation Using Mono- and Multi-Culture Approaches

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The nutritional value of buckwheat makes it a promising ingredient for the development of symbiotic products. This study evaluated the effect of selected lactic acid bacteria (LAB) on buckwheat fermentation, analysing pH, LAB growth patterns, and shifts in sugar profile during fermentation. A buckwheat suspension was prepared containing 8 and 10% (w v^{-1}) buckwheat in water. The samples were inoculated with 0.01 U each of *Lactobacillus plantarum* subsp. *plantarum*, *Lactobacillus acidophilus*, *Lacticaseibacillus paracasei* subsp. *paracasei* and *Lacticaseibacillus rhamnosus* (Mediterrania Biotechnologie, Italy), as well as combinations of tested monocultures (in total, 0.01 U) were analysed. Fermentation was carried out at 37 °C for 10 h, with samples analysed at the beginning and after 2, 4, 8, and 10 h. MRS medium was used for LAB enumeration at 37 °C for 48 h. The sugar (raffinose, fructose, sucrose, glucose) changes were determined by HPLC Shimadzu LC-20 Prominence (Japan). After 4 h of fermentation, the pH of 10% buckwheat suspension containing monocultures *Lactobacillus plantarum* subsp. *plantarum* and *Lacticaseibacillus paracasei* subsp. *paracasei*, the substrate pH decreased from 7.44 to 4.35 and 4.55, respectively, while the LAB CFU increased from 5.30 to 8.59 and 8.84 $\log_{10}$CFU mL^{-1}, respectively. By contrast, in the sample with *Lactobacillus plantarum* subsp. *plantarum* and *Lacticaseibacillus paracasei* subsp. *paracasei* multicultures, the pH fell to 4.30 within 4 h, and lactic acid bacteria growth was significantly faster, reaching 9.06 $\log_{10}$CFU mL^{-1}. Analysis of the fermentation patterns confirmed the intensive metabolic activity of *Lactobacillus plantarum* subsp. *plantarum* and *Lacticaseibacillus paracasei* subsp. *paracasei* multiculture, as evidenced by the decrease in pH, active sugar consumption, and accumulation of organic acids during fermentation.

Keywords:
Buckwheat, Lactic acid bacteria, Fermentation, Sugars, pH reduction, Functional foods

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A LevelDB Approach to Organism-Specific Storage of Theoretical Peptides

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Efficient organization and retrieval of theoretical peptide information are essential for proteomic research. This work presents a database design for digested protein sequences based on LevelDB, using a key based on organism identity (taxonomy identifier) and peptide mass. In contrast to existing mass-centric peptide databases such as MaCPepDB, which primarily index peptides by mass across large combined protein sets with organism information applied only as an additional filter, the proposed approach uses a composite key to organize entries per organism and enables direct access to peptides of a selected organism. Protein sequences from the UniProtKB/Swiss-Prot database were digested in silico, and the resulting peptide masses were stored with a fixed decimal precision under each organism's taxonomy identifier. Each key therefore defines a specific combination of organism and discrete mass value, while the associated value contains all peptides that correspond to that stored mass within the given organism's publicly available protein dataset. For a selected organism, mass-based queries are performed either for a single mass value (exact match at the chosen precision) or for a specified mass interval, in both cases retrieving all peptides with stored masses falling within the given bounds. Within every organism, proteins are first digested into peptides and these peptides are effectively ordered by mass through the sorted LevelDB key space, which enables efficient range-based searches within defined mass intervals and allows researchers to explore peptide profiles across different species or strains in a biologically meaningful way. The proposed system provides a practical framework for organism-specific peptide retrieval. The database operates locally, without the need for a separate server or relational infrastructure, making it portable and easy to maintain on average personal computers. This design can be particularly useful for laboratories that need fast access to theoretical peptide data without relying on large-scale computing resources.

Keywords:
Proteomes, Bioinformatics, LevelDB, Optimized peptide database, *In silico* digestion

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Optimizing Plant Growth-Promoting Bacteria from Irish Peatlands as Potential Nano-Biofertilizers for Sustainable Agriculture

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Plant growth-promoting bacteria (PGPB) are promising biofertilizers that can replace synthetic bulky fertilizers. PGPB improve plant growth, soil quality, increase nutrient availability such as phosphate and potassium and improves food production and safety. Previous studies have confirmed that *Bacillus* species possess plant-growth promoting (PGP) traits. Current study hypothesized that magnetic iron oxide nanoparticles (IONPs) could enhance the PGP traits of peat-derived microbiota from Irish peatlands. Peat-derived bacteria were isolated from peat soils collected in county Offaly and county Laois. *Bacillus* strains were identified by 16s rRNA sequencing. Selected *Bacillus* isolates were screened for PGP traits including phosphate solubilization, Indole 3-acetic acid (IAA) production, exopolysaccharide (EPS) production, salt and heavy metal tolerance. A candidate, *Bacillus* isolate-P9B2, was selected for optimization and to study interactions between bacteria and IONPs. IONPs were synthesized via reverse co-precipitation method and characterized by SEM, XRD, FTIR and DLS. Morphology of IONPs was spherical with an average hydrodynamic radius of 78 nm. The *Bacillus* isolate-P9B2 exhibited stronger PGP traits than other *Bacillus* isolates. *In-vitro* assessment with IONPs revealed that viability of P9B2 increased at 2.5 mg mL^{-1} of IONP with a capture affinity of 96.49%. The phosphate solubilization capacity of the isolate-P9B2 gradually increased by 23.45, 23.77 and 43.86% when treated with IONP concentrations of 1.25, 0.625 and 0.312 mg mL^{-1}, respectively. Similarly, IAA production was increased when the concentration of IONP increased. However, the production of EPS was decreased when the concentration of IONP decreased. Overall, our findings concluded that lower IONP levels not only enhanced PGP traits but also increased the viability of the *Bacillus* isolate-P9B2. Follow up studies anticipate further addressing viability using different assays, nano-encapsulation techniques for P9B2 and evaluating the survival rate with IONPs.

Keywords:
Iron oxide nanoparticles, *Bacillus* spp., Peatlands, Plant-growth promoting

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Extending Shelf-Life and Preserving Postharvest Quality of Strawberries through Innovative Edible Coating Designed from Fresh-Produce Waste

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Rising global food demand and substantial underutilized fresh-produce waste highlight the need for circular economy solutions in food packaging. This study developed sodium alginate-based edible films incorporating fruit processing residues as functional additives. Formulations were optimized via Response Surface Methodology using standardized fine powders prepared from orange, grapefruit, and apple pomaces. The optimized composition – 1.10% citrus waste powder, 1.40% apple pomace powder, and 3.50% carnauba wax/coconut oil solution – yielded films with improved mechanical properties (tensile strength: 7.04 MPa; elongation: 29.59%), greater hydrophobicity (water contact angle: 75.84°), enhanced UV-Vis barrier capacity, and notable antioxidant activity. FTIR analysis confirmed strong intermolecular interactions between alginate, fruit waste powders, and hydrophobic components, indicating reinforced structural integrity. When applied to strawberries, the coating effectively delayed microbial spoilage, maintained colour and moisture, and preserved sweetness over 10 days at 4 °C, extending shelf life by 4 days compared to uncoated control samples. These findings demonstrate the feasibility of valorising agri-food by-products to produce multifunctional edible coatings, contributing to waste reduction/valorization, food preservation, and sustainable postharvest management within a regenerative economy framework.

Keywords:
Bio-inspired edible coatings, Fruit pomace valorization, Circular economy in food packaging, Strawberry shelf-life extension, Food quality preservation

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Beyond the Usual Targets: Supercritical CO_2 Extraction of Lipophilic Compounds from Blackcurrant Pomace

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Blackcurrant pomace (BP), a by-product of juice production composed mainly of seeds and skins, represents a valuable source of polyphenols, particularly anthocyanins, as well as lipophilic compounds that have received comparatively less attention. Supercritical CO_2 extraction (SC-CO_2) provides a green and selective approach, preserving heat-sensitive lipophilic constituents while avoiding the use of organic solvents. The aim of this study was to determine the optimal SC-CO_2 conditions for isolating the BP lipophilic fraction and to provide a detailed characterization of its phytosterol, fatty acid, and tocopherol composition. Extractions were performed at different temperatures (40, 50, and 60 °C), pressures (200, 300, and 400 bar), and CO_2 flow rates (30 and 40 g/min) to optimize extract yield. The extract obtained under optimal conditions was then analyzed for phytosterols, fatty acids, and tocopherols. The optimal extraction conditions were 50 °C, 200 bar, and a CO_2 flow rate of 30 g/min, under which an extract yield of 7.44% was obtained. Among the phytosterols, β-sitosterol was the most abundant, comprising 83% of the total phytosterol content (50.12 mg 100 g^{-1}) with an individual concentration of 44.50 mg 100 g^{-1}. Minor phytosterols such as campesterol, stigmasterol, Δ5-avenasterol, and Δ7-sitosterol further contribute to the nutraceutical potential of the extract. Fatty acids were predominantly polyunsaturated (PUFA, 71.63%), with linoleic acid (42.61%) and γ-linolenic acid (16.52%) as the major components, accompanied by monounsaturated (MUFA, 18.29 %) and saturated fatty acids (SFA, 10.06 %). The tocopherol content totaled 42.38 mg 100 g^{-1}, comprising α-tocopherol (27.43 mg 100 g^{-1}), γ-tocopherol (11.50 mg 100 g^{-1}) and δ-tocopherol (3.45 mg 100 g^{-1}). The combination of high PUFA and tocopherol content highlights both the nutritional and antioxidant potential of the extract, while bioactive phytosterols may contribute to cholesterol reduction and offer additional health benefits. These results indicate that BP is a valuable source of lipophilic bioactives, with SC-CO_2.

Keywords:
Blackcurrant pomace, Supercritical CO_2 Extraction, Phytosterols, Fatty acids, Tocopherols

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Prediction of Milk Composition from Mid-Infrared Spectral Data: Comparing PLSR to Alternative Machine Learning Algorithms

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Mid-infrared (MIR) spectroscopy is widely applied for routine milk analysis. As a secondary analytical technique, it requires predictive models correlated with laboratory data for the quantification of analytes. Partial least square regression (PLSR) is the most commonly employed technique for these models, nevertheless, it may not effectively model complex nonlinear relationships that can exist for minor, economically-important components in milk. Machine learning (ML) algorithms, however, can cope with large, nonlinear, and complex datasets. This study aimed to investigate the effects of spectral preprocessing and regression algorithms for the prediction of individual fatty acids (FA) using MIR spectroscopy, particularly to assess whether ML techniques can improve models compared to the standard approach (PLSR). A dataset of 1,242 MIR spectra from bulk milk samples of 378 New Zealand farms was employed, with concentrations for 25 individual FA determined by GCMS. Initially, comparison of spectral preprocessing methods was carried out, employing combinations of techniques related to removal of spectral regions, outlier removal, variable selection, and scatter correction. Preprocessed datasets with optimum PLSR model performance were divided into training and validation sets (75:25), and calibrations with regression algorithms: PLSR, Random Forest (RF), Gradient Boosting Machines (GBM), Artificial Neural Network (ANN) and Support Vector Regression (SVR) were developed. For the optimised preprocessed data set (excluding areas of no interest with no other preprocessing), alternative algorithms showed% improved R^2 for the predictions compared to the PLSR model of; -32% to 40% for RF (average -10%), -18% to 63% for GBM (average 0%), -2% to 72% for SVR (average 11%), and 3% to 84% for ANN (average 20%). This work offers new insight into preprocessing and calibration algorithms for optimising prediction of FA composition from MIR spectroscopy, particularly for emerging ML techniques. Furthermore, it encourages the use of newer/advanced algorithms in the compositional analysis of complex food matrices.

Keywords:
Machine learning, Composition prediction, Calibration algorithms

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Eco-Friendly Recovery of High-Value Carotenoids from *Chlorella vulgaris* Using Novel NaHDESs

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Microalgae are emerging as versatile bio-resources for the sustainable production of high-value compounds. This study explores Natural Hydrophobic Deep Eutectic Solvents (NaHDESs) for the green extraction of carotenoids from *Chlorella vulgaris*, addressing the dual challenge of efficiency and environmental impact in biocompound recovery. A series of NaHDESs, based on combinations of medium-chain fatty acids, were developed and characterised for their physicochemical properties. The most promising solvent system, made using nonanoic/dodecanoic acid in a 3:1 molar ratio, was selected for further optimisation using response surface methodology. Extraction conditions were fine-tuned to maximise the recovery of key carotenoids (lutein, zeaxanthin, β-carotene) and associated antioxidant activity. Compared to traditional solvents, NaHDESs offered higher yields and safer, biodegradable alternatives with potential applications in functional food development, nutraceutical, and biorefinery industries. This approach paves the way for scalable, eco-conscious processes in microalgal biotechnology, highlighting the possible role of NaHDESs in future food and bioactive compound extraction technologies.

Keywords:
Carotenoids, Green extraction, Microalgae

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Pectin Extraction from Saba Banana Peel Waste

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The extraction of pectin from 'Saba' banana (*Musa acuminata* x *balbisiana*) peel represents a promising approach to food waste valorization while addressing global pectin demand. This comparative study evaluates ultrasound-assisted extraction (UAE), microwave-assisted extraction (MAE), and conventional methods (acid and enzymatic extraction) regarding pectin yield, purity, and functional properties. Acid extraction achieved the highest pectin yield (up to 20%), followed by microwave (≈ 14%) and enzymatic methods (≈ 6%), with ultrasound typically yielding 4–5%. However, yield alone does not determine pectin quality, as purity and functional properties are critical for food and pharmaceutical applications. Acid-extracted pectin (AP) demonstrated superior yield and anhydrouronic acid (AUA) content and higher ash content but lower color quality, potentially limiting applications without additional purification. Pectin obtained by MAE and UAE had moderate yields with favorable properties. UAE pectin (UEP) had higher protein content, lower interfacial tension, and higher emulsifying capacity, generating smaller emulsion droplets and improved stability. Pectin obtained by and MAE and after purification showed desirable properties with higher purity and low-methoxyl characteristics. Rheological analysis revealed that all Saba banana pectins contributed to shear-thinning, non-Newtonian behavior in food systems, with yield stress and consistency parameters comparable to or exceeding commercial citrus pectins. UAE and MAE pectins increased beverage viscosity under physiological digestion conditions, potentially enhancing satiety effects. *In vitro* assays demonstrated that pectins from all extraction methods effectively bind cholesterol and bile acids, indicating promising lipid-lowering properties, with acid-extracted pectin showing the strongest binding capacity. In conclusion, extraction method significantly impacts pectin yield, purity, and technological-functional performance. Acid extraction remains optimal for yield and purity but requires additional processing for color and ash improvement. UAE and MAE offer rapid, eco-efficient alternatives producing pectins suitable for texture modification, stabilization, and health-promoting food applications, providing practical guidance for selecting extraction protocols tailored to specific pectin applications in food and nutraceutical innovation.

Keywords:
Saba Banana Peel, Pectin, Ultrasound-assisted extraction, Microwave-assisted extraction

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Wheat Bran Based Biorefinery – Proof of Concept

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Wheat bran, a byproduct of the wheat milling process, forms the outer layer of the grain and represents about 14–19% of its weight. It consists of several layers—the pericarp, testa, nucellar layer, and aleurone. The pericarp and testa are rich in cellulose, hemicellulose, and lignin, contributing to the high dietary fiber content. The aleurone layer is nutritionally dense, containing proteins, lipids, B vitamins, minerals (iron, zinc, magnesium), and bioactive compounds such as phenolic acids and flavonoids. Originally regarded as a low-value byproduct mainly used for animal feed, wheat bran has gained attention due to its potential within the framework of European sustainability policies. The European Green Deal, Circular Economy Action Plan, and Bioeconomy Strategy promote the efficient use of renewable resources and the reduction of waste through innovative value chains. Within this context, biorefineries are considered key technologies enabling the transformation of agricultural residues, such as wheat bran, into bio-based materials, chemicals, and energy. Currently, over 200 biorefineries operate in Europe, but most focus on producing biofuels, bioethanol, or biodiesel. A fully integrated biorefinery converting food industry residues into multiple high-value products has not yet been realized, and only a few studies have validated this concept. The present work introduces a wheat bran biorefinery—a concept tested at small industrial scale, exploring the isolation of ferulic acid and proteins, biochar production, and anaerobic processing of wheat bran.

Keywords:
Biorefinery, Wheat, Bran, Biogas, Protein, Biochar

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Optimizing Shrimp Shell Valorization: Comparative Study of Drying Methods on Nutritional and Functional Quality

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Shrimp shell is a valuable byproduct of seafood rich in natural polymers, ash and carotenoids with antioxidant properties. The drying method used during processing can affect the quality of these compounds. This study examines the effects of three drying methods on chemical parameters (dry matter, protein, lipid, ash), antioxidant properties (carotenoid content, DPPH antioxidant activity) and functional parameters (water and oil absorption capacities, solubility) of the shrimp's shell powder. The goal is to identify the best method for preserving its valuable components and enhancing its potential uses. The shrimp shells, taken from the same batch, were subjected to three different drying methods: (1) microwave drying at 200–250 W for 6.5 min, (2) convective drying at 50 °C for 3 h, and (3) sun drying for 10 h under ambient conditions (with an average temperature of 21 °C, relative humidity of 68%, and a wind speed of 15 km/h). Results showed that convective drying preserved protein content (52.87%), enhanced antioxidant capacity (lowest IC_{50} = 0.90 mg mL^{-1}), and retained the highest carotenoid concentration (0.96 mg g^{-1} β-carotene equivalent). Microwave drying demonstrated superior fat retention (3.38%) and moderate antioxidant and functional performance. Sun drying resulted in lower biochemical stability. In conclusion, convective drying appears to offer the best balance between preservation of nutritional and functional quality and structural integrity of shrimp by-product powder.

Keywords:
Shrimp shell, Drying, Quality, Powder, Biochemical properties

Acknowledgements
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Valorization of By-Products in the Croatian Olive Sector: Practices, Barriers, and Opportunities

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The olive oil sector generates significant quantities of by-products, including pomace, vegetable water, pits and pruning residues. Managing these residues presents both an environmental challenge and an economic opportunity. Applying circular economy principles allows for the transformation of these materials from waste into valuable resources. This research was conducted as part of the Erasmus+ CIRCOLIVE project, which included five European countries (Spain, Italy, Greece, Portugal and Croatia), however this paper focuses on findings from Croatia. Data were collected through an online survey distributed to Croatian olive growers and mill owners, as well as through structured interviews with relevant sector experts. The aim was to identify current practices and methods for the valorization of by-products, applied in Croatian olive cultivation, to collect best practices, and to understand potential barriers that limit their implementation or further exploitation of their full potential. The results showed that, while there is high awareness of the importance of sustainability in Croatia, the application of circular practices remains limited. The most common method for valorizing pruning residues was mulching to improve soil quality. According to the results, olive pomace was primarily used for composting, while only a porton of pits, separated from pomace, were used for heating or mulching. More advanced forms of valorization, such as the extraction of bioactive compounds, were rarely found. The main barriers highlighted by stakeholders include high initial investment costs in technology, a lack of specialized knowledge and skills, and complex administrative and legal procedures. This research confirmed a significant gap in the Croatian olive sector between awareness of sustainable practices and their actual implementation. Nevertheless, systematic valorization of by-products offers strong potential; innovative technologies and circular business models could boost producers' competitiveness, open new revenue streams, and reduce the sector's environmental footprint.

Keywords:
Olive sector, Valorization, Olive-by-products, Sustainability, Circular economy

Acknowledgements
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Biotechnological Valorisation of Rice Okara for High-Protein Fruit Purées: From Protein Hydrolysis to Functional Food Prototypes

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This study describes a multi-actor biotechnological approach for the valorisation of rice okara into stable, high-protein fruit purées. Fresh okara supplied by White&Green was stabilised by SimplYeast through dehydration (OAD) and hydrolysis (thermal, OAT; enzymatic, OAE), generating protein-rich flours containing 68.7 ± 0.2 to 69.8 ± 0.5% protein, 1.7 ± 0.0 to 2.8 ± 0.0% ash, and 1.3 ± 0.0 to 2.2 ± 0.1% lipids. Characterization showed that both hydrolysis treatments improved flour properties, increasing solubility from 24.8 ± 3.2 (OAT) to 49.7 ± 1.8% (OAE2) and degree of hydrolysis from 0.50 ± 0.10 (OAE1) to 12.66 ± 0.56% (OAE2). Enzymatic hydrolysis markedly enhanced bioactive potential, raising total phenolics from 114.9 ± 6.7 to 453.8 ± 65.9 mg GAE g^{-1} and antioxidant capacity from 400.5 ± 37.9 to 27.090 ± 2.046 µmol TE g^{-1} (ORAC), confirming strong functional improvement for food use. Based on these results, fruit purées combining apple pomace (Compal) and banana with 5% okara flour were developed. Two stages were followed: (i) exploratory testing with all flours, including physicochemical and sensory analyses, and (ii) optimisation using OAD and OAT, adjusting the recipe and standardising the protocol—pre-hydration of okara flour with water and xanthan gum (5 min at 100 °C) followed by stepwise mixing of fruit components and acidifiers. Pilot-scale trials at Yogan confirmed process reproducibility, and SONAE supports market integration. Optimized purées reached 3.5 g protein 100 g^{-1}, with 21% of total energy from protein, fulfilling EU “high-protein” standards. Improved texture, colour and sensory performance, particularly for OAT-based purées, were observed. Protein solubility, emulsifying capacity and antioxidant activity confirmed the positive effect of hydrolysis on structure–function behaviour.
This work exemplifies a circular bioeconomy model, showing how controlled protein hydrolysis transforms underutilised co-products into sustainable, value-added ingredients.

Keywords:
Protein hydrolysis, Circular bioeconomy, Functional food development

Acknowledgements
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Growth Kinetics and Antimicrobial Profiles of Two *Xylaria* Species Isolated from Bulgaria

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The species of the genus *Xylaria* are ascomycetous fungi known for producing bioactive secondary metabolites with diverse and pharmacologically relevant properties. Despite their ecological and pharmacological significance, their in vitro growth characteristics and bioactive potential remain insufficiently studied. This investigation explores the growth kinetics and antimicrobial activity of *Xylaria karsticola* and *Xylaria polymorpha*, newly isolated from Bulgarian habitats. Growth rates were assessed on both synthetic and complex agar media, and key mycelial growth parameters were determined. Biomass obtained through submerged cultivation was extracted using various solvents and the resulting extracts were evaluated against Gram-positive and Gram-negative bacterial strains. The ethyl acetate extract of *X. karsticola* exhibited notable antibacterial activity, particularly against *Pseudomonas aeruginosa* ATCC 9027 (MIC: 15.26 µg mL^{-1}) and *Salmonella enterica* ATCC 13076 (MIC: 62.25 µg mL^{-1}). The butanol extract of *X. polymorpha* demonstrated the highest activity against *Escherichia coli* ATCC 8739 (MIC: 62 µg mL^{-1}). These findings highlight the biotechnological potential of *Xylaria* species as promising sources of natural antimicrobial agents and support further pharmacological investigation.

Keywords:
Xylaria, Growth kinetics, Antimicrobial activity, Secondary metabolites, Bulgarian ascomycetes

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Total Phenolic Content and Antioxidant Capacity of Lavandula Extracts (*Lavandula* × *intermedia* 'Budrovka') Obtained by Ultrasound–Assisted Extraction

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Lavandula is a bushy, evergreen, perennial flowering plant that is generally widespread in the Mediterranean region and has antioxidant, anti-inflammatory, and antimicrobial properties. It contains essential oils, tannins, monoterpenes, sesquiterpenes, anthocyanins, minerals, saponins and phenolic compounds. Phenolic compounds can be considered largely responsible for the lavandula extracts' antioxidant activity since they possess redox properties which allow them to act as antioxidant agents. Response surface methodology was used as a tool for optimization of extraction parameters (water and 70% ethanol as solvent, temperature 30 and 50 °C as well as duration of sonification 10, 20 and 30 min) in order to obtain extracts with high biologically active compound (BACs) content and antioxidant capacity (AOCs). The total phenolic content in the prepared extracts was determined by the Folin-Ciocalteu method, while the antioxidant activity was tested using the DPPH (2,2-difenil-1 picrilhydrazyl) assay. Total phenolic content (TPC) and AOC were significantly affected by the solvent used, along with extraction temperature and sonification time. The results show that for aqueous extracts, temperature and extraction time have no significant effect on the TPC, whereas for ethanol extracts, a higher TPC was observed in extracts obtained at 30 °C and an extraction time of 30 min. The optimal total phenolic contents were achieved in extracts produced with water as solvent at 30 °C and 30 min of ultrasound assisted extraction (1344.78 ± 21.68 mg GAE 100 g d.m.$^{-1}$), while the best reducing activity was obtained for ethanolic extract prepared using ultrasound during 20 min at 30 °C (62.66 ± 1.17 μmol TE 100 g d.m.$^{-1}$).

Keywords:
Phenolic compounds, Lavandula, Ultrasound–Assisted Extraction, Antioxidant capacity, Response surface methodology

Comparative Analysis of Culture Media Effect on the Mycelial Growth of Medicinal Mushroom *Inonotus hispidus*

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This study investigates the influence of culture medium composition on the mycelial growth of the medicinal mushroom *Inonotus hispidus* under in vitro cultivation. The growth of a newly isolated Bulgarian strain, *Inonotus hispidus* GA4B was assessed on 12 synthetic media to identify the most suitable one for cultivation. Growth modeling using logistic and reverse-autocatalytic equations across all media revealed that malt extract agar (MEA) was the most suitable, with a maximum specific growth rate (μ_{max}) of 0.511 ± 0.012 d^{-1}. Comparable growth was observed on Czapek-Dox medium (μ_{max} = 0.502 ± 0.017 d^{-1}), although the resulting mycelium was of a lower density. Further experiments established 28 °C as the optimal temperature for mycelial development of *I. hispidus* on MEA. Application of the Arrhenius equation, using a fourth-order polynomial model for the pre-exponential factor, enabled accurate prediction of μ_{max} across the 19–37 °C range, showing strong agreement between theoretical and experimental values. Additionally, pH 6.5 was identified as optimal for the growth of *I. hispidus* on MEA medium. A pH-dependent kinetic model was developed, effectively predicting μ_{max} within the pH range of 4.5 to 7.5. Collectively, these findings provide a robust kinetic framework for predicting the growth of *I. hispidus* GA4B under varying temperature and pH conditions during in vitro cultivation.

Keywords:
Inonotus hispidus, *In vitro* cultivation, Growth kinetics modelling, Basidiomycetes

Acknowledgements
This research was funded by THE NATIONAL SCIENCE FUND OF BULGARIA, under contract No. KP-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".

Optimization of Flocculant Application for Enhanced Biomass Harvesting and Biodiesel Production from *Phaeodactylum tricornutum*

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The growing global demand for renewable energy has intensified research interest in sustainable biofuel sources, with microalgae emerging as a promising feedstock due to their rapid growth, high lipid content and low land use. Among them, *Phaeodactylum tricornutum*, a marine diatom, is notable for its ability to accumulate 20–30% lipids by dry weight, particularly under nitrogen-limited conditions. Its capacity to grow in saline water adds to its sustainability by reducing competition with freshwater use. Efficient harvesting remains one of the key challenges in microalgal biotechnology, as the small size, negative charge and low density of algal cells complicate biomass recovery. Flocculants are widely used to efficiently sediment microalgae, making downstream processing for biodiesel production more cost-effective. Ferric chloride ($FeCl_3$) and copper sulfate ($CuSO_4$) are commonly applied due to their availability, low cost, and proven harvesting efficiency. This study aimed to evaluate the effect of different concentrations (0.05–0.15 g L^{-1} $FeCl_3$ and 0.5–1.5 g L^{-1} $CuSO_4$) of these flocculants on biomass yield, lipid content and biodiesel potential, in order to optimize their application. Microalgae monocultures were flocculated by $FeCl_3$ or $CuSO_4$, followed by mixing, sedimentation, decantation, centrifugation, and drying to measure biomass yield. Lipids were extracted using ultrasound-assisted hexane extraction, and biodiesel was produced via K_2CO_3-catalyzed transesterification, with yields measured gravimetrically. The results demonstrated that the dry biomass and lipid yield grew proportionally with the higher concentrations of $FeCl_3$, with biodiesel only obtained at the highest concentration (0.15 g L^{-1}). In contrast, while higher $CuSO_4$ concentrations increased biomass yield, the lipid and biodiesel productivity were decreased. These findings suggest that flocculant choice and concentration not only affect harvesting efficiency but also influence overall biodiesel yield potential. This highlights the importance of optimizing upstream processes and opens new directions for improving the efficiency and sustainability of microalgae-based biodiesel production.

Keywords:
Microalgae, Lipid extraction, Biofuel, Sustainability

Exploring the Brewing Potential of Triticale Malt: A Sustainable Alternative to Barley

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Beer, one of the oldest biotechnological products, continues to evolve in response to consumer demand for diversity and sustainability. While barley malt remains the dominant raw material in traditional brewing, the use of alternative cereals is gaining momentum—now accounting for over 80% of global beer production. Triticale, the first man-made hybrid cereal developed by crossing wheat and rye, represents a promising option in this context. Unlike many adjuncts, which reduce enzymatic activity and require enzyme supplementation, triticale malt exhibits naturally high α-amylase and proteolytic activities. Moreover, its starch has a low gelatinization temperature, allowing it to be processed during mashing without additional thermal process. These properties make triticale malt a sustainable and energy-efficient alternative that could reduce production costs and the carbon footprint of brewing. The objective of this study was to evaluate the impact of brewing with malted triticale variety NS Paun, approved in both Serbia and the EU, at grist ratios of 10, 30, and 50%. A modified mashing regime was applied, characterized by temperature rests favorable for pentosan degradation—compounds associated with increased wort viscosity. As a result, wort viscosity was reduced compared to the control sample – 100% barley malt, while extract content increased with higher triticale malt proportions in the grist. The highest extract content (8.79 ± 0.02 g 100 g^{-1}) was obtained in wort with 50% triticale malt. Free amino nitrogen (FAN) levels also increased with more triticale in the grist, remaining within MEBAK-recommended limits (110–180 mg L^{-1}). An increase in triticale malt proportion led to higher color intensity in hopped worts. Ethanol content in green beer increased accordingly, with the highest value (2.95 ± 0.02% v/v) measured in beer produced using 50% triticale malt. Vicinal diketone levels followed the same trend, ranging from 0.14 ± 0.01 to 0.21 ± 0.01 mg L^{-1}.

Keywords:
Triticale, Mashing, Brewing, Malt

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Enhancing Functional and Sensory Properties of Cream Cheese Spread using Herbal and Vegetable Additives

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Cream cheese spread is a popular dairy product, appreciated for its smooth consistency and mild flavor. Enrichment with plant-based additives offers potential to improve both sensory appeal and functional properties. This study evaluated the effects of rosemary flavoring powder, dried chive seasoning, and red and yellow pepper pastes on the chemical composition, texture, color, and sensory characteristics of cream cheese spread over 14 days of refrigerated storage. Additives significantly influenced product parameters. Dry matter content increased in samples with rosemary (36.31%) and chive (35.34%) compared to the control (35.23%), while red (33.86%) and yellow pepper (31.27%) samples showed reductions. Fat content decreased in pepper-enriched variants, with the lowest value in the yellow pepper sample (21.00%) vs. the control (26.00%). Color analysis revealed increased yellowness (b^* = 18.78) in the yellow pepper variant and enhanced redness (a^* = 11.13) in the red pepper sample. All enriched formulations exhibited lower hardness than the control (e.g., ~300 g in the chive sample vs. 380 g). Sensory analysis showed the highest scores for the yellow pepper and control samples, particularly for color (4.8/5) and taste (4.6/5). Principal component analysis identified lightness, firmness, and pH as major contributors to sample differentiation. The results demonstrate that incorporating herbs and vegetables into cream cheese spread can improve visual appeal, diversify flavor, and modify texture, offering a promising strategy for the development of innovative, functional dairy products.

Keywords:
Cream cheese spread, Plant-based additives, Color parameters, Texture analysis, Sensory evaluation

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Oxidative Stability of Pork Meatballs Formulated with Addition of Brewers Spent Grain

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The importance of meat in the diet should not be underestimated; however, in light of sustainable production and towards the reformulation of healthier meat products, the use of meat extenders for partial replacement of meat in these products is increasingly analyzed. Different by-products from the food industry are being considered for this purpose. Brewer's spent grain (BSG) is the major by-product of the brewing industry, and is considered to be material rich in protein and fiber. The aim of this study was to determine the influence of BSG, as a meat substitute, on the oxidative stability of meatballs during cold storage. Meatballs, prepared from lean pork (90%) and solid fatty tissue (10%), were divided into three groups – control (C), and experimental samples containing 3 (sample 3BSG) and 6% (6BSG) of BSG, as meat replacement. All samples were stored at 4 °C for 5 days. BSG had positive influence on total protein content, since there was a significant difference between C (19.23%) and 6BSG (19.65%). The pH value was the lowest for the control sample at the end of storage, compared to 3BSG and 6BSG. Lipid oxidation was relatively low for all samples, but still it was significantly lower at the end of storage period in sample 6BSG (0.16 mg MDA kg^{-1}) compared to the control sample (0.24 mg MDA kg^{-1}). Color changes where were significantly higher in samples C, compared to 3BSG and 6BSG, during the whole storage period. The obtained results, regarding increased total protein content and positive effect on oxidative stability, promote BSG usage in meat products as meat extender.

Keywords:
Meatballs, BSG, Oxidation

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Low-Alcohol Beer Production with Congress Mash Method

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Moderate beer consumption has been linked to health benefits due to compounds from barley (malt) and hops. However, these benefits are limited by alcohol's negative effects. With growing health awareness and concerns about alcohol abuse, consumer demand for low-alcohol and alcohol-free beers has increased. The production of these beers relies on physical methods (e.g., thermal or membrane techniques) and biological methods that adjust the brewing process to limit fermentation, resulting in minimal ethanol production. Biological methods are commonly used, as they do not require additional equipment. The definitions of “low-alcohol” and “alcohol-free” vary in different countries, but mostly ethanol content in alcohol-free beer is restricted to 0.5% v/v. This study aimed to evaluate the quality of wort, hopped wort, and alcohol-free green beer produced from 100% barley malt using the Congress Mash method. Target wort extract content was 8.5, 7.5, and 6.5%. Fermentations were performed with yeast *Saccharomyces cerevisiae* var. *chevalieri*. All wort parameters were within acceptable values, indicating its quality. Bitterness of hopped worts ranged from 40 to 48 BU. All produced beers reached the ethanol limit by day 2 of the fermentation. The beer produced from the 7.5% extract wort had the lowest ethanol content. According to the manufacturer, the yeast strain used does not assimilate maltose. However, the yeast did assimilate maltose, but to a limited extent during fermentation (around 3%).

Keywords:
Alcohol-free beer, Mashing, Yeast

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Innovative Perspectives on Olive Leaf, Thyme, and Green Walnut Husk Extracts in Dairy: A Review of Polyphenolic Composition and Antioxidant Efficacy

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Oxidative stress, as well as the inflammation resulting from it, is a major contributor to the development of numerous chronic diseases. Instead of using conventional drugs, which may cause various side effects, researchers are increasingly exploring plant-based raw materials with potential anti-inflammatory and antioxidant properties. Among these are olive leaves (*Olea europaea*), thyme (*Thymus vulgaris*), and green walnut husks (*Juglans regia*). Olive leaves are rich in oleuropein, hydroxytyrosol, and verbascoside; thyme contains thymol, carvacrol, and rosmarinic acid; while green walnut husks are characterized by high concentrations of ellagitannins, juglone, and flavonoids. The antioxidant activity of these extracts has been widely investigated in numerous studies using various methods, including in vitro assays such as DPPH, FRAP, and ABTS. Moreover, the incorporation of olive leaf, thyme, and green walnut husk extracts into dairy products has shown very promising results. In addition to enhancing the oxidative stability of the products and extending their shelf life, these extracts also improve the nutritional profile and enhance the functional properties of the final product. Furthermore, they may contribute to sensory enhancement and the inhibition of lipid peroxidation and microbial spoilage, thereby offering a dual role as natural preservatives and health-promoting agents. This review provides an overview of the polyphenolic profiles of olive leaf, thyme, and green walnut husk extracts, as well as their impact on the functional and technological properties of dairy products, alongside recent innovations in extraction techniques. These findings support the potential of natural plant-based extracts in the development of clean-label functional dairy products.

Keywords:
Dairy products, Extraction methods, Functional foods, Plant extracts, Polyphenols

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Microwave-Assisted and Conventional Extraction of Phenolic Compounds from Raspberry Pomace: UHPLC Characterization and Antioxidant Activity

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The aim of this study was to investigate the extraction of phenolic compounds from raspberry pomace (*Rubus idaeus* var. Polka) by microwave-assisted extraction (MAE) and conventional solvent extraction (CE) using 50% ethanol acidified with 1% formic acid as extraction solvent. The total phenolic and anthocyanin content was determined by spectrophotometric methods and the phenolic profile by UPLC-MS/MS methods, while the antioxidant activity was determined by DPPH, ABTS and FRAP assays. The raspberry pomace extracts obtained with MAE contained higher content of total phenols (2964.82 mg 100 g dw^{-1}) and total anthocyanins (20.30 mg 100 g dw^{-1}) compared to the extracts obtained with CE (1876.35 and 14.76 mg 100 g dw^{-1}). UPLC-MS/MS analysis revealed the presence of anthocyanins, phenolic acids, flavonols, flavanols, and procyanidins in all extracts analyzed, with the MAE extracts having a higher phenolic content. Anthocyanins were the predominant phenolic class, accounting for 54.82 (MAE) and 42.26% (CE) of the total identified phenolics with cyanidin-3-glucoside being the most abundant anthocyanin, with concentrations of 80.54 mg 100 g dw^{-1} in MAE extracts and 63.12 mg 100 g dw^{-1} in CE extracts. Procyanidin B1 was the second most abundant compound, with 15.05 mg 100 g dw^{-1} in MAE extracts and 10.53 mg 100 g dw^{-1} in CE extracts. In terms of antioxidant activity, MAE extracts showed slightly lower DPPH (86.22 µmol TE 100 g^{-1}) and ABTS values (43.79 µmol TE 100 g^{-1}) compared to CE (112.60 and 44.53 µmol TE 100 g^{-1}), but significantly higher FRAP activity (7236.27 vs. 5677.51 µmol TE 100 g^{-1}). The results suggest that MAE is an efficient method for the extraction of phenolic compounds from raspberry pomace, especially anthocyanins with strong antioxidant potential. These results support the use of raspberry pomace as a valuable ingredient in the development of functional foods and pharmaceutical formulations.

Keywords:
Anthocyanins, Antioxidant activity, Conventional and microwave-assisted extraction, Phenolic content, Raspberry pomace

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3D Printing of Gluten-Free Snacks: Impact of High-Fiber Ingredients on Printability and Nutritional Profile

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Given the growing interest in personalized nutrition and dietary foods, this study investigated the application of 3D printing technology in developing gluten-free fiber-enriched snacks. The main objective was to customize nutritional formulations using gluten-free high-fiber ingredients while ensuring printability of the dough and structural stability of the final products after drying (130 °C/30 min). To ensure a high fiber content and a balanced nutritional profile, four snack recipes were enriched with natural fiber sources: psyllium (0.81%), pumpkin seed meal (2.02%), flaxseed flour (2.06%), and ground chia seeds (2.06%). The dough's rheological properties (MCR92 Anton Paar), print quality (FoodBot D2 printer), and the texture (TA1, Ametek Lloyd Instruments) and nutrient composition of the final snacks were analyzed. Psyllium-based dough showed the highest elastic modulus (72145 Pa), complex viscosity (9136 Pa·s), and thixotropic properties (65% recovery in G'), resulting in minimal deformation during printing (≤ 10%) and drying (22.6%). While all formulations were printable, pumpkin seed snacks were the least crunchy (27.35 Nmm) and least hard (3.53 N), whereas flaxseed snacks displayed the highest hardness (12.87 N). From a nutritional perspective, psyllium snacks contained the highest total fiber (95.1 mg g^{-1}), flaxseed snacks the highest soluble fiber (23.2 mg g^{-1}), pumpkin seed snacks the most protein (311.4 mg g^{-1}) and minerals (22.3 mg g^{-1}), while chia and flaxseed snacks were richest in polyunsaturated fatty acids (10% of total fat). These results show that 3D printing enables the development of gluten-free snacks with customized nutritional and textural properties. Future research should address the sensory properties, consumer acceptance and shelf-life of such products.

Keywords:
3D food, Rheology, Texture, Deformation, Specific dietary needs

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The Influence of Different Extraction Parameters on the Concentration of Astaxanthin Extracted from Shrimp (*Parapenaeus longirostris*) By-Products

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Astaxanthin occurs naturally in various marine organisms, including shrimp. It has a range of beneficial biological potentials as a powerful antioxidant carotenoid pigment. The production of shrimp meat generates large amounts of shrimp by-products that can be used for astaxanthin extraction. It can be extracted using different extraction methods, including ultrasound-assisted extraction (UAE). In this study, the shrimp waste (cephalothorax and tail shells) was freeze-dried and homogenized. The powder was sieved, and fractions of different sizes were obtained. Different weights (1 and 2 g) of the three obtained fractions (<90, 90–250, and 250-500 µm) were extracted in duplicates with acetone, ethanol, and hexane (1:10 w/v), using UAE for 60 min at room temperature. The amount of astaxanthin was measured spectrophotometrically, and the results were expressed in µg astaxanthin mL^{-1} of extract. The concentration of astaxanthin ranged from 0.83 ± 0.02 to 6.73 ± 0.02 µg mL^{-1}, with the highest amount recorded in the 90–250 µm fraction when 2 g were extracted with ethanol. Overall, ethanol was the best solvent choice for the extraction of astaxanthin for all fractions, when compared to acetone and hexane. Having the highest astaxanthin concentration, the 90–250 µm was again extracted from 5 g of shrimp by-product following the same protocol, this time for 30 and 60 min to test the influence of time on the astaxanthin concentration. The results showed that extraction for 30 min yielded higher astaxanthin concentration in acetone and ethanol extracts, 1.87 ± 0.03 and 2.75 ± 0.02 µg mL^{-1}, respectively, while astaxanthin concentration was higher in hexane extracts (3.91 ± 0.02 µg mL^{-1}) after 60 min. It can be concluded that all tested parameters do influence the concentration of astaxanthin; thus, solvent choice and extraction time should be considered and further optimized based on the extracts' future use and application (pharmaceuticals, nutraceuticals, food).

Keywords:
Astaxanthin, Shrimp by-products, Green extraction

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Utilization of Chickpea Flour for Enhanced Stability and Salt Reduction in Double Emulsions

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Double emulsions are preferred over conventional emulsions for their superior ability to encapsulate and protect sensitive ingredients, ensuring controlled release and enhanced stability. This research investigates the potential of this method for salt reduction in food products, utilizing chickpea flour as a natural emulsifier. Double emulsions, with their ability to encapsulate sodium in both the inner and outer aqueous phase, offer a novel strategy to reduce salt content while maintaining the sensory perception of saltiness. Double emulsions were prepared using different chickpea flour concentrations (10, 15, and 20%) and overall salt concentrations (1, 1.5, and 2%). The emulsions were characterized through particle size, rheological properties, long-term stability, and optical imaging. Our findings demonstrated that chickpea flour concentrations of 20% produced the most stable emulsions, with stability above 90% at both 4 and 22 °C for up to 8 weeks. Higher salt concentrations, however, led to decreased long-term stability, dropping to 75% at 22 °C after 8 weeks. Particle size analysis revealed that emulsions with 20% chickpea flour had the smallest droplet size (34.4 ± 5.13 µm), compared to emulsions with 15% (41.3 ± 1.80 µm) and 10% (61.4 ± 2.04 µm) flour concentrations, indicating improved stability and more uniform particle size distribution. Optical images confirmed the well-structured nature of the emulsions, showing smaller, more uniform droplets in formulations with higher chickpea flour concentrations. Our study demonstrates that chickpea flour is a promising natural stabilizer for double emulsions, offering enhanced emulsion stability and effective sodium reduction in food products. By utilizing chickpea flour, healthier food formulations that maintain stability for a long time can be obtained.

Keywords:
Double emulsion, Chickpea flour, Salt reduction, Rheology, Particle size, Stability

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Fenugreek Gum-Based Double Emulsions for Sodium Reduction in Food Products

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The need for sodium reduction in food products has gained increasing attention due to its association with various health issues. This study investigates the use of fenugreek gum as a stabilizer in water-in-oil-in-water type double emulsions to reduce salt content while preserving the sensory characteristics of food. Fenugreek gum was extracted from fenugreek seeds and incorporated in the outer aqueous phase of the emulsions. Our results indicated that increased fenugreek gum concentrations (1.0, 1.5, and 2.0%) enhanced the stability of the emulsions. Emulsions with 2.0% fenugreek gum exhibited the highest stability, with the emulsions retaining 100% stability at 4 °C for up to 15 weeks. The emulsions with higher salt concentrations showed a significant decrease in long-term stability, indicating that salt adversely affected the stability at higher levels. Particle size analysis revealed that emulsions with 2.0% fenugreek gum produced the smallest droplet size of 7.28 ± 0.136 µm, compared to emulsions with 1.0% fenugreek gum, which had an average droplet size of 8.54 ± 0.252 µm. This was accompanied by a narrower particle size distribution, indicating more uniform emulsions. Overall, emulsions with higher gum content (2.0%) had more consistent droplet sizes. Rheological analysis indicated that emulsions with 2.0% fenugreek gum exhibited higher apparent viscosity values of 0.50 ± 0.01 Pa·s for the lowest salt concentration, compared to emulsions with 1.0% fenugreek gum, which showed 0.17 ± 0.02 Pa·s at the same salt concentration. The flow behavior index (n) decreased as gum concentration was increased, indicating more non-Newtonian behavior. Our findings suggest that fenugreek gum can be used as an effective stabilizer for double emulsions, providing a natural and sustainable solution for reducing salt content in food products.

Keywords:
Double emulsion, Fenugreek gum, Salt reduction, Particle size, Stability

Acknowledgements
This research was supported by The Scientific and Technological Research Council of Türkiye (TUBITAK) with the Project number 123N833.

Chemical Composition and Structure of Coffee and Coffee By-Products

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Coffee is one of the most appreciated beverages in the world due to its unique aroma and flavor characteristics. It is prepared using various hot water brewing methods that produce a considerable amount of by-products, namely spent coffee grounds (SCG). Not only SCG, but also coffee silver skin (CSS) is another by-product that is produced in large quantities during the roasting of green coffee. Both are known to be a rich source of macro- and micronutrients and bioactive compounds, so their reuse instead of disposal could be beneficial. In this work, CSS and SCG are analyzed in terms of their approximate chemical composition, total phenols and fatty acids and characterization of their structure in dried, crude by-products and oil extracts using FT-IR spectroscopy. To evaluate CSS and SCG, the same analyses were also performed for green coffee and roasted coffee from which these residues were obtained. The results of the chemical composition showed that the by-products contain high amounts of ash, fat and especially fiber (21 - 28%). On the other hand, green and roasted coffee are a better source of sugars and proteins with a content of 5.49 and 25.61%, respectively, as well as total phenols (69.13 - 71.13 mg g^{-1}). Although the by-products had lower levels of total phenols (10.84 - 13.09 mg g^{-1}) than coffee, their reutilization seems appropriate considering that they are normally discarded. The fatty acid content of coffee and coffee by-products is different and, for example, linoleic acid as omega-6 fatty acid was found in the highest amounts in SCG (41.84%). The FTIR spectra of the fat extracts from coffee and coffee by-products correspond to the structure of triglycerides, while the FTIR spectra of crude coffee and coffee by-products correspond to the chemical structures of the analytes determined by approximate chemical analysis.

Keywords:
Coffee, Coffee by-products, Chemical composition, Chemical structure, Fatty acids, FT-IR spectroscopy

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Distribution Patterns of Minerals and Bioactive Compounds in White Mold-Ripened and Blue-Veined Cheeses

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This study provides a comprehensive compositional analysis of white mold-ripened and blue-veined cheeses, with a focus on the spatial distribution of minerals and selected bioactive compounds. Commercially available cheeses were analyzed: white mold-ripened and blue-veined varieties, produced from both pasteurized and raw milk. To evaluate distribution patterns of nutrients within cheeses, samples were taken from three different areas of the cheese: the total cross-section, rind, and core. Elemental analysis revealed substantial differences in mineral distribution, particularly in white mold-ripened cheeses. Calcium and phosphorus contents were significantly higher in the rind than in the core of white-mold ripened cheeses, with the differences up to 66-fold, which is attributed to pH-driven migration and the formation of poorly soluble phosphate salts. Zinc and magnesium showed moderate variation, but were still more concentrated in the rind. In contrast, levels of sodium were consistently higher in the core. Bioactive compounds, namely γ-aminobutyric acid (GABA), biogenic amines (BA), and polyamine spermidine (SPD), were analyzed. SPD was highly concentrated in the rind of white mold-ripened cheeses, in some samples exceeding core levels by more than 100-fold. This pattern reflects the growth and metabolic activity of molds on the cheese surface. GABA levels were also elevated in the rind, likely due to microbial glutamate decarboxylation. Importantly, cheeses made from raw milk tended to have much higher concentrations of nutritionally undesirable BA compared to cheeses made of pasteurized milk. The results indicate that the rind of mold-ripened cheeses, especially those made from pasteurized milk, may have a favorable nutritional profile, due to elevated calcium, zinc, GABA, and SPD contents, along with low levels of BA. These findings highlight mold-ripened cheeses as a valuable source of minerals and bioactive compounds, and emphasize their contribution to a balanced diet.

Keywords:
Mold-ripened cheese, Distribution, Minerals, γ-aminobutyric acid, Spermidine, Biogenic amines

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Oat Sourdough Type I and II: Fermentation Kinetics, Enzymes Activity and Metabolites Concentration

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Oat sourdough is gaining increasing interest among researchers and food producers; however, commercial starter cultures specifically formulated for oat fermentation are currently unavailable. This study aimed to develop a spontaneously fermented oat sourdough starter through daily back-slopping over five days (every 23 h). The effects of starter type (spontaneous type-I vs. commercial Diostart Wheat Classic®), dough yield (DY 200 or 300), and fermentation temperature (28 or 38 °C) were evaluated. Acidification kinetics was monitored, and after 16 h of fermentation, microbial counts, total titratable acidity (TTA), enzyme activities, antioxidant capacity, and metabolite concentrations were assessed. In the spontaneous type-I starter, lactic acid bacteria (LAB) outnumbered yeasts (~9 vs. ~6 log CFU g^{-1}), closely resembling the microbial composition of the commercial wheat-based starter. During fermentation, both groups increased by 1–2 log units, depending on the interaction of DY with temperature or starter type. Final pH values ranged from 4.6 to 5.4, and TTA from 3.15 to 5.85 mL 0.1 M NaOH. Lipase activity was primarily influenced by temperature, while polyphenol oxidase (PPO) and phytase activities increased significantly (up to 68 and 90%, respectively), depending on all three variables. Fermentation also reduced free fatty acids and phytate content (up to 36%) while increasing total phenolics and antioxidant activity (up to 117 and 43%, respectively). Higher temperatures favored LAB growth, acidification, TTA, and phytase and PPO activity, while higher DY (300) promoted yeast proliferation, lipase activity, and antioxidant capacity. In conclusion, sourdough fermentation improved the nutritional and functional quality of oat flour. Among the tested conditions, type-I sourdough with DY 300 showed the most consistent and beneficial effects, making it a promising strategy for bakery applications.

Keywords:
Oat sourdough, Spontaneous fermentation, Acidification kinetics, Enzyme activity, Phytates, Antioxidants

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Engineering Yeast *Saccharomyces cerevisiae* with Human Steroid Transporters for Enhanced Estrogen Biosensing

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Estrogen and estrogen-like compounds influence human and animal health and behaviour even at very low concentrations, making their sensitive detection crucial. Whole-cell biosensors based on yeast *Saccharomyces cerevisiae* are commonly used for this purpose. However, their performance is often limited by the slow, passive uptake and active secretion of target compounds, which reduces their overall sensitivity. To overcome this limitation, we engineered *S. cerevisiae* strains to express candidate human steroid transporters predicted to facilitate the import of estrogenic molecules into the cell. Each transporter was fused to GFP, enabling us to confirm successful expression, and introduced into a panel of reference yeast strains in which key cellular structures are pre-labelled with red fluorescent proteins. This approach allowed us to visualise co-localisation, distinguish correctly targeted transporters from mislocalised variants, and prioritise functional candidates. In the next phase, these validated, properly localised transporters will be combined with estrogen-responsive constructs to benchmark improvements in detection sensitivity and dynamic range. The here-described approach establishes a next-generation framework for constructing more sensitive whole-cell biosensors aimed at detecting phyto- and xenoestrogens in food and environmental samples.

Keywords:
Saccharomyces cerevisiae, Whole-cell biosensors, Estrogen detection, Steroid transporters

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Inhibition of β-glucosidase by Different Copper Salts in Model Systems: Insights into Phenolic Compound Formation in Virgin Olive Oil

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β-glucosidase plays a central role in the metabolism of the olive fruit by hydrolyzing secoiridoid glucosides and releasing aglycones, which strongly influence the phenolic profile of olives and thus also the virgin olive oil. These phenolic compounds, especially aglycones, are highly valued for their antioxidant, anti-inflammatory and general health-promoting properties, as well as for their contribution to the sensory quality and oxidative stability of virgin olive oil. However, the activity of β-glucosidase can be affected by external factors, including fungicides used in olive cultivation. Copper-based fungicides are still widely used and effective for disease control, but their intensive use has raised concerns about environmental impact and food quality. One possible consequence of copper accumulation in olive tissue is the interaction with endogenous enzymes that influence the formation of phenolic compounds. Understanding how copper ions affect β-glucosidase activity is therefore crucial for assessing their broader effects on olive fruit metabolism. This study investigated the inhibitory effects of different copper salts at a range of concentrations on β-glucosidase activity. Enzyme activity was determined using *p*-nitrophenyl-β-D-glucopyranoside as a substrate, allowing for quantitative assessment of inhibition. Results revealed a clear concentration-dependent inhibition of β-glucosidase activity by copper salts. Increasing copper concentrations consistently led to stronger inhibition of the enzyme, confirming that copper ions directly interfere with the catalytic mechanism. IC_{50} estimations suggest that the extent of inhibition depends not only on concentration but also on the chemical form of copper. These results emphasize the need to better understand the role of copper in olive cultivation, as its impact on β-glucosidase activity may ultimately shape the phenolic composition of virgin olive oil. Such knowledge can guide the reduction of copper inputs and support the transition towards more sustainable plant protection practices.

Keywords:
Copper salts, β-glucosidase, Enzyme inhibition, Virgin olive oil, Phenolic compounds, Sustainable food processing

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The Effect of High-Intensity Ultrasonication on the Printability of 3D Gluten-Free Snack Products

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3D food printing is an emerging technology offering personalized nutrition, novel textures, and waste reduction through the use of by-products. Although different types of food can be 3D printed, snacks represent an ideal product due to their versatility and increasing popularity. However, the printability of dough depends largely on its rheological properties, which can be modified by various pretreatments of dough. The aim of this study was to investigate the effect of high intensity ultrasound (HIU 400 W, 24 kHz) pretreatment at amplitudes of 60, 80, and 100%, during 6.5 and 13 min on the printability of 3D-printed gluten-free snacks based on millet flour, sweet potato and rice proteins. An extrusion-based 3D printer was used to produce 12-layer snacks using a 1.2 mm nozzle at a printing speed of 10 mm s^{-1}. Dough rheology was characterized, followed by instrumental analyses of texture, color, and shape deviations of the printed and dried snacks. HIU treatment at 60% amplitude for 6.5 min provided the best dimensional accuracy, improving shape fidelity by 9.6% and reducing width and length deviations by 2.5% compared with the control. Prolonged treatment (13 min) at 60% increased snack hardness by 97%, whereas treatment at 100% amplitude for 13 min caused excessive starch degradation, reduced viscosity and hindered printability. Samples treated at higher amplitudes (80 and 100%) retained lighter and reddish hues, while treatment at 60% enhanced darkening. The water absorption index increased with longer treatment times and higher amplitudes, peaking at 100% amplitude for 13 min. HIU pretreatment shows potential for improving the 3D printing performance of gluten-free dough, however, careful parameter optimization is required to balance texture, printability, and product quality.

Keywords:
3D print, Gluten-free, Snack, High intensity ultrasound

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Impact of Thermal Processing on the Aroma Profile, Color and Texture of Beef Meat

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The aim of this study was to investigate the effects of thermal processing on the aroma profile, colour, and texture of beef by analysing *longissimus dorsi* muscles. Volatile compounds were extracted using headspace solid-phase microextraction (HS-SPME) and identified by gas chromatography–mass spectrometry (GC-MS). Colour was determined according to the CIE Lab system, while texture was measured using texture profile analysis (TPA). Thermal processing had a statistically significant ($p < 0.05$) effect on all colour parameters (*L**, *a**, *b**, *C**, *Hue*, and ΔE), with higher values observed in cooked compared to raw samples, indicating increased lightness and overall colour intensity. Texture analysis revealed significant ($p < 0.05$) changes in all parameters, with increases in hardness, cohesiveness, springiness, gumminess, and chewiness, accompanied by a decrease in adhesiveness after cooking. A total of 51 volatile compounds were identified in beef, including 16 aldehydes, 10 alcohols, 1 acid, 4 ketones, 13 aliphatic hydrocarbons, 4 aromatic hydrocarbons, 1 furan, and 2 terpenes. The overall concentration of most compound classes increased after cooking, particularly aldehydes, ketones, and furans, which are closely linked to the development of characteristic cooked beef aroma. In conclusion, thermal processing induces marked modifications in beef quality traits by altering its colour and texture and by intensifying the volatile compound profile, especially lipid-derived aldehydes. These findings provide a better understanding of the molecular and sensory mechanisms underlying beef flavour and texture development during cooking.

Keywords:
Thermal processing, Beef, Volatile compounds, Color, Texture

Onion Peels: Hidden Power in Food Waste

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The food industry produces considerable amounts of waste and by-products, which represent an economically viable and environmentally sustainable source of bioactive compounds. Onion peels, as by-products rich in valuable phenolic compounds, offer promising applications in the food sector. The efficiency of solid-liquid extraction and the recovery of bioactive compounds are strongly influenced by the particle size of the raw material. In this study, the effect of onion peel particle size (>500 µm and 250–500 µm) on total phenolic content (TPC) and biological activities, including antioxidant (FRAP, DPPH) and antimicrobial (MIC, MBC) properties, was investigated. In freeze-dried extracts, the >500 µm fraction showed higher TPC (653.67 ± 5.69 mg GAE g^{-1} extract) and greater antioxidant activity in both FRAP (37.84 ± 0.81 mM TE) and DPPH (34.78 ± 0.50% inhibition) assays. Both fractions showed good antimicrobial activity against Gram-positive bacteria, with the lowest MIC and MBC values observed for *L. monocytogenes* (0.08 mg extract mL^{-1} solvent), indicating high susceptibility. In contrast, lower antimicrobial activity was observed against Gram-negative strains. The fraction with the highest biological potential (>500 µm) was incorporated into edible films (0.5%) to evaluate its effect on extending the shelf life of tomatoes. The films were applied by dipping, and the growth of total bacteria (TBC), yeasts, molds, and *E. coli* was monitored over 10 days at 20 °C. The extract-enriched film did not inhibit the growth of yeasts and molds, the main spoilage microorganisms in tomatoes. This study highlights the potential of onion peel extracts, especially from the >500 µm fraction, as a natural source of antioxidants and antimicrobials. Extract-enriched films could support future sustainable and functional food packaging strategies, but further research should test higher extract concentrations in edible films.

Keywords:
Onion peels, By-product, Antioxidant, Antimicrobial, Edible films

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Model of Cooling Chamber

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Cooling helps keep food fresh and prolongs shelf life. As a result, cooling chambers are crucial across the food processing industry. The aim of this study was to design and create a model of a cooling chamber with PID temperature regulation and assess its performance. The quadratic chamber model with 1 L internal volume was designed and made from extruded polystyrene (XPS) with a wall thickness of 50 mm. Arduino UNO R3 microcontroller, Dallas DS18B20 temperature transducers, TEC1-12706 Peltier elements, LCD and micro switches were used to control and measure temperatures. The PID controller was optimised using the Chen-Hrones-Reswick empirical synthesis method. The developed system regulates the desired temperature in the chamber of -20 °C ± 1 °C. The developed model is appropriate for simulating the operation of thermoelectric cooling on a laboratory scale for teaching purposes.

Keywords:
Cooling chamber, Automatic regulation, PID regulation, Microcontroler, Peltier elements

Effect of Enzymatic Pretreatment Prior to Hydrodistillation on the Yield of Citrus Peel Essential Oil

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Due to their rich and varied composition, citrus peels offer a multitude of uses, transforming what is often considered waste into a valuable resource. One solution to reduce waste costs and obtain a valuable new product is to isolate essential oil from citrus peels. As the yield of essential oil from citrus peels is low, efforts are being made to increase the yield of essential oil while maintaining or improving the quality of the oil. Therefore, various pretreatment processes for citrus peels immediately prior to Clevenger hydrodistillation are being investigated. In this study, the effect of enzymatic pretreatment by reflux extraction with pectinase, cellulase and xylanase and their mixtures in purified water and citrate buffer on the yield of essential oil from orange, mandarin and clementine peels was investigated. When comparing different citrus peels, oranges consistently produced the highest oil yield (from 19.5 mL oil kg^{-1} peel in hydrodistillation without pretreatment to 19.9 mL oil kg^{-1} peel in hydrodistillation with pretreatment by reflux extraction with pectinase and enzyme mixture). This was followed by clementines and mandarins, i.e. 14.6 to 14.9 mL oil kg^{-1} and 9.8 to 10.0 mL oil kg^{-1} peel, respectively, depending on the pretreatment used (or not). As the results for oranges and other citrus peels show, small differences in essential oil yields were observed between the different pre-treatments. Based on the results obtained, it can be concluded that enzymatic pretreatment of citrus peels by refluxing prior to hydrodistillation in purified water and citrate buffer increases the essential oil yield compared to non-enzymatic treatment for oranges (up to 2.6%) and mandarins (up to 2%), but not for clementines.

Keywords:
Citrus peel, Essential oil, Clevenger hydrodistillation, Enzymatic pretreatment

Cocoa Fiber as a Novel Ingredient of Dark Chocolates

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The aim of this research was to investigate potential of use of cocoa fiber as a substitute for cocoa part and partial substitute of cocoa mass in production of dark chocolates. Samples with 5, 7, 9, 11 and 13% of cocoa fiber were produced in laboratory conditions, with refining on 3-roll refiner, using laboratory conche and hand-tempering on marble table. Rheological properties (Viscotester iQ, Haake), particle size distribution (Mastersizer 200, Malvern Instruments), oxidative stability (RapidOxy 100, Anton Paar), and sensory properties were determined, revealing that cocoa fiber increase particle size, Casson yield stress and plastic viscosity, and decrease oxidative stability of dark chocolates. However, all analyzed parameters were in the acceptable range. Sensory analyses showed that cocoa fiber may be added up to 11% without significant changes of sensory properties, while higher proportions increase acidity and decrease sweetness of chocolates.

Keywords:
Cocoa shell fiber, Dark chocolate, Rheological properties, Oxidative stability, Particle size, Sensory properties

Acknowledgements
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Physico-Chemical and Surface Properties of Biopolymer Films with Sea Fennel Flowers

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Biopolymer films containing natural antioxidants, specifically made of sea fennel flower and sea fennel essential oil, have been developed as active packaging materials for fish preservation. For such applications, it is essential that coating formulations provide an effective barrier to gases, particularly oxygen, to minimize its impact on the product oxidation. Additionally, water sensitivity influences the release and the activity of the incorporated active compounds. The performance of biopolymer formulations, especially their sensitivity to water, depends on the properties of the added compounds. Therefore, this study investigated the influence of the added natural preservatives on the physico-chemical (thickness, gas and water vapour barrier), and surface properties (color, surface tension and surface structure) of various film formulations (made of carrageenan, alginate and chitosan). The results indicated that the addition of sea fennel essential oil reduced the sensitivity to water of the produced film formulations, primarily due to its hydrophobic nature. Notable differences in surface properties were also observed, with significant impact on color, structure, and surface tension. Understanding the performance of these materials is a critical step in determining appropriate application conditions for their use as edible coatings for fresh Adriatic fish.

Keywords:
Biopolymer edible, Sea fennel, Barrier, Water vapour, Surface properties

Acknowledgements
The research was funded by the Croatian Science Foundation as part of the project IP-2022-10-1837 "Sustainable concept in ACTive edible COatings development for shelf-life extension of fresh Adriatic FISH".

Optimization of SCO_2 Extraction and Comparison of the Bioactive Composition of Blackcurrant Pomace

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The valorization of berry pomace, a by-product of juice production, has gained increasing interest due to its high content of bioactive compounds. In this study, supercritical CO_2 extraction (SCO_2) was used to optimize the defatting of blackcurrant pomace, aiming to enhance the recovery of phenolic compounds, anthocyanins and antioxidant activity. The SCO_2 extraction is an advanced, non-toxic and environmentally friendly method for isolating bioactive compounds from plant material using carbon dioxide above its critical temperature and pressure, which enables selective extraction and protects heat-sensitive components such as phenols and anthocyanins. In optimization experiments, 50 °C, 30 mL min^{-1} CO_2 flow rate and 200 bar pressure were identified as the optimal extraction conditions. Both defatted and non-defatted pomace were subjected to microwave-assisted extraction and analyzed for total phenolic content, anthocyanin content and antioxidant activity using standard spectrophotometric methods. The results showed that defatted blackcurrant pomace consistently had higher levels of the bioactive compounds analyzed compared to the non-defatted pomace. Antioxidant activity was also increased in all defatted samples, indicating that the removal of lipids improves the extractability and stability of phenolic and anthocyanin compounds. This study highlights the potential of supercritical CO_2 extraction not only as a sustainable method for lipid removal from berry pomace, but also as a strategy for enriching bioactive compounds and improving antioxidant properties. The findings provide a basis for the development of functional ingredients from berry processing by-products and contribute to waste valorization and the production of high-quality nutraceuticals.

Keywords:
Berry pomace, CO_2 extraction, Bioactive compounds, Antioxidant activity

Acknowledgements
This research was funded by the Croatian Science Foundation project, grant number IP-2022-10-5499.

Supercritical CO_2 Extraction as a Tool for Targeted Valorization of Berry Pomace Bioactives

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Supercritical CO_2 extraction is an emerging green technology for the valorization of food industry by-products, offering an environmentally friendly approach to recover valuable bioactive compounds. This study applied supercritical CO_2 extraction under previously optimized conditions to pomace from red currant, black currant, chokeberry, and blueberry. The objectives were to characterize the lipophilic fraction of each pomace obtained by extraction and to evaluate the potential of the defatted pomace as a source of polar bioactive compounds. The chemical characterization of the defatted pomace included determination of total phenols and anthocyanins, while the oil fraction was analyzed for sterols, tocopherols and fatty acids. The results revealed notable differences among the investigated pomace samples. Chokeberry pomace retained the highest levels of polar bioactive compounds, including phenols and anthocyanins. In contrast, red and black currant showed dominance in the lipophilic fraction, being the richest in sterols, tocopherols and fatty acids. These findings demonstrate that supercritical CO_2 extraction enables the selective recovery of different groups of bioactive compounds from berry pomace. Chokeberry pomace stands out as a valuable source of polar antioxidants, whereas currant oil fractions are particularly rich in lipophilic phytochemicals. This differentiation underscores the potential for targeted raw material selection and tailored extraction strategies to support the development of functional ingredients and high value-added products from agro-industrial residues.

Keywords:
Pomace, Berry, Supercritical CO_2, Phenols, Sterols, Tocopherols

Acknowledgements
This work was supported by the Croatian Science Foundation under the project number IP-2022-10-5499.

Ethanol Production on Buckwheat Straw Hydrolysate Obtained after Dilute Acid or Alkali Pretreatment by Yeast *Scheffersomyces lignosum*

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The transition to circular bioeconomy requires efficient valorization of lignocellulosic biomass, such as agricultural byproducts. Buckwheat straw represents one such feedstock to produce biofuels and biochemicals. A critical step in its utilization is pretreatment, which disrupts the plant structure to facilitate further processing. In this study, dilute acid and alkali pretreatments were conducted in a high-pressure reactor, yielding two distinct fractions: a solid residue-pretreated buckwheat straw (PBWS) and a liquid stream-buckwheat straw hydrolysate (BWSH). The solid PBWS is typically subjected to enzymatic hydrolysis to release fermentable sugars like glucose and xylose, resulting in a relatively clean hydrolysate low in lignin and inhibitors. However, a liquid stream - BWSH from the initial pretreatment poses a greater challenge due to its high concentration of soluble lignin, furfurals, phenolic and organic acids, which are toxic to many microorganisms. This study evaluated the tolerance, growth and metabolic activity of the non-*Saccharomyces* yeast, *Scheffersomyces lignosum* on these inhibitory liquid streams. This yeast was selected for its ability to use both glucose and xylose; primary sugars present in lignocellulosic hydrolysates. Batch fermentations were conducted at 30 °C under microaerophilic conditions without pH control on four media: raw acid BWSH, raw alkali BWSH, and their respective neutralized versions. No growth occurred in raw alkali BWSH, likely due to the combined effect of high pH and inhibitor content. In contrast, growth was observed in both neutralized hydrolysates and in the raw acid BWSH. Ethanol was produced in concentrations ranging from 7.14 to 8.15 g L^{-1}. The results highlight the robustness of *S. lignosum* and its tolerance to the inhibitory compounds found in acid-pretreated hydrolysates. In addition, these findings offer a route for more complete valorization of buckwheat straw within a circular bioeconomy framework.

Keywords:
Buckwheat straw, Acid pretreatment, Alkali pretreatment, *Scheffersomyces lignosum*, Fermentation, Ethanol

Acknowledgements
This research was funded by Croatian Science Foundation, grant number HRZZ-3075, “Biorefinery system for biofuels and biochemicals production from non-food lignocellulosic raw materials”, Biorefinery-NFLRM.

Sustainable Polyphenolic Extraction and Valorization of *Camellia sinensis* L. Leaves Herbal Dust

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Green tea is the most popular herbal tea worldwide and it is produced from dried *Camellia sinensis* L. leaves. According to the European Medicines Agency (EMA), it is a medicinal product indicated for the relief of fatigue and sensation of weakness. During filter tea production process, a significant quantity of fine powder is generated due to grinding of the plant material. This fine powder, herbal dust, is often discarded as waste and may constitute up to 40% of the processed plant material. This study aimed to explore the valorization potential of green tea herbal dust through the extraction of polyphenolic compounds using two green extraction methods: Ultrasound-Assisted Extraction (UAE) with a sonotrode and Subcritical Fluid Extraction (SBFE). Extraction conditions varied with respect to solvent (96% ethanol, ethanol-water (50:50, v/v), or water), temperature for SBFE (120, 140, 160 or 180 °C), and extraction time for UAE (3 or 10 min). Total Phenolic Content (TPC) was determined by the Folin–Ciocalteu assay, qualitative profiling was performed with high-resolution LC-ESI-QTOF MS/MS, and quantitative analysis was carried out by HPLC-PDA. The highest TPC was obtained with ethanol-water (50:50, v/v), yielding 4420.0 mg GAE L^{-1} in SBFE at 120 °C and 3234.52 mg GAE L^{-1} in UAE after 10 min. The extracts were rich in gallic acid, gallic acid esters, and catechins. Seven phenolic compounds were successfully quantified in every SBFE extract except from gallocatechin gallate which was not detected in the water extract at 120 °C. Similarly, gallocatechin gallate and epicatechin gallate were not found in UAE water extracts, likely due to their poor water solubility. These results provide evidence of the high polyphenolic content of Camellia sinensis leaves herbal dust extracts, indicating their potential as a valuable resource in waste management. The use of green extraction techniques enables their application in various industries.

Keywords:
Herbal green tea dust, Ultrasound-assisted extraction, Subcritical fluid extraction, LC-ESI-QTOF MS/MS, Phenols

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From Stakeholder Voices to Competence Framework: Developing SMART4FOOD Training Modules for Small and Family Farmers in Europe

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The SMART4FOOD project addresses emerging competence gaps among small and family farmers across six European countries (Croatia, Cyprus, Ireland, Italy, Turkey, Slovakia). Evidence was gathered through 36 in-depth interviews, 6 regional focus groups, and a stakeholder survey with 147 respondents, encompassing farmers, vocational trainers, and policy actors. Findings highlight that while farmers demonstrate strong practical expertise in land and livestock management, they face growing challenges linked to climate variability, digitalization, regulatory complexity, and market pressures. Four recurring technical areas of concern were identified: soil and nutrient management, pest and disease control, water use and climate adaptation, and post-harvest handling and product quality. Additionally, four horizontal competence areas emerged as critical: climate awareness and risk management, financial planning and farm business management, agri-administration and compliance literacy, and cooperation-based farming approaches. Drawing on these results, SMART4FOOD developed a modular vocational training framework aligned with EU competence frameworks (GreenComp, DigComp, EntreComp, and CAP-related competences). The framework consists of eight practice-oriented modules—Smart Soil Use, Smarter Crop Protection, Water-Wise Farming, Post-Harvest Value, Resilient by Design, Better Farm Planning, Smart Farm Records, and Collaborative Farming. Training is designed for adult, non-traditional learners, emphasizing micro-learning, accessibility, and offline compatibility to address rural constraints. In conclusion, the project demonstrates how bottom-up stakeholder engagement can inform competence mapping and curriculum design. The SMART4FOOD framework equips small-scale farmers with digital, entrepreneurial, and sustainability-oriented skills, enhancing resilience, improving market access, and supporting alignment with EU Green Deal and CAP objectives

Keywords:
Small and family farmers, Competence framework, Vocational Education and Training (VET), Sustainable Agriculture

Acknowledgements
This work was supported by the European Union. The authors gratefully acknowledge the contributions of farmers, vocational educators, and policy stakeholders across partner countries whose insights informed the SMART4FOOD competence framework. Their engagement was essential in shaping the project's outcomes and ensuring its relevance to small and family farmers.

Bioactive Compounds and Polyphenol-Rich Plant Extracts in Chicken Myofibrillar Protein System: Structural, Functional, Antioxidant and Sensory Implica

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This study investigated the interactions between isolated chicken myofibrillar proteins (MPs) and bioactive plant-derived compounds, especially triterpenes, glycosides, polyphenols, and a mix of polyphenols in form of extracts from *Centella asiatica*, *Melissa officinalis*, *Salvia officinalis*, and blackcurrant juice and pomace. Both individual molecules and full extracts were examined to evaluate their influence on protein structural stability, functional properties, antioxidant potential, and sensory attributes. A multidisciplinary approach was applied, combining spectrofluorometry, SDS-PAGE, differential scanning calorimetry, rheology, scanning electron microscopy, antioxidant assays (ABTS, DPPH, FRAP), and sensory analysis. The results demonstrated that triterpenoid-rich *C. asiatica* extract reduced gelation temperature, improved storage modulus (G'), and enhanced oxidative stability of MPs. Extracts of *M. officinalis* and *S. officinalis* modulated gel microstructure and viscoelastic properties through hydrogen bonding and π–π interactions, while blackcurrant pomace significantly increased polyphenol content and antioxidant activity but weakened gel strength. Notably, synergistic effects were observed when using complex extracts rather than individual compounds, confirming the importance of phytochemical diversity in modulating protein systems. The findings highlighted the potential of herbal and fruit-based extracts as natural modulators of muscle protein gels, offering improved antioxidant protection, structural stabilization, and novel sensory attributes. These results support the application of polyphenol-rich extracts in the development of innovative, clean-label, protein-enriched foods.

Keywords:
Myofibrils, Plant extracts, Protein gels, Antioxidant activity, Polyphenols, Sensory evaluation

Acknowledgements
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Influence of Nitrogen Source and Carbon/Nitrogen Ratio on *Neochloris aquatica* Biomass Growth and Fatty Acid Composition

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As alternative fuel feedstocks, microalgae pair high lipid content with rapid and abundant growth, positioning them ahead of many crops. Microalgal growth and fatty-acid composition are influenced by multiple factors, including nitrogen, carbon and iron availability, salinity, light intensity, and the cultivation regime. Nitrogen availability is generally considered the most significant, as sufficient nitrogen supports biomass formation, while nitrogen limitation redirects carbon toward lipid accumulation and alters the fatty-acid profile relevant to biodiesel quality. This study evaluated the effect of nitrogen source (sodium nitrate, yeast extract) and carbon/nitrogen (C/N) ratios (10:1, 30:1, 50:1) on the growth and lipid profile of *Neochloris aquatica*. Cultures were grown in Bold's Basal Medium (BBM) with 10 g L^{-1} glucose and the appropriate nitrogen concentration to reach target C/N ratio. Two controls were included: BBM without glucose and BBM with 10 g L^{-1} glucose but without added nitrogen. Biomass growth was determined spectrophotometrically and by gravimetric dry weight determination while fatty-acid composition was analyzed by gas chromatography. All nitrogen-supplemented, glucose-fed cultures showed higher biomass and lipid content than both controls (without glucose and without nitrogen). As expected, higher nitrogen content (10:1) favored higher biomass and lower lipid content, while lower nitrogen content (50:1) promoted lipid accumulation at the expense of biomass. Sodium nitrate resulted in higher biomass and lipid content compared to yeast extract (0.55 g L^{-1} d^{-1} biomass productivity (SN10) and 4.45% lipid productivity (SN50)). Dominant fatty acids were linoleic, oleic, and palmitic, while α-linolenic was notable in BBM control. PUFA dominated most cultivations (≈ 42–54%), followed by MUFA (≈ 25–37%) and SFA (≈ 11–24%). Obtained results reveal that strategic selection of nitrogen source and C/N ratio directs *N. aquatica* toward desired biomass or lipid targets, with sodium nitrate outperforming yeast extract while preserving PUFA-dominant profiles relevant to biodiesel quality.

Keywords:
Microalgae, *Neochloris aquatica*, Nitrogen limitation, Nitrogen source, Fatty acid composition, Biomass growth

Acknowledgements
This research was funded by Croatian Science Foundation, grant number HRZZ-3075, "Biorefinery system for biofuels and biochemicals production from non-food lignocellulosic raw materials", Biorefinery-NFLRM.

Survival and Effect of Probiotic Bacteria *Bifidobacterium animalis* subsp. *lactis* on Ice Cream Quality

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Increasing awareness of the link between diet and health is driving demand for functional foods. Ice cream, a popular frozen dessert, holds significant potential for enhancing nutritional intake and promoting overall health. Due to its specific structure and storage at low temperatures, ice cream is an effective medium for incorporating probiotic bacteria and developing functional products. This study aimed to examine the impact of probiotic soy *Bifidobacterium animalis* subsp. *lactis*, with and without added inulin, on ice cream quality and the survival of probiotic bacteria over 60 days of storage. Results showed a slight decrease in pH and colour intensity during cold storage, while the presence of inulin contributed to greater consistency and stability. A high overrun ensured a light texture, although a slight decrease was observed over time. The combination of inulin and a higher probiotic content accelerated melting while also improving bifidobacteria survival. Overall texture evaluation indicated some irregularities; however, despite this, the ice cream shows potential for use in the production of functional foods.

Keywords:
Ice cream, Functional product, Prebiotics, Probiotic bacteria

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From Waste to Value: Pigments in Fruit and Vegetable By-Products

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The agri-food sector generates considerable amounts of by-products that are often discarded, despite being rich sources of bioactive compounds. However, these materials can be used as raw sources of pigments and other biomolecules with potential applications in the food and cosmetic industries. This study aimed to evaluate the pigment content in various fruit and vegetable waste (sour cherry pomace and peels of eggplant, red onion, zucchini, cucumber, carrot, and sweet potato) using different extraction solvents. Anthocyanins were isolated from sour cherry pomace, eggplant, and red onion peel using 30 and 70% ethanol acidified with citric acid. Ethanol (96%) and acetone were used to extract chlorophylls from zucchini and cucumber peel, as well as carotenoids from carrot and sweet potato. All pigments were extracted using ultrasound-assisted extraction and determined spectrophotometrically, along with the antioxidant (FRAP, DPPH, and ABTS assays) and antimicrobial potential of the extracts. Red onion peel was the richest source of anthocyanins, particularly in the acidified 70% ethanol extract (424.39 mg 100 g dm^{-1}). Chlorophyll content was similar in zucchini (218.48 mg 100 g dm^{-1}) and cucumber (234.90 mg 100 g dm^{-1}) peels; however, acetone was more efficient for zucchini peel, while 96% ethanol was more effective for cucumber peel. Carrot peel had a higher carotenoid content (50.65 mg 100 g dm^{-1}) than sweet potato peel (30.74 mg 100 g dm^{-1}), with both yielding better results in acetone. All samples demonstrated strong antioxidant capacity in all three assays, but samples rich in anthocyanins showed the highest values. Neither of the extracts showed antimicrobial activity against the selected Gram-positive and Gram-negative bacteria, lactic acid bacteria, or yeasts. The examined by-products proved to be valuable sources of natural pigments with strong antioxidant capacity, highlighting their potential as natural colorants for the food and cosmetic applications. However, the optimal solvent for their isolation should be carefully selected.

Keywords:
Agri-food waste, Anthocyanins, Chlorophylls, Carotenoids, Solvent, Natural colorants

Acknowledgements
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Exploring Solvent Effectiveness in Extracting Coumarins from Lavender

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Lavender, esteemed for its aromatic qualities and therapeutic benefits, is rich in a variety of bioactive compounds, including essential oils, flavonoids, and coumarins, which contribute to its health-promoting properties. These compounds have been linked to anti-inflammatory, antimicrobial, and calming effects, making lavender a valuable resource in natural medicine and wellness. Recent advances in extraction and analytical techniques have underscored the importance of utilizing environmentally benign solvents to minimize ecological impact while maximizing efficiency. This study focuses on the extraction of coumarins, herniarin and umbelliferone, from lavender using a magnetic stirrer over a 60-min period. A variety of green solvents were employed, including water, aqueous ethanol solutions, ethanol, and both hydrophilic and hydrophobic deep eutectic solvents to assess the influence of solvent type on yield. Also, the extraction process was conducted at temperatures of 30, 50, and 70 °C to assess the influence of thermal conditions on yield. The findings reveal that almost all hydrophilic solvents are effective in extracting coumarins, with temperature proving to be a important factor in enhancing extraction efficiency. Among the solvents tested, aqueous ethanol solvent demonstrated superior effectiveness, resulting in higher yields of herniarin and umbelliferone compared to hydrophobic alternatives. In the study, 50% ethanol emerged as the most effective solvent for extracting umbelliferone and herniarin. Among the deep eutectic solvents (DES), choline chloride:urea (1:2) proved optimal for umbelliferone, while choline chloride:oxalic acid (1:1) was most effective for herniarin. For hydrophobic deep eutectic solvents, menthol:acetic acid (1:1) demonstrated the best performance for both coumarins. These results suggest that optimizing solvent selection and temperature conditions can significantly improve the sustainability and efficiency of natural product extraction processes. Further research could explore the aspects of solvent interactions and their impact on compound stability and yield.

Keywords:
Coumarin, Deep eutectic solvents, Lavender

Changes in Water Surface Tension Induced by Plasma Treatment

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High voltage electrical discharge plasma (HVED) has emerged as a promising, non-thermal technology for modifying the physicochemical properties of liquids, including water. This research examines how HVED treatment, resulting in plasma activated water, influences the surface tension (SFT) of water, with particular focus on the mechanisms responsible for its reduction. Plasma was generated under ambient conditions with argon, nitrogen and oxygen being used as working gases, and demineralized water samples were exposed for varying treatment voltages (20 and 30 kV) with fixed duration (7 min). Two types of high voltage electrodes were used: titanium and silver made electrodes. Also, two different configurations of reactors were used – gaseous and liquid plasma reactor. Measurements of surface tension were conducted using the pendant drop method after plasma exposure. The surface tension is calculated using image analysis software. The results demonstrate a noticeable decrease in the surface tension of water following plasma treatment, with reductions being noticeably different for each of the gases used. This phenomenon is primarily attributed to the dissolution of reactive oxygen and nitrogen species (RONS) into the liquid phase, leading to the formation of hydrogen peroxide, nitrites, and nitrates. These reactive species alter the molecular structure and hydrogen bonding network at the air–water interface, increasing surface activity and reducing cohesive forces among water molecules. Additionally, a slight acidification of the treated water was observed, further contributing to surface tension reduction. Results show that biggest drop in SFT is noticed when argon is used with both high voltage electrodes. The findings confirm that HVED effectively lowers the surface tension of water without introducing significant thermal effects, highlighting its potential for applications in surface engineering, sterilization, and chemical processing. By treating water with HVED it is possible to wet the surface easier, as the flow of water enhances with lower SFT.

Keywords:
Surface tension, Plasma activated water, Surface energy, High voltage electrical discharge plasma

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Innovative Application of Flaxseed Protein in Cellular Agriculture

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Despite increasing investment, the production of cultivated meat from in vitro–grown animal cells continues to face major obstacles—most notably, the creation of affordable, animal-component-free cell culture media. One of the main challenges is the dependence on animal blood serum, which, although commonly used, is costly, contentious, and may pose safety concerns during the cell cultivation for the production of meat analogs. Our innovation addresses this issue by developing a medium with substantially reduced serum content, thereby maintaining or even enhancing cell culture performance. The key innovation lies in utilizing a plant-derived protein isolated from flaxseed oil cake, a nutrient-rich by-product of vegetable oil production. When included in the low-serum cell culture medium, this protein effectively promotes the differentiation of myoblasts and adipocytes, two essential cell types responsible for generating cell-based biomass required in cultivated meat production. This economical and sustainable approach holds promise for both cultivated meat experts and oilseed crop producers, while promoting environmental sustainability, animal welfare, and public acceptance of emerging food technologies.

Keywords:
Flaxseed protein, Flaxseed oil cake, Low-serum media, Myoblast cultivation, Adipocyte cultivation, Cultivated meat

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Yeast-Based Production of Sweet-Tasting Proteins: A Sustainable Biotechnological Approach to Healthier Sugar Alternatives

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Excessive sugar consumption is a major dietary concern worldwide, contributing to various metabolic and cardiovascular disorders. Artificial sweeteners have been widely adopted as sugar substitutes; however, increasing evidence of their potential adverse health effects has prompted the search for safer alternatives. Sweet-tasting and taste-modifying proteins, derived from natural sources and characterized by their non-caloric properties, represent promising candidates to replace artificial low-calorie sweeteners. However, their natural abundance is limited, and extraction from native sources remains economically unfeasible. Recombinant production using microbial hosts offers a sustainable and scalable solution. In this study, *Saccharomyces cerevisiae* was used as a production platform for sweet-tasting proteins, leveraging its well-characterized secretion and surface-display systems to simplify downstream processing. Two expression strategies were designed: (1) cell-surface anchoring, achieved by fusing the sweet protein gene to CCW12, encoding a covalently bound cell wall protein; and (2) extracellular secretion, facilitated by fusion to the α-mating factor (MF) prepro-peptide, a native secretion signal of *S. cerevisiae*. Protein expression, secretion, and cell wall localization were verified using Western blot analysis. This work establishes a foundation for a yeast-based bioproduction system capable of expressing and displaying sweet-tasting and taste-modifying proteins. Such a platform holds potential for scalable, cost-effective production of natural, non-caloric sweeteners, offering a viable alternative to sucrose and current artificial sweeteners in the food and beverage industry.

Keywords:
Sweet proteins, *Saccharomyces cerevisiae*, Recombinant protein, Surface display, Western blot

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Alginate-Based Microencapsulation of *Clitoria ternatea* Extract with Double Emulsion Technique: A Natural Delivery System for Functional Food Application

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The development of natural and sustainable encapsulation systems is essential for improving the stability and functionality of plant-derived bioactives in food applications. This study aimed to encapsulate an optimized *Clitoria ternatea* (CT) extract—rich in polyphenols and anthocyanins—using alginate-based biopolymers and a water-in-oil-in-water ($W_1/O/W_2$) double emulsion stabilized with guar gum. Six formulations were prepared: controls without oil (C1: alginate; C2: alginate + xanthan gum), double emulsions with rapeseed oil (F1: alginate; F2: alginate + xanthan), and double emulsions with rapeseed + ginger oil (F3: alginate; F4: alginate + xanthan). The microcapsules were characterized for morphology, swelling, encapsulation efficiency (EE), loading capacity (LC), phenolic release, FTIR spectra, and antibacterial activity. Microscopic analysis revealed that double-emulsion systems (F1–F4) formed uniform, spherical, and stable capsules compared to controls, which exhibited collapse and fragmentation upon drying. The combination of xanthan gum and oil phases significantly reduced swelling and enhanced EE (up to 71.18%) and LC (up to 160.77 mg GAE g^{-1}). Formulation F4 (alginate–xanthan with rapeseed + ginger oil) demonstrated the lowest swelling degree and most sustained phenolic release, confirming its structural compactness. FTIR spectra verified successful encapsulation and preservation of anthocyanin functional groups. Biological assays showed that both CT extract and ginger oil inhibited *Escherichia coli* and *Pseudomonas aeruginosa*, while encapsulated systems exhibited controlled release of these bioactives. Overall, the F4 formulation provided the most promising encapsulation performance and stability, demonstrating the potential of double-emulsion alginate–xanthan systems for natural colorant and functional ingredient delivery in food technology.

Keywords:
Clitoria ternatea, Ginger oil, Double emulsion, Microencapsulation, Polyphenol, Functional food

Acknowledgements
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The Stability of Large Palindromic Sequences in the *Saccharomyces cerevisiae* Genome is Dependent on the Growth Temperature

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Palindromes in DNA are consecutive, inverted repeats of the same sequence. A sequence is considered a perfect palindrome if the two inverted repeats are completely homologous and if they are not separated by a non-palindromic spacer sequence. Since inverted repeats are complementary to each other within the same DNA strand, large palindromic sequences often form secondary structures such as hairpins or cruciforms (double hairpins). Such secondary structures can be lethal to the cell as they cause DNA replication and transcription to stall, often leading to double-stranded breaks and DNA recombination. Existing literature shows that temperature has a strong effect on the probability of secondary structure formation *in vitro*. Since temperatures in natural environments can fluctuate in a short time frame, it is essential to determine the effect of differing temperatures on the stability of palindromic sequences in the eukaryotic genome, *in vivo*. In this study, the yeast *Saccharomyces cerevisiae* was used as a model eukaryotic organism. Perfect palindromes of different lengths and quasi-palindromes with different spacers were inserted into the yeast genome, and the "pop-out" recombination rate was measured, which in the constructed experimental system reflects the probability of a double-strand break caused by the formation of a secondary structure. It was observed that the recombination rate of both perfect and quasi-palindromes increases significantly when the yeast is grown at higher temperatures. This effect was evident even within the moderate temperature range of 22–37 °C. However, in its natural environment, yeast can be exposed to more extreme temperature fluctuations. From the obtained results it is possible to conclude that environmental temperature has a potential impact on genome evolution as well as the composition and number of palindromes within the genome of microorganisms.

Keywords:
DNA recombination, Palindrome, Yeast *Saccharomyces cerevisiae*, Genome stability

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Folic Acid Encapsulation in RuBisCO–Gum Arabic Complexes for Controlled Release in the Gastrointestinal Tract

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Agriculture generates approximately 5 billion tons of crop residues annually, much of which consists of green waste. Leaves of oilseed crops are rich in proteins, with the enzyme RuBisCO making up a significant part of their protein content. Despite its huge potential, this protein remains underutilized due to difficulties in extraction, its limited solubility, and the fact that its full application is yet to be explored. This study aimed to extract RuBisCO from pumpkin green leaves and investigate its potential to form complexes with gum Arabic, serving as a carrier for the oral delivery of folic acid. A combination of isolation techniques—ammonium sulfate salting out followed by three cycles of acidic precipitation—yielded a protein water-soluble fraction with over 90% purity. This protein fraction was used to form complexes with gum Arabic, testing various protein-to-gum weight ratios (1:1, 2:1, 3:1, and 5:1) to evaluate their ability to encapsulate folic acid in concentration of 61 μg mL^{-1}. Complex formation tracked via ζ-potential changes exhibited a maximum between pH 2.74 and 4.15, depending on the composition used. Encapsulation efficiency ranged from 61 to 81%, while the yield of complexes varied between 62 and 81%, depending on the formulation. The protein-to-gum ratio of 1:1 demonstrated the most favorable delivery properties, with 35% of folic acid released in simulated gastric fluid and the remaining vitamin gradually released in simulated intestinal fluid over 200 min. The obtained complexes were tested in citric acid-glucose solutions, used as model simulants of fruit juice. The pH of the solutions was adjusted to match the isoelectric point of the complexes. At a complex concentration of 1 mg mL^{-1} in the juice simulant, an initial burst release of 13% of folic acid was observed, while the complexes remained stable over a two-week storage period at room temperature.

Keywords:
Rubisco, Encapsulation, Leaf protein

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Periodically Constricted Oscillatory Flow Reactor Design for Enzymatic Production of Emerging Prebiotics from Sunflower Meal

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With the increase in production demands, lignocellulosic waste generated from food industry has become a feedstock of interest for obtaining value-added products through various upcycling methods. Emerging prebiotics represent a class of food additives which can be derived from lignocellulose, with xylooligosaccharides as one of the most promising representatives with various positive effects on human health. However, traditional methods for prebiotic production often rely on harmful chemicals and can suffer from poor product quality due to toxic by-product formation. Moreover, specialized corrosion-resistant equipment for high temperature processing is often required. Most commonly, lignocellulosic biomass is treated in stirred tank bioreactors operating in batch mode, while (semi)continuous processing and other reactor configurations remain less prevalent. In this work, a periodically constricted oscillatory flow reactor was designed for semi-continuous prebiotic production from sunflower residue. The modular meso-scale reactor was manufactured via 3D printing and tested for multiphase processing by adjusting the oscillatory flow parameters to achieve a uniform distribution of biomass particles in the system. Subsequently, the reactor was benchmarked against the traditional batch system for simultaneous enzymatic hydrolysis and solid-liquid extraction of prebiotic oligosaccharides from pretreated sunflower meal. The adopted pretreatment method aligns with the biorefinery concept and consists of alcohol extraction of polyphenols, followed by protein hydrolysis. The proposed reactor design has shown potential for bioprocess intensification by enabling semi-continuous operation in multiple stages of the green and sustainable enzymatic process for sunflower meal valorization.

Keywords:
Emerging prebiotics, Xylooligosaccharides, Enzymatic hydrolysis, Multiphase processing, Bioprocess intensification

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When Ultrasound Meets Plant Power: Upgrading Tomato Juice Functionality

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The modern food industry is increasingly seeking to replace conventional thermal processing with innovative, energy-efficient, non-thermal technologies. Alongside to technological advancements, another key objective is to enhance existing food products by incorporating natural ingredients that preserve or improve their nutritional quality. Accordingly, this study aimed to evaluate the impact of plant-based protein and powder additions, combined with ultrasound treatment, on the physicochemical and functional properties of tomato juice. Fresh tomatoes were collected from an organic farm in Croatia. After removing the skins and seeds, the pulp was ground, filtered, and mixed (70% filtrate, 26% pulp) to prepare the tomato juice. The juice was divided into aliquots and supplemented with 1% pea protein (PP) or 1% olive powder (OP). Samples were treated with ultrasound using a probe diameter of 9 mm at 40% amplitude for 1, 3, or 5 min. Statistical analysis revealed a significant effect of protein addition on the concentration of bioactive compounds, while the effect of ultrasound was evident only in selected samples. The addition of olive powder significantly increased the content of bioactive components compared to pea protein. However, all protein-enriched samples exhibited higher levels of bioactives than the untreated control. Extending the ultrasound treatment further enhanced the concentration of bioactive compounds and antioxidant properties, with the best result (48.84% DPPH reduction) observed in the sample containing 1% OP treated for 5 min. The highest lycopene content (3.839 mg mL^{-1}) and β-carotene concentration (2.912 mg mL^{-1}) were also detected under these conditions. Spin trapping experiments confirmed that samples with higher bioactive content exhibited lower free radical concentrations. These findings demonstrate that the combination of ultrasound processing and olive powder enrichment synergistically improves the antioxidant capacity and functional quality of tomato juice. This approach shows strong potential for the development of high-value, non-thermally processed, plant-based beverages.

Keywords:
Non-thermal food processing, Ultrasound treatment, Plant-based ingredients, Bioactive compounds, Functional beverages

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Comparison of the Effects of Different Thermal Processing Techniques on the Phytochemical Composition and Antioxidant Capacity of Kale

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Vegetables are a major food group important for proper nutrition. They are rich in dietary fibers as well as vitamins, minerals and phenolic compounds, responsible for their antioxidant properties. To ensure safety and enhance flavor, they are commonly thermally processed before consumption. However, thermal processing can significantly influence their phytochemical composition and thus alter their nutritional quality. The effect of five different thermal processing techniques – cooking, blanching, steaming, steaming followed by pan-frying and air-frying – was investigated. The content of different groups of polyphenols and antioxidant capacity were quantified spectrophotometrically in 70% ethanol extract, whereas photosynthetic pigments were determined in 80% methanol extracts. Results showed that blanched, steamed and pan-fried kale had significantly lower amount of total phenolics and flavonoids than cooked kale. Among the tested thermal processing techniques, air-fried kale had a notably higher amount of total flavonols and proanthocyanidins compared to cooked kale (223 and 54%, respectively), while blanched, steamed and pan-fried kale had less proanthocyanidins than cooked kale. Pan-frying resulted in significantly increased total tannin content (151%) compared to cooking. The amount of total hydroxycinnamic acids was lower in steamed and pan-fried samples compared to cooked kale. All tested techniques, compared to cooking, led to overall reductions (significant or tendential) in chlorophyll *a*, chlorophyll *b*, carotenoids, β-carotene, lycopene, and porphyrins. Antioxidant capacity, assessed by DPPH and FRAP assay, was higher in all thermally processed samples compared to cooked kale. According to ABTS, only steaming and pan-frying increased the antioxidant capacity significantly. Since, compared to traditional cooking, pan-frying and air-frying preserved or enhanced the highest number of health-promoting polyphenols and antioxidant capacity, these techniques might represent optimal thermal processing technique for kale.

Keywords:
Air-frying, Pan-frying, Photosynthetic pigments, Polyphenols

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Effect of Drying Method on the Composition and Properties of Bay Laurel and Rosemary

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Aromatic plants have been used since ancient times for medicinal and nutritional purposes, as well as for food flavoring and preservation. Two of the most common and widely used Mediterranean aromatic plants are bay laurel (*Laurus nobilis* L.) and rosemary (*Rosmarinus officinalis* L.). The aim of this study was to examine the influence of different drying methods (freeze drying, dehydrating, oven drying, and air drying) on the color parameters of samples, as well as on the content of total and individual phenolic compounds (by spectrophotometric and chromatographic methods) and antioxidant activity (FRAP, DPPH, ORAC). Rosemary and bay leaf extracts with the highest phenolic contents were tested for their effect on lipid stability of sunflower oil by the OXITEST and Rancimat methods. The best color parameters were exhibited by freeze-dried plant material, which also showed the highest total phenolic content (305 mg GAE L^{-1} in rosemary and 139 mg GAE L^{-1} in bay laurel). Of the 14 identified phenolic compounds in rosemary extracts, rosmarinic acid was the most abundant, ranging from 29.53 μg mL^{-1} in the oven-dried sample to 79.49 μg mL^{-1} in the freeze-dried sample. In bay laurel extracts, among the six identified compounds, epicatechin was dominant, with the lowest concentration (2.81 μg mL^{-1}) found in the oven-dried sample and the highest (6.07 μg mL^{-1}) in the freeze-dried sample. Variations in antioxidant activity were detected among samples which points to the impact of individual compounds rather than overall phenolic content on the investigated properties. Both extracts exhibited a pro-oxidative effect on sunflower oil, which potentially limits their use as natural preservatives in a lipid medium.

Keywords:
Laurus nobilis, *Rosmarinus officinalis*, Drying, Antioxidants, Phenolics, Oxidative stability

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Evaluation of Extraction Method on Total Phenolic Content and Antioxidant Activity of Olive Leaves

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Olive leaves, a major by-product of the olive oil industry, are generated in large quantities during olive harvesting and pruning, particularly in Mediterranean countries. Olive leaves are a rich source of phenolic compounds and have been increasingly studied for their antioxidant activity and health-promoting compounds in nutrition and functional food applications. For the purpose of this work, olive leaves were freeze-dried and ground to a powder. This study aimed to evaluate the impact of different extraction methods, namely ultrasound-assisted extraction (UAE) and microwave-assisted extraction (MAE), on the total phenolic content (determined by the Folin–Ciocalteu assay) and antioxidant activity (reducing capacity measured by the FRAP method) of olive leaf powder. The highest yield of total phenolic compounds was observed with UAE (66 mg GAE g^{-1}), while a two-fold lower content of phenolics was detected in extracts prepared by MAE (34.96 mg GAE g^{-1}). Antioxidant activity results were consistent with total phenolic content, confirming the crucial role of phenolics in reducing activity. These findings highlight that the choice of extraction method influences both the quantity and bioactivity of the obtained extracts. In this study, UAE proved to be the most efficient and sustainable technique, suggesting its potential for large-scale application in the valorization of olive leaf biomass. This work supports the integration of green extraction technologies in the development of high-value products from agricultural by-products.

Keywords:
Olive leaves, Extraction, Total phenolic content, Antioxidant activity

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Physicochemical Characterization and Antimicrobial Efficacy of Plasma-Activated Water Generated by Gas- and Liquid-Phase Reactors

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Plasma-activated water (PAW) is an emerging green technology produced by exposing water to non-thermal plasma discharges, resulting in the generation of reactive oxygen and nitrogen species (RONS) such as hydrogen peroxide, nitrate, nitrite, and short-lived radicals (Thirumdas et al., 2018). These species impart PAW with strong oxidative and antimicrobial activity, making it a potential alternative to conventional chemical disinfectants and fertilizers. In this study, gas-phase and liquid-phase plasma reactor configurations were employed to investigate the physicochemical properties of PAW and its antimicrobial efficacy. Experiments were conducted at applied voltages of 20 and 30 kV for 7 min using argon, oxygen, and nitrogen as working gases. The concentrations of hydrogen peroxide, nitrate, and nitrite were quantified, and the antimicrobial activity of PAW was evaluated against *Candida utilis* 11, *Salmonella enterica* var. Typhimurium 3064, *Lactobacillus plantarum* 73, and *Listeria monocytogenes* 3112 after 3 and 24 h of exposure. The results demonstrated significant microbial inactivation, confirming the effectiveness of PAW as a sustainable antimicrobial treatment. This study confirms that plasma-activated water is highly effective in reducing microbial populations, with its antimicrobial activity strongly influenced by plasma parameters and working gas composition. The results highlight PAW as a sustainable and environmentally friendly alternative to traditional chemical disinfectants.

Keywords:
Plasma activated water, Reactive species, Inactivation

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Functional and Antioxidant Potential of Coffee Silver Skin as a Coproduct of Interest for the Food Industry

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The global coffee industry generates large amounts of waste, representing approximately 86% of the total weight of processed coffee cherries. Among these by-products, coffee silver skin released during the roasting process stands out for its rich composition of bioactive compounds with potential applications in the food industry. The valorization of this coproduct aligns with the sustainability and circular economy goals promoted by the 2030 Agenda. This study aimed to evaluate the functional potential of coffee silver skin samples obtained from three countries (India, Vietnam, and Ruanda) by determining their total phenolic content (TPC), total flavonoid content (TFC), antioxidant capacity, and inhibitory activity against digestive enzymes (α-amylase and α-glucosidase). Extracts were obtained using aqueous and organic solvents, and analyses were performed using standardized spectrophotometric methods (Folin-Ciocalteu, DPPH, and ABTS+). The results revealed significant differences ($p < 0.05$) among origins. The sample from Vietnam exhibited the highest levels of TPC (111.20 ± 2.41 ug mL^{-1}) and TFC (34.93 ± 3.51 ug mL^{-1}) as well as the strongest antioxidant capacity against free radicals. Regarding enzyme inhibition, the samples from the Robusta variety (India and Vietnam) showed greater α-amylase inhibition (53.26 ± 4.14 and 54.47 ± 3.27% respectively) compared to the sample from Ruanda (34.16 ± 11.59%) (Arabica variety), while no significant differences ($p > 0.05$) were observed in α-glucosidase inhibition. These findings highlight the potential of coffee silver skin as a natural source of bioactive compounds with antioxidant properties and inhibitory activity against carbohydrate-digesting enzymes. Its valorization as a functional ingredient represents a sustainable alternative for the food industry, contributing to waste reduction and the development of products with potential health benefits.

Keywords:
Coffee, Silver skin, Phenolic compounds, Antioxidants, Circular economy, α-amylase

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Impact of Diverse Gelators on the Stability and Properties of Gelled Emulsions

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Low molecular weight organic gelators are molecules capable of forming unidirectional self-assembled aggregates through non-covalent interactions and consequently preventing the flowing properties of the solvent used. Innovative and patent-protected, these gelators exhibit excellent gelation efficiency in vegetable oils and emulsions, alongside notable thermal and mechanical stability, self-healing behavior, prolonged stability over time, and the ability to simultaneously deliver both hydrophilic and lipophilic bioactives in a controlled manner. In these gelators the molecules are connected by strong intermolecular hydrogen bonds between planar oxalamide units. This research focused on the effect of different chiral oxalamide gelators on the stability and properties of gelled w/o emulsions, as well as on their rheological properties and morphology. The compounds shared the same functional group and alkyl chain, but differed in their amino acid backbone. The rheological measurements performed on the gelled w/o emulsions showed similar or even better viscoelastic properties compared to the vegetable oil gels. For gelator 4-P, the storage modulus (G') of the oil gel and w/o emulsions ranged from 200 to 4 000 Pa. The oil gel and w/o emulsions exhibited similar yield point and loss factor values (tan δ), whereas the aqueous gel showed a noticeable deviation. All gels and w/o emulsions demonstrated effective self-healing, particularly the aqueous gel, which recovered nearly 90% of its original structure within 1 min.

Keywords:
Oleogels, Emulsions, Rheology, Microscopy

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Influence of Oleogel Incorporation on the Rheological Properties and Microstructure of Sweet Spreads

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Oleogels are composed of gelator and a liquid oil such as sunflower, soybean, or olive oil. Low-molecular-weight organic gelators (LMOGs) are small molecules capable of forming unidirectional self-assembled aggregates through non-covalent interactions, which entangle into a three-dimensional fibrous network. Patent-protected LMOGs demonstrate high gelation efficiency in vegetable oils and emulsions, along with thermal and mechanical stability, self-healing ability, long-term stability, and controlled release of both hydrophilic and lipophilic compounds. Oleogels play an important role in the food, cosmetic, and pharmaceutical industries, and in the food sector, they represent a promising alternative to saturated fats. Due to increasing regulatory restrictions on saturated fats and growing consumer awareness of health issues, attention has been directed toward identifying small organic molecules capable of effectively structuring liquid oils into gels. Gelator 6P-based oleogels with different mass concentrations were prepared and mixed into four different sweet spread bases (two almond spreads and two cashew nut spreads). The sweet spreads were divided into two categories: a classic version and a plant-based version. The bases were formulated by removing saturated fats and replacing them with a specified volume of sunflower oil. All samples were monitored over time to visually assess structural hardening and stability during prolonged storage. Oscillatory rheological measurements were performed, including amplitude and frequency sweep tests. The results obtained from the amplitude sweep revealed that the plant-based versions exhibited higher G' (storage modulus) values compared to the classic versions. Frequency sweep tests were performed to assess viscoelastic behavior across a range of oscillation frequencies. By varying the concentration of gelator in the oleogel, it is possible to tune the viscoelastic properties to resemble those of conventional sweet spreads.

Keywords:
Oleogels, Spreads, Rheology

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Influence of Organogelators as Fat Substitutes on the Rheological Properties of Savory Spreads

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Low molecular weight organogelators are molecules that self-assemble into networks capable of immobilizing oils. They show mechanical stability, self-healing properties and a long period of stability. The applicability of oil gelators is envisaged in food, cosmetics, and the pharmaceutical industry. Special emphasis was given to the potential applications of the examined oil gels as fat substitutes in food products. The replacement of traditional fats in food products with organogelators represents an innovative approach to improve the nutritional profile and functional properties. The aim of this study was to investigate the impact of two different organogelators, designated as gelator 1 and gelator 2, on the rheological properties of savory spreads at gelator concentrations of 0.2-1.0 wt%. Gelled savory spreads were analysed by oscillatory rheology to assess changes in the physical properties and product stability. The gelled savory spread with 0.5 wt% of gelator 1 showed storage modulus of 4608.5 Pa and a loss factor 0.22 while the gelled savory spread with the same concentration of gelator 2 showed a storage modulus of 3640.6 Pa and a loss factor 0.22. The obtained results show that gelator 1 improves the spread's firmness compared to gelator 2, but the gelled spreads with both gelators possess an ordered structure. This study highlights the potential of organogelators as a healthier alternative to conventional fats in the formulation of functional food products.

Keywords:
Oleogels, Spreads, Rheology

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Sweet Potato (*Ipomoea batatas* L.) as Natural Nutraceuticals Source for Yogurt Production

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Sweet potato, *Ipomoea batatas* L., a member of *Convolvulaceae* plant family, has a high nutritional value and sensory versatility in terms of taste, texture, and flesh color. Orange-pulp sweet potatoes (OPSP), as a functional and sustainable ingredient, can reduce the need for sugar or synthetic sweeteners added during yogurt production, while providing a naturally sweet flavor and vibrant color due to beta-carotene. The aims of this study were to establish the optimal technological parameters in the manufacturing of yogurt enriched with OPSP and to determine the effect of this ingredient on physicochemical composition, sensory, and antioxidant properties of the yogurt. The sweet potato was added in the form of puree into the whole cow's milk, previously pasteurized at 85-90 °C and cooled to 46 °C, in concentrations of 10; 15 and 20%, respectively. The addition of yogurt starter culture was in all variants 2.5% of the milk quantity. The samples were analyzed for chemical composition, antioxidants and sensory quality during a 28 days storage period. The obtained results revealed that the increase in the intake of OPSP in the milk mass determined the extension of the incubation period from 4.5 (samples with 10%) to 7.5 h (samples with 20%) to reach a pH of 4.6 in yogurt. An increased in level of OPSP caused a lowering of acidity for all enriched yogurt samples. The crude protein, fat, minerals except for iron, decreased significantly, while crude fibre increased significantly with an increase of OPSP. The vitamin C and retinol contents increased with percentage of added OPSP to 3.5 mg vitamin C kg, respectively 13.5 mg retinol kg. The panelists preferred the yogurt with 15% OPSP over the yogurt with 10 and 20%. The importance of this type of yogurt assortment, comes from the additional nutritional value of the orange sweet potato.

Keywords:
Ipomoea batatas, Yogurt, Antioxidants, Nutraceuticals

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Green Extraction of Bioactive Compounds from Oil Industry By-Products using NADES: From Sustainable Process Design to Functional Applications

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The oil processing industry generates large amounts of by-products and waste materials, such as soap stock and expeller residues, which remain underutilized despite their richness in valuable bioactive compounds. The valorization of those by-products represents a key step toward sustainable biorefinery and circular economy models. This research focuses on developing eco-friendly extraction methods for recovering bioactive phenolics and proteins from oil processing residues, using Natural Deep Eutectic Solvents (NADES) as green alternatives to conventional solvents. Extraction was carried out using fifteen different NADES systems to compare their ability to recover bioactive compounds. The obtained extracts were evaluated for antioxidant capacity and cytotoxic activity. Analyses revealed that choline chloride-based NADES extracts exerted stronger effects on cell viability in both normal (HaCaT) and tumor (HeLa) cell lines compared to betaine-based NADES, despite similar total phenolic content. Moreover, extracts from ChCl-based NADES showed more pronounced inhibition of tumor HeLa cells than normal HaCaT keratinocytes, whereas extracts obtained with betaine-based NADES displayed no significant difference between cell types. Cytotoxic effects were dose-dependent, with increasing extract concentration resulting in higher growth inhibition. Cell death assays confirmed that reduced HeLa cell viability is primarily linked to apoptosis. The obtained extracts also demonstrated antioxidant activities, underscoring their potential applications as natural antioxidants and preservatives in foods and as anti-aging and protective agents in cosmetics.

Keywords:
Natural deep eutectic solvents, Oil industry by-products, Green extraction, Phenolics, Sustainable biorefinery

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Effect of Lactic Acid Bacteria and Yeasts Fermentative Activity on the Physicochemical Parameters of Black Chokeberry (*Aronia melanocarpa* L.) Pomace

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The valorization of berry fruit processing byproducts - such as pomace, which consist of seeds, pulp, and peel - is a growing scientific, economic, and ecological trend. Black chokeberry (*Aronia melanocarpa* L.) pomace is a rich source of bioactive compounds, especially anthocyanins, which are valuable to the food and pharmaceutical industries. However, extracting these compounds can be challenging, prompting the development of alternative strategies such as microbial fermentation. Fermentation can alter the composition of pomace, enhance its nutritional and biological properties, and improve the efficiency of bioactive compound extraction. This study aimed to investigate the impact of fermentative activity by selected microorganisms—lactic acid bacteria (LAB) and yeasts—on the physicochemical properties of chokeberry pomace. After 24 h of fermentation (at 32 °C for LAB and 30 °C for yeasts), pH, total phenolic content (TPC), and total anthocyanin content (TAC) were measured and compared with non-fermented samples. Additionally, the effect of supplementing the pomace with different carbon and nitrogen sources was evaluated. The results showed that the type of microorganism had no significant effect on pH (3.62–3.79), while the addition of organic nitrogen sources to *Candida utilis* increased the pH to 4.75. *Lactobacillus plantarum* (from the LAB group) and *Candida utilis* (from the yeasts group) were selected for further experiments due to a slight increase in TPC and TAC. The addition of carbon and nitrogen sources influenced both parameters. Different carbon and nitrogen sources resulted in higher TPC in most pomace samples fermented by *Lactobacillus plantarum* and *Candida utilis*. Although the addition of carbon sources led to an increase of the TAC in some samples, the addition of nitrogen sources did not significantly change the TAC for both microorganisms.

Keywords:
Black chokeberry, Pomace, Fermentation, Lactic acid bacteria, Yeast, Phenolic compounds

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High-Power Ultrasound-Modified Pectin from Citrus Waste as Sustainable Biopolymer Coating for Extending Strawberry Shelf-Life

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This study examined the physicochemical and functional enhancement of citrus waste pectin modified by high-power ultrasound (HPU) and its application as a sustainable biopolymer coating for strawberry preservation. Pectin was extracted from orange waste powder (peels and pomace) and treated with pulsed HPU for 2–5 min and compared with non-modified and commercial pectin controls. HPU treatment significantly increased the degree of esterification (up to 73.5%) and methoxyl content (~11.7%), indicating structural rearrangement without extensive degradation. The optimized formulation (F-HPU-MCP-2) exhibited a favourable balance between processing efficiency and functionality, showing high elasticity (EAB = 16.4%), strong UV shielding (T = 0.0%), improved surface hydrophobicity (WCA = 55.9°), and notable antioxidant activity. When applied to strawberries, this coating reduced weight loss, minimized fungal growth (~1 log reduction), retained texture, delayed colour deterioration, and extended shelf-life by two days relative to uncoated fruits. In addition to maintained visual quality. These findings demonstrate that HPU modification enhances pectin's structural integrity and bioactivity, offering a green, effective strategy for edible coatings in sustainable postharvest preservation.

Keywords:
Citrus by-products, Ultrasound-modified pectin, Esterification degree, Biopolymer coatings, Sustainable food packaging, Postharvest fruit preservation

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Prelaminar Use of Encapsulated Radish as Colorant and Antioxidant of Cricket Burgers

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Radish (*Raphanus sativus*) is widely consumed worldwide and contains high levels of anthocyanins with potential as natural colorants and antioxidants in meat products. However, its high content of organosulfur compounds, responsible for the characteristic strong odor, limits its industrial application. Meanwhile, the incorporation of cricket flour as a protein source and partial meat replacer has recently gained attention. This study aimed to encapsulate radish juice to reduce organosulfur compounds and protect anthocyanins, and to evaluate its use as a natural additive in pork burgers partially replaced with cricket flour (10%). The anthocyanin profile of radish juice was analyzed by HPLC using cyanidin-3-glucoside as a standard. Four burger formulations were prepared: control (CB, 100% pork), extract burger (EB, 100% pork + 5% encapsulated radish juice), cricket burger (CkB, 90% pork + 10% cricket flour), and cricket burger with extract (CkBE, 90% pork + 10% cricket flour + 5% encapsulated radish juice). Color was measured spectrophotometrically, and lipid oxidation was assessed using the TBARS method during refrigerated storage. Twelve anthocyanins were identified in radish juice and ten in the encapsulated extract, mainly pelargonidin derivatives acylated with phenolic acids. Anthocyanin concentrations were 2.35 mg mL^{-1} in radish juice and 0.59 mg g^{-1} in the encapsulated form. Lipid oxidation values were similar among CB, EB, and CkBE on days 2 and 3 ($p > 0.05$) but differed by day 5 ($p < 0.05$), with CkB showing the lowest TBARS values. The colorant effect was observed day 5 only on EB, while no noticeable differences were observed in CkB and CkBE due to the darker color imparted by cricket flour. Encapsulated radish juice demonstrated potential as a natural antioxidant and colorant for meat products; however, at the tested concentration, it showed limited visual effects in pork–cricket hybrid burgers.

Keywords:
Natural additives, Anthocyanins, Radish, Meat products

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Near-Infrared Spectroscopy and Chemometrics in the Automatization of Artisan Sourdough Mixing Process – Possibilities and Limitations Study

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Artisan sourdough bread is experiencing a rise in demand, which is mainly driven by its health benefits such as improved digestibility, beneficial influence on gut health, lower glycemic index and better nutrient bioavailability. The production process of artisan sourdough bread is mostly connected to the crafts of the bakers producing it, making it difficult to achieve process standardization and automatization. Also, the analytical methods for process monitoring are often time consuming and require sample preparation. Currently, research on the use of near-infrared spectroscopy (NIRs) as a fast, in-line method for dough mixing monitoring is gaining popularity. This study aimed to determine whether NIR spectroscopy can be used to monitor the sourdough mixing process and connect the NIRs spectra with dough mixing time (min) and mixing power (W). The dough mixture comprised of a sourdough starter and a composite mixture of Manitoba white flour, Manitoba whole grain flour, rye flour and corn extrudate, and was mixed using an Escher M40 spiral mixer (Escher Mixers, Vicenza, Italy) with integrated Sinamics G120C PN frequency converters. Samples were taken in regular time intervals (0-20 min) during the mixing process and NIR spectra were recorded using a handheld NIR spectrometer (λ=900-1700 nm, NIR-MR2, InnoSpectra, Taiwan). Spectra were subjected to chemometric analysis, which included the development of PLS models which used NIR spectral data (predictors) for the mixing time and mixing power (targets). The developed models showed high R^2 values for both, time and power in the calibration process (R^2time = 0.96, R^2power = 0.81), however, the R^2 values diminished for the validation process (R^2time = 0.88, R^2power = 0.19). This leads to a conclusion that NIR spectroscopy can be successfully used for quantitative prediction of mixing time, but further data is needed to confirm whether the PLS model can be used and validated prediction for mixing power.

Keywords:
Dough mixing, Automatization, NIR spectroscopy, Chemometrics

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Stability and Application of Sourdough Starter from Automated Fermentation

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The stability of sourdough starter for artisan bread production is crucial for consistent product quality and effective production planning. This study aimed to investigate the stability of wheat sourdough starter produced by automated fermentation under different process conditions (dough yield 200–225%, inoculum 60–80%, temperature 12–28 °C). The pH, temperature, and starter weight were monitored automatically. Samples taken from the fermenter were further analyzed for viable lactobacilli and yeast cell counts, lactic and acetic acid concentrations, conductivity, optical density (OD600, -800 dilution), and NIR spectra in the wavelength range 904–1699 nm (NIR-128-1.7-USB/6.25/50 µm, Control Development Inc., USA). Chemometric analysis was performed, and partial least squares (PLS) models were developed using UnscramblerX software (Camo, Norway). The optimally fermented starter was used in six composite bread doughs containing wheat, corn, and/or rye flour (with wet gluten content ranging from 22–35% and ash content from 0.5–0.9%, depending on the recipe) to measure rheological properties with an extensograph (Brabender, Germany). The pH of the starter remained stable despite varying process conditions due to automatic back-slopping. The starter contained a mixture of lactobacilli and yeasts in a ratio of 0.5 to 1.4. A dough yield of 200% and an inoculum of 80% proved favorable, as reduced inoculum concentration, increased dough yield, or increased temperature decreased the number of bacteria and yeasts. Lactic acid predominated over acetic acid, with their molar ratio ranging from 2.9 to 3.7. Based on the developed PLS models, NIR spectroscopy can be used for qualitative monitoring of starter fermentation time, conductivity, OD600, and lactic acid content. Composite dough with added starter exhibited better elastic properties, i.e., higher resistance to extension and lower extensibility compared to dough without starter. This indicates the suitability of the starter for producing artisan composite bread.

Keywords:
Sourdough starter, Organic acids, NIR, Composite dough, Artisan bread production

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LAMP-Based Molecular Assay for Reliable Differentiation of Truffle Species

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Truffles are highly valued delicacy belonging to the genus Tuber, with approximately 180 different species identified, of which around 13 are commercially available. Truffle production and consumption are increasing, mainly due to increased cultivation. One of the main differences among species is the chemical composition, whereby higher-value truffles contain a rich spectrum of organic compounds, predominantly sulfur derivatives and alcohols responsible for their characteristic aroma. Typical examples include black truffle (*Tuber melanosporum*), white truffle (*Tuber magnatum*), summer truffle (*Tuber aestivum*) and winter truffle (*Tuber brumale*). Contrary, lower-value truffles, such as whitish or bianchetto truffle (*Tuber borchii*) and Chinese black truffle (*Tuber indicum*), contain significantly lower concentrations of these compounds, resulting in a weaker aroma profile. In practice, higher-value truffles are often substituted by lower-valued ones, with the lack of intense flavor compensated by synthetic aromas. The main compound responsible for the distinctive truffle flavor is 2,4-dithipentane. Given the above differences, reliable and precise methods for distinguishing truffle species would be beneficial. Morphological identification demands expertise and may be challenging, therefore a molecular approach offers an efficient alternative. Loop-mediated isothermal amplification (LAMP) is a rapid and highly specific DNA amplification method employing six primers. The reaction occurs at a constant temperature of 60–65 °C, without requiring sophisticated equipment, which makes it suitable for field application. During the LAMP reaction, magnesium pyrophosphate is formed, which also allows visual detection. The development of such a LAMP system enables rapid and reliable molecular discrimination between morphologically similar, but economically different truffle species, which significantly improves authenticity control and quality assurance in the food industry. We are developing a LAMP system suitable for on-site testing that allows the differentiation of 6 different truffle species.

Keywords:
Truffle authentication, Food authenticity, DNA-based identification, On-site testing, Food quality assurance, Loop-mediated isothermal amplification (LAMP)

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Green Solvent Extraction of Carotenoids from Tomato Processing Waste: Evaluation of Edible Oils, Limonene, and Eutectic Mixtures

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Tomato processing waste represents a valuable source of bioactive compounds, especially carotenoids. Due to their high sensitivity, the extraction step is crucial for carotenoid isolation from the plant matrix to prevent degradation, preserve chemical structure, and achieve high recovery. Conventional carotenoid extraction methods commonly utilize large volumes of organic solvents, resulting in significant environmental impact. Therefore, recent research has focused on alternative green solvents, including supercritical fluids, edible oils, natural eutectic solvents, ionic liquids, and terpenes. This work aimed to compare the efficiency of the most commonly used green solvents, such as olive and sunflower oils, limonene, and mixtures of menthol:thymol, menthol: lactic acid, and capric acid:lauric acid, as eutectic solvents, on the carotenoid extractability from tomato processing waste. The samples were prepared with a solid-to-solvent ratio of 1:20, and the extraction was performed on a magnetic stirrer (550 rpm, 30 min), at room temperature in the dark. After the extraction, samples were centrifuged and saponified to remove impurities, particularly fats, to minimize the matrix effect during carotenoid quantification by HPLC. The presence of lutein, α- and β-carotene, as well as lycopene, was confirmed by HPLC analysis in oil extracts. In contrast, lutein was not detected in extracts obtained with limonene and deep eutectic solvents. Specifically, lycopene was not detected in limonene extracts, likely due to the differences in polarity between the solvent and the compound. Additionally, the findings indicated that olive oil yielded the highest amounts of lutein, α- and β-carotene, while the mixture of capric and lauric acid exhibited the greatest yield in terms of lycopene. Given that olive oil and the mixture of capric and lauric acids demonstrated the highest extraction efficiencies, further research and optimization of the carotenoid extraction process are essential to achieve maximum yields.

Keywords:
Tomato processing waste, Green extraction, Carotenoids

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Production of Functional Encapsulation Systems from Pomegranate Peel Extract Using the Electrospinning and Electrostatic Extrusion Techniques

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In the present study, pomegranate peel was investigated as a natural source of phenolic compounds for encapsulation in the form of nanofibers and beads using electrospinning and electrostatic extrusion techniques. The bioactive composition of the pomegranate peel was determined using spectrophotometric and chromatographic (HPLC-PDA) methods. For electrospinning, the prepared aqueous extract was encapsulated using mixtures of pullulan and various polymers (collagen hydrolysate, polyethylene oxide, carboxymethyl cellulose, pectin, nutriose, xylan and fava bean proteins; 12%, w/w) as carriers, prepared in ratios of 50:50, 60:40, and 80:20, with the addition of Tween 20 (0.9%). During electrospinning, the applied voltage ranged from 11 to 15 kV, the distance between the needle and the collector was 10–14 cm and the flow rate was 1 mL h^{-1}. For electrostatic extrusion, the aqueous extract was encapsulated using mixtures of alginate and other polymers (collagen hydrolysate, polyethylene oxide, carboxymethyl cellulose, pectin, nutriose, and xylan; 2%, w/w). During electrostatic extrusion, the applied voltage was 700 kV, the distance between the nozzle and the hardening bath was 28 cm, the applied pressure ranged from 80 to 400 mbar, the frequency was 40–1940 Hz, and the nozzle diameters were 300, 450 and 750 µm. The resulting nanofibers and beads were subjected to polyphenolic composition analysis and *in vitro* digestion, while their morphology was examined using an optical microscope. Ellagic acid (2.80 mg g^{-1} dw), protocatechuic acid (7.18 mg g^{-1} dw), and gallic acid (2.54 mg g^{-1} dw) were detected in the pomegranate peel. In electrospinning, the highest encapsulation efficiency of approximately 80% was obtained using mixtures of pullulan/fava bean protein 80:20 and pullulan/pectin 80:20 mixtures. In electrostatic extrusion, the highest encapsulation efficiency, only 13%, was achieved using the alginate/polyethylene oxide (80:20) mixture.

Keywords:
Encapsulation, Electrospinning, Electrostatic extrusion, Pomegranate peel

Development and Characterization of Innovative Coffee-Enriched White Chocolates

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Chocolate is a popular confectionery product worldwide, and demand for it is continually increasing. Because of its popularity across all age groups, chocolate serves as an excellent matrix for enrichment with various bioactive compounds and their delivery to the consumer. In this context, white chocolate is particularly noteworthy, as it does not contain the non-fat cocoa solids, so it does not contain bioactive compounds derived from cocoa beans. Conversely, green coffee beans are a potentially rich source of bioactive compounds, especially polyphenols, with chlorogenic acids being the most abundant. The aim of the present study was to characterize the bioactive properties of green Arabica and Robusta coffee beans by determining total phenolic content and antioxidant capacity (DPPH and ABTS methods) using spectrophotometric methods, as well as the content of individual bioactive compounds using HPLC-PDA methodology. Green coffee beans were incorporated into white chocolate formulations in a content of 3.5 and 7%, and the bioactive composition, melting profile (by DSC), and sensory parameters of the chocolates were assessed. Green Robusta coffee beans contained a higher level of total polyphenols (55.25 mg GAE g dmb^{-1}), caffeine (17.72 mg g dmb^{-1}) and chlorogenic acid (44.27 mg g dmb^{-1}) compared to Arabica coffee beans (43.23 mg GAE g dmb^{-1}; 10.76 mg g dmb^{-1}; 40.73 mg g dmb^{-1}). The total phenolic content in chocolate prepared without green coffee beans was 0.85 mg GAE g dmb^{-1}, while the addition of 7% green Robusta coffee beans resulted in the highest increase in total polyphenols to 2.81 mg GAE g dmb^{-1}, along with increased chlorogenic acid and caffeine contents. The highest overall acceptability score was given to the sample prepared with 7% Arabica coffee beans, while the lowest score was given to the sample without green coffee beans.

Keywords:
Green coffee beans, White chocolate, Functional food, Polyphenols, Caffeine

Sensory Evaluation of Physical Attributes of Eco-Innovative Food Packaging in the Project BioPHA-ComFPack Project (Phase I)

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In the BioPHA-ComFPack project (2024–2026), the objective is to develop biodegradable and compostable active packaging suitable for extending the shelf life of industrially processed food products. Biobased and biodegradable components - PLA, PBAT, PBS, PHA, and starch-based bioplastics - were used to design eco-innovative packaging (five laboratory prototypes) during Phase I of the project. To evaluate the physical properties of the laboratory packaging prototypes, a sensory assessment was conducted based on six attributes: hardness, flexibility, brittleness, surface smoothness, gloss, and perforation resistance. The relevance of these attributes depends on the user's perspective (industrial producer vs. end consumer). From the consumer's point of view, aesthetics, tactile feel, and practicality (surface smoothness, gloss, flexibility, perforation resistance) are more important than hardness and brittleness. For industrial producers, all attributes influence processing, packaging performance, durability, and equipment compatibility. In this study, the attributes of the eco-innovative prototypes were compared to conventional fossil-based packaging used for dehydrated cream of broccoli soup, stored under three temperature regimes (−18, +20, and +30 °C). After 3 and 4 months of storage, compared to conventional packaging, the eco-innovative prototypes showed significant variations in the intensity of all attributes across all temperature conditions. The results have implications for Phase II, which will focus on improving the properties of eco-innovative packaging for industrial processed food product.

Keywords:
Biodegradable packaging, Agro-food waste, Food product, Eco-innovation, Consumer

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Impact of Heat Treatment on Bioactive Compounds and Color Parameters in Different Aronia Juice Varieties

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Black chokeberry (*Aronia melanocarpa*) is recognized for its richness in bioactive compounds, particularly polyphenols such as anthocyanins, procyanidins, phenolic acids, flavonols, and flavanols, which contribute to its strong nutritional and functional properties. The composition and stability of these compounds are strongly influenced by processing conditions, especially heat treatment. This study investigated the effects of thermal processing at 60 and 80 °C for 5, 10, 30, 60, and 120 min on four Aronia juice varieties Nero, Rubina, Viking, and Galicjanka. The analyses focused on Total Polyphenol Content (TPC), Total Anthocyanin Content (TAC), antioxidant activity (DPPH assay), and color characteristics. Results showed that both temperature and heating duration considerably affected the chemical composition and antioxidant properties of the juice varieties. Regarding the TPC, Rubina variety exhibited the highest polyphenol content, while 'Viking' showed the lowest, with values ranging from 4180.80 ± 131.51 mg GAE L^{-1} at 80 °C for 5 min to 8284.84 ± 14.72 mg GAE L^{-1} at 80 °C for 30 min, respectively. For TAC, the Galicjanka variety heated at 60 °C for 60 min showed the highest value (45.19 ± 1.10 mg L^{-1}), whereas Viking heated at 80 °C for 10 min recorded the lowest (16.10 ± 0.21 mg L^{-1}). In terms of antioxidant capacity, measured by the DPPH assay, Rubina demonstrated the strongest activity (7853.83 ± 302.34 mg L^{-1} at 60 °C for 60 min), while Galicjanka showed the lowest (3420.42 ± 46.68 mg L^{-1} at 60 °C for 5 min). Additionally, Rubina exhibited clearly visible color differences ($2.1 < \Delta E^* < 3.4$) compared to the other varieties. Overall, Rubina stood out as the most stable and bioactive variety, showing the highest TPC, strongest antioxidant activity, better retention of anthocyanins, and greater color stability under heat treatment compared to Nero, Viking, and Galicjanka.

Keywords:
Heat treatment, Bioactive compounds, Aronia juice, Antioxidants, Polyphenols

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Sustainable Biorefinery of Agricultural By-Products: Integrating Green Extraction Technology and Life Cycle Assessment for High-Value Rice Bran Oil

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Rice bran, a major milling by-product, represents an often-overlooked yet extraordinarily rich source of bioactive compounds, particularly tocopherols and γ-oryzanol—powerful antioxidants essential for both health and food innovation. This study addresses the critical challenge of extracting and preserving these valuable compounds in an efficient and sustainable manner, an imperative for the modern bioeconomy. We critically compared three extraction methodologies (Soxhlet, maceration, and supercritical CO_2, SC-CO_2) to identify the optimal technique regarding recovery, composition, and environmental impact. The results clearly demonstrate that, while oil yields were comparable, SC-CO_2 extraction set a new benchmark for quality. This green, solvent-free methodology not only ensured the maximum preservation of bioactives (recording 116.9 μg g^{-1} of tocopherols and 13.2 mg g^{-1} of γ-oryzanol) but also produced an oil characterized by a markedly superior fatty acid profile (86.3% unsaturated fatty acids) compared to the thermal- or solvent-extracted oils (which showed a higher saturated fraction). The application of a Life Cycle Assessment (LCA), a key element for modern scientific validation, confirmed the technical superiority. SC-CO_2 extraction resulted in the lowest overall ecological burden, positioning it as the ultimate green choice. This evidence converges to place SC-CO_2 extraction as the enabling technology for the valorization of rice bran into a high-quality, antioxidant-rich, and sustainable functional ingredient for the food and cosmetic industries. Overall, this integrated chemical and environmental approach provides a robust model for transforming agricultural residue into a pillar of the circular bioeconomy.

Keywords:
By-products valorization, Rice bran oil, Green extraction, Life cycle assessment

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Characterization and Applications of Non-Starch Saccharides of Black Cumin (*Nigella sativa* L.) Press Cake and Seeds

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Nigella sativa L. is native plant for countries from South to Southwest Asia. It was used from ancient times for medicinal purposes, as counteracting asthma, diabetes, hypertension, fever, inflammation, bronchitis, dizziness, eczema, and gastrointestinal disturbances. *Nigella sativa* L. is commonly known as black cumin. It produces small, black seeds which are composed 21–45% of oil, 20–25% of carbohydrates, 21% of protein and 6% of dietary fiber. Constituents of the latter fraction are non-starch polysaccharides. Their activities include, for example acting as antioxidants, anti-inflammatory, anti-diabetic, immunomodulatory and increasing the diversity of gut microbiota. Oil from black cumin seeds, in most cases, is obtained by cold pressing. Oil yield, composition, and organoleptic properties as well as the composition of polysaccharides in press cake may be influenced by the specific pretreatment of the seeds before the oil extraction. The aim of the study was to compare the influence of specific pretreatments on oil yield and the non-starch polysaccharides composition in black cumin seeds press cake and the possibility of their usage as additives to selected diary products. Pretreatments used include soaking the seeds in distilled water, as well as at pH 3 and 9, blanching in the water bath at 95 °C for 3 min, use of ultrasounds by 15 and 30 min. Control sample without any treatment was also studied. Oil yield varied from 24.3 (15 min of ultrasounds) to 32.6% (blanching). Independent on the pretreatment method, dominant monosaccharide of water insoluble polysaccharide fraction was mannose. There was no straight dependence between individual monosaccharides content in press cake and oil yield. Exceptional was the arabinose after hydrolysis using methanolysis protocol where its content correlated strongly (r = 0.89). Press cake from black cumin seeds may be applied to large variety of dairy products as for example yoghurts with positive influence on its organoleptic and pro-healthy properties.

Keywords:
Black cumin, Dairy products, Press cake

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Antioxidant and Antibacterial Activities of Bitter Orange (*Citrus aurantium* L.) and Sweet Orange (*Citrus sinensis* L. Osbeck) Peel Extracts

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Citrus fruits have significant economic value due to their consumption as fresh produce and their processing into various products. Citrus processing generates a substantial amount of peel waste, which is a valuable source of bioactive compounds with potential antimicrobial properties. This study investigated the antioxidant and antibacterial activities of bitter orange (BO) and sweet orange (SO) peels. The antioxidant activity of the extracts was evaluated by DPPH and ABTS assays, and the total polyphenolic content was also determined. The antibacterial activity of the peel extracts was tested on Gram-positives (*Listeria monocytoge*nes, *Staphylococcus aureus*) and Gram-negatives (*Escherichia coli*, *Salmonella enteritidis*). Flavedo and albedo extracts were prepared by extraction in an ultrasound bath (25 °C, 15 min) using ethanol (sample to solvent ratio 1:10), vacuum concentrated, and tested by agar disc-diffusion (5 mm discs) at 25 mg mL^{-1} in DMSO. The results showed that BO contains a significantly higher proportion of polyphenols (over 50%) and greater antioxidant activity than SO. In BO`s, the albedo was a richer source of phenolic compounds than the flavedo, while in SO, the flavedo had higher polyphenol content and greater antioxidant activity than the albedo, regardless of the assay used. No inhibitory activity was observed against any of the tested Gram-positive bacteria. Among the Gram-negative strains, *S. enteritidis* exhibited moderate susceptibility, with inhibition zones of 9.1 and 8.13 mm for BO and SO extracts, respectively. In contrast, *E. coli* was more resistant to all extracts than *S. enteritidis*. Although control antibiotics produced substantially larger inhibition zones (more than twice the diameter), higher concentrations of citrus peel extracts may provide a naturally derived, consumer-acceptable alternative for pathogen control in specific applications. Valorization of orange peel waste can significantly reduce agro-industrial waste by transforming it into a source of value-added antibacterial and antioxidant extracts, thereby supporting a circular economy.

Keywords:
Bitter orange, Sweet orange, Flavedo, Albedo, Antioxidant activity, Antibacterial effect

OLIVE - EduTech: An Interdisciplinary Approach to Monitoring the Physiological Response of the Olive Tree to Different Pruning Intensities while Devel

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Olive is economically an important crop that requires regular and proper pruning to achieve sustainable yield and profitable production. Pruning is a key agrotechnical measure that regulates yield and facilitates the application of other cultivation practices. Despite the well-known importance of pruning, the number of scientific publications on this topic is limited, and there are different views among experts about its impact on yield. Therefore, an interdisciplinary research group (agronomy, geography, pedagogy and chemistry) will be formed within the OLIVE – EduTech project, with the aim of determining the physiological response of olive trees to different pruning intensities and developing methods for mediating the transfer of knowledge to olive growers who apply this practice to a limited extent. The specific objective of the project is to quantify the impact of different pruning intensities on yield, olive physiology, fruit quality and the composition of olive oil, minerals and phenols in the leaf. The impact of pruning will be quantified using spectral and morphometric parameters, by estimating the amount of removed biomass, and by chemical analyses. In addition, students and olive growers will be educated on the importance of proper pruning and the acquisition of knowledge about this skill will be monitored. Expected results include: improving knowledge about olive pruning, introducing new methods and developing specialized equipment for fruit and olive oil analysis at the University of Zadar, increasing scientific productivity, and popularizing science in the field of olive growing. A key focus of the project will be to investigate how agronomic practices, with particular attention to pruning, affect olive fruit quality parameters determining the characteristics of olive oil.

Keywords:
Education, Geospatial technologies, Yield, Olive leaf, Olive fruit, Workshop

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Assessment of Drying Temperature on Sensory and Bioactive Compounds of Quince Fruit

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Consumption of healthy snacks has become popular with the increasing number of obesity and obesity related health problems. Dried fruits are a significant candidate for this group of foods due to their nutritional value and convenient access and consumption. Quince fruit (*Cydonia oblonga*) is a well-known fruit, especially in China, Uzbekistan, Iran, Morocco, Argentina, and Azerbaijan, which has a characteristic and pleasant odor with a distinctive taste. However, many people do not like it as a fresh fruit because of its bitter taste. In this study, the potential of dried quince was evaluated as a healthy snack alternative with high bioactive content, as perceived by consumers. Therefore, the quince samples were dried under constant airflow at three different temperatures: 50, 60, and 70 °C. After drying, the color, total phenolic content (TPC) and antioxidant activity were measured to assess the effect of drying temperature. The results showed that the highest antioxidant activity (35.85%) was observed in the sample when the drying temperature was 50 °C, although the lightest color was observed with the sample dried at 70 °C (77.36 ± 0.18) and the highest yellowness was found with the sample dried at 50 °C (27.41 ± 0.15). In terms of TPC, there was no significant difference examined between the samples 50 °C (525 ± 7.60 mg GAE 100 g dry matter^{-1}) and 70 °C (515 ± 3.32 mg GAE 100 g dry matter^{-1}), though they were significantly different from the sample dried at 60 °C (477 ± 7.23 mg GAE 100 g dry matter^{-1}). To determine the consumer acceptance, the sensory analysis was performed with untrained panelists and the highest score was achieved for the sample dried at 70 °C in terms of appearance, texture, flavor, taste, aftertaste and overall acceptability. On the other hand, 50% of the panelists reported that the same sample is the most similar to the fresh quince fruit. These results indicate that dried quince can be considered a healthy alternative snack option when dried at 70 °C.

Keywords:
Quince fruit, Antioxidant activity, Sensory, Healthy snack, Drying

Consumer Acceptance of a Plant-Based Pumpkin Snacks Produced by Hot Air Drying and Freeze-Drying Methods

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In recent years, consumers are increasingly becoming more aware of health benefits of food products. The current trends are also guiding consumer's attention to the products with specific properties such as plant-based/vegan, gluten-free, products with nutritional quality, clean label and locally-produced ingredients. For these reasons, this study aimed to produce a snack having these properties with high consumer acceptability. Therefore, two formulations of pumpkin-based snacks are produced, adding dates and chia seeds with or without rice flour. Pumpkin (*Cucurbita moschata*), which is a local product with rich content of phenolic compounds, flavonoids and vitamins and low content of carbohydrates (approx. 12%), was used as the main ingredient. Along with their nutritional content and functional properties, dates were used for their sweetness, while chia seeds and rice flour were added to improve texture and mouthfeel. After mixing the ingredients and shaping the products (round shape with 3 cm diameter and 0.5 cm height), they were subjected to hot-air drying at 70 °C and freeze-drying at -50 °C, 5000 mbar. Afterwards, four types of samples (hot-air-dried and freeze-dried with rice flour, and hot-air-dried and freeze-dried without rice flour) were evaluated by untrained 50 panelists with the aspect of appearance, aroma, taste, crispiness, mouthfeel, and general liking on a 7-point hedonic scale (7=Like very much, 1=Dislike very much). As a result, with the exception of mouthfeel, all freeze-dried samples received significantly higher scores than hot-air dried samples. However, freeze dried and hot-air-dried samples did not receive significantly different scores among themselves. Although all freeze-dried samples received average scores higher than 5, the highest scored sample at all attributes was the freeze-dried products without rice flour. Therefore, this study showed that a pumpkin-based vegan, gluten-free product with a clean label (only three ingredients) and high consumer acceptability was possible to prepare using the freeze-drying method.

Keywords:
Consumer acceptance, Plant-based, Sensory evaluation, Pumpkin

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Valorization of Agri-Food Waste for PHA Production: Preliminary Process Design and Life Cycle Assessment in BioPHA-ComFPack Project

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Bio-based and biodegradable polyhydroxyalkanoates (PHA) are primarily produced commercially through microbial fermentation of plant-derived sugars obtained from sources such as sugarcane, corn, tapioca, and cellulosic biomass. PHA is extracted from bacterial cells, purified, and used in the production of biodegradable packaging, as well as in the textile industry, medicine, and other applications. Production using agri-food waste as a secondary feedstock is environmentally preferable but also more complex, with processes still under development. Life Cycle Assessment (LCA) can support the optimization of production processes by analyzing all stages of the product life cycle—from raw material acquisition, through production, distribution, and use, to final disposal ("from cradle to grave"). Within the BioPHA-ComFPack project (2024–2026), one of the objectives is to design an efficient process for obtaining PHA from fruit and vegetable by-products at laboratory scale (up to TRL 4). Since there is no literature specifically addressing the production of PHA from by-products of industrial processing of peas, apples, tomatoes, peppers, and plums, an experimental process was developed and compared with PHA production from glucose. In the initial phase, the LCA system boundaries were limited to the processing stage and its unit operations, including inputs and outputs. Current results of PHA conversion efficiency from by-products via submerged fermentation using Cupriavidus necator, compared to glucose-based production, indicate that acid hydrolysis pretreatment is necessary to release sugars from the by-products. Moreover, the quality and composition of the by-products significantly influence the process. In the next stages, the process design will be further optimized to achieve the highest possible PHA yield with the lowest energy consumption.

Keywords:
Bio-based, PHA, Agri-food waste, LCA

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Valorization of Crab By-Products for the Recovery of Carotenoid-Rich Extracts through Optimized Conditions

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Crustacean by-products, particularly crab carapaces, represent a valuable source of bioactive compounds such as carotenoids, which can be recovered and utilized as antioxidants or colorants in food or nutraceutical formulations. The present study aimed to optimize the extraction of carotenoids from crab carapace using a response surface methodology (RSM) approach. Raw carapaces were obtained directly from a seafood processing facility and subjected to an initial pre-treatment. A portion of the material underwent steam boiling to simulate industrial shell removal, followed by drying at 60 °C for 16 h. The remaining material was kept raw and dried under similar conditions. Both dried samples were subsequently pulverized and used for carotenoids extraction in an ultrasonic bath with various solvents: *n*-hexane, ethyl acetate, ethanol, ethanol–water solution (80:20, v/v), and acetone. Preliminary screening indicated that the ethanol–water solvent yielded the highest recovery. Subsequently, optimization of extraction parameters (solid-to-liquid ratio and extraction time) was performed for both pre-treated and raw materials using a central composite design within the RSM framework. Total carotenoids concentration (expressed as mg astaxanthin 100 g of dry material^{-1}) and total phenolics content (expressed as mg gallic acid 100 g of dry material^{-1}) were selected as the responses. Notably, the raw carapace samples exhibited higher astaxanthin concentrations than the pre-treated material, suggesting that thermal exposure may partially degrade heat-sensitive carotenoids during processing. Overall, these findings highlight the potential of minimally processed crab carapace as a sustainable raw material for natural carotenoid recovery. The results provide a foundation for the development of environmentally friendly extraction protocols and valorization strategies for crustacean processing by-products within a circular bioeconomy framework.

Keywords:
Crustacean by-products, Crab shells, Astaxanthin, Antioxidants, Green chemistry, Colorants

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Optimization and Characterization of Phlorotannin Extraction from *Padina pavonica*

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Phlorotannins are a complex group of polyphenolic compounds uniquely synthesized by brown macroalgae (*Phaeophyceae*), playing biological roles throughout the algal life cycle (1,2). They are known for their diverse biological activities and potential applications in nutraceutical, pharmaceutical, and cosmetic formulations (3). Chemically, they are polymers of phloroglucinol that exhibit wide structural variability in terms of polymerization degree and branching patterns, which largely accounts for the diversity of their extraction procedures (1,4). This study aimed to optimize extraction and purification procedures for isolating phlorotannins from *Padina pavonica*, a brown macroalga widely distributed along the Adriatic coast. Five extraction protocols were compared, varying in solvent polarity, pH adjustment, and solid-phase extraction (SPE) purification. After evaporation to dryness, extracts were re-dissolved in ethyl acetate:methanol (EtOAc/MeOH) or methanol:water (MeOH/H_2O) prior to LC-MS analysis. Two of five extraction protocols resulted in a high number of identified phlorotannins. Higher signal intensities and broader molecular weight distribution in the EtOAc/MeOH fraction (26 and 39 phlorotannins) indicate more efficient solubilization of medium and reduced oxidative degradation. These results highlight the superior selectivity and stability of the EtOAc/MeOH system combined with the optimized extraction protocol, establishing a robust methodological framework for comprehensive profiling and future bioactivity assessment of *Padina pavonica* phlorotannins.

Keywords:
Phlorotannins, Brown macroalgae, Solid-phase extraction (SPE), LC-QTOF-MS, Extraction optimization, Total phenolics

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From Data to Success: How AI-DoE Modelling Enhances Food Process Optimization and Product Quality

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Modern food development increasingly benefits from combining Artificial Intelligence (AI) with Design of Experiments (DoE) - a data-driven approach that goes beyond traditional trial-and-error. This AI-DoE methodology confidentially identifies optimal solutions and key process factors influencing product quality, enabling faster and cost-effective development. In our powdered dehydrated food formulation study, three common process settings were explored; mixing time, drying temperature, and feed solids concentration. These factors are known to affect product quality, yet the exact combination that maximized product quality and production process efficiency was previously unknown. The AI-DoE resolved this by identifying the optimal parameter combination, the “sweet spot”, that delivered both high product quality and production process efficiency. Additionally, factor importance analysis showed that drying temperature had nearly twice the impact of mixing time on final product quality. Moreover, hidden dependencies were also uncovered; for instance, longer mixing improved product quality only when feed solids concentration was moderate, while at higher solids levels, extended mixing unexpectedly reduced performance due to aggregation. From these insights, a design space was established, defining safe and efficient operating ranges where product quality remains consistent. AI-DoE methodology performed in R and Python helps teams confirm optimal formulations, make informed decisions within the Operating Design Space (ODS), predict outcomes, and maintain consistent product quality. By revealing the optimum conditions, key factors, and parameter interactions, it supports Quality by Design (QbD) principles and ensures full process transparency. This deeper understanding enables smoother technology transfer and easier deviation handling across production. When applied properly, AI-DoE methodology can accelerate development by up to 50% and reduce costs by 40–60% turning it into a strategic tool that transforms efficiency and insight directly into success.

Keywords:
Product development, Design of Experiments, AI-driven optimization, Operational cost reduction, Process knowledge

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Why Frozen Fish Degrades: Molecular Insights into Optimal Freezing and Storage

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Frozen fish and meat products often lose their original flavor, aroma, and texture during storage due to lipid oxidation and protein degradation—chemical processes that alter sensory quality and shorten shelf life. Understanding these transformations at the molecular level is essential for improving preservation and maintaining product value. This study combined AI-driven molecular analysis with advanced analytical chemistry to uncover how key flavor-related compounds evolve during storage of large-mouth bass fillets. Comprehensive two-dimensional gas chromatography–time-of-flight mass spectrometry (GC×GC–TOFMS) identified 66 volatile molecules associated with freshness and degradation. A subset of 40 reliable and relevant compounds was then analyzed across different freezing and storage treatments: two groups frozen at −18 and −60 °C, then stored at −18 °C, plus two groups stored at −40 and −60 °C with initial freezing at −60 °C. Samples were analyzed at 30 and 90 days to track volatile profile changes. Each molecule's structure was retrieved as a SMILES string from the PubChem database and transformed into cheminformatics representations through the calculation of molecular descriptors and fingerprints - quantitative features capturing molecular shape, polarity, and reactivity. Using AI-assisted clustering, similarity analysis, and dimensionality reduction techniques including Principal Component Analysis, t-distributed Stochastic Neighbor Embedding, Uniform Manifold Approximation and Projection, and Linear Discriminant Analysis, volatiles were grouped into molecular "families" sharing structural and physicochemical traits related to oxidative behavior. These associations revealed which compounds are most susceptible to temperature fluctuations and which remain stable under deep-freeze conditions, effectively generating a predictive molecular "fingerprint" of freshness. For seafood and meat manufacturers, these findings provide a data-backed framework for optimizing freezing conditions, antioxidant formulations, and raw material selection. This integrative approach bridges AI, chemistry, and food science, transforming complex molecular data into predictive preservation strategies that reduce waste, protect flavor, and enhance shelf-life and market value of frozen foods.

Keywords:
Unsupervised learning, Molecular representations, Lipid oxidation, Shelf-life prolongation, Quality maintenance

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Bridging Chemistry and Taste with AI: Computational Advances for Flavor Prediction

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Sweet, bitter, umami or nutty - the way we experience flavors depends on how molecules in food interact with taste receptors in our mouth. Predicting these interactions is essential for designing new flavors and improving food products, but existing computational tools often rely on simplified representations of molecules that do not fully capture how they behave in real life. Current predictive tools need improvement by creating more detailed molecular descriptors. Instead of using only static chemical features, we can study how flavor molecules move and fit into taste receptors over time. To do this, we can use two computer-based techniques: one that predicts how a molecule initially attaches to a receptor (molecular docking) and another that simulates its movement and flexibility in a realistic environment (molecular dynamics). These methods will allow us to see not just where molecules bind, but how stable and strong those interactions are. We used GROMACS to simulate ligand–receptor dynamics, capturing interaction strength, conformational changes, and stability. These dynamic features were integrated into molecular fingerprints from FlavorDB, BitterDB, and BitterSweet to improve prediction of flavor–receptor interactions. A preliminary classifier combining molecular fingerprints and MD-derived descriptors was trained on 10 bitter and 10 non-bitter molecules. Predictive power and diversity will be further enhanced using diffusion-based generative models that learn complex molecular patterns through iterative denoising. Finally, this work could lead to improved computational models that help scientists and food technologists design flavors with greater precision. Such advancements may drive innovations in food science, nutrition, and health-related applications, including products that enhance taste perception for individuals with dietary restrictions. In the long term, these developments could contribute to AI-driven systems that mimic human taste and smell - laying the foundation for an “AI tongue and nose“.

Keywords:
Flavor–Receptor interaction, Molecular docking, Molecular dynamics, Molecular fingerprints, AI-driven taste systems

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Physicochemical and Techno-Functional Characterization of *Acheta domesticus* Flour and Its Impact as a Novel Alternative Ingredient in Meat Systems

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One of the main challenges in the food industry is increasing the use of sustainable raw materials that reduce environmental impact. Reducing meat use in processed products is a key strategy, with insects emerging as a promising alternative due to their high-quality protein, unsaturated fats, and highly bioavailable minerals at a relatively low cost. However, their techno-functional and sensory effects in meat products must be verified. This study aimed to characterize the techno-functional properties of house cricket flour (HCF) and evaluate the effect of its concentration on the color and reflectance spectrum of raw-cured meat pastes. Dry-cured meat systems were formulated with 100% lean pork (control) and partial meat replacements with 5, 7.5, 10, and 12.5% HCF (T5, T7.5, T10, and T12.5). Each mixture contained 6% paprika and 5% date juice and was homogenized until uniform. Techno-functional properties (WHC, OHC, EC, ES, GC, and SC), mineral and proximate composition, and color parameters were determined following AOAC and AMSA guidelines. ANOVA and Tukey's test ($p < 0.05$) were used for statistical analysis. HCF showed WHC: 2.65 g g^{-1}; OHC: 1.48 g g^{-1}; EC: 44.8%; ES: 100%; GC: >20%; SC: 3.90 mL g^{-1}; and high protein content (73.5%) with notable levels of Fe, Zn, and Mn. No significant pH differences were found ($p > 0.05$), but water activity decreased with the addition of HCF. The *L**, *a**, and *b** color coordinates decreased slightly, with all samples within the orange-red range. Reflectance decreased as HCF concentration increased, with isosbestic points observed at wavelengths of 360–530 nm and 540–590 nm. HCF demonstrated strong potential for use in meat products. It caused minimal changes in techno-functional parameters while slightly affecting color. Concentrations above 10% produced no additional spectral differences, suggesting 10% as an optimal incorporation level.

Keywords:
Acheta domesticus flour, Techno-functional properties, CIELAB color coordinates, Reflectance spectra, Isobestic points, Meat systems

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Influence of Transmembrane Pressure and Membrane Characteristics on Polyphenolic Composition in Partially Dealcoholized Plavac Mali Wine

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The aim of this study was to evaluate the effect of partial dealcoholization by reverse osmosis using two different 1812 spiral-wound membranes (TRISEP® ACM3 and ACM4™) and two transmembrane pressures (25 and 35 bar) on the polyphenolic composition of Plavac mali wine. Wines were dealcoholized to achieve a 2% vol. reduction of ethanol. Concentrations of total polyphenols, tannins, anthocyanins and chromatic characteristics were determined spectrophotometrically, while free anthocyanins and flavan-3-ol monomers, dimers and trimers were analyzed by UHPLC/UV/FLUO/MS. Partial dealcoholization did not affect total polyphenols or tannins, as no significant differences were observed between dealcoholized and control wines. In contrast, anthocyanins showed a decreasing trend with increasing TMP, with the strongest reduction occurring when the ACM4 membrane was operated at 35 bars. Flavan-3-ol monomers, dimers and trimers also decreased under higher pressures, indicating that these compounds are sensitive to membrane selectivity and operating conditions, with the decline being more pronounced for monomers and dimers than for trimers. Chromatic properties reflected these compositional changes, showing reduced color intensity and a shift toward higher hue values consistent with anthocyanin loss. Overall, these results suggest that while reverse osmosis can effectively reduce alcohol content, careful consideration of processing parameters and membrane type is essential to preserve the phenolic and color characteristics of the wine.

Keywords:
Wine, Partial dealcoholization, Reverse osmosis, Anthocyanins, Procyanidins, Plavac mali

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Aroma Profile of Plavac Mali Wines Partially Dealcoholized by Reverse Osmosis: Effect of Operating Parameters

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Partial dealcoholization of wine by reverse osmosis (RO) was performed to reduce the alcohol content by 2% vol. The study was conducted on Plavac mali wine (15% vol.) using two different 1812 spiral-wound membranes (TRISEP® ACM3 and ACM4™), both operated at transmembrane pressures (TMPs) of 25 and 35 bar. The control (non-dealcoholized) wine was compared with RO-treated wines to investigate the potential impact of RO on the wine's aroma profile. Aroma compounds including terpenes, higher alcohols, esters, and fatty acids were analyzed by gas chromatography–mass spectrometry (GC/MS) following solid-phase microextraction (SPME). The results highlighted the importance of membrane type as well as TMP selection for determining wine aroma composition. RO using the ACM3 membrane resulted in significantly lower concentrations of esters—particularly ethyl acetate, ethyl butanoate, and ethyl hexanoate—as well as significantly lower concentrations of higher alcohols, primarily isoamyl alcohol ($p < 0.05$). In contrast, the ACM4 membrane produced significantly lower concentrations of terpenes and fatty acids. Moreover, the effect of TMP was more pronounced for the ACM3 membrane: operation at higher pressure (35 bar) resulted in significantly higher concentrations of ethyl acetate, 2-phenylethyl acetate, and ethyl hexanoate, as well as significantly lower concentrations of citronellol and isoamyl alcohol ($p < 0.05$). For the ACM4 membrane, operation at 35 bars resulted in significantly higher concentrations of 1-butanol and 2-phenylethyl acetate, along with slightly increased concentrations of isoamyl alcohol, 1-octanol, and decanoic acid ($p < 0.05$).

Keywords:
Wine, Partial dealcoholization, Reverse osmosis, Transmembrane pressure, Aroma, Plavac mali

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Cereal Grains as Sustainable Substrates for the Cultivation of Medicinal Mushrooms in Functional Food Development

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Ganoderma lucidum (Reishi) and *Pleurotus ostreatus* (Oyster mushroom) are two well-known medicinal mushrooms recognized for their rich profiles of bioactive compounds and growing importance in the development of functional foods. Use of cereal substrates as medium for cultivation of medicinal mushrooms could be promising for development of functional foods. Cereal grains have emerged as effective and sustainable substrates for the cultivation of medicinal mushrooms, offering both nutritional support and functional enhancement. The integration of cereal substrates not only improves the efficiency of mushroom cultivation but also contributes to the development of functional foods with enhanced therapeutic potential. This study evaluated the effects of cultivating *Ganoderma lucidum* and *Pleurotus ostreatus* on wheat bran, buckwheat, and barley groats as substrates. The cultivation period lasted 21 days, after which spectrophotometric methods and high-performance liquid chromatography (HPLC) analysis were performed to quantify selected bioactive and nutritional components, including glucans, total protein, flavonoids, ergosterol, ubiquinone, antioxidant activity, and polyphenols. The results revealed that fungal growth increased the concentrations of these compounds. Based on these findings, fungal–cereal composites can be considered promising candidates for the development of functional foods and nutraceutical products.

Keywords:
Medicinal mushroom, Cereal, Fermentation, Functional food

Acknowledgements
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Reuse of Hops after Dry Hopping

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This study explores the feasibility of reusing hops after their application in the dry hopping process, during which low temperatures limit the extent of alpha-acid isomerization. The objective was to assess whether such hops, once dried, still contain enough bitter compounds to be effectively reused in traditional kettle hopping. Two hop varieties, Styrian Dragon and Aurora, were applied in three- and five-day dry hopping treatments, then dried and reused in kettle hopping. Bitterness was evaluated spectrophotometrically (IBU) and via high-performance liquid chromatography (HPLC). Results indicated that the alpha-acid content decreased by 29% in Aurora and by 36% in Styrian Dragon following dry hopping. However, reused hops generated similar or even higher iso-alpha-acid concentrations compared to fresh hops, particularly after 60 min of wort boiling. The highest bitterness levels exceeded 90 IBU, confirming that hops maintain sufficient bittering potential after dry hopping. Overall, these results suggest that reusing hops post dry hopping is technologically viable and represents a sustainable strategy for minimizing waste and reducing raw material costs in brewing.

Keywords:
Hops, Reuse, Dry hopping, Bitterness, Iso-alpha-acids

Novel Approach for Production of Low Carbohydrate Beer

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The growing global demand for sustainable and nutritious food sources has intensified the search for novel protein alternatives, with plant-based proteins receiving particular attention. Despite their potential, the efficient isolation of high-quality proteins from plant materials remains challenging, primarily due to the presence of dietary fiber and various antinutritional compounds. Each step in an improperly designed isolation process can lead to significant changes in protein characteristics, affecting not only their functional but also their nutritional properties. One of the most critical yet potentially harsh steps in protein isolation is drying. The impact of drying conditions on protein properties was investigated using wheat bran protein isolated via the pH-shift method. The protein fraction was extracted using 0.05 M NaOH (1:10 w/v) for 1 h. After centrifugation, the supernatant was collected and acidified to pH 4 using 1 M H_2SO_4 to induce protein precipitation. The resulting suspension was centrifuged again, and the obtained protein sediment was subsequently spray-dried under varying inlet (180 – 200 °C) and outlet temperature (70 – 90 °C) conditions. The characteristics (protein content, water and oil holding capacity, solubility, SDS-PAGE etc.) of the spray-dried wheat bran protein isolate (WBPI) samples were then compared to those of similarly prepared freeze-dried samples. Statistical analysis confirmed that the drying method significantly influenced the properties of WBPI. Freeze-drying was found to be a gentler technique, better preserving the native protein structure. However, with optimized process parameters, especially outlet temperature, the limitations of spray-drying can be mitigated. With the correct spray drying temperature settings, the protein content in the isolated material can be increased by up to 5%. Furthermore, spray-drying may beneficially alter certain functional properties of proteins. For the spray-dried WBPI samples, a decrease in oil-binding capacity of more than 50% was observed compared to the lyophilized WBPI (2.931 ± 0.146 g g^{-1}). The water-binding capacity of the spray-dried WBPI decreased by approximately 25% (2.180 ± 0.077 g g^{-1}). However, the improvement of WBPI solubility was observed after spray-drying.

Keywords:
Low-carbohydrate beer, Diastatic malt, Mashing optimization, Enzymatic saccharification

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Production and Characterization of Functional Flakes Products from Different Types of Maize (*Zea mays* L.)

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The combination of climate change, rapid population growth and an aging demographic underlines the growing imperative on human health and food security. Cereal-based products such as flakes and snacks are widely consumed in everyday diets, spanning ready-to-eat breakfast cereals. Enriching these foods through the incorporation of functional ingredients is a promising way to enhance their health-promoting potential. Corn is one of the most diverse of the world's grain crops and plays an especially important role in the world's agriculture and food supply. Developing novel colored genotypes contributes to the increased availability and range of commercial production of pigmented maize varieties. Different maize types—white, yellow, red and black—have attracted considerable attention from researchers, industry and consumers alike. This study examines the simultaneous effects of maize type (white, yellow, red and black) and screw speed (350, 500, and 650 rpm) on the physical, technological and functional properties of flake products. Among the treatments, flour made from black maize extruded at 350 rpm showed the best physical-technological performance, mineral composition and antioxidant activity. The combination of Tukey's HSD test and principal component analysis allows for an in-depth investigation of statistically significant differences among attributes and the classification of samples based on these attributes. The findings indicate that flakes produced from black maize flour at 350 rpm represent a novel functional cereal product, combining excellent physical-technological and functional properties—chiefly elevated antioxidant activity—and therefore show strong potential for market introduction as a functional snack product. Therefore, it can be concluded that type of corn and screw speed of extruder significantly affected physical-technological, mineral, and biochemical characteristics of the flake product. In the case of increased screw speed, positive changes in physical-technological features of flakes, prepared from various types of corn, were observed: bulk density and hardness decreased, while the expansion index increased.

Keywords:
Flakes products, Black corn, Functional foods, Extrusion

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Gelatin-Zein Coated Paper Sheet with Enhanced Properties for Food Packaging Applications

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The growing demand for environmentally friendly and functional packaging materials has driven the development of coated paper formulations with improved mechanical and barrier properties. However, the application of gelatin-zein coatings in paper packaging remains limited, particularly in terms of performance comparison between different coating substrates. Protein-based films offer excellent oxygen barrier properties, high malleability, and elasticity, helping protect food from physical damage, environmental exposure, and quality loss. Corn protein is primarily composed of zein, which is rich in hydrophobic amino acids but deficient in essential ones such as tryptophan and lysine. Zein's role in food preservation has not been sufficiently explored by application type, which is essential for its scientific development and targeted use. Zein forms strong hydrogen bonds with gelatin, creating stable nanofiber films. Gelatin/zein nanofibers show better flexibility and retain a 3D porous structure even after 24 h in water or ethanol. In this study, rice straw paper was coated with glycerol-plasticized gelatin containing using impregnation and lamination techniques. The effects of coating on grammage, bulk density, morphology, mechanical strength, and water/gas barrier properties were evaluated. The coated paper demonstrated a uniform gelatin-zein distribution, confirmed by scanning electron microscopy. Water vapor permeability significantly decreased from 3.090×10^{-13} g·m/m²·s·Pa (calendered paper) to 1.94×10^{-13} g·m/m²·s·Pa when a sizing agent was added. Water contact angle measurements showed 114° for calendered paper and 109° for sized + calendered paper, indicating increased hydrophobicity in both cases. Moreover, both paper types exhibited improved mechanical properties (breaking length and tear index) and enhanced barrier performance following coating application. In conclusion, rice straw paper shows strong potential for sustainable food packaging when coated with gelatin-zein formulations. Calendared paper provided better coating uptake and higher hydrophobicity, while sized and calendared paper achieved lower water vapor permeability and superior barrier performance. The optimal choice depends on whether higher coating absorption or lower permeability is preferred, making both coated papers viable for targeted food packaging applications.

Keywords:
Gelatin-Zein Coating, Paper Functional Properties, Food Preservation, Barrier Performance, Biopolymeric Films

Influence of Intermittent Microwave Assisted Convective Drying on Microstructure of Avocado Peel

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Drying is a crucial post-harvest operation that extends the shelf life of fruit by-products and enhances their potential use as functional ingredients. This study investigates the microstructural differences between convective-dried and intermittent convective–microwave dried avocado (*Persea americana*) peel, focusing on both inner and outer surfaces using scanning electron microscopy (SEM) at 2000× magnification. Although several studies have examined the drying behavior of avocado peel, the structural changes in avocado peel during drying have not been thoroughly investigated. In this work, avocado peels were dried using a combined microwave and hot-air drying method (IMCD) at 60 °C, with microwave power levels ranging from 90 to 360 W applied intermittently in 2-min intervals. The outcomes were then compared to those obtained from conventional convective drying (CD) conducted at 60 °C. The results show that the drying technique significantly affects surface morphology, structural integrity, and microtopography. Intermittent microwave-assisted convective drying accelerated drying but caused greater microstructural damage, resulting in a porous, irregular, and fractured outer surface. These structural differences have functional implications. The rougher and more porous surface produced by IMCD drying may enhance water adsorption or extractability of bioactive compounds due to increased surface area and microchannel exposure, while the surface of the convective-dried peel may better retain mechanical strength. This study contributes to the growing field of hybrid drying technologies and supports the use of fruit by-products as natural sources of antioxidants and colourants in food and nutraceutical applications.

Keywords:
Intermittent microwave drying, Convective drying, Avocado peel, SEM

Nutrition, Consumer Behavior and Global Health Challenge

Effect of Confitera Date Flour Addition on the Technological and Sensory Properties of Frankfurt-Type Sausages

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Meat products are increasingly questioned regarding sustainability, health implications, and changing consumer habits. In terms of sustainability, the use of zero-mile or local ingredients, as well as higher fiber and mineral content, is gaining support. Spain hosts the largest palm groves in Europe, and the production of fresh dates (Confitera cultivar) presents a highly attractive opportunity. Confitera dates are an excellent source of fiber and potassium (over three times higher than average) and possess remarkable antimicrobial and antioxidant properties beneficial for the meat industry. Through the valorization strategy AGROALNEXT VALORACV, date processing allows sugar reduction and yields a “flour-type” product suitable for various food industries. This flour exhibits promising techno-functional properties, including water and oil holding capacity and emulsifying ability, making it an interesting new ingredient for meat products. The aim of this study was to evaluate the technological feasibility of adding date flour at different concentrations (0, 3, and 6%) and its effects on the chemical, physical, physicochemical, and sensory properties of Frankfurt-type sausages. Three independent batches were prepared for each concentration. Proximate analyses were performed according to AOAC methods, color was determined following AMSA guidelines, and oxidation was measured using the TBA method. ANOVA was applied for statistical evaluation. Sensory attributes–general appearance, color, firmness, juiciness, overall flavor, and overall taste–were assessed using a 9-point hedonic scale. Results showed that the addition of date flour did not significantly alter the nutritional composition of the product. The formulation proved industrially viable, enhancing technological and sensory properties, and notably improving oxidative stability. From a sensory perspective, samples containing 3% date flour achieved the highest ratings, mainly due to their improved appearance, firmness, flavor, and overall taste, confirming the potential of date flour as a functional and sustainable ingredient in meat product innovation.

Keywords:
Date palm fruit, Dietary fiber, Confitera date, Frankfurt-type sausage, Meat color, Lipid oxidation

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Preparation and Characterization of Bioactive Gelatin Hydrolysate from Seabass Scales (*Lates calcarifer*): Antioxidant and DPP-IV Inhibitory Properties

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This work aimed to prepare and characterize fish scale gelatin hydrolysates containing bioactive properties. Gelatin was extracted from seabass (*Lates calcarifer*) scales and hydrolyzed using 3% papain for 5 h. The resulting gelatin hydrolysate exhibited higher antioxidant and anti-diabetic activities than fish scale gelatin. It yielded 69.84 ± 0.97% hydrolysate, with a degree of hydrolysis of 74.59 ± 1.26%, and an IC_{50} value of 2.49 ± 0.12 mg mL^{-1} for dipeptidyl peptidase-IV (DPP-IV) inhibitory activity. The IC_{50} values for the antioxidant activities of the fish scale gelatin hydrolysate were 2.39 ± 0.02 mg mL^{-1} for DPPH, 2.48 ± 0.07 mg mL^{-1} for ABTS, 1.48 ± 0.02 mg mL^{-1} for hydroxyl radicals (OH), and 13.87 ± 0.38 mg mL^{-1} for hydrogen peroxide (H_2O_2). Fractionation of the hydrolysate was performed using ultrafiltration membranes with molecular weight cut-offs of >10 kDa, 3–10 kDa, 1–3 kDa, and <1 kDa. Among these, the 3–10 kDa fraction exhibited the highest bioactivities, with IC_{50} values of 3.17 ± 0.18 mg mL^{-1} for DPPH, 2.80 ± 0.07 mg mL^{-1} for ABTS, 1.40 ± 0.02 mg mL^{-1} for OH, 8.88 ± 0.05 mg mL^{-1} for H_2O_2, and 2.89 ± 0.07 mg mL^{-1} for DPP-IV inhibitory activity. These results suggest that fish scales are a sustainable and valuable source for producing bioactive peptides with potential applications in functional foods and nutraceuticals.

Keywords:
Fish gelatin hydrolysate, Antioxidant, Anti-diabetic, By-products, Fish scale

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Colonic Absorption May Underlie Unchanged Faecal SCFAs after Prebiotic Inulin-Type beta-Fructans Intake in Patients with Psoriasis: Project INGUTSKIN

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Psoriasis is associated with chronic immune activation, which has been linked to increased gut permeability and microbial imbalance. Prebiotics are widely recognised for their potential to support gut health by promoting microbial homeostasis. We conducted a randomised controlled trial to assess the impact of an inulin-based prebiotic on faecal short-chain fatty acids (SCFAs), key metabolites of bacterial fermentation, in patients with mild psoriasis. Fifty-six participants with psoriasis were randomised to receive either inulin formulation (2 × 7.5 g/day) or a maltodextrin placebo for eight weeks. A healthy control group of 32 adults was included for baseline comparison. Faecal SCFAs were determined using gas chromatography with flame ionisation detection after diethyl ether extraction in the presence of 2-ethylbutyric acid, against calibration standards. At baseline, total faecal SCFAs averaged 59 $\mu mol \cdot g^{-1}$ in patients and 67 $\mu mol \cdot g^{-1}$ in healthy controls. Acetic acid was the predominant SCFA (>30 $\mu mol \cdot g^{-1}$), followed by propionic and butyric acids (~10 $\mu mol \cdot g^{-1}$), while branched-chain SCFAs and valeric acid were present in smaller amounts (4 and 1.5 $\mu mol \cdot g^{-1}$, respectively). After the eight-week intervention, total SCFAs remained stable in the prebiotic group (70 $\mu mol \cdot g^{-1}$) but increased in the placebo group (81 $\mu mol \cdot g^{-1}$). Statistical analysis showed no significant differences in total or individual SCFAs between psoriasis patients and healthy controls, except for iso-butyric acid, which was higher in psoriasis (1.96 $\mu mol \cdot g^{-1}$, $p < 0.05$). Linear SCFAs increased over time ($p < 0.05$), with a significant intervention–time interaction for butyric acid, which rose more in the placebo group ($p < 0.05$). Overall, supplementation with prebiotic inulin did not significantly alter the faecal SCFA profile in patients with psoriasis. The apparent stability of SCFA concentrations may reflect efficient colonic absorption rather than a lack of microbial fermentation. Alternatively, microbial shifts may have occurred without affecting overall SCFA production.

Keywords:
Psoriasis, Prebiotics, Inulin-type beta-fructans, Short-chain fatty acids, Faecal metabolites, Gut health

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How Social Determinants of Dietary Habits Drive Childhood Obesity: Insights from the CroCOSI Study

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According to the latest data, 36.10% of children in the Republic of Croatia have overweight and obesity. The aim of this study was to examine the understudied social determinants of dietary habits associated with obesity. The study was conducted on a nationally representative sample of 5608 children (51.0% boys and 49.0% girls) from 234 elementary schools across Croatia, as part of the CroCOSI study. Results show that children who regularly have breakfast, have a lower risk of obesity, whereas children who consume breakfast only at school have a higher likelihood of developing obesity. More frequent consumption of fruit, vegetables, breakfast cereals, and sweet snacks is associated with a lower likelihood of obesity, while more frequent consumption of soft drinks increases the risk. Children whose mothers (OR = 1.33; 95% CI 1.01–0.76) and fathers (OR = 1.34; 95% CI 1.01–2.78) have a university degree are more likely to have breakfast daily. Children of fathers with a secondary school education more frequently consume fruit (OR = 0.75; 95% CI 0.58–0.98), while children of mothers with secondary education more frequently consume vegetables (OR = 0.57; 95% CI 0.43–0.77). Children of mothers with higher education less frequently consume cereals (OR = 0.55; 95% CI 0.36–0.86). An increase in parental education level is associated with reduced consumption of soft drinks and sweet snacks. Consumption of soft drinks decreases with higher household income per capita (OR = 1.00; 95% CI 0.99–0.99), while a larger number of household members increases the frequency of sweet snacks consumption (OR = 1.05; 95% CI 1.01–1.09). These findings highlight the importance of social factors in shaping dietary habits and emphasize the need for targeted public health interventions to prevent childhood obesity the importance of social factors in shaping dietary habits.

Keywords:
Dietary habits, Obesity, Children, Socioeconomic determinants

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The Interplay Between Ultra-Processed Food Consumption and Mediterranean Diet Adherence in Relation to BMI Among American Adults

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Ultra-processed foods (UPFs) contribute nearly 60% of American's diet and are associated with increased risk of a number of negative health outcomes. Few studies have observed the influence of UPF intake on adherence to healthy dietary patterns, such as the Mediterranean diet (MD), and their combined effect on health. The purpose of this study is to examine the relationship between UPF intake and Mediterranean diet adherence, and their combined effect on body mass index (BMI) among American adults. We drew on data from the 2017/18 National Health and Nutritional Examination Survey. Participants aged ≥18 years with complete dietary data were included in our study (n = 4339; 52.15% female). Dietary data collected by two 24-hour recalls were classified according to the Nova system for UPFs. MD adherence was assessed using a modified version of a literature-based MD score, and participants were arranged into tertiles. BMI was calculated based on height and weight measured in the Mobile Examination Centre. The average MD score was 6.77 (SE: 0.07). Those in the first MD tertile had the highest ($p < 0.0001$) UPF intake (60.06% daily energy intake), followed by the second (55.41%), and third tertiles (48.00%). Logistic regression analyses demonstrated that higher UPF intake was associated with higher odds of being in the lowest MD tertile in unadjusted (OR: 12.98; CL 95%: 6.85-24.61) and fully-adjusted (OR: 9.26; CL 95%: 4.58-19.73) models. The average BMI was 29.75 (SE: 0.29) and was significantly lower in higher MD tertiles ($p > 0.0001$). Following linear regressions, the relationship between UPF intake and BMI was significant even with consideration for MD adherence in unadjusted (β: 4.28; SE: 0.67) and fully-adjusted (β: 3.37; SE: 0.85) models. These findings demonstrate that UPF intake is related to adiposity independent of diet quality, prompting future research to examine potential mechanisms linking UPF to poor health.

Keywords:
Ultra-processed foods, NOVA, Mediterranean diet, Weight status

Acknowledgements
The linkage of the Nova Classification System for Industrial Food Procession with ASA24 (version) and NHANES Dietary Data (years/cycles) is supported in part by the National Cancer Institute, Bethesda, MD.

Assessing the Nutritional Adequacy of Food-Surplus Redistribution Menus in Yogyakarta, Indonesia

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Food rescue organisations emerged as initiatives to prevent food waste in the community, aiming to reduce hunger by redistributing surplus food from food businesses. Surplus food can be nutritious, but its nutritional content is sometimes not prioritised. Aim: To estimate the nutritional content and composition of surplus food from the food donors of a Food Rescue Organisation in Yogyakarta, and evaluate the content based on dietary recommendations in Indonesia. Method: This cross-sectional study collected data on the quantity, menus, and types of surplus food redistributed by Berbagi Bites Jogja from hotels and bakeries to food charity recipients from July 2024 to October 2025. The nutritional content was estimated by calculating macronutrients using the Indonesian Food Composition Table (TKPI) database by the Ministry of Health of Indonesia. For comparison, the Recommended Dietary Allowance (RDA) for the Indonesian population (AKG 2019) was used as the standard for children, adolescents, and adults. Results: Among all the redistributed food, the amounts of energy, total fat, and carbohydrate remain inadequate (less than 30% of the RDA) for all population standards. Only the amount of protein for the child and adult standards fulfills more than 30% of the DRI. There is no significant difference in nutritional fulfilment among the eight food donors. Only carbohydrates show a significant difference across all donors, with food donor A fulfilling more than 30% of the DRI for carbohydrates ($p < 0.05$). The donated surplus food groups were mainly sourced from grains and cereals by seven of the eight food donors, with ingredients including rice, noodles, pasta, and bread. This study suggests that all actors in food rescue activity should consider the nutritional quality aspects. Furthermore, this study encourages nutritional quality improvement of surplus food while highlighting that food charities not only contribute to waste prevention but also support public health outcomes.

Keywords:
Nutrition evaluation, Food donation, Surplus food, Food rescue, Food redistribution, Food waste prevention

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Fructan Content in Slovenian Food and Estimated Consumption of Fructans in Adult Population

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This study evaluates the fructan content in 40 commonly consumed foods in Slovenia and estimates daily fructan consumption to assess its role in FODMAP (fermentable oligo-, di-, monosaccharides, and polyols) intake, relevant to irritable bowel syndrome (IBS) management. Fructans, especially short-chain types, can exacerbate IBS symptoms due to their rapid fermentation in the gut. The analysis showed that the fructan content in food was generally low, ranging from 0.1 to 1.97 g 100 g fresh weight^{-1}, with onions having the highest concentration (1.97 g 100 g^{-1}) followed by wheat flour (0.75 g 100 g^{-1}). To estimate daily fructan intake, a model was developed using food consumption data from the SiMenu 2017/2018 survey, which recorded the frequency and quantity of food consumption. By combining this data with the measured fructan contents, the study estimated an average daily fructan intake of 1.6 to 1.7 g day^{-1} in the Slovenian population, with no significant difference between genders. This assessment offers initial insights into FODMAP consumption at a national level and contributes to the foundation for a FODMAP intake database. Such data is essential for understanding the dietary impact on IBS symptoms and can inform dietary management strategies. The study highlights that while individual foods may have low fructan content, cumulative daily intake is relevant for individuals sensitive to fermentable carbohydrates. Future research should expand the food database and refine intake estimates to improve dietary guidance for IBS patients and the general population.

Keywords:
Fructan content, Daily consumption, FODMAP intake

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Caffeine Consumption Patterns and Mental Health in Higher Education Students: Insights from a Portuguese Population

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Caffeine, the most consumed psychoactive substance globally, can improve alertness and mood in moderate doses but may have adverse effects when consumed excessively. This study assessed caffeine intake patterns and their association with anxiety, stress, and depression among Portuguese higher education students. A cross-sectional study was conducted with a convenience sample of 292 students. Data were collected through an online questionnaire comprising sociodemographic and lifestyle variables, a semi-quantitative food frequency questionnaire assessing caffeine-containing foods and beverages, the Caffeine Motives Questionnaire, and the Portuguese validated version of the DASS-21 scale for the assessment of anxiety, stress, and depression. The sample consisted predominantly of female students (77.1%) with a mean age of 22 years. Mean daily caffeine intake was 119.6 ± 130.9 mg, mainly from espresso coffee (49.7 ± 62.5 mg). Only 2.1% of participants reported no caffeine consumption, while 3.1% exceeded the recommended upper limit. Caffeine intake was positively associated with age and was higher among smokers. The main motivations for consumption were combating sleepiness, enhancing alertness, and enjoying the taste. Most participants presented normal levels of depression (63.7%), anxiety (58.2%), and stress (61.6%), reflecting overall normal emotional well-being. Female students reported significantly higher scores in all three dimensions. Higher anxiety and stress scores were significantly correlated with greater intake of decaffeinated products ($R = 0.191$, $p = 0.001$; $R = 0.216$, $p < 0.001$) and chocolate-based products ($R = 0.157$, $p = 0.007$; $R = 0.168$, $p = 0.004$). Depressive symptoms were positively correlated with the consumption of cocoa beverages ($R = 0.137$, $p = 0.020$) and alcoholic beverages mixed with energy drinks ($R = 0.126$, $p = 0.031$). Caffeine consumption among participants was common but generally remained well below the recommended upper limit of 400 mg per day. No significant associations were found between total caffeine intake and symptoms of anxiety, stress, or depression. Overall, caffeine use was moderate and compatible with good mental health status in this population.

Keywords:
Caffeine consumption, Consumer behaviour, Anxiety, Stress, Depression

Encapsulation of Probiotic Strains with Edible Biopolymers: Advantages for Targeted and Controlled Release of Bioactive Compounds

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Recent studies have highlighted the potential of biopolymers as encapsulation materials for bioactive compounds, opening new opportunities in different applications. Their unique properties, particularly the ability to achieve controlled and targeted release of active constituents, have made biopolymers increasingly attractive for drug delivery, both in industry and consumer applications. Research has explored the development of biopolymer-based capsules incorporating powders, essential oils, pharmaceutical compounds such as vitamins or drugs, antioxidants, polyphenols, active ingredients, or probiotics. Notably, encapsulated probiotics showed enhanced viability over non-encapsulated forms. The present study focuses on the encapsulation of *Lactobacillus plantarum* within a biopolymer matrix composed of sodium alginate and starch. Capsules were prepared using the extrusion method. Physical properties, such as microstructure, microtopography, diameter, mass, swelling ratio, transmittance, opacity, and color were assessed. Antioxidant activity through DPPH radical scavenging assay was performed. The survival rate of *Lactobacillus plantarum* was evaluated under simulated gastric and intestinal conditions. The results demonstrated that encapsulation of the probiotic strain enhanced its viability and targeted delivery, exhibiting minimal solubility in the gastric environment while undergoing complete dissolution in the intestinal environment. Capsule diameters ranged from 3.01 to 4.19 µm, with no visible pores or fissures. Color variations were minimal and dependent on the biopolymer composition, with luminosity increasing in the order: sodium alginate < starch-alginate mixture < starch. In simulated gastrointestinal fluids, capsules slightly decreased in size in gastric juice and expanded in intestinal juice. Capsules with higher starch content exhibited the greatest swelling, whereas those with higher alginate content swelled the least. These results confirm that both sodium alginate and starch are effective encapsulation materials for bioactive compounds. In vitro testing showed that the capsules remained stable in gastric fluids and disintegrated in intestinal fluids. Starch addition proved to be a cost-effective strategy that facilitated capsule disintegration in intestinal conditions.

Keywords:
Sodium alginate, Starch, Health, Wellness, Nutraceutical delivery, Probiotics

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Leftover Challenge: From Play to Educated Changes

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The Leftover Challenge project, culminating in a classroom-ready game, aims to educate students about food waste and its reduction. This presentation details the game's development, testing, and refinement across five European countries (Slovenia, Italy, Greece, Netherlands and Romania), incorporating feedback from students, teachers, and partners. The game's design followed a structured process, emphasizing creativity and iterative improvement. Key insights from the project's Best Practices Report for preventing leftover food highlighted the need for hands-on, interdisciplinary learning, simple language with clear visuals, and activities engaging families and the wider community. The game aimed at raising awareness about environmental impact of the food was tested through paper prototypes with students aged 8-12. Initial feedback led to improvements in visuals, instructions, and learning goals. A second prototype confirmed the changes made the game more accessible and engaging, boosting both students understanding and teacher confidence. Key challenges included addressing abstract concepts like environmental scoring and geographic navigation, particularly among younger students. The game presents selected foods and informs about environmental impact of the food and the logistics needed to make this food available. There is also emphasizes on less typical forms of food. Cultural sensitivity and localization were also addressed by including regional examples and making the game available in multiple languages. The final stage involves finalizing translations and creating a user guide for teachers, ensuring they feel prepared and supported. The finished game will be distributed to participating countries, inviting students to explore food origins, waste reduction strategies, and the impact of their food choices. The Leftover Challenge game aims to be understandable, fun, meaningful, and ready to inspire new conversations about food, sustainability, and the future.

Keywords:
Educational game, Food waste reduction, Environmental impact, Interdisciplinary learning

Body Mass Index and Puberty Onset in Croatian Boys

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This study examines the relationship between body mass index (BMI) and the onset of puberty among 300 boys aged 11.5 ± 0.4 years from the City of Zagreb and its surroundings in Croatia (first, 2022-2023 wave of the PyrOPECh project). Anthropometric measurements and assessment of pubertal status were carried out using Tanner's staging system by school medicine specialists as part of a periodic health examination for elementary school students. To assess long-term dietary intake, a specially designed food propensity questionnaire (FPQ) comprising 111 questions was used. Parents or guardians participated as proxies in the dietary assessment. According to World Health Organization recommendations, BMI was expressed as a BMI z-score depending on the boy's ag e. In total, 9% of boys were classified as underweight, 54% had normal weight, 23% were overweight, and 14% were obese. More than half (55%) of overweight and obese boys started puberty, compared to 30% of underweight boys and 46% of boys with normal weight. A higher z-scored BMI was associated with higher odds of puberty onset (odds ratio 1.36 with 95% confidence interval [1.09, 1.72]; p = 0.008) in a logistic regression model adjusted for boys' age and usual physical activity, season, maternal age at menarche, and weight gain during pregnancy, parental education, and area of residence. Overweight and obese boys had a significantly higher frequency of consumption of pâté (Mann-Whitney test p = 0.019) and fish products (e.g. fish fingers) (p = 0.024) compared to boys of normal weight. The same trend was noted for wienerwurst and pork fat, although the difference was not statistically significant (p = 0.08 for both comparisons). The observed link between childhood overweight and early puberty onset in boys, along with their poor dietary habits, emphasizes the need to enhance national nutrition initiatives and encourage healthier eating habits among adolescents.

Keywords:
Adolescence, Dietary assessment, Elementary school students, Food propensity Questionnaire, Nutrition, Tanner stages

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Rethinking Dairy Quality: Implications of β-Casein for Human Health and Consumption

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Traditional quality indicators in dairy products such as sensory, physicochemical, and microbiological parameters have historically overshadowed nutritional quality. Although milk caseins are widely recognized as valuable animal proteins in the human diet, emerging evidence suggests that β-casein plays a critical role in consumer health. The importance of nutritional quality as a key indicator of overall dairy quality is evident, and consequently, the objective of this research was to analyze the current state of the scientific literature on the relationship between β-casein nutritional quality and human health outcomes. This objective was addressed through a systematic literature review methodology using the Scopus database. The findings revealed that A1 and A2 β-casein are the two most prevalent genetic variants, differing by a single amino acid at position 67 (histidine vs. proline), yet this minor variation leads to significant physiological differences. A1 β-casein promotes a higher release of the bioactive opioid peptide β-casomorphin-7, which has been associated with gastrointestinal discomfort, intestinal inflammation, dysbiosis, impaired gut barrier function, dairy intolerance, and an increased risk of type 1 diabetes and ischemic heart disease. Conversely, A2 β-casein appears to exert fewer adverse effects, positioning it as a potentially healthier alternative for dairy consumers. This review identifies critical research gaps and future challenges in dairy science, particularly regarding β-casein profiling as a tool for improving nutritional quality. These findings highlight the need to redefine dairy quality standards beyond traditional criteria, integrating molecular and health-relevant markers. Establishing β-casein composition as a criterion for product classification could contribute to more informed dietary recommendations and innovation in the dairy industry.

Keywords:
Protein, β-casein, Nutritional quality, Dairy products, Human health

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Is Dairy Product Intake Related to the Short-Chain Fatty Acids Profile in Men with Asthenozoospermia?

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Dairy products are one of the main food groups providing the body with essential nutrients and may influence the gut microbiota's diversity and activity. In light of emerging research on diet–microbiota interactions, the aim of the present study was to examine the influence of dairy product consumption on SCFA profiles in men with asthenozoospermia. A cross-sectional study was conducted in 2022 among 90 men aged 18–49 years. Dairy product consumption was assessed using a validated semi-quantitative Food Frequency Questionnaire (FFQ) of 145 food items. Based on the literature, low-lactose products were those containing less than 2 g of lactose per 100 g of product, and dairy products were classified as low-fat when the fat content was 2% or less for milk and less than 5% for other dairy products.The evaluated reproductive biomarkers included semen analysis using computer-assisted semen analysis (CASA) and a hormonal profile comprising serum testosterone, LH, FSH, and SHBG. Asthenozoospermia was detected in 13 men. LC-MS/MS were used to measure stool SCFAs (acetic acid, propionic acid, butyric acid, isovaleric acid, valeric acid, and caproic acid). The mean daily dairy product intake was 352.9 ± 230.3 g. A positive correlation was observed between FSH and acetic acid ($r = 0.648$, $p < 0.047$), as well as between intake of semi-skimmed/low-fat dairy products and isovaleric acid ($r = 0.643$, $p < 0.018$). Consumption of high-lactose dairy products was also positively correlated with isovaleric acid ($r = 0.593$, $p < 0.033$. In contrast, intake of full-fat dairy products showed a significant negative association with caproic acid ($r = –0.555$, $p < 0.049$). These findings highlight differential relationships between specific dairy categories and the SCFA profile, suggesting that dietary fat and lactose content in dairy products may play role in shaping gut microbial metabolism in men with reduced sperm motility. Further research is warranted to confirm the mechanisms underlying observed relationships.

Keywords:
Diet, Male fertility, Microbiota, Short chain fatty acids, Dairy products, Nutrition

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Consumers' Food Safety Awareness, Risk Perceptions and Related Behaviors in Croatia and EU: Insights from the Eurobarometer 2025

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Consumers' awareness and perceptions of food safety–related risks are crucial, as they shape attitudes, purchasing behavior and trust in regulatory systems, which in turn affect both, regulatory decisions and food production practices. To examine these perceptions and linked attitudes, the Eurobarometer 2025 on Food Safety in the EU survey was conducted across all EU Member States and seven candidate countries. Differences were observed across countries, as well as age, gender, profession, and education level, highlighting that food risk perception is multidimensional and influenced by various social and demographic factors. Key findings indicate that Croatian results largely mirror those at the EU level, with cost and food safety as primary factors influencing food purchasing choices, while product origin as well holds greater importance in Croatia. Awareness of food safety issues remains high, both at EU level and Croatia, with particular attention to antibiotic and hormone residues, pesticide residues, additives, and growing concerns about microplastics. Television remains the dominant source of information, both in Croatia and Europe, while social media and online platforms are gaining importance. Trust in EU institutions and national food safety authorities has grown, with Croatia showing the largest increase in institutional trust among Member States. Overall, findings suggest that food risk perception and related behaviors are complex and influenced by both individual and contextual factors, reflecting specific national priorities in Croatia while remaining largely aligned with broader European trends.

Keywords:
Food safety, Risk perception, Consumer awareness, Croatia, EU, Eurobarometer

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Development of Almond-Coconut Bonbon Assortments with Focus on Their Physico-Chemical, Nutritional, Textural, Sensory, and Biological Activities

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The evolving dietary preferences towards healthier options remain a significant topic of discussion. There is a necessity for the creation of innovative products with improved attributes to satisfy the needs of modern consumers. This research examines the formulation of raw bonbons made from almond “milk” and various fruits (apricots, plums, and their hybrid) while analyzing and comparing their physico-chemical properties (such as moisture and ash content, color spectra, titratable acidity, pH), nutritional composition (calculation method), textural characteristics in dynamics at days 1, 3 and 5 of storage, antioxidant activity, vitamin C content and water activity (days 1, 3 and 5 of storage). A control sample was included alongside three variations of the original recipe corresponding to each fruit (apricot, plum, and plum-apricot). The moisture content varied from 2.94 ± 1.66% (variation 2) to 4.78 ± 1.94% (variation 1). All samples exhibited steady water activity data during the 5 days of storage. The CIE-Lab data indicated differences among the three fruits utilized for the bonbon base. The findings suggest that, although there is a degree of similarity among the samples, the selection of fruit influences the final product. Future studies could provide even more valuable insights for desserts without added sugar.

Keywords:
Beneficial nutrition, Plant-based nutrition, No added sugar, Prunus fruits, Raw snacks

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Insect Powders (*Acheta domesticus* and *Tenebrio molitor*) as Functional Ingredients for the Development of Hybrid Sausages

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This work is part of the SPRINT project between researchers from the Sao Paulo State (Brazil) and Miguel Hernandez University (Spain) UMH-FAPESP. The growing demand for sustainable protein sources has driven interest in alternative ingredients with lower environmental impact. Edible insects have emerged as a promising option due to their high nutritional value, superior feed conversion efficiency compared to traditional animal-based proteins and reduced resource requirements, contributing positively to climate change mitigation. In this sense, the development of hybrid meat products has emerged as a more sustainable alternative to the consumption of traditional meat products. This study evaluated the partial replacement of meat with cricket (*Acheta domesticus*, AD) and mealworm (*Tenebrio molitor,* TM) flours in the formulation of an emulsified meat product: Frankfurt-type sausages. Five different formulations were developed by varying the type of insect flour (AD or TM) and its inclusion level (7.5 and 15% w/w). The flours were characterized for their physico-chemical and techno-functional properties, while the sausages were assessed for proximate composition, physico-chemical parameters, and sensory acceptability. Results showed that sausages with a flour content of 7.5% flour achieved the best balance between technological functionality and consumer acceptance. Both insect flours demonstrated favorable water and oil binding capacities, with AD flour exhibiting superior performance, which contributed to improved emulsion stability in a concentration-dependent manner. Protein content increased with higher flour levels, particularly in the 15% AD formulations. Sensory analysis indicated that sausages with 7.5% substitution were the most acceptable to consumers. In conclusion, *Acheta domesticus* and *Tenebrio molitor* flours represent viable functional ingredients for the reformulation of meat products, offering potential for the development of more sustainable and nutritionally enhanced alternatives (hybrid meat products) without compromising sensory quality.

Keywords:
Edible insects, Hybrid meat products, Sausages, Sustainability, *Acheta domesticus*, *Tenebrio molitor*

Acknowledgements
This work is part of the SPRINT project between researchers from the Sao Paulo State (Brazil) and Miguel Hernandez University (Spain) UMH-FAPESP.

Perspectives and Challenges Functional Cookies with Osmotic Dehydration Peach to Improve Human Diet and Modern Lifestyle

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Urban population has been increasingly characterized by sedentary lifestyle, low physical activity and a reliance on "fast food." Today, the focus is on increasing the use value of secondary food industry products such as sugar beet molasses. Osmotic dehydration is a simple process because it does not require energy consumption or high temperatures. Peaches are aromatic fruits with a sweet taste, high organoleptic properties and a favorable nutritional content (free of sodium, fat and cholesterol and a rich content of vitamins A and C). Cookies are a top-rated wheat-based product consumed worldwide due to their different flavors, reasonable price, long shelf life and readiness to eat. Modifying cookie formulations to enhance their nutritional and functional qualities often alters the dough properties, which in turn affects the quality of the final product. For this reason, the impact of adding osmotic dehydration peach (ODP) on technological, nutritive and sensory characteristics of cookies was investigated in this work. Cookie samples were produced the pilot plant of the Institute of Food Technology in Novi Sad according to the standard procedure of the AACC method, which included dough mixing, shaping and baking with the addition of 5, 10, 15, and 20% ODP as a replacement for part of the flour. The technological characteristic of the cookies were determined by the baking in weight loss (from 7.9 to 16.0%), diameter to thickness ratio R/T ratio (from 6.01 to 7.61) and the hardness (from 5.5 to 45.4 g). The addition of ODP to cookies leads to an increase in protein, total carbohydrate and sugar content and a decrease in starch, fat and ash. The best Z-score analysis had cookies with 15% ODP based on technological, nutritional and sensory evaluations. This kind of product contributes to the promotion of innovative food products designed for modern lifestyles.

Keywords:
Cookies, Osmotic dehydration, Technological analysis, Nutritive analysis, Sensory analysis

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Biflavonoid Profiling of Common Juniper (*Juniperus communis* L.) from Ten Different Growing Locations

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Common juniper (*Juniperus communis* L.) is a slow-growing evergreen conifer whose cones (often referred to as berries) are widely used in the perfume and pharmaceutical industries, as well as in the production of alcoholic beverages and as a spice. Its needles are also utilized for the extraction of essential oils. In traditional medicine, common juniper has been valued for its anti-inflammatory, antioxidant, and antiseptic properties, as well as for its effectiveness in alleviating various abdominal disorders. Moreover, juniper is one of the plant species known to accumulate biflavonoids—the dimeric forms of flavonoids—which significantly contribute to the overall biological activity of juniper. Despite their importance, the distribution and environmental factors which may influence biflavonoid level in common juniper remain underexplored. In this study, an HPLC-DAD method was employed in order to explore the presence of seven biflavonoids (cupressuflavone, amentoflavone, bilobetin, ginkgetin, isoginkgetin, hinokiflavone, and sciadopitysin) in wild juniper samples collected from ten different growing locations in Bosnia and Herzegovina. Four biflavonoids - amentoflavone, cupressuflavone, bilobetin, and hinokiflavone - were consistently detected and quantified in needles, ripe and unripe cones. Significantly higher total biflavonoid concentrations were found in needles (range from 3,5-6 mg g^{-1} dry weight) compared to cones (range from 0,2 to 1 mg g^{-1} dry weight), with amentoflavone identified as the predominant compound, reaching concentrations up to 3 mg g^{-1} dry weight in needles. The results of the determination of total and individual biflavonoid content showed moderate variations depending on the growing location, suggesting that environmental factors may influence the biosynthesis of these specialized metabolites, although the specific factors remain to be determined.

Keywords:
Juniperus communis L., Biflavonoids, Tissue-specific accumulation, HPLC-DAD

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The "Student Bag": Development of a New Concept Based on the Mediterranean Diet to Improve the Diet of University Students in Croatia

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Dietary and other health-related habits established during young adulthood, particularly during university, may represent a significant factor in maintaining health and preventing chronic diseases later in life. Student restaurants play a crucial role in shaping dietary habits and promoting healthy, sustainable dietary patterns, such as the Mediterranean diet. This study aimed to examine the opinions of university students in Croatia regarding meal proposals that could improve the offer in student restaurants and enhance resemblance of one's diet to the Mediterranean dietary pattern. The study was conducted using mixed methods (Exploratory sequential design). In the qualitative phase, a focus group of student representatives from the University of Zagreb generated proposals for new meals, taking into account the project's goals such as sustainability, practicality, and Mediterranean diet principles. Based on the results of the focus group, a questionnaire was developed and completed by 1187 students from 70 higher education institutions across Croatia. The analysis showed that gender, age, and type of accommodation significantly influenced the willingness to choose Mediterranean dietary options: female students, older students, and those living in private accommodation were more inclined to choose such options, while the region of study had no impact. Students expressed interest in practical and subsidized meal options such as salads, tortillas, nuts, olive oil, and ready-to-eat meals "to go" (the "student bag" concept). The focus group findings were confirmed by the survey, with tortillas and salads (as complete meals) highlighted as preferred options for the "student bag" content. The results suggest potential for enhancing student restaurants' menus by incorporating foods characteristic for the Mediterranean diet, which could contribute to healthier eating habits, academic success, and the long-term well-being of the student population.

Keywords:
Mediterranean diet, Student restaurants, "Student bag", Dietary habits

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Quality of Life and Dietary Choices in Individuals with Severe Mental Disorders

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Individuals with severe mental disorders (SMD) often report lower satisfaction with quality of life (QoL) compared to healthy individuals, which may play a role in dietary choices. This study aimed to assess the correlation between QoL, specifically life satisfaction and dietary choices. A cross-sectional study conducted in October 2021 encompassed 46 individuals with SMD. Using structured, purpose-designed questionnaires, sociodemographic data, life satisfaction (Likert scale), and food consumption frequency (non-quantitative Food Frequency Questionnaire) were assessed. Relationships between variables were assessed using Spearman correlation coefficients. The lowest average satisfaction score (3.3 ± 1.5) was reported for health, while the highest (4.0 ± 1.1) was reported for relationships with family and loved ones. Satisfaction with living standard showed moderate positive correlations with intake frequency of milk ($\rho = 0.32$; $p = 0.033$), cured meat products ($\rho = 0.42$; $p = 0.004$), and carbonated soft drinks ($\rho = 0.35$; $p = 0.018$). Similarly, satisfaction with health moderately correlated with the frequency of sweetened non-carbonated beverages ($\rho = 0.29$; $p = 0.048$) and coffee ($\rho = 0.31$; $p = 0.036$) consumption. Sense of achievement and security about the future both showed low to moderate positive correlations with consumption frequency of salty snacks ($\rho \approx 0.30$; $p < 0.05$). On the other hand, sense of security negatively correlated with intake of vegetable dishes ($\rho = -0.30$; $p = 0.044$). Altogether, results suggest that a higher life satisfaction does not necessarily align with healthy dietary choices in individuals with SMD, which may be another indicator of the need for tailored nutritional intervention in this population.

Keywords:
Severe mental disorders, Quality of life, Life satisfaction, Food frequency Questionnaire, Dietary choices

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Evaluation of the Nutritional Profile of Commercially Available Complementary Foods in Slovenia: According to the WHO Nutrient Profile Model

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After six months of life, breast milk is insufficient in terms of energy and nutritional physiology for infants, making the introduction of complementary foods (CF) necessary. Little is known worldwide about the quality of commercially available complementary foods (CACFs) and whether the ingredients, nutritional values and labelling of CASFs are consistent with draft nutrient profile model for CACFs for infants and young children up to 36 months old in the WHO European Region. We examined 241 CACF samples available on the Slovenian market and noted the target age group, the presence of added sugar or sweeteners and the fat and sodium content indicated on the label. The results were compared with the nutrient profile model proposed by WHO/Europe. The results showed that almost 40% of the samples were labelled as suitable for infants under 6 months, which could undermine breastfeeding and contribute to the early introduction of nutritionally unsuitable foods. 37% of the samples contained added sugars or sweetening agents. All samples conformed to the nutritional profile model for CACFs proposed by WHO/Europe, indicating suitability for infants and young children up to 36 months in terms of fat content. The upper limit for sodium content was exceeded in 19% of samples from different categories. All beverages and 90% of snacks were labelled as suitable for children under 36 months, which is not in line with the nutrient profile model proposed by WHO/Europe. Based on our findings, and recognising that nutrition in the first 1,000 days of life is critical for growth and development, we conclude, that CACFs should be reformulated and that a higher content of (bitter) vegetables should be encouraged. There is also a need to prepare a legislative framework for CACFs, addressing both content and labelling.

Keywords:
Complementary feeding, Complementary foods, Nutrient profiling, Nutrition labels, Sugar

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Effect of Freeze Drying and Freeze-Thawing on Swallow-Related Rheological Properties of High-Protein Agar-Collagen Fluid Gels

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Fluid gels characterized by specific rheological properties and complex microstructural organization can be used to meet all essential dietary requirements for dysphagia, ensuring safe nutrition and the intake of all necessary nutrients. Due to the high water content, they have a relatively short shelf life that can be overcome by well-known methods such as drying and freezing. The selection of the method must be based on good recovery of the initial fluid gel properties, which are required for the dysphagia diet. This study investigated the effect of freeze drying and freeze-thawing on the stability, droplet size, and swallow-related properties as measured by rheological methods (frequency-dependent viscoelasticity, shear recovery behavior, shear yield stress, viscosity at 50 s^{-1}) and International Dysphagia Diet Standardization Initiative (IDDSI) tests of high-protein (20% collagen) agar-collagen fluid gels prepared by varying agar concentration from 0.5 to 2.0% w/w. It was found that the freezing process had no negative effect on the properties of all the fluid gels tested. After the freezing-thawing, the samples exhibited the same stability, droplet size, and rheological properties as well as the same thickness level (based on IDDSI) that are essential for safe swallowing. On the contrary, after freeze-drying and rehydration, all samples exhibited an increase in the polydispersity index (from 3.2 to 5.9). Such structural changes affected changes in consistency from slightly thick (level 1) to moderately thick (level 3), an increase in shear recovery behavior as well as in storage (G') modulus values, particularly in the 1.5% and 2.0% samples. Such poor retention of the swallow-related fluid gel characteristics is considered undesirable for targeted application. In conclusion, freezing has a high potential for extending the shelf life of agar-structured fluid gel systems, offering promising applications in the expanding dysphagia-related food segment.

Keywords:
Dysphagia, Freeze-drying, Elderly, Fluid gel

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Are We Ready for a Sustainable Diet with Edible Insects? Generational Differences in Acceptance

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Due to climate and environmental challenges, sustainable diets are becoming increasingly important for the future of the planet and public health. In this context, edible insects stand out as a nutritious and environmentally friendly alternative. This study aimed to examine generational differences in attitudes toward sustainable eating and the willingness to consume foods containing edible insects. The research was conducted online with 362 subjects, divided into four generational groups: Boomers (n=34), Gen X (n=106), Millennials (n=64), and Gen Z (n=158). The highest willingness to include edible insects in the diet was shown by Gen X subjects, who also proved to be the most consistent with their stated support for sustainable development. Although 89% of all subjects claimed to support sustainability, only 39% reported willingness to consume insect-containing products. Among them, Gen X showed the highest willingness (45%), while Gen Z the lowest (34%). Among those who stated they support sustainability, 79% also supported including insects in animal feed and consuming such animals if it benefits the environment. Millennials showed the strongest support (86%), while Gen Z again showed the lowest (75%), indicating a gap between their values and willingness to act. On the other hand, when it comes to potential health benefits, willingness increased — 62% of all respondents were open to consuming insects. Gen Z showed moderate openness (61%), while Boomers were the most willing (74%). Despite Boomers generally being the least open to new foods, health seems to be a strong motivator. Overall, most respondents claimed to support sustainable development, though not necessarily through consuming insects, but likely via other means that warrant further investigation. Better education and the development of sustainable food options remain necessary for future change.

Keywords:
Sustainable diet, Edible insects, Entomophagy, Generational differences

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Fluid Intake and Dietary Supplementation in Children Training Gymnastics

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The aim of this study was to assess fluid intake and intake of dietary supplements (DS) in children training gymnastics. Cross-sectional observational study encompassed 44 children (23 boys and 21 girl) from 1 to 10 years old with at least one training of gymnastics weekly. Data were collected using structured purpose-designed anonymous voluntary questionnaire. Questions were either close ended or Likert-type scale. Most of the parents thinks that DS for children are safe (64%), effective (61%) and beneficial (64%). As a result, high level of supplementation is present. Highest representation for supplementation was found for probiotics (93%), followed by immunity boosters (63%), and vitamins and minerals (66%). DS were used either rarely (2-68%) or occasionally (23-30%). Regular supplementation was not reported. 41% of children used DS as prevention and 59% for healing. Children used syrup (61%) or pills (39%) while other form of DS were not reported. All parents (100%) agree that by drinking enough of fluids dehydration can be prevented, and that dehydration causes lower concentration, muscular cramps and imbalance. Despite these beliefs, they reported that their children don't drink before, during or after training (66%) and that their total daily fluid intake is from 0.5-1.5 L (93%) or 2-5 glasses (98%). All parents (100%) agree that exercise increases water loss, which was reflected in higher fluid intake on training days for 68% of children. Water was the most frequently consumed fluid in only 14% of children while most children drank a combination of water and other fluids. Altogether, results suggest that parental knowledge and attitudes on DS and hydration are not implemented in practice. Additional study should be conducted with focus on revealing reasons behind low implementation in order to develop tailored nutritional intervention for this population.

Keywords:
Children, Dietary supplements, Hydration, Gymnastics

Prebiotic Inulin-Type β-Fructans Supplementation Affects Skin Lesions and Biophysical Skin Parameters in Patients with Psoriasis: Project INGUTSKIN

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Psoriasis (PS) is a chronic inflammatory skin disease that causes itching, erythema, and scaling, impairing quality of life. Its treatment is long-term and complex. Objective: This randomised, controlled clinical trial aimed to determine the effect of 8-week supplementation with a prebiotic inulin-type fructans (ITFs) preparation vs. placebo (maltodextrin) on the severity of skin lesions, skin biophysical parameters, and quality of life in patients with mild psoriasis (N = 56) (Psoriasis Area and Severity Index; PASI < 10). Methods: Severity of skin lesions: PASI, BSA (Body Surface Area); Dermatology Life Quality Index (DLQI); skin biophysical parameters: viscoelasticity, reaction time, hydration, transepidermal water loss, and ultrasonography (USG) imaging (DermaLab Combo device; Aalborg, Denmark); BMI (Body Mass Index) and anthropometric parameters: total and visceral fat content, muscle mass, fat-free mass, and total body water (TANITA MC780, Poland) were analysed in PS patients before and after supplementation with ITFs vs. Placebo. Results: After prebiotic supplementation, a downward trend in total and visceral fat content was observed, accompanied by a significant ($p < 0.05$) increase in muscle mass and fat-free mass, compared to baseline. Regardless of the supplement (ITFs vs. placebo) used during the 8-week intervention, the scores for the PASI, BSA, and DLQI worsened. However, the skin biophysical parameters, such as viscoelasticity, reaction time, hydration, and transepidermal water loss, showed improvement in regions with psoriatic lesions following prebiotic supplementation. Additionally, in patients receiving prebiotics, ultrasound imaging revealed a more structured dermal layer in lesions, in contrast to the heterogeneous and disordered dermal structure at baseline.

Keywords:
Psoriasis, Prebiotics, Skin disease, Biophysical parameters, Quality of life

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Motivations and Barriers toward Sustainable Diets among University Students: Insights from a Pilot Study

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The transition toward sustainable diets is essential for improving human health and mitigating environmental impacts. This pilot study aimed to explore key motivations and barriers in the context of sustainable dietary choices among university students. A cross-sectional survey was conducted among 75 students (58.7% female; mean age 21.3 ± 1.0 years) using a structured questionnaire assessing knowledge, attitudes, and behaviours related to sustainable diets. Motivations (importance of food characteristics) and barriers were evaluated using a five-point Likert scale. (1 = not at all important/not a barrier, 5 = very important/major barrier). Results are presented as Top 2 Box percentages, representing the proportion of respondents who rated an item as important/very important or as a significant /major barrier. Students identified healthiness (85.3%), sensory pleasure (85.3%), affordability (84.0%), and convenience (77.3%) as the most important factors when choosing food. Other sustainable attributes such as seasonality (62.7%), local origin (60.0%), and no additives (60.0%) were moderately valued. Female students placed greater emphasis on animal welfare ($p = 0.014$) and emotional aspects of eating ($p = 0.042$) in comparison with male colleagues. The most frequently reported barriers were lack of information (44.0%), lack of time (44.0%) and cost (42.7%). Female students stronger emphasised lack of information ($p = 0.032$) as barriers for adopting sustainable diet. The findings indicate that although students recognize the importance of sustainable food characteristics when choosing food, choices, informational and practical constraints may limit behaviour change. These insights can inform targeted educational strategies and interventions promoting sustainable eating among young adults, alongside necessary changes in institutional food services and restaurants towards more sustainable dietary models.

Keywords:
Sustainable diet, University students, Motivation, Gender differences, Food choice

Do Labels of Commercial Probiotics Keep their Promises? Microbial Survival, Label Accuracy, and Gut Stability

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The survival and viability of probiotic microorganisms were evaluated in various commercial formulations; capsules, chocolate sticks, drops, yogurt and kefir—before and after simulated in vitro gastrointestinal (GIT) digestion. Maintaining an adequate concentration of viable probiotic microorganisms throughout their shelf life and during GIT transit is essential to ensure their beneficial effects on the host. Ten commercially available probiotic products were analyzed to assess the consistency between declared and actual colony-forming unit (CFU) values and to determine their survival rate under simulated digestive conditions. Results indicated that liquid formulations showed the highest consistency with label claims in initial CFU concentration, although they generally exhibited a reduction in CFU after simulated digestion. In contrast, lyophilized (capsule-based) products displayed variable initial CFU counts with minor deviations from declared values, yet most retained sufficient viability after GIT simulation to provide potential health benefits. The chocolate-based probiotic formulation (chocolate sticks) showed the greatest inconsistency both before and after digestion. Overall, the findings emphasize the need for stricter quality control and accurate labeling, particularly for non-liquid probiotic formulations.

Keywords:
Probiotic formulations, Label accuracy, GIT survival

Beyond Water: Assessing the Beverage Energy Impact in the Diet of Croatian Children

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Beverages represent an important component of children's diets, contributing not only to hydration but also to total energy intake, especially when they contain added sugars. Understanding how much energy comes from drinks is essential to guide healthier choices, preventing and reducing obesity, and promote balanced dietary patterns from an early age. To evaluate the energy impact of beverages on the diets of Croatian children, we utilized data from the National Food Consumption Survey on Infants and Children (OC/EFSA/DATA/2016/02 CT3), which follows the EU Menu methodology. The survey encompassed 535 toddlers (1 - 3 years old) and 963 older children (3 - 9 years old), a nationally representative sample. The beverage categories covered in this assessment were: 100% fruit juices, soft drinks, teas, and fruit/vegetable nectars. Data from the Croatian EU Menu survey conducted among children from 1 up to 9 years indicate that the mean daily energy intake ranges from 1350 to 1480 kcal day^{-1}, depending on beverage consumption patterns. Among the analyzed beverage categories, the highest relative energy contribution was observed for fruit and vegetable nectars (3.4%) and soft drinks (3.2%), followed by 100% fruit juices (2.7%), while tea contributed only 0.6%. Altogether, beverages accounted for around 10% of total daily energy intake. Average consumption was highest for soft drinks (≈158 mL day^{-1}) and tea (≈145 mL day^{-1}), while for 100% fruit juice and nectars, the daily amounts consumed were equal (≈79 mL day^{-1} each). Although the beverages analyzed in this assessment represent a relatively modest proportion of total energy intake, their combined contribution remains nutritionally relevant in Croatian children. Soft drinks and fruit/vegetable nectars are the main energy source among beverages, whereas tea, despite higher consumption quantity, contributes negligible energy. These findings highlight the need for continued dietary surveillance and targeted public health interventions to reduce sugar-sweetened beverage consumption in childhood.

Keywords:
Toddlers, Children, Beverages intake, EU Menu, Croatia

Ultra-Processed Foods and Mental Health: Exploring Links with Depression and Anxiety

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Background: The growing consumption of ultra-processed foods (UPFs) has raised increasing concerns about their impact not only on physical health but also on mental well-being. UPFs are industrial formulations high in calories, added sugars, unhealthy fats, and food additives, but low in essential nutrients and fiber. Emerging evidence suggests a possible link between high UPF intake and the development of mental disorders such as depression and anxiety. Objective: This study aimed to investigate the relationship between UPF consumption and mental health—specifically symptoms of depression and anxiety—through a systematic literature review complemented by a population-based online survey. Methods: A systematic review of the literature was conducted using PubMed (2020–2025), identifying 14 high-quality studies examining UPF intake and mental health. An online questionnaire also assessed participants' eating habits, lifestyle behaviors, and perceived connections between diet and emotional well-being. Results: Among 70 respondents, most reported frequent consumption of UPFs, such as sweets, snacks, and soft drinks, along with a high prevalence of emotional symptoms, including anxiety, irritability, fatigue, and sleep disturbances. Approximately 67% believed that UPFs negatively affect mental health, and 65% acknowledged that emotional states influence food choices. Conclusion: The findings reinforce existing evidence of a negative association between UPF-rich dietary patterns and mental health. Despite participants' awareness of this link, discrepancies between knowledge and practice persist. Promoting food literacy, emotional coping strategies, and healthier food environments appears crucial to improving both nutritional and psychological well-being.

Keywords:
Public health nutrition, Mental health, Ultra-processed foods, Dietary patterns, Depression, Anxiety

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From Innovation to Nutrition: The Role of 3D Food Printing in Personalized and Sustainable Diets

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Introduction: Three-dimensional (3D) food printing, also known as additive manufacturing, uses computer-aided design software to control the layer-by-layer construction of 3D food, the most established extrusion-based method. This method utilizes edible materials, such us fruit and vegetable juice and powder, starch, meat, chocolate, and seaweed, as printing materials. Objective: To study the operation of 3D food printing and its possible applications and prospects in the health and food industry. Methods: A literature review was conducted using the ScienceDirect, B-on, and PubMed databases, targeting our research with the keywords “3D printing”, “food”, “nutrition”, and “health”. Of the 1674 results obtained, 32 were selected based on their title, abstract, and finally by full reading of the text. Only articles published in the last five years were selected. Results: 3D food printing allows the customization of food design and its nutritional aspects, simplifying the food chain and the expansion of food material sources. Materials used for 3D food printing must meet three requirements: printability, applicability, and suitability for post-processing. In addition, printing parameters such as nozzle speed, diameter, and height, extrusion speed, and internal fill percentage have a major influence on the precision and texture of the printed foods. Conclusion: The technique is a promising technology that enables the creation of nutritionally personalized food and increases the sustainability of the food chain by using foods of low interest and by-products. However, the longevity of 3D-printed food and public acceptance remain major challenges.

Keywords:
Food innovation, Food technology, Sustainability, 3D food printing, Personalized nutrition

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Influence of the Dietary Diary App (DDApp) on the Modification of Dietary Habits

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Nowadays, an increasing number of people use various mobile applications to monitor their dietary habits; therefore, the aim of this study was to examine how one such application (Dietary Diary App, DDApp) can influence changes in diet quality. 40 participants (18–67 years, 8 male/32 female) included in this study were asked to record servings of 11 food and beverage groups (“click” was enough) consumed over a 10-week period using the DDApp, a tool that helps users record and track food intake to monitor users’ diet and achieve specific dietary goals. The study involved adults, either healthy or unhealthy but not requiring a therapeutic diet whose dietary recommendations would conflict with the nutritional goals outlined in the application. All participants logged into the DDApp so that researchers could download data. For each participant, the number of dietary goals achieved over 10 weeks was computed. Every goal achieved was coded as 1 point both for foods good for health (with a recommended minimum number of servings per day or week) and for foods not-so-good for health (with a recommended maximum number of servings per week) while non-achieves as 0 points. Results were reported as sum of points in three categories of foods: in total (0–11), good for health (0–6), not-so-good for health (0–5). Diet quality was assessed twice, before and after 10 weeks of DDApp using, with food frequency method using KomPAN® questionnaire regarding the last 12 monts. The Pro-Healthy Diet Index (pHDI) and the Non-Healthy Diet Index (nHDI) were calculated for data collected before and after 10 weeks, respectively. Participants progressively met more goals related to reducing not-so-good foods (mean weekly increase by 0.30 points; $p < 0.01$), accompanied by a significant reduction in nHDI (by 20.1%; $p < 0.01$) during the 10 weeks. The pHDI non-significantly increased (by 8.1%) over the same period. The DDAppis a useful tool formiddle-term modification of dietary habits and improvement in overal diet quality, especially as the reduction of not-so-good foods consumption.

Keywords:
Mobile applications, Diet-related diseases, Dietary diary, Diet quality, Nutritional prevention, Dietary recommendations

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The Association Between Dietary Habits and Knowledge of the Menstrual Cycle Phases in Female Students

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The menstrual cycle and dietary habits are important aspects of young women's health, with hormonal changes affecting appetite, energy expenditure, physical performance, food consumption, and sleep. The menstrual cycle is a complex sequence of changes regulated by the endocrine system and also influences a woman's behavior, metabolism, and lifestyle. This cross-sectional research investigates knowledge of menstrual cycle phases and eating habits among female students from three faculties at the University of Zagreb: the Faculty of Food Technology and Biotechnology (PBF), the Faculty of Kinesiology (KIF), and the Faculty of Humanities and Social Sciences (FFZG). A total of 111 respondents (average age 21.9 ± 1.0 years) completed a structured online questionnaire covering lifestyle, menstrual cycle characteristics, dietary behavior and patterns, and knowledge of the menstrual cycle. Statistical analysis showed significant differences between menstrual phases and physical exercise capacity ($p < 0.0001$). KIF students had the highest physical activity levels in the postmenstrual phase, while activity levels for all respondents were lowest during menstruation. Better dietary habits and more regular breakfast consumption were observed among PBF students. Sleep duration exceeded 5 h per day in each group, and regular menstruation was most common among KIF students (85%). Dysmenorrhea was highly prevalent (71 – 86%), predominantly of moderate to high severity, while premenstrual symptoms, especially carbohydrate cravings, were most common among PBF students. Higher consumption of plant foods (fruit, vegetables, nuts, olive oil) was associated with less heavy menstrual bleeding as reported. These findings suggest that certain dietary habits and lifestyle behaviors are linked to menstrual cycle phase among young women. Furthermore, the high general level of menstrual cycle knowledge provides a solid basis for incorporating targeted nutritional instruction and menstrual health promotion into university health education curricula.

Keywords:
Menstrual cycle, Dietary habits, Menstrual cycle disorders, Nutrition knowledge

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The Effect of Orotic Acid on Glucose Uptake in Human Intestinal Cell

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Milk and dairy products are an important component of the human diet, providing not only nutrients but also bioactive compounds that may influence metabolic functions. Among these, orotic acid (OA), a natural pyrimidine precursor, has attracted attention due to its potential regulatory role in carbohydrate metabolism. Although OA is present in cow's milk in relatively small amounts, its biological activity suggests that it may contribute to the metabolic effects associated with dairy consumption. Glucose absorption in the small intestine is mediated by transporters such as SGLT-1 and GLUT-2, whose function can be modulated by various dietary compounds. To the best of our knowledge the impact of OA on intestinal glucose transport has not yet been fully elucidated. Understanding this relationship could provide new insights into how milk-derived molecules influence glycemic regulation. The present study aimed to investigate the effect of OA on glucose uptake in human intestinal epithelial cells (Caco-2 cell line). Differentiated Caco-2 cells (day 21 of culture) were incubated for 24 h with OA at concentrations of 1, 3, and 10 μg mL^{-1}. Phlorizin (100 μg mL^{-1}) was used as a positive control. Following incubation, cells were starved for 2 h in serum-free medium and subsequently exposed to the fluorescent glucose analog 2-(N-(7-nitrobenz-2-oxa-1,3-diazol-4-yl)amino)-2-deoxyglucose (2-NBDG) for 30 min. Fluorescence intensity, normalized to total protein content, was used to quantify glucose uptake. Orotic acid significantly decreased glucose uptake by Caco-2 cells compared to the untreated control ($p < 0.05$). The observed inhibition was concentration-dependent. Our findings indicate that OA can modulate intestinal glucose absorption by reducing glucose uptake into enterocytes. This suggests that dietary intake of milk and dairy products containing OA may contribute to improved glycemic control. Further studies are required to clarify the underlying molecular mechanisms and the potential long-term physiological relevance of these findings.

Keywords:
Orotic acid, Glucose uptake, Caco-2 cell line, 2-NBDG, Intestinal absorption

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ReS-Food Project: Education for a Sustainable Food Chain

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The ERASMUS+ KA2 ReS-Food (Reducing Food Waste and Rescue Surplus Food Supplies) project aimed to develop a methodological and educational framework for reducing food waste and rescuing surplus food through innovative vocational training. The project brought together partners from non-EU (Serbia) and EU countries (Croatia, Hungary, Greece, and Cyprus) to create online practical tools and training programmes that connected businesses in the Ho.Re.Ca. sector with humanitarian organisations. ReS-Food was structured around five work packages focused on developing the ReS-Food methodological framework, creating an educational package and curriculum, and designing the ReS-Food e-learning hub. The project promoted green skills, digital tools, and circular economy principles within the food sector. Its main outcomes included the Measure My Food Waste Status Tool and the ReS-Food Courses, all integrated into a user-friendly e-learning platform designed to facilitate knowledge transfer and the exchange of best practices across Europe. Furthermore, the platform aims to enhance professional competencies and foster effective cooperation between enterprises and humanitarian organisations, thereby contributing to the reduction of the environmental impact of food waste by transforming it into social and environmental value.

Keywords:
Food waste reduction, Surplus food rescue, Education, e-learning, Sustainable development, Green skills

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Prevalence and Characteristics of Energy Drink Consumption Among Adolescents

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Adolescence represents a critical period of growth and development during which lifestyle habits are formed. In this stage of life, risky behaviors such as the consumption of energy drinks, alcohol, and cigarettes are often adopted. These habits may have both short-term and long-term effects on health and overall quality of life. The aim of this study was to examine the prevalence and characteristics of energy drink consumption among adolescents and to identify possible associations with other risky behaviors, including alcohol and cigarette use. Cross-sectional study was conducted on a sample of 1.073 adolescents who voluntarily participated in on-line questionnaire-based survey. Data were collected in September 2025 and analyzed according gender and presence of chronic diseases that could restrict the consumption of these substances. The results showed that majority of adolescents (88.4%) do not suffer from chronic illnesses that would medically restrict them from consuming energy drinks, alcohol or cigarettes. The consumption of energy drinks was reported in 72.7% of surveyed adolescents. Alcohol consumption was reported in 45.3% of surveyed sample, while 59.1% of adolescents reported smoking cigarettes. Adolescents who consumed alcohol significantly more frequently consumed energy drinks ($p < 0.001$) and adolescents who smoked cigarettes significantly more frequently consumed energy drinks ($p < 0.001$). These findings emphasize the need for preventive actions and educational programs aimed at raising awareness among young people about the potential health consequences of such behaviors. Promoting healthier lifestyle choices during adolescence could play an essential role in reducing the prevalence of risky habits and their long-term impact on public health.

Keywords:
Energy drinks, Adolescents, Risky behaviors, Alcohol, Cigarettes, Health

Consumer Attitudes and Preferences Regarding Rare Honey Varieties

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Protein analysis can be applied as an alternative method for assessing honey varieties. Although honey contains only trace amounts of protein, these may be related to its botanical origin. In this study, the total protein content of rare honey varieties samples (amorpha, ivy, wild cherry, garland thorn, sage, mint, rapeseed, sunflower, heather) was determined. Results ranged from 0.09% in sage honey to 0.50% in wild cherry honey. Considering the selection of rare honey types for analysis, data on consumer attitudes and preferences were also collected from 158 anonymous respondents via an online questionnaire. Generally, respondents most preferred floral (35%) and acacia honey (33%), with origin (32%), taste and flavor (27%) being the main factors influencing their choice. Quality of honey is most often assessed based on its taste and flavor (39%), with light-colored honey (57%), a mild, delicate taste (47%), and a floral aroma (43%) being preferred. Willingness to try unfamiliar honey flavors is low (6%), while the most preferred rare honey varieties are wild cherry (34%), sage (25%), and sunflower (21%), and the least preferred are ivy (24%) and garland thorn honey (22%). These findings highlight the need of further research and dissemination efforts aimed at promoting rare honey varieties, emphasizing their unique characteristics and potential relevance for consumers, sustainable apiculture, and biodiversity preservation.

Keywords:
Consumer attitudes, Consumer preferences, Rare honey varieties, Protein content

Enrichment of Low Sugar Cookie with Watermelon Rind Powder

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Consumer demand for healthier and functional foods has recently increased, leading to the development of novel food and cookie formulations. As a result, cookie formulations that are high in protein, gluten-free, nutritious, functional, fat-free, and sugar-free have been created. Sugar-free cookies are produced by substituting sweeteners such as xylitol instead of sugar. Xylitol is a sugar-alcohol with a lower glycemic index and commonly used in food formulations. Watermelon is one of the widely consumed fruits. It is high in vitamin A, vitamin B complex, folate, vitamin C, thiamine, riboflavin, niacin, and pantothenic acid in addition to amino acid citrulline. However, during watermelon processing, a large part of the watermelon (rind), accounting for 30-40% is discarded. Watermelon rind (WR) has become popular due to its protein content and bioactive compounds for fortification purposes. In this study, the effect of watermelon rind powder (WRP) on wheat cookies containing xylitol was evaluated in terms of nutritional, physical, and sensory properties. Preliminary studies were carried out to determine the optimum conditions for producing WRP with the highest bioactive properties. Watermelon rind was dried at different temperatures (50, 60 and 70 °C) and results revealed that drying at 70 °C yields the highest total phenolic content so WRP was prepared by drying at 70 °C. In the cookie formula, the fortified wheat flour was replaced with WRP at levels of 5, 10, and 15% and sugar was replaced with xylitol. Cookie samples were also analyzed for moisture and ash content. Replacing wheat flour with WRP resulted in increase of total phenolic content of the cookies. This study suggests that rind, the most underutilized part of watermelons, is rich in bioactive compounds and can be used in the production of low-sugar cookies.

Keywords:
Cookie, Sensory analysis, Watermelon rind powder, Sweetener, Total phenolic content

Dietary Habits and Adherence to the Mediterranean Diet in COPD Patients: Relations with Pulmonary and Metabolic Health

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Chronic obstructive pulmonary disease (COPD) is a disabling respiratory disease and a significant global public health problem. It is often associated with other chronic diseases and comorbidities. Increasing evidence suggests that diet, particularly the Mediterranean diet, contributes to disease progression and patient outcomes. The objective of this cross-sectional study was to assess dietary habits, adherence to the Mediterranean dietary pattern, nutritional status, and lung function in 35 COPD patients (10 men, 25 women) undergoing pulmonary rehabilitation at Clinical Hospital Centre Zagreb. Data collection included anthropometric measurements, biochemical and hematological analyses, spirometry (Forced Expiratory Volume in 1 second (FEV1); Forced Vital Capacity (FVC); and FEV1/FVC ratio), and evaluation of diet using the validated Mediterranean Diet Serving Score (MDSS). The mean age of participants was 61.7 ± 13.5 years. Only 30% of men and 8% of women achieved the MDSS cutoff (≥13.5 points) for adherence to the Mediterranean diet, while the remaining participants followed a Western dietary pattern. Women adhering to the Mediterranean diet had more favorable lung function parameters (FEV1 and FEV1/FVC) than the group means. Gender-related differences were observed in body composition (fat mass, muscle mass, visceral fat) and glucose levels. Comorbidities such as cardiovascular and metabolic diseases were common and also influenced nutritional status and outcomes as well. The findings indicate low adherence to the Mediterranean diet among Croatian COPD patients, but suggest a potential correlation with improved lung function, especially in women. This dietary pattern – rich in antioxidants, fiber, and anti-inflammatory compounds– may be a valuable adjunctive therapy in COPD treatment. Longitudinal and intervention studies would be necessary to confirm these associations and to provide evidence-based nutritional recommendations for this patient group.

Keywords:
Mediterranean diet, COPD, Pulmonary function, MDSS, Nutrition

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Exploring Italian Consumers' Attitudes toward Entomophagy: The Role of Food Neophobia and Demographic Traits

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Food neophobia, or the reluctance to try novel foods, represents a significant barrier to the acceptance of sustainable alternative protein sources, such as insect-based foods. This study examines the psychological, demographic, and cultural factors that influence consumers' willingness to adopt insect-based products. A quantitative survey was conducted with n=442 adult partecipants, recruited to be representative of the general population. Food neophobia was assessed using the Food Neophobia Scale (FNS; mean = 27.09 ± 10.95, Cronbach's α = 0.86), and participants' willingness to try insect-based foods was measured via a 2-item Likert-type questionnaire. Demographic variables (age, mean = 32.5 ± 13.2 years, gender distribution = 62% female, 38% male), educational level (46.4% high school, 40% bachelor's degree, 13.6% master/PhD), dietary habits (>80% omnivorous), and openness to new experiences were also collected. Responses were analysed using Pearson correlations and multiple regression models. Results indicate that higher levels of food neophobia are strongly associated with lower acceptance of insect-based products ($r = -0.44$, $p < 0.0001$). Younger participants, individuals with higher education, and those demonstrating greater openness to novel experiences were more likely to try insect-derived foods. Additionally, diverse dietary habits were positively correlated with acceptance, suggesting that exposure to a variety of foods may reduce reluctance toward unfamiliar items. Cultural and psychological barriers emerged as primary obstacles, highlighting the need to address consumer perceptions alongside nutritional and environmental benefits. In summary, food neophobia significantly reduces willingness to adopt insect-based foods, while age, education, openness to new experiences, and dietary diversity enhance acceptance. These findings highlight the need for concise educational initiatives and awareness campaigns to support the integration of sustainable protein sources into mainstream diets.

Keywords:
Food neophobia, Insect-based foods, Consumer acceptance, Sustainable protein, Dietary behavior

Diabesity Control using Combined Drug, Dietary and Physical Activity Interventions

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Obesity is a significant driver for type 2 diabetes (T2D), with excess adiposity contributing to up to 80% of T2D cases in some populations. Weigth reduction improves glycemic control and attenuates metabolic and inflammatory pathways involved in disease progression and complications. Glucagon-like Peptide-1 receptor agonists (GLP-1Ras), including semaglutide, are approved for the treatment of T2D and obesity and have demonstrated benefits on glycemia, body weight, visceral adiposity and cardio-reno-hepato-metabolic outcomes. A complex, single center, randomised, controlled, four-arm, parallel group study was initiated to examine the effects of pharmacological intervention with semaglutide alone or combined with personalized, intensive nutrition/physical activity, aimed at stimulating GLP-1, on antropometric, metabolic, inflammatory and metagenomic parameters in individuals with overweight, obesity and T2D. The target group enrolls adults aged 18-75 years with T2D (≥3 months), HbA1c > 6.5%, BMI >25 kg m^{-2}, and stable weight (≤ 3 kg change in 90 days), evaluated consecutively during routine diabetes care. Exclusion criteria include prior GLP-1RAs use, type 1 diabetes, pregancy and lactation, endocrine obesity, uncontrolled thyroid disease, recent structured weight-loss intervention, pshychiatric disorders, or substance abuse. Participants are randomized to semaglutide ± personalized lifestyle intervention or to standard care ± personalized lifestyle intervention. Baseline assessments include anthropometry and body composition (InBody 970), metabolic, hepatic and lipid panels, uric acid, inflammatory biomarkers (CRP, IL-6, TNF-α), metabolic hormones (GLP-1, ghrelin, leptin, adipokines), and stool metagenomics. Validated questionnaires assess diet, activity, diabetes knowledge and quality of life. Group characteristics include a mean age of 59.5 ± 9.2 years, 59.2% female, mean diabetes duration 7.0 ± 6.3 years, body weight 94.6 ± 17.9 kg, BMI 34.6 ± 6.1 kg m^{-2} and HbA1c 7.41 ± 0.64%. This study will add to current knowledge by evaluating whether semaglutide, combined with lifestyle interventions, can affect metabolic and inflammatory parameters, body weight and composition, as well as gut microbiota profiles. These effects are expected to translate into improved patient-reported outcomes and to pave the pathway toward a more integrated and structured drug- lifestyle intervention model.

Keywords:
Semaglutide, Nutritional, Type 2 Diabetes, Obesity

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The Impact of Hydration Status on Inspiratory Muscle Strength and Function in Patients with Chronic Obstructive Pulmonary Disease

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The alterations in body composition are common in patients with chronic obstructive pulmonary disease (COPD). One of the segments of body composition is hydration status, the disturbance of which is related to pulmonary function, but there is lack of information on its effects on inspiratory muscle strength and function. Therefore, the aim of this study is to observe the hydration status of adult COPD patients and to assess whether its distribution is related to inspiratory muscle strength and function. In 49 patients with COPD (64.6% men; 66.5 ± 8.9 years) attending pulmonary rehabilitation at the Special Hospital for Pulmonary Diseases in Zagreb, hydration status was determined by bioelectrical impedance and inspiratory muscle strength and function were assessed according to standard protocols using the PowerBreathe and ultrasound devices. On average, the patients had 50.2% of total body water (TBW), and 66.7% of them had a sufficient amount of it (45-60% for women; 50-65% for men). The extracellular body water (ECW) accounted for 45.1% of TBW and intracellular (ICW) for 54.9%, corresponding to a ratio (ECW/ICW) of 0.8 ± 0.1. The average phase angle (PhA) was 5.2 ± 1.8 degrees, while it was within an appropriate range in only 18.8% of patients. The correlation analysis revealed that a higher maximum inspiratory pressure (MIP) was related to a higher TBW ($r = 0.286$; $p = 0.049$) and PhA ($r = 0.397$; $p = 0.005$). In addition, diaphragm thickness at the end of inhalation (DTmax) and exhalation (DTmin) was positively related to TBW, ECW and ICW, while a lower ECW/ICW ratio was associated with greater DTmin ($r = -0.324$, $p = 0.025$). No correlation was found between the parameters of hydration status and DTmax/DTmin. In conclusion, hydration status may serve as a potential indicator for predicting inspiratory muscle strength and function in COPD patients.

Keywords:
COPD, Hydration status, Fluid distribution, Maximum inspiratory pressure, Diaphragm thickness

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Association Between Dietary Patterns and Inspiratory Muscle Strength and Function in Patients with COPD

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It is known that a dietary pattern such as the Mediterranean diet can promote muscle strength, while the characteristics of the Western diet can have negative effects. However, there is a lack of information on how these dietary patterns may affect respiratory muscle strength and function. The aim of this study was to investigate the correlation between dietary patterns of COPD patients and the inspiratory muscle strength and function. The three 24-hour recalls were used to determine the dietary patterns of 71 patients with COPD (55% men; 66.6 ± 8.3 years). Patients were recruited at the Specialized Hospital for Lung Diseases (Zagreb, Croatia; September 2023 - May 2024). Assessments of dietary patterns and inspiratory muscle strength and function were performed during pulmonary rehabilitation according to standard protocols. For the analysis, all foods and beverages were categorized into 13 food groups. On average, the patients had 1528 ± 405 kcal of daily energy intake. Of all 13 food groups, higher maximum inspiratory pressure (MIP) values were associated with the higher contribution of vegetables ($r = 0.340$; $p = 0.001$) and meat and fish products ($r = 0.270$; $p = 0.036$) to daily energy intake, while lower MIP values were associated with the legumes, seeds and nuts food group ($r = -0.351$, $p = 0.004$). Only a negative association was found between diaphragm thickness at the end of expiration and the contribution of the alcohol group to daily energy intake ($r = -0.257$; $p = 0.032$). These results underline the possible influence of specific dietary patterns on the inspiratory muscle strength and function. The results could help to develop nutritional strategies for pulmonary rehabilitation.

Keywords:
COPD, Dietary habits, Food groups, Maximum inspiratory pressure, Diaphragm thickness

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The authors would like to thank the medical staff of the Special Hospital for Pulmonary Diseases for their cooperation and support in collecting data for this study.

Assessment of Brazilian Consumers' Knowledge and Consumption of Gluten

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This study aimed to evaluate the knowledge of Brazilian individuals regarding gluten, their consumption or restriction of this protein, and the motivations behind dietary restriction. Data collection was performed through a self-administered online questionnaire composed of two sections: (1) five questions for all participants and (2) sixteen questions for individuals who reported restricting or avoiding gluten in their diet. A total of 305 individuals participated, most of whom were female (77%), adults (97%), and had higher education (34%). When asked to identify the type of nutrient gluten, 56% correctly responded that it is a protein, while others classified it incorrectly as a carbohydrate (19%), fat (3%), fiber (4%) or that they did not know (18%). Regarding food sources of gluten, participants identified wheat (93%), barley (57%), oats (53%), rye (51%), and triticale (9%); however, some incorrectly included rice (23%), cassava (14%), and corn (13%). Seventy-five individuals (24%) reported restricting gluten, with partial (85%) or total restriction (15%). Among them, 31% reported having some form of gluten-related disorder, 44% did not, and 25% were unsure. Of those who reported some gluten-related disorder (n=23), detection was most often through an elimination diet (70%), followed by intestinal biopsy (22%) and serological testing (22%). The decision to exclude gluten was mainly influenced by healthcare professionals (61%), media (24%) and recommendations from friends and/or relatives (11%). Reported adherence difficulty ranged from moderate (34%) to no difficulty (15%). The main challenges included limited availability at restaurants or social events (30%), high product cost (25%), difficulty finding gluten-free options (23%), and concerns about contamination (22%). The findings reveal widespread misconceptions about gluten, frequent self-imposed dietary restrictions without medical confirmation, and difficulties maintaining a gluten-free diet. These results highlight the need for improved public education, evidence-based guidance, and policies promoting accurate diagnosis of gluten-related disorders.

Keywords:
Surveys and Questionnaires, Gluten-free foods, Gluten-related disorder, Diet, Consumption pattern

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The authors would like to thank all participants who generously took the time to complete the online survey and contribute to this research.

From Ingredient Characterization to Clinical Evaluation: Developing Protein- and Fiber-Enriched Food Products for a 65+ Population (Diet65+ Project)

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One of the most significant demographic shifts of the 21st century is the substantial increase in the 65+ population. Healthy aging has been tightly linked to adequate nutrition. Nonetheless, diminished appetite, reduced sensory perception, and physiological changes affect digestion and nutrient absorption, demanding new food products designed specifically for these consumers. The Diet65+ Project develops sustainable, nutrient-rich foods designed to meet the needs and enhance the eating experience of older adults. To achieve this goal, more than 30 ingredients were characterized for their nutritional composition, as well as their amino acid and fatty acid profiles. To address challenges in developing protein-enriched products, they were further characterized for their functional properties, such as water- and oil-holding capacities, solubility, and digestibility. This characterization allowed the development of a fruit and cereal purée, a versatile vegetable paste, and an instant soup/purée, each enriched in protein and/or fiber. For the soup/purée, six different formulations were developed (6.76 ± 0.93 g of protein 100 g^{-1}), comprising versions with and without a chickpea protein concentrate. These soups were characterized in terms of colour, brix degree, pH, protein, fat, carbohydrates, ash content, amino acids, and fatty acids profile, soluble protein content, as well as their antioxidant potential. Their gastrointestinal behavior was evaluated using a static *in vitro* digestion model adapted for older adults (INFOGEST). The gastrointestinal tract had a positive impact on the antioxidant potential, as evidenced by a significant increase in antioxidant potential observed in all soups after digestion. This effect may be attributed to the action of digestion, which promotes the breakdown of proteins into smaller molecular-weight peptides with strong antioxidant activity. All the improved formulations were evaluated in sensory trials, and a nutritional intervention study is underway to evaluate the effects of these products on gut microbiota, gastrointestinal symptoms, and their feasibility for daily consumption.

Keywords:
Elderly, Functional foods, High-fiber products, High-protein products, Gastrointestinal tract digestion, Gut microbiota

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Sensory Evaluation, Acceptability, and Consumer Insights of Protein- and Fiber-Enriched Foods Tailored for Older Adults: the Diet65+ Project

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The World Health Organization data has been demonstrating the significant and accelerating aging of the global population, presenting health and social challenges. Healthy aging critically depends on maintaining optimal nutritional status. However, age-related declines in appetite, sensory acuity, and digestion often make this difficult. These challenges justify the need for novel food solutions specifically designed for older adults. The Diet65+ Project addresses this need by developing food products while combining nutritional science and sustainable food innovation with the emotional aspects of eating. Three different categories of products - a fruit and cereal purée, a versatile vegetable paste, and an instant soup/purée - enriched in protein and/or fiber - were developed. These products were evaluated in two sensory trials, with both male (10; 68.00 ± 2.71 years) and female (9; 64.33 ± 6.65 years) participants. Each activity included the sensory analysis of six products (two versions of each), followed by a focus group to explore perceptions, motivations, and opinions. Both female and male participants indicated that no single factor drives food choice; multiple motivations interact. Still, the dimensions of health, natural composition, weight control, and sensory appeal were the most relevant criteria. Fruit and cereal purées demonstrated higher acceptability, while soups also received strong approval, especially among women - several participants mentioned including these products in their daily diet. Regarding moldable vegetable pastes, it is worth noting that both groups of participants have identified aspects for improvement. Still, the acceptability of these products was significantly higher in the female sample. The characteristics of both preparations of this product were not recognized as familiar by the male participants. These results suggest that the positive perception of soups and fruit-and-cereal purées as healthy contrasts with the more cautious attitude toward the vegetable pastes, viewed by some as processed foods.

Keywords:
Healthy aging, Older adults, Sensory evaluation, Functional foods, Food acceptability, Food-related emotions

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Comparing Mediterranean Diet Adherence Between Mediterranean and Western Populations: Evidence from Croatia and the United States

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The Mediterranean diet (MD) emphasizes whole, minimally processed foods and is associated with reduced chronic disease risk and mortality among diverse populations. However, MD adherence varies globally due to cultural, socioeconomic, and geographic factors. To better understand how globalization and the nutrition transition influence dietary patterns across diverse cultural contexts, the aim of the present study was to compare MD adherence between Western (United States; US) and Mediterranean (Croatia) countries. This study used data from the 2017/18 National Health and Nutrition Examination Survey (NHANES; US; n = 4339) and the 2018 - 2023 Croatian national food consumption survey on adolescents and adults (NIPNOD; Croatia; n = 1672). For both national surveys, dietary data among adults (≥ 18 yrs.) was obtained from two 24-hour dietary recalls and averaged across both days. MD adherence was assessed using an adapted version of the literature-based Mediterranean diet score, where participants were scored based on energy-adjusted intakes across nine food categories. The total MD score ranged from 0 (lowest adherence) to 18 (highest adherence). Independent t-tests were used to assess differences. The energy-adjusted MD score was greater in Croatia than in the US (7.35 vs. 6.82; $p = 0.025$). Preliminary analyses found that fruit (1.48 vs. 0.34; $p < 0.0001$), dairy (1.20 vs. 0.63; $p < 0.0001$), meat (1.37 vs. 1.04; $p < 0.0001$), legumes (0.60 vs. 0.47; $p = 0.0013$), and olive oil (0.03 vs. 0.01; $p = 0.0001$) scores were significantly greater in Croatia than the US, whereas grains (0.52 vs. 1.86; $p < 0.0001$), and alcohol (0.65 vs. 0.97; $p < 0.0001$) scores were significantly greater in the US. Fish and vegetable scores did not significantly differ between the two countries. Total MD score, associated with greater intake of several key Mediterranean diet components, was higher among Croatian adults compared to US adults, however, adherence to the MD was low in both countries. These results demonstrate the growing prevalence of Western dietary patterns in Mediterranean countries.

Keywords:
Mediterranean diet, National survey, Cross-country comparison, Croatia, USA

Sensory Evaluation of Starch-Free Low-Fat Dairy Spread Formulations

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The growing demand for healthier food products has stimulated the development of fat-reduced dairy spreads with improved nutritional profiles and sensory acceptance. This study aimed to evaluate the sensory properties of low-fat butter formulations without the use of modified corn starch. A total of 21 formulations were developed, varying the proportions of fat and replacer components (xanthan gum, milk protein, and emulsifier (mono- and diglycerides of fatty acids)). These components were selected due to their capacity to mimic the structural and sensory properties of fat, contributing to texture, mouthfeel, and stability of the final product. Preliminary screening identified three formulations as the most promising, which were further subjected to sensory evaluation. Attributes such as appearance, color, consistency, flavor, and overall acceptability were assessed. A total of 34 butter consumers participated in acceptance tests and check-purchase intention evaluations. Sensory analysis revealed high scores for color, flavor, appearance and consistency for the formulation flavored with oregano essential oil and oregano leaves (f22), where 54.5% of panelists agreed (score 4) with all parameters, and for the formulation with oregano essential oil, oregano leaves, and garlic, where 45% of panelists strongly agreed (score 5) with all parameters. In order of preference, addition of garlic stood out with 63.6% preference. This study highlights the potential of using natural hydrocolloids, dairy proteins, and emulsifiers as fat replacers and modified corn starch in the design of healthier dairy spreads. Further studies are underway to optimize shelf-life stability and explore consumer acceptance in broader markets.

Keywords:
Low-fat butter, Starch-free formulation, Fat replacer, Healthier food

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Effect of *In-Vitro* Infant Gastrointestinal Digestion on Digestibility, Antioxidant Activity, and Metabolic Profiles of Bovine and Non-Bovine Colostrum

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This study aimed to assess the digestibility, degree of proteolysis (DP), antioxidant capacity, and the release of different metabolites from camel, bovine, sheep, and goat colostrum milks upon in vitro simulated infant gastrointestinal digestion. Colostrum samples were digested using static *in-vitro* simulated infant gastrointestinal digestion. The DP, protein digestibility using SDS-PAGE, and antioxidant activity were analyzed in all the colostrum samples in pre-and-post digestion. Capillary electrophoresis-mass spectrometry (CE-MS) system equipped with liquid chromatography-quadrupole was used for the detection of sugars, amino acids, organic acids, and charged metabolites. The study indicated an increase in the DP and antioxidant activity after gastrointestinal digestion in all samples. Notably, DP following gastrointestinal digestion of bovine colostrum was significantly higher than camel, sheep, and goat colostrum. Sheep colostrum showed the highest 2,2'-Azino-bis-3-ethyl-benzothiazoline-6-sulfonic acid (ABTS) and 2,2-Diphenyl-1-picrylhydrazyl (DPPH) radical scavenging activity. Cumulatively, 175 metabolites were identified pre-and post-digestion. The concentration of different metabolites varied among various sources of colostrum. Metabolomic analysis further revealed that the concentration of amino acids increased after gastrointestinal digestion, being highest in sheep (undigested: 103323 ± 3684.777; after gastrointestinal digestion: 519557 ± 11981.68 nmol g^{-1} DW) followed by camel colostrum (undigested: 11385.7 ± 278.8549; after gastrointestinal digestion: 481970 ± 18450.46 nmol g^{-1} DW). However, depending on the source of colostrum, some other metabolites, like sugars and organic acids, showed a decrease in concentration of metabolites after digestion. There was an increase in the degree of proteolysis and antioxidant activity after gastrointestinal digestion as compared to undigested samples. To the best of our knowledge, no studies are available on the comparative analysis of camel, bovine, sheep, and goat colostrum in terms of their digestibility, antioxidant properties and release of metabolites upon in-vitro simulated infant gastrointestinal digestion. While initial findings of this study are promising, further research is needed to explore its utilization as a potential ingredient in infant nutrition.

Keywords:
Colostrum, *In-vitro* infant gastrointestinal digestion, Digestibility, Antioxidant activity, Metabolomics

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Camel Milk Oligosaccharides as Potential Prebiotics for Infant Nutrition

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Human milk is the optimal source of nutrition for infants, providing essential nutrients, bioactive compounds, and immune-supporting components crucial for growth and development. Among its many beneficial components, human milk oligosaccharides (HMOs) stand out as the third most abundant solid constituent after lactose and lipids. These complex carbohydrates play a pivotal role in shaping the infant gut microbiome, enhancing immune function, and preventing pathogen adhesion, contributing to overall health and well-being. Given the significance of HMOs, there is growing interest in exploring HMOs alternative sources of structurally similar oligosaccharides, for use in infant formulas. Such alternatives can help bridge the gap for non-breastfed infants and support gut health and disease prevention. Camel milk has been considered closest to human milk in terms of its composition and biological function. However, information related to the biological functions of camel milk oligosaccharides (CMOs) is limited or non-existent. Therefore, in this investigation an attempt was made to investigate the prebiotic properties and CMOs utilization ability by various probiotic bacteria. This study evaluated the impact of CMOs from different breeds (Afghanistani, Emirati, Pakistani, Sudanese) on the growth, metabolite production, and adhesion of four probiotic strains: *Lactobacillus reuteri* DSM 17938, *Lactobacillus rhamnosus* GG, *Bifidobacterium breve* BC50, and *Bifidobacterium lactis* BB12. Growth analysis revealed that CMOs significantly enhanced probiotic proliferation, with Pakistani-CMOs exhibiting the strongest effects, outperforming dextrose and showing comparable or superior efficacy to lactose. SCFA analysis demonstrated increased acetate and lactate production, indicating a beneficial metabolic shift supporting gut health. Probiotic adhesion assays confirmed that CMOs, particularly from Pakistani and Sudanese breeds, enhanced bacterial attachment to intestinal epithelial cells, a crucial factor for gut colonization and probiotic efficacy. These findings highlight the potential of CMOs as functional prebiotics, particularly in infant nutrition and gut health applications, with promising implications for synbiotic formulations and microbiota modulation.

Keywords:
Milk oligosaccharides, Probiotics, Prebiotics, Gut micrbiome, Camel milk

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Association of Non-Sugar Sweetened Beverages and Gut Microbiota and Their Interaction with Type 2 Diabetes Incidence: The HELIUS Study

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Non-sugar sweetened beverages (NSSB) are widely consumed as alternatives to sugary drinks. Emerging evidence suggests that NSSB intake may alter gut microbiome composition, potentially influencing cardiometabolic and cancer risk. This study investigated the association between NSSB consumption and gut microbiome composition, and their interaction on incident type 2 diabetes (T2D), an area not previously explored using large observational data. We used cross-sectional data from 785 participants in the multi-ethnic Healthy Life In an Urban Setting (HELIUS) cohort (mean age 52.3 ± 9.9 years; 53% women; 550 non-consumers, 235 ever-consumers of NSSB). Dietary intake was assessed using an ethnic-specific food frequency questionnaire. Gut microbiota were profiled using 16S rRNA gene sequencing. Associations between NSSB intake and alpha-diversity (Shannon index, richness) and beta-diversity (weighted UniFrac) were examined using multivariable linear regression and PERMANOVA, respectively. Differential abundance of genera was assessed using ANCOM-BC2. Longitudinal analyses of incident T2D were conducted using logistic regression to test interactions between NSSB intake and NSSB-related taxa. Models were adjusted for demographic, lifestyle, and dietary factors. Of the 785 individuals, 235 were ever-consumers of NSSB. No significant differences were observed in alpha-diversity. However, beta-diversity differed significantly between consumers and non-consumers (PCo1: 14.6%, PCo2: 3.9%; p = 0.001). ANCOM-BC identified 22 genera associated with NSSB intake. Ever-consumers showed higher abundances of *Akkermansia* (LFC = 0.46; 95% CI: 0.21–0.72) and *UBA1819* (LFC = 0.29; 95% CI: 0.11–0.47). No statistically significant interactions between NSSB intake and selected genera were observed for incident T2D. Habitual NSSB intake is associated with distinct gut microbiome profiles, consistent with experimental findings. Although no interaction with T2D incidence was detected, visual inspection of interaction plots indicates that larger studies are needed to further investigate potential causal mechanisms.

Keywords:
Non-sugar Sweetened beverages, Type 2 Diabetes, Gut Microbiota

Acknowledgements
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Food and Water Safety and Quality

Presence of Pyrrolizidine Alkaloids (PAs) in Herbal Infusions from Croatian Markets

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Due to the adverse effects that pyrrolizidine alkaloids (PAs) may have on human and animal health (hepatotoxicity, genotoxicity, mutagenicity, carcinogenicity, etc.), it is important to pay attention to their presence in food. PAs are natural toxins produced as secondary metabolites, primarily in plant species. Structurally, they are diverse esters formed by the reaction of necine bases and necic acids, occurring naturally as tertiary bases or as N-oxides of pyrrolizidine alkaloids (PANOs). Humans most commonly ingest them through the consumption of plant-based foods, especially herbs, teas, and herbal infusions. The primary aim of this study was to analyze the presence and identify PAs in samples of herbal infusions. Samples were purchased at a local market in Novi Zagreb, and all herbal infusions originated from the territory of the Republic of Croatia. The study was conducted on a total of five samples: peppermint, chamomile, fennel, lemon balm, and comfrey, in the Liquid chromatography and mass spectrometry laboratory of the Teaching Institute of Public Health "Dr. Andrija Štampar". For the identification and quantification of PAs, a liquid chromatography-tandem mass spectrometry method (LC-MS/MS) was used. The obtained results showed the presence of PAs/PANOs in all tested samples (with intermedine, echinatine-N-oxide, and rinderine-N-oxide dominating), and the quantified concentrations were as follows: peppermint 38.3 μg kg^{-1}, chamomile > 5 μg kg^{-1}, fennel 114 μg kg^{-1}, lemon balm 468 μg kg^{-1}, and comfrey 407 μg kg^{-1}. The maximum permitted level of PAs for the specified types of herbal infusions, as defined by EU Regulation 2023/915, is 400 μg kg^{-1}. Accordingly, the determined concentrations in the lemon balm and comfrey samples exceed the prescribed limit. Considering the small number of analyzed samples, the results of this study indicate the need for further investigations to contribute to the protection of consumer health.

Keywords:
Pyrrolizidine alkaloids, Herbal infusions, Croatian markets

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Integrative Metabolomic Insights Into Garlic's Adaptive Responses to Drought and Heat Stress

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Abiotic stresses, such as drought and elevated temperature, increasingly threaten crop productivity and nutritional quality. In this study, conducted in climate chambers, garlic (*Allium sativum* L.) plants were exposed to combinations of water-available and drought conditions under ambient and elevated temperature regimes to explore key mechanisms behind garlic's adaptation. A two-factorial design included 4 treatment groups: W+/T−, W+/T+, W−/T−, and W−/T+. Metabolomic profiling quantified changes across amino acids, organic acids, sugars, vitamins, polyphenols, organosulfur compounds, phytohormones, and the glutathione redox pair (GSH/GSSG). Under optimal conditions (W+/T−), metabolite levels reflected balanced primary and secondary metabolism, with baseline amino acids, organic acids, sugars, and phytohormones supporting growth and energy metabolism, while polyphenols, vitamins, and GSH/GSSG ratio, remained at equilibrium. Elevated temperature (W+/T+) primarily increased organic acids and sugars, accompanied by reduced amino acids, indicating enhanced respiration and carbon allocation toward glutathione biosynthesis for redox homeostasis. Vitamins, organosulfur compounds, and polyphenols, were also upregulated, reflecting the presence of osmotic stress. Drought conditions (W−/T−) triggered depletion of organic acids and sugars and stimulated phytohormone biosynthesis, promoting amino acid biosynthesis and subsequent increases in vitamins, organosulfur compounds, and polyphenols. In conjunction with the decreased GSH/GSSG ratio, observed trends in other metabolite classes are indicative of oxidative stress. Combined drought and elevated temperature conditions (W−/T+) induced strong reprogramming of both primary and secondary metabolism, with marked increases in organic acids, amino acids, sugars, polyphenols, organosulfur compounds, and vitamins, highlighting cross-talk between osmotic and oxidative stress responses mediated via hormonal and redox regulation. This work provides a holistic view of garlic's metabolic plasticity under single and combined abiotic stresses, offering insights into mechanisms of stress resilience and strategies for developing crops with improved nutritional and functional quality under climate change.

Keywords:
Abiotic stress, Adaptation, Biochemical mechanism, Phytochemistry, Plasticity

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The Polyphenolic Biodiversity of Wild Asparagus (*Asparagus acutifolius* L.) from the Istrian Peninsula

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Wild asparagus (*Asparagus acutifolius* L.) is a valuable Mediterranean species recognized not only for its culinary use but also for its rich nutraceutical profile. It contains a diverse array of bioactive compounds, particularly polyphenols, which contribute significantly to its health-promoting properties. These polyphenolic compounds act as potent antioxidants, neutralizing reactive oxygen species and reducing oxidative stress at the cellular level. Studies have demonstrated that variations in phenolic composition strongly influence the total antioxidant capacity of wild asparagus extracts. In this study wild asparagus accessions collected in the Istrian peninsula were grown at the same agro-climatic conditions to assess the biodiversity of polyphenolic composition as well as their total antioxidant capacity. In total 46 polyphenolic compounds were identified and quantified by LC-ESI-QqQ. The most abundant as well as the most diverse polyphenolic subclass found in wild asparagus shoots were flavonols, followed by hydroxycinnamic acids, hydroxybenzoic acids, flavanols, flavones, stilbenes, and anthocyanins. One dihidroxyflavonol and one hydroxybenzaldehyde were also identified. The 3-*O*-rutinoside moieties of isorhamnetin, quercetin and kaempferol were the most abundant polyphenolic compounds in wild asparagus accessions. The samples originating from Kanfanar exhibited one of the highest concentrations of total polyphenolic compounds. They also displayed one of the highest antioxidant activity, as shown by all three methods used (DPPH, FRAP and ORAC). Consequently, this species represents a promising natural source of antioxidants with potential applications in functional foods and nutraceutical formulations aimed at supporting human health.

Keywords:
Nutraceuticals, Mass spectrometry, Landraces

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An Integrated System Design for Olive Growing Enabled by Artificial Intelligence Technology in Rural Areas of Med Regions Addressing Water, Soil and Energy Challenges

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This study investigates the potential of integrating environmental sensing and data analytics to predict and enhance olive oil quality in Mediterranean production systems. Olive oil quality depends strongly on soil and climatic conditions, yet long-term and high-resolution datasets remain scarce for many Mediterranean regions. This limitation constrains the ability to quantify how environmental variability influences biochemical oil properties such as free acidity, peroxide value, and phenolic composition. High-frequency environmental data were collected using µMETOS 300 US sensor stations that continuously monitor soil moisture, soil temperature, vapor pressure deficit, evapotranspiration, solar radiation, humidity, and precipitation. These environmental datasets were integrated with in situ field observations detailing tree morphology, fruit biophysical traits, and laboratory analyses of oil quality parameters collected from pilot orchards in Gemlik (Turkey) and Siġġiewi (Malta). The two locations represent distinct Mediterranean microclimates, providing a valuable comparative basis for studying cross regional variability in olive oil production. The study aims to analyze the relationships between environmental dynamics and oil quality indicators while developing and evaluating machine learning and statistical modeling approaches to establish robust, interpretable, and predictive strategies capable of estimating oil quality outcomes under varying climatic and soil conditions. The results are expected to contribute to precision agriculture by supporting data driven decision making, optimizing resource use, and strengthening the climate resilience and sustainability of olive oil production across Mediterranean regions.

Keywords:
Olive oil quality estimation, Agro-environmental data analytics, Predictive modeling, Smart farming systems, Climate-resilient agriculture

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Aflatoxin B1 in Cereals: A Growing Challenge for Food Safety and Public Health in the Last Decade

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Among the hundreds of mycotoxins, special attention is paid to aflatoxins, especially aflatoxin B1 (AFB1) as the most toxic and widespread representative of these contaminants. AFB1 has strong hepatotoxic, carcinogenic, and immunosuppressive effects, and is a major public health and food safety concern worldwide. Cereals and cereal products, as staple foods in human and animal diets, are particularly susceptible to contamination during pre-harvest growth, post-harvest storage, and processing stages. The aim of this study is to provide an overview of the occurrence, risk factors, and control measures of AFB1 in cereals based on the results of the ten-year period (2015-2024). The data obtained show a sporadic but frequent contamination of cereals during all investigated period, with the highest AFB1 content of 755 μgkg^{-1} and a peak occurrence in the maize samples from 2024 (27%), which is related to the presence of the mould *Aspergillus flavus*. Climatic conditions, such as high temperatures and drought, significantly increase fungal growth and toxin production, highlighting the potential impact of climate change on future contamination trends. In addition, improper storage practises and inadequate drying of grains further contribute to AFB1 accumulation. Current monitoring programmes in the European Union and worldwide underline the need for continuous monitoring, as even low levels of chronic exposure pose a significant health risk. Prevention strategies include good agricultural practises, biological control, and post-harvest decontamination procedures. In addition, advances in rapid detection methods, such as immunoassays and molecular approaches, provide valuable tools for early identification of contaminated batches. To summarise, AFB1 contamination of cereals remains a persistent challenge that requires coordinated efforts in research, monitoring, and risk management. Strengthening preventive strategies and developing innovative detection methods are essential to protect consumer health and ensure the safety of the food supply chain.

Keywords:
Aflatoxin B1, Cereals, Moulds, Storage, Climatic conditions, Risk management

Acknowledgements
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Advances in Analytical Techniques for Monitoring Physico-Chemical Parameters in Wastewater

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Monitoring of physicochemical parameters in wastewater is essential for assessing water quality, protecting the aquatic environment and complying with environmental legislation. Key indicators such as pH, electrical conductivity, turbidity, total dissolved solids (TDS), total suspended solids (TSS), dissolved oxygen (DO), biological oxygen demand (BOD), and chemical oxygen demand (COD) provide valuable information on pollutant load and water treatment efficiency. High BOD, COD, and solids content often indicate significant organic contamination, usually originating from municipal waste streams and industrial discharges. Although conventional laboratory methods, such as spectrophotometry, titrimetry, ion chromatography, and atomic spectroscopic techniques, remain the gold standard for accuracy, they often require extensive sample preparation and cannot provide near real-time monitoring. To address these limitations, recent advances have focused on electrochemical and spectroscopic techniques that offer high sensitivity, portability, and in situ applicability. Innovations include multiparametric sensor platforms that integrate electrochemical probes (potentiometric, amperometric, and impedance-based) with spectroscopic instruments (UV-Vis, fluorescence, FTIR, Raman), allowing for the simultaneous measurement of multiple water quality indicators. The incorporation of nanomaterials, fiber optics, and microfluidic systems has improved detection limits, selectivity, and stability in complex wastewater matrices. Wireless data transmission and cloud-based analysis facilitate continuous, real-time monitoring and rapid decision-making in wastewater treatment plants. Current trends point toward hybrid monitoring frameworks that combine the analytical precision of traditional laboratory methods with the agility of portable and online detection systems. This integration not only improves early warning capabilities for contamination events but also supports sustainable water management through efficient process control and compliance verification.

Keywords:
Biosensors, Electrochemical, Spectroscopical, Water monitoring

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Effects of Retail Packages on Retaining the Quality of Cucumbers during Shelf Life and Home Storage

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Cucumbers are perishable food items, and may suffer from softening, shriveling, yellowing, peel damage, decay and sliminess during marketing and home storage. The goal of this study was to examine to what extent different retail packages may assist in preserving the quality of cucumbers and reduce postharvest losses during marketing and home storage. The experiment was conducted at the commercial packinghouse of Malka Farms, Sde Yitzhak, Israel. The treatments included: 1) Control, 2) polystyrene tray + PVC wrap, 3) micro-perforated polypropylene (PP) bags, 4) macro-perforated PP bags, and 5) marketing of loose fruit and home storage in polyethylene (PE) bags. To simulate commercial supply chain conditions, the fruit were held for one day in a shaded warehouse and then stored for two days at 15 °C to simulate logistics management. Afterwards, the fruit were either stored for up to 2 weeks under continuous shelf life at 22 °C, or stored for one day at 22 °C (simulation of shelf life in the supermarket), and afterwards stored for up to 2 weeks in a home refrigerator at 4 °C (simulation of home storage). The results indicated that the micro-perforated PP bags and especially the polystyrene trays + PVC wraps remarkably reduced cucumber losses during extended shelf life. For example, after 7 days at shelf life only 67% of the control fruit were suitable for marketing as compared to 100% of the packed fruit. In addition, all packages remarkably reduced food losses during home refrigerated storage. For example, after 7 days of home storage, only 13% of the control fruit were suitable for consumption as compared to between 60-80% of the packed fruit. It is concluded that proper packaging is beneficial in order to retain the quality and reduce food wastage of cucumbers.)

Keywords:
Food losses, Retail packaging, Cucumbers, Shelf life

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REACTION – Awareness, Alert and Response for CB Threats in Food Defence

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The food chain is a sector that is vulnerable particularly to being jeopardised both by accidental events of contamination and intentional threat attacks. Since these incidents in most cases have cross-border impacts, effective collaboration among a wide range of international stakeholders is required to prevent where possible, or otherwise cope with these challenges. Unfortunately, at the European level, efficient tools for the identification and analysis, response and communication, and appropriate mitigation of, in particular, foodborne chemical (C) and biological (B) threats are either limited, or completely absent. The vision of the REACTION project is to increase Europe's resilience towards foodborne chemical and biological (CB) threats. While in the food safety and food security arena, a significant number of successful international projects and initiatives are already underway, we believe that the food defence sector urgently requires additional attention. Our overall goal is to strengthen Europe's food defence capability to respond to intentional malicious attacks, through (a) the development of a data-driven monitoring tool for food defence, (b) the development a cost-efficient and streamlined CB threat identification pipeline, (c) the development of AI-supported food defence management tool, (d) the creation of a European-led International Food Defence Expert Forum, and (e) the design of an information awareness raising campaign for CB threats. REACTION is driven by an experienced consortium of 14 leading European Institutes, Universities, national food safety and defence authorities, agri-food chain representatives, as well as technology providers, who will cooperate with an International Advisory Board of world-class actors from the food defence arena. In this talk, I will present our project to experts and seek for collaborations concerning the expert forum.

Keywords:
Food defence and safety, AI-based monitoring, Novel analytic methods

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Evaluation of Algerian Honeys by their Physicochemical Analysis and Biological Properties

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Honey is a vegetable and animal product which comes from nectar and / or honeydew. It is used in different nutritional and therapeutic fields. Several Algerian honeys were studied for their physicochemical parameters (moisture, pH, proteins, proline, hydroxymethylfurfural, ash, color, electrical conductivity, and optical rotation), floral origin and phenolic compound contents. Antioxidant, antibacterial activities, and inhibitory enzymes were tested too. All honeys were acidic ($3.65 \leq pH \leq 4.35$) and most had low moisture content. Electrical conductivity varied between 0.29 and 1.78 $mScm^{-1}$. Results for ash, protein and proline contents showed that the majority of honeys were in agreement with legislation and were authentic. Hydroxymethylfurfural values (from 1.5 to 34.73 mg kg^{-1}) agreed with the international requirements. The honeys were rich in total phenolic compounds (22.41 to 96.16 mg gallic acid equivalents 100 g^{-1}), and flavonoids (8.90 to 80.02 mg quercetin equivalents 100 g^{-1}). The results of antibacterial activity showed that the honeys were more effective against Gram-positive bacteria (*Staphylococcus aureus* and *Staphylococcus aureus FRI 6*) than against Gram-negative bacteria (*Escherichia coli* and *Salmonella typhi*). All honeys showed inhibitory activity against acetylcholinesterase, α-glucosidase, pancreatic lipase and tyrosinase. Statistical analysis revealed that the darker color of honey is a good indicator of higher antioxidant content and better biological properties. Honey can also be integrated as a therapeutic agent in different strategies for the prevention and treatment of several diseases such as arthritis, Alzheimer's disease, obesity and hyperpigmentation.

Keywords:
Honey, Bioactive compounds, Biological properties, Physico-chemical parameters

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Formulation of Margarine Enriched with Lentisk Oil and Honey: Characterization and Oxidative Stability

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This study focused on the use of *Pistacia lentiscus* oil and honey as natural sources to formulate margarine with improved quality and oxidative stability. For this purpose, five margarines were formulated with honey and different concentrations of lentisk oil. Analyses were performed on oil and honey used, and then physicochemical characterization and several oxidative stability tests were applied to assess margarine quality like the peroxide index, Schaal test, Rancimat test, specific extinction at K270 nm and K232 nm and the thiobarbituric acid test. The results showed that a lentisk oil and honey have a high content of total phenolics and total flavonoids and have good antioxidant activities. In addition, the evaluation of the oxidative stability of enriched margarines during 3 months of storage demonstrated that margarine with 2% lentisk oil added (M1) had an improved oxidative stability index determined by the Rancimat test (22.26 h), better than the control and margarines added with 5 (M2), 10 (M3), and 15% (M4) of lentisk oil. Overall, margarines prepared with high concentrations of lentisk oil (M2–M4) did not differ from the control, while only M1 was able to improve the stability of margarine with a slight influence on physicochemical parameters. The production of margarine enriched with 2% lentisk oil improves the properties of the product, and could be used for margarine production.

Keywords:
Formulation, Honey, Lentisk oil, Margarine, Oxidative stability

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Quality Parameters of Selected Types of Honey

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Honey is a complex food product produced by bees (*Apis mellifera*) from plant nectar or secretions of plant parts and insects. Its composition and physicochemical properties vary depending on its geographical and botanical origin which are crucial for assessing its quality. Quality control of honey on the market includes checking its authenticity from the aspect of the production process and the correctness of the labelling of the type and/or geographical origin, the requirements that the honey must meet being prescribed by international standards and the national legislation of each country. The aim of this work was to evaluate the quality of different types of honey (chestnut, acacia, sage, floral honey) and honeydew from different producers supplied by local family farm and stores. Therefore, the following physicochemical parameters were tested: refractive index, moisture content, electrical conductivity, pH, total acidity, sugar content and HMF content, and the results obtained were compared with the values prescribed by Regulation on Honey (NN 53/2015). The highest moisture content (25.36%) and the highest total acidity (25.46 mmol kg^{-1}) were determined in the floral honey samples. Electrical conductivity is determined in the range from 107.33 (acacia) to 1036.00 $mScm^{-1}$ in the chestnut sample while the refractive index in all samples was on average about 1.50. The HMF content in the samples was 1.37–8.96 mg kg^{-1} sample and thus below the permissible limit of the Regulation. The lowest content of reducing sugars was found in honeydew (60.01%), which also contained the lowest amount of sucrose (0.93%). According to the results, three honey samples (one floral honey and two honeydew) did not meet the criteria prescribed by the Regulation due to their high moisture content, one chestnut honey and one honeydew due to electric conductivity while the other samples met the criteria of the Regulation in all performed analyses.

Keywords:
Honey, Honeydew, Quality, Physico-chemical parameters

Polycyclic Aromatic Hydrocarbons in Environment and Food of Animal Origin: Occurrence, Legislation and Determination

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Polycyclic aromatic hydrocarbons (PAHs) are a class of organic compounds that contain carbon and hydrogen atoms and have more than two condensed benzene rings. PAHs are associated with risks to human health, particularly carcinogenesis. One form of exposure to these compounds is the ingestion of contaminated food, which can occur during high-temperature preparation and processing (e.g. grilling, smoking, toasting, frying and deep-frying) and from PAHs in soil, air and water (i.e. from environmental pollution such as imperfect combustion or pyrolysis of organic matter during industrial processing and from motor vehicle exhaust). The deposition of PAHs from the air leads to their entry into the soil, which is their main route of entry into the environment - sediments and water. Analytical methods for the determination of PAHs in environmental samples include extraction, purification and detection methods. Sample preparation is an important step in the analysis of PAHs, especially in complex food matrices that require efficient extraction and clean-up steps to isolate PAHs from co-extracting matrix components. This review gives an overview of the available literature - from sample preparation procedures, extraction and clean-up methods to instrumental analytical methods in different matrices - from soil, water (wastewater, drinking water, surface water) to food of animal origin (egg, milk) - and thus providing a unique overview in one place. The paper also provides an overview of the occurrence of PAHs in different types of matrices in the context of legislation.

Keywords:
Polycyclic aromatic hydrocarbons, Environment, Food of animal origin, Determination

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Polar Pesticides in the Environment: A Review of Their Occurrence and Detection Methods

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Polar pesticides are frequently used in agriculture due to their low cost and high effectiveness, but they also pose a significant threat to the ecosystem. Due to their high water solubility, they penetrate the environment very easily and pose a threat to all living organisms. Some of the polar pesticides applied end up in the soil and can enter surface and groundwater through runoff and leaching, enter the food chain and represent a potential exposure pathway for humans. The best-known polar pesticide, glyphosate, is widely used and faces the problem of developing weed resistance, which is why another polar pesticide, glufosinate, is increasingly being used as an alternative. After application, they can be biotransformed in the soil by mineralisation, immobilisation or leaching and form metabolites that also enter the environment and the food chain. The quantification of polar pesticides is a major challenge due to the high polarity and amphoteric nature of the molecules, the low molecular weight, the high solubility in water and the lack of a chromophoric group. For these reasons, it is not possible to quantify them with the multiresidual methods used in pesticide analysis, such as the QuEChERS method (Quick, Easy, Cheap, Effective, Rugged, Safe). Instead, the QuPPe (Quick Polar Pesticides) method is used in combination with advanced techniques, most commonly with liquid chromatography coupled with tandem mass spectrometry (LC-MS/MS). To summarise, continuous monitoring of the use of polar pesticides, i.e. monitoring their concentration in different environmental matrices, the development of advanced analytical methods and strict regulatory requirements are essential for risk mitigation and protection of the entire ecosystem. This review provides an insight into the presence of SRM (Single Residue Methods) polar pesticides in the environment and the possibility of monitoring their concentrations using modern analytical methods and techniques.

Keywords:
Environment, Polar pesticides, LC-MS/MS, QuPPe method, SRM

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Is there a Link between Food Safety Culture and Internal Audits in Retail Settings?

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Companies with a strong food safety culture (FSC) are generally associated with fewer food safety non-conformities and incidents. However, several research studies indicate that FSC assessments should be conducted alongside observations of actual food safety practices to validate FSC results. In this study, the link between FSC in a retail chain in Croatia and internal audit results was examined. Additionally, employee motivation was assessed, and its relationship to FSC and audit results were described. A structured employee questionnaire based on the European Commission guidelines (2022/C 355/01) was used to assess FSC, targeting staff from various departments and regions. Internal audit results were evaluated using the GFSI (Global Food Safety Initiative) checklist, while employee motivation was measured through perceptions of workload, work atmosphere, and long-term interest in employment with the company. The results indicated a high overall level of FSC (mean = 4.51). No significant correlation was found between audit results and either FSC or motivation, while motivation showed a strong positive correlation with FSC ($r = 0.528$, $p < 0.05$). Significant regional differences were observed, with employees in the Zagreb region having lower average FSC scores.

Keywords:
Food safety, Food safety culture, Internal audits, Retail

What is More Relevant for the Risk of Listeriosis in Soft Goat's Cheese: Pasteurization or Competition? An Answer Based on QMRA

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Ready-to-eat (RTE) dairy poses a particular risk of listeriosis, especially for vulnerable groups such as pregnant women, children, and the elderly. *Listeria monocytogenes* may enter cheese-processing environments through raw milk or post-process contamination. The development of effective control systems requires an identification of the main risk factors based on a suitable risk assessment. This study developed kinetic models for *L. monocytogenes* inactivation during milk pasteurization and growth during cheese storage. Inactivation data on goat's milk was obtained in a Mastia thermoresistometer and fitted to the Bigelow model using the bioinactivation software using a one-step algorithm to obtain a z-value of 5.69 °C and a D60 value of 0.30 log min. Growth kinetics were obtained in a laboratory-scale soft goat's cheese model. Results were described using the Baranyi model fitted using biogrowth, concluding that *L. monocytogenes* would be able to grow during cheese storage at room temperature (μ = 0.30 log CFU/h; λ = 3.5 h). Nonetheless, the background cheese microbiota (particularly, lactic acid bacteria) inhibits the growth of the pathogen through competition, introducing an early stationary phase compatible with Jameson effect. These models were used to improve current risk assessment models. The model was implemented as a Monte Carlo simulation using the biorisk package to account for variability and uncertainty. Through scenario analysis, we conclude that milk pasteurization and bacterial competition exert a different control for *L. monocytogenes*. Pasteurization reduces the mean consumer exposure, lowering the expected number of cases. However, competition limits the maximum microbial concentration in the cheese, a factor of great relevance for *L. monocytogenes* due to its relatively high infective dose. Therefore, competition limits the possibility of rare events of high illness probability. This academic study underlines the potential of quantitative microbial risk assessment to better understand risk factors, ultimately improving food safety strategies.

Keywords:
QMRA, Goat's cheese, Predictive microbiology, Food safety

Application of Artificial Neural Networks to Evaluate Shelf Life of Virgin Olive Oils Produced with Innovative Technologies

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Accurate shelf-life assessment of virgin olive oil (VOO) remains a major challenge for the olive oil industry, as both overestimation and underestimation can lead to substantial economic losses. Although producers typically declare an 18-month shelf life, some VOOs retain acceptable quality for up to 24 months, while others deteriorate within 12 months. Reliable predictive models are therefore essential for optimizing product labeling and quality management. This study aimed to develop reliable shelf-life prediction models for VOOs produced by conventional and innovative processing technologies, based on quality parameters (peroxide value-PV and K-values), oxidative stability index (OSI), and antioxidant capacity (AC) monitored over 24 months. Artificial Neural Networks (ANNs) were developed for VOOs obtained through conventional production and innovative treatments—flash thermal treatment (FTT), ultrasound (US), pulsed electric field (PEF), and their combination. Multilayer Perceptron (MLP) models were trained, tested and validated in Statistica v.14 using quality parameters and processing variables (temperature, time, ultrasound power, and electric field strength) as inputs, with storage time as the output. From 500 generated networks per model, the optimal ones were selected based on the coefficient of determination (R^2) and the sum of squares (SOS) error. Sensitivity analysis was performed to identify which variables influence shelf life under each treatment the most. All five models exhibited strong agreement between experimental and predicted values, with $R^2 > 0.90$ across training, testing, and validation phases. The US model achieved the highest predictive accuracy (± 1.26 months), while the conventional model showed the lowest (± 2.5 months), likely due to the smaller dataset. Global sensitivity analysis identified variety, OSI, and K232 as the most influential factors. These results confirm the dominant role of varietal composition and antioxidant content in OSI. Notably, the processing parameters associated with the innovative treatment techniques did not significantly affect developed ANN models.

Keywords:
Virgin olive oil, Shelf-life, Artificial neural networks, Innovative technologies

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The Nutritional Profile of the Sweet Onion Landrace "Premanturska Kapula" (*Allium cepa* L.) in Relation to Bulb Size

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The Mediterranean region is particularly rich in traditional onion varieties, both sweet and pungent. The synthesis of phytochemicals occurs alongside the general development and maturation of vegetables; however, the relationship between onion bulb size and the content of antioxidant compounds, antioxidant capacityAc and nutritional traits remains unclear, as does the origin of such variations. This study aimed to examine the biochemical and nutritional characteristics of the sweet onion landrace Premanturska kapula and to assess how bulb size influences its phytochemical and nutritional profile. The Premanturska kapula landrace exhibited high levels of soluble sugars, antioxidant capacity and phenolic compounds. The predominant flavonols identified were quercetin-3,4'-diglucoside and quercetin-4'-glucoside, while protocatechuic acid was the main phenolic acid detected. Bulb size was found to affect the composition of sugars: larger bulbs contained higher amounts of sucrose and fructooligosaccharides, whereas smaller bulbs were richer in glucose. Neither total sugar content nor bulb dry matter varied significantly with bulb size. Phenolic compounds were more abundant in smaller bulbs, suggesting a connection between bulb development and the allocation of phenolics within the plant. This relationship may stem from agronomic factors such as bare-root transplanting or open pollination, which increase genetic variability. From a consumer standpoint, smaller and medium-sized bulbs offer higher concentrations of polyphenolics and simple sugars, while larger bulbs are richer in fructooligosaccharides, compounds recognized for their significant health-promoting properties.

Keywords:
Antioxidant capacity, Polyphenolic compounds, Landraces

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Under Stress Conditions, LAB Strains Exhibited Increased Resistance to Antibiotics and Higher Rates of Gene Transfer

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Antibiotic resistance is currently one of the most important public health challenges. This issue concerns not only pathogenic microorganisms but also lactic acid bacteria (LAB) widely applied in the food industry. LAB strains are exposed to various environmental stresses during food production and preservation, including low pH, high NaCl concentration, low temperature, and high-pressure processing (HPP). These stress conditions may influence the resistance phenotype, gene expression, and the ability of LAB to transfer antibiotic resistance genes, thus contributing to the spread of resistance in the environment. The aim of this study was to evaluate the impact of food-related stress factors on survival, gene expression, and horizontal gene transfer in LAB strains. Eight strains, including *Lactobacillus helveticus*, *Lactiplantibacillus paraplantarum*, *Lacticaseibacillus rhamnosus*, and *Lactococcus lactis* ssp. lactis, were examined. The analyses included survival assays, real-time PCR for resistance gene expression, flow cytometry, and conjugation experiments with the recipient strain *Enterococcus faecalis* JH2-2. The results demonstrated that physicochemical stresses significantly affected both the survival rate and antibiotic resistance profiles of LAB. The highest survival (>90%) was observed under 4% NaCl, while the lowest (<50%) followed HPP at 400 MPa. Acidic and osmotic stresses induced increased expression of aminoglycoside resistance genes (aac(6')Ie-aph(2")Ia, aph(3')-IIIa) and tetracycline resistance gene (tetM), along with higher gene transfer frequencies. In contrast, cold stress reduced the expression of all analyzed genes. The findings suggest that environmental factors relevant to food processing and storage can promote the spread of antibiotic resistance. Therefore, careful verification of LAB strains used in the food industry is necessary to minimize the risk of their role as reservoirs of resistance genes.

Keywords:
Stress conditions, Lactic acid bacteria, Antibiotic resistance

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Responses of Lactic Acid Bacteria to Non-Thermal Food Processing: Focus on Antibiotic Resistance Genes

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Lactic acid bacteria (LAB) are widely used in the food industry due to their technological and probiotic properties. However, the potential of these microorganisms to serve as reservoirs and vectors of antibiotic resistance genes (ARGs) raises safety concerns. The present study aimed to evaluate the impact of non-thermal food processing—specifically high-pressure processing (HPP)—on antibiotic resistance phenotypes and gene expression profiles in selected LAB strains. Ten LAB strains, including *Lactiplantibacillus paraplantarum*, *Lactocaseibacillus paracasei*, *Latilactobacillus curvatus*, *Lactobacillus helveticus*, and *Lactococcus lactis* subspecies, were examined. The strains were selected based on the presence of at least one ARG and a low minimal inhibitory concentration (MIC) for the corresponding antibiotic. HPP treatments were applied at 300–400 MPa for 1–5 min. Post-treatment analyses included determination of MIC values and quantification of gene expression levels using Real-Time PCR. HPP significantly altered both resistance phenotypes and gene expression patterns. The MIC values for chloramphenicol and ampicillin increased after pressurization, whereas those for aminoglycosides (gentamicin and kanamycin) decreased. Expression of stress response genes (clpL, groEL, dnaK) increased markedly under all tested pressure conditions. Furthermore, expression of genes conferring resistance to tetracyclines (tetM, tetW), β-lactams (blaZ), and chloramphenicol (cat) increased, while aminoglycoside resistance genes (aac(6')-Ie-aph(2'')-Ia, aph(3')-IIIa) were downregulated. These findings suggest that non-thermal processing technologies such as HPP may modulate the antibiotic resistance profiles of LAB by inducing stress responses that alter gene regulation. Although LAB are not considered pathogenic, such changes could enhance the persistence and dissemination of ARGs in food environments. Therefore, both the selection of LAB strains and optimization of food processing parameters are crucial to minimize the potential spread of antibiotic resistance in the food chain.

Keywords:
Non-thermal food processing, HPP, Lactic acid bacteria, Antimicrobial resistance

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Rapid Authentication of Garlic Powder Using Near-Infrared Spectroscopy and Chemometrics

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Food adulteration is the intentional act of reducing a product's quality by removing, adding, or substituting a substance with one of lower value for financial gain. Garlic powder is particularly susceptible to adulteration due to the ease with which it can be imitated, making it a common target for counterfeit products. Documented adulterants include talc, chalk, and various starches and flours, such as maltodextrin, corn, potato, and rice flour. The increasing prevalence of adulterated garlic powder highlights the need for new, rapid, and non-destructive analytical methods that require minimal sample preparation. Near-infrared (NIR) spectroscopy, when combined with chemometric analysis, has become a widely accepted technique in the agri-food industry for detecting undesirable compounds in food. This method is valued for being environmentally friendly, non-invasive, low-cost, and capable of providing fast and accurate results. This study investigates the potential application of near-infrared spectroscopy (NIRs) for detecting starch adulteration in garlic powder. Samples containing different concentrations of starch (0–100%) were prepared and analyzed for the following properties: particle size distribution (d (0.5) and D [3,2]), bulk density, Hausner ratio, water activity, moisture content, color, conductivity, total dissolved solids (TDS), pH, and the concentrations of total polyphenols and starch. NIR spectra of the powdered samples were recorded and analyzed using principal component analysis (PCA). Additionally, partial least squares (PLS) models were developed, which, based on the R^2 and root mean square error (RMSE) values, successfully demonstrated the capability of NIR spectroscopy for quantitative prediction of the following properties: d (0.5) and D [3,2], water activity, *a** and *b** color coordinates, chroma, hue, total color change, conductivity, TDS, pH and concentrations of total polyphenols and starch.

Keywords:
Adulteration, Near-infrared spectroscopy, Chemometrics

Key Success Factors for Implementing GMP and HACCP in Food Services

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The objective of this research was to analyze current scientific evidence on the success factors in the implementation of Hazard Analysis and Critical Control Points (HACCP) and Good Manufacturing Practices (GMP) systems to ensure food safety in food service operations. A systematic literature review was conducted, covering studies published between 2000 and 2024 in various contexts, including school and university cafeterias, prisons, hotels, restaurants, and shared kitchens. The reviewed studies employed methodologies based on microbiological monitoring, internal and external audits, knowledge, attitudes, and practices (KAP) surveys, as well as predictive models of performance in food safety and quality. The findings revealed that successful implementation of HACCP and GMP systems is primarily driven by four interrelated factors: continuous employee training, systematic verification and auditing, process traceability, and strong institutional commitment. These factors collectively contribute to significant reductions in microbial loads, improved hygiene standards, and the consolidation of a robust food safety culture among food handlers. Moreover, the integration of technological monitoring tools and risk-based approaches was identified as an emerging trend to enhance system performance and sustainability. The results underscore the critical importance of structured and evidence-based food safety management systems as cornerstones for preventing foodborne diseases and promoting public health. Despite proven effectiveness, variability in implementation and limited resources remain key challenges, particularly in institutional and large-scale catering environments. This review concludes that the joint application of HACCP and GMP represents a scientifically validated and adaptable strategy for strengthening food safety governance in food service operations globally.

Keywords:
Food safety, HACCP, Good Manufacturing Practices (GMP), Food service operations

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Consumer Perception and Opinion on Food Safety Along with Withdrawal and Recall

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Food safety represents one of the key issues of public health and consumer trust in the food supply chain. Product withdrawals and recalls, although essential for protecting health, often trigger distrust and negative public reactions. Understanding consumer perception and behavior in such situations is crucial for improving the effectiveness of the food safety system and communication with the public. The aim of this study was to examine consumer perception and opinion in Croatia regarding food safety and the system of product withdrawals and recalls. The research was conducted through an online survey on a sample of 164 respondents of different ages, genders, educational levels, and places of residence. The questionnaire consisted of 20 questions addressing demographic characteristics, knowledge of withdrawal and recall procedures, behavior/experience with withdrawn or recalled products, and attitudes toward food safety. The results show that the majority of respondents are familiar with the concepts of withdrawal and recall (90%) and are aware of general information related to these procedures (75%). The main sources of information reported were the media and social networks, while official sources were largely overlooked. Product withdrawal or recall was found to reduce trust in the manufacturer and negatively affect consumer perception, leading to avoidance of future purchases of the same product and substitution with competing products. Trust in institutions showed to be low, with more than 60% of respondents stating that they did not feel sufficiently educated about food safety, although they expressed interest in acquiring further knowledge. It can be concluded that there is a significant gap between the regulatory framework and consumer perception. Improving transparency, timeliness of communication, and involving consumers through education and accessible official sources are necessary measures to enhance public trust and strengthen the effectiveness of the food safety system.

Keywords:
Risk communication, Consumer behavior, Food quality control, Public health, Education

Uncovering Non-Human Sialic Acid Signatures in *N*-Glycans from Cheddar and Processed Cheese Product

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Non-human sialic acid (i.e., Neu5Gc; *N*-glycolylneuraminic acid) is a sugar molecule commonly found in mammalian tissues and certain dairy products. Humans have lost the ability to synthesize Neu5Gc due to an inactivating mutation in the CMAH gene but can still incorporate it into tissues through dietary sources. This incorporation may lead to immune sensitization and the generation of anti-Neu5Gc antibodies, contributing to chronic inflammation and other potential health risks. Although the presence of Neu5Gc is well characterized in red meat, its occurrence in dairy products remains an area of active investigation. In this study, we investigated non-human sialic acid–containing N-glycans in two dairy products: sharp cheddar cheese and processed cheese slices. Analysis was performed using nano-HPLC-ESI-MS/MS. Non-human sialic acid (Neu5Gc)–containing *N*-glycans were detected in cheddar cheese but were absent in processed cheese slices. This discrepancy likely reflects differences in processing conditions, such as heat treatment and enzymatic modification, which can alter glycan composition and sialylation patterns. The detection of non human sialic acid (i.e. Neu5Gc) in cheddar cheese provides direct evidence of its presence in dairy matrices and indicates that compositional and processing factors influence its retention. In sharp cheddar cheese, several Neu5Gc-containing complex-type *N*-glycans were identified, eluting predominantly between 31 and 36 min, with signal intensities ranging from approximately 2×10^5 to 3×10^6 a.u. These peaks correspond to Neu5Gc-positive N-glycan structures detected exclusively in cheddar cheese, while no Neu5Gc species were observed in processed cheese slices. The results suggest that processing steps such as heat treatment, emulsification, and enzymatic modification may degrade or remove Neu5Gc-bearing glycans. Overall, these findings highlight the importance of continued research into the bioavailability and immunogenic properties of non-human sialic acid (Neu5Gc), its health effects across populations, and its potential role in inflammation and immune-related diseases. Understanding the dietary impact of Neu5Gc in common foods such as cheese could provide valuable insights for personalized nutrition.

Keywords:
N-glycolylneuraminic acid, Cheddar, Cheese product

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Chemical and Sensory Characterization of Virgin Olive Oils from Hvar Island

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Olive growing on Hvar island has been present for more than two millennia. The specifics of the growing area and the mild Mediterranean climate give special aromatic and taste properties to Hvar olive oils, which have been winning the highest awards at domestic and international competitions for many years. In addition, Hvar still does not have a Protected Designation of Origin (PDO) for "Hvar olive oil". The aim of this research is to determine the chemical and sensory characteristics of virgin olive oils (VOO) from Hvar island. The set of different analyses were carried out on the oil samples obtained from autochthonous and introduced olive cultivars cultivated on Hvar island (oblica, levantinka, drobnica, leccino, pendolino). Besides common quality parameters (determination of free fatty acids and peroxide value, spectrophotometric measurement of absorbances), the fatty acids composition (gas chromatographic method) and the proportion of total phenols (spectrophotometrically) were determined during two consecutive years. The most aboundand fatty acid was monounsaturated oleic acid, in the range from 75.61 up to 79.65% of total fatty acids. The values for total phenols was the highest for monovarietal VOO from levantinka (457.25 mg kg^{-1} as galic acid). The sensory analysis of virgin olive oils was performed by trained professional panel of the Institute for Adriatic Crops from Split, Croatia, approved by the Croatian Ministry of Agriculture, according the official IOC method. The descriptive sensory analysis was used for a detailed description of each VOO in the form of star diagram. The obtained results represent the valuable database needed for the specification for PDO application.

Keywords:
Characterization, Protected Designation of Origin (PDO), Sensory analyses, Virgin olive oil

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Impact of a Natural Plant Extract on the Physicochemical Properties, Texture and Oxidative Stability of Hybrid Burgers

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Hybrid burgers, a combination of animal and plant proteins, offer a sustainable alternative to conventional meat products by combining the sensory appeal of meat with the nutritional and environmental benefits of plant-based ingredients. The global hybrid meat products market, driven by demand for healthier low-meat foods, will reach USD 1.314,9 million by 2035, growing 9.5% annually. Developing such products requires optimization of physicochemical and structural properties while maintaining the product's quality and acceptable taste. This study aimed to develop a clean-label hybrid burger by incorporating a natural plant extract from aromatic plants to enhance the quality and oxidative stability of the final products. The effect of the plant extract addition, either in liquid or in dry form, on the physicochemical properties, texture, as well as on the oxidative stability of the produced hybrid burgers was investigated. In this view, four samples were prepared; (i) a conventional (non-hybrid) burger (100% meat protein) as control, (ii) a hybrid burger without the plant extract, (iii) a hybrid burger enriched with the plant extract in liquid form and (iv) a hybrid burger with the extract in powder form. All hybrid formulations were produced using minced beef and selected clean-label functional ingredients, such as textured vegetable proteins (TVPs) and isolates, fibers, dehydrated plant flakes, natural flavorings and colorants. Analyses included color measurement, determination of water-holding capacity, texture profile analysis (TPA) and monitoring of lipid oxidation via TBARS during storage in the fridge. Results indicated that the inclusion of the plant extract could retard lipid oxidation and extend the shelf life of hybrid burgers without adversely affecting color or texture. These findings highlight the potential of natural plant extracts as clean-label ingredients that enhance product quality and support the development of high-added value hybrid products.

Keywords:
Hybrid burger, Sustainable meat alternatives, Clean-label formulations, Natural antioxidants, Oxidative stability, Texture profile analysis

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This research has been conducted in the frame of "Clusters of Research Excellence (CREs)" 2024 – 2026 ("ClHybMeat: Development of clean label foods based on plant materials and hybrid products of animal origin", action code: ΥΠ3ΤΑ-0560085) was co-financed by National Hellenic Funds and the European Union (European Regional Fund).

Microbiological Quality and Preservation of Hybrid Burgers Enriched with a Natural Plant Extract

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Meat alternatives, including hybrid burgers that combine animal and plant-based proteins, are designed to reduce the environmental impact of meat production while maintaining desirable sensory and nutritional characteristics. However, their complex composition introduces distinct challenges related to microbiological safety and shelf-life stability, as the inclusion of plant-derived components can alter physicochemical properties such as pH, water activity, and nutrient availability, influencing microbial behavior. This study aimed to develop and evaluate a clean-label hybrid burger formulation in terms of microbiological quality and stability through the incorporation of a natural aromatic plant extract. Such extracts are rich in bioactive compounds (e.g., phenolics), that may possess antimicrobial properties against spoilage and pathogenic microorganisms. Four burger variants were produced: a conventional beef burger (control), a hybrid burger without the extract, and two hybrid formulations enriched with the extract in either liquid or dry (powder) form. The samples were evaluated during refrigerated storage (4 °C) at regular intervals (e.g., day 0, 3, 6) in terms of total viable counts, psychrophilic bacteria, lactic acid bacteria, spoilage microorganisms, yeasts and *Enterobacteriaceae*. Results demonstrated that both plant-based ingredients and the aromatic plant extract affected the microbiological profile and shelf-life of the samples. These findings highlight the potential of natural plant-derived bioactive compounds to enhance the microbiological safety, shelf-life, and overall quality of clean-label hybrid meat products.

Keywords:
Meat analogues, Microbiological safety, Natural plant extracts, Clean-label formulation, Shelf-life extension, Functional ingredients

Acknowledgements
This research has been conducted in the frame of " Clusters of Research Excellence (CREs)" 2024 – 2026 ("ClHybMeat: Development of clean label foods based on plant materials and hybrid products of animal origin", action code: ΥΠ3ΤΑ-0560085) that was co-financed by National Hellenic Funds and the European Union.

Effects of Combining Organic Acid and Essential Oil as an Alternative to Replace Potassium Sorbate in Fruit Preparations

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The replacement of synthetic preservatives by natural alternatives is an increasing demand in the food industry, driven by consumer preference for clean-label products. This study investigated the substitution of potassium sorbate (PS) in red fruit preparations using combinations of propionic acid (PA) and lemongrass essential oil (LEO) with antimicrobial potential against fungi, yeasts, and bacteria, while maintaining safety and stability of the product. Six treatments were developed with different combinations of PA and LEO applied in concentrations ranging from minimum inhibitory concentration (MIC)/4 to 2 × MIC against *Lactobacillus plantarum*, *Escherichia coli*, *Candida intermedia*, *Pichia fermentans*, *Aspergillus niger* and *Penicillium glabrum* incorporated in red fruit preparation during 28 days. The systems were kept refrigerated (4 ± 2 °C) and counts were performed for each microorganism every 7 days. Inoculums of 105 and 102 spores mL^{-1} were used for fungi, 106 CFU mL^{-1} for bacteria and 103 CFU mL^{-1} for yeast. For all treatments, it was observed that there was no growth of any bacteria or yeast from the 1st day of the study. The 2 × MIC treatment inhibited fungal growth from day 7 onwards, followed by the MIC treatment, which inhibited fungi from day 14 onwards, with results similar to those of PS to *A. niger* (105 spores mL^{-1}), followed by the MIC/2 treatment which also inhibited *P. glabrum* (105 spores mL^{-1}) from the 7th day. All treatments completely inhibited the growth of both fungi with 102 spores mL^{-1} from 1st day (*P. glabrum*) or day 7 (*A. niger*), results similar to those of PS. These findings demonstrate the potential of replacing potassium sorbate with natural antimicrobial systems based on propionic acid and lemongrass essential oil in fruit-based products. Future work will focus on optimizing sensory attributes, assessing shelf-life performance, and evaluating the scalability of these formulations for industrial implementation.

Keywords:
Organic acids, Essential oil, Natural antimicrobials, Fruit preparations, Clean-label

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Impact of Microclimate and Hygiene of the Production Environment on Contaminating Molds and the Shaping of the Ripening Cheese Microbiome

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The contamination of cheese with undesirable molds represents a serious issue for the dairy industry, affecting product quality, sensory attributes, and potentially food safety due to mycotoxin production. This study focuses on evaluating the impact of the production environment on the incidence and diversity of contaminating molds in a cheese manufacturing facility. The aim of the study was to identify how environmental factors and operational hygiene influence the composition of the cheese microbial community, which has a fundamental impact on its quality, sensory properties, and consumer safety. Not only the incoming raw materials but also the production environment (air, equipment surfaces, walls of ripening cellars, and personnel) can serve as a primary source of microbial contamination. Undesirable molds, particularly from the genera *Penicillium* (e.g., *P. commune*, *P. crustosum*), *Aspergillus*, and *Cladosporium*, are highly adaptable to ripening conditions (low pH, high humidity, low temperature) and are easily disseminated by air. Samples from various production phases and the environment were analyzed using modern microbiological and molecular methods, specifically Real-Time PCR. The findings indicate that air in the ripening rooms and insufficiently sanitized surfaces represent the main critical control points for the introduction of contamination. Contaminating molds can enter into competition with starter cultures (e.g., *Lactococcus*, *Brevibacterium*) and thus disrupt the desired ripening process. The composition of the entire cheese microbiome is a complex ecosystem influenced by the environmental temperature, relative humidity, and airflow. Proper control of these parameters, along with the implementation of effective air filtration and a strict hygiene regimen, is crucial for supporting the growth of the desired microflora and suppressing undesirable contaminants. Managing the environmental microbiome is essential for ensuring the consistent quality and safety of cheese products.

Keywords:
Production contamination, Smear-ripened cheeses, *Penicillium*, PCR

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Efficacy of Melaleuca, Oregano and Thyme Essential Oils in Enhancing Lipid Stability

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Lipid oxidation constitutes a primary mechanism of deterioration in food science and industrial applications, resulting in significant economic losses and potential health risks and leads to rancidity, flavor degradation, loss of essential nutrients, and the formation of potentially toxic secondary products. The economic imperative to extend the shelf-life and maintain the quality of lipid-containing products necessitates the use of effective stabilizers. Essential oils, due to their antioxidant and antimicrobial potential, can be an alternative to synthetic stabilizers. This study presented the efficiency of melaleuca (tea tree), oregano and thyme essential oils in extending the shelf-life of sunflower oil, rich in unsaturated fatty acids (linoleic). The essential oils were characterized compositionally by gas chromatography coupled with mass spectrometry. They were added to sunflower oil at a concentration of 250 mg L^{-1} individually and in combination of 2 essential oils. The shelf life was determined by measuring the induction period at 90, 80, and 70 °C using the Oxitest device from Velp, Italy. The results were processed using the OXISOFT program of the OXITEST device, including the repeatability test, the comparison test, and the test for determining the shelf life at 20 °C. In the case of sunflower samples with tea tree and thyme essential oils, oxidation stability at 20 °C increased by 18% individually and by 21.3% in combination, thus observing an enhancement of the antioxidant effect when adding 125 mg L^{-1} of melaleuca essential oil and 125 mg L^{-1} of thyme essential oil. Oregano essential oil had a lower efficacy, increasing the stability period at 20 °C by only 7.5% compared to the control. In combination, oregano and melaleuca essential oils increased the stability period of sunflower oil by 18%.

Keywords:
Lipid oxidation, Induction period, Shelf life, Essential oil

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Occurrence and Risk Assessment of β-Lactam Residues in Milk in Croatia

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Milk is one of the most nutritionally valuable foods in the world, rich in nutrients including vitamins, minerals, and proteins. Intensive farming largely relies on the use of antibacterial agents to maintain animal health, particularly for preventing and treating mastitis, which affects cow health and milk quality. The use of antibiotics in dairy cows and failure to observe the withdrawal period, can lead to the presence of antibiotic residues in milk and dairy products, posing a potential risk to public health. Residues of veterinary drugs can cause serious consequences such as acute poisoning, allergic reactions, bacterial resistance and human flora imbalance. This study evaluated the presence and distribution of 15 β-lactam antibiotics in 1.636 milk samples collected in Croatia over a 7-year period. Analyses were performed using ultra-high-performance liquid chromatography coupled with triple quadrupole mass spectrometry (UPLC–MS/MS). Residues were detected in 94 samples (5.8%), with 46 samples (2.8%) showing concentrations above the maximum residue limits (MRL). The most frequently detected antibiotics were penicillins, particularly amoxicillin, ampicillin, and penicillin G, with the highest concentrations of 102.4 μg kg^{-1} (amoxicillin) and 577.5 μg kg^{-1} (penicillin G). Cephalosporins accounted for 28.4% of the detected results, with the maximum concentration obtained for cefoperazone (267.4 μg kg^{-1}). The detected levels of residues were further correlated with milk consumption data to assess consumer exposure and evaluate potential health risks in Croatia. The estimated daily intake (EDI) indicated that exposure values for all age groups -including adults, adolescents, children, and toddlers - remained below the acceptable daily intake (ADI). The highest relative risk was identified for amoxicillin in the toddler group (up to 41.8% of the ADI for high consumers), yet still within safe limits. Overall, despite the occurrence of higher concentrations in individual samples, the estimated consumer exposure to milk does not pose a significant health risk. In conclusion, monitoring β-lactams in milk and evaluating consumer exposure are crucial for maintaining milk safety and protecting public health.

Keywords:
Milk, β-lactams, UPLC–MS/MS, Occurrence, Risk assessment, Croatia

Is Our Food Safe? Melamine and Cyanuric Acid in Milk, Baby Food, and Protein Supplements

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Melamine and cyanuric acid can contaminate food in several ways, including intentional adulteration, and their presence may cause serious negative effects. Therefore, their presence in food products represents a significant risk to the health of consumers. This study aims to quantify melamine and cyanuric acid in 15 milk, 15 baby food, and 26 protein supplements available on the Croatian market using a validated UHPLC–MS/MS method and to assess potential risks to consumer health. Cyanuric acid concentrations above the limit of quantification (LOQ) were found in five milk samples (33.3% detection frequency), with a range from 0.261 to 0.385 mg kg^{-1} and a mean concentration of 0.309 mg kg^{-1}. In protein supplements, melamine was detected above the LOQ in six samples (23% detection frequency), with a mean concentration of 0.303 mg kg^{-1} and concentrations ranging from 0.200 to 0.571 mg kg^{-1}. No concentrations above the LOQ were found in baby food samples. This is the first study to confirm the presence of melamine and cyanuric acid in protein supplements and milk on the Croatian market. The findings suggest these products are safe for consumers but also highlight the need for ongoing surveillance due to the potential for intentional or incidental adulteration.

Keywords:
Melamine, Cyanuric acid, UHPLC-MS/MS, Milk, Baby food, Protein supplements

Influence of High Hydrostatic Pressure Processing on Sensory, Physicochemical and Microbiological Properties of Smoked Bacon

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The meat product smoked bacon belongs to the group of semi-permanent dry meats made from one piece of meat, within the category of heat-treated meat products, with a relatively short shelf life and the potential for degradation of quality. Application of high hydrostatic pressure treatment can ensure microbiological safety and preserve the quality. The aim of this work is to investigate the effect of processing pre-packaged sliced meat product with high hydrostatic pressure on spoilage microorganisms, and to determine the physicochemical and sensory characteristics, as well as microbiological activity during storage for 0, 60, 120, 180 days at +4° C. Smoked bacon weighing 350 g was processed with pressures of 350, and 550 MPa, for 0, 3, 6 and 9 min. The processing parameters were identified and optimized, and the impact of time (0, 3, 6 and 9 min) and pressure (350, and 550 MPa) at standard temperature (22 °C) has been evaluated with respect to physical-chemical, sensory and microbiological properties of smoked bacon. High pressure process was applied successfully, presenting a good performance in terms of the physicochemical, antimicrobial and sensory characteristics and extending the shelf life.

Keywords:
High pressure processing, Smoked bacon, Physicochemical properties, Microbiological properties, Sensory characteristics, Shelf life

Vera Johanides Symposium

Development of Biotechnological Sector in Croatia

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Biotechnology is involved with all aspects of human activities and it has critical role in the world economic development. The most popular classification of biotechnology is the use of four (red, green, white and blue) colors, but classifications with almost all tones of rainbow are also known. The sustainable use of sea resources to create industrially interesting products and applications is in the focus of blue biotechnology. In Croatia, blue biotechnology is characterized by marine fish and shellfish farming as well as microalgae cultivation. It has great potential for further development through the high-quality resources and knowledge how to convert these resources into high added value products. The green biotechnology is dealing with creation of new varieties of agricultural plants as well as with bio-fertilizers and bio-pesticides production. In Croatia, a few companies are working on development of new varieties of corn, wheat, barley as well as production of bio-fertilizers. However, the whole sector has to be more open for cooperation with research institutions in order to increase its competitive abilities in European framework. Health preservation, manufacture and discovery of drugs, therapies and diagnostics are in the focus of red biotechnology. In this sector, a few Croatian companies are successfully dealing with manufacture and discovery of active drug substances. White biotechnology is mostly dealing with novel or improvement of traditional industrial bioprocesses. In Croatia, it has great potential for production of traditional (e.g. wine, beer, baker's yeast) and novel (e.g. enzymes, biofuels, bio-chemicals) products due to availability of different renewable feedstock and industrial capacity and knowledge for these productions. The cooperation between research institutions and companies is crucial for further development in these areas. The generator of further economic development in Croatia is closely related to the development of biotechnological sector.

Keywords:
Biotechnology, Sustainable development, Croatia

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Phosphoproteome Dynamics of *Streptomyces rimosus* during Submerged Growth and Antibiotic Production

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Streptomyces rimosus is the best-known producer of oxytetracycline (OTC), which belongs to the tetracyclines — one of the most successful classes of antibiotics. In 2024, the global OTC market was valued at USD 1.2 billion and is projected to reach USD 1.8 billion by 2033. The substantial market value of this antibiotic underscores the need for enhanced productivity of commercial strains and a deeper understanding of the regulatory mechanisms governing its biosynthesis. Protein phosphorylation plays a key regulatory role in cell signaling, gene expression, and cell differentiation across all domains of life. In bacteria, phosphoproteomic studies have primarily focused on model and pathogenic species, while very few have addressed industrially important microorganisms. For the first time, we performed a detailed analysis of the dynamic (phospho)proteomic profiles during growth and antibiotic production in liquid cultures of *S. rimosus*. In this study, we observed significant changes in protein synthesis and phosphorylation in numerous cellular proteins during growth stages that coincide with OTC production and the morphological transitions of this industrially important bacterium. Notably, most of these proteins have not been detected previously. Our results therefore expand current knowledge of phosphorylation events associated with key cellular processes and antibiotic biosynthesis, greatly enrich the phosphoproteome of *Streptomycetes*, and add newly identified phosphoproteins to the database of prokaryotic phosphoproteomes. These findings may ultimately guide new research directions aimed at unraveling the complex regulatory networks in *Streptomyces* species.

Keywords:
S. rimosus, Oxytetracycline, Pellet fragmentation, Peptide dimethylation labeling, Phosphoproteome, Proteome

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Future is Today: AI in Biotechnology, Food Technology and Nutrition

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Nowadays, we are all aware of the profound impact that advancements in artificial intelligence (AI) have on daily life, science, and technology. From the perspective of biotechnology, the synergy between bioinformatics and AI opens new avenues for research and applications addressing some of the most pressing global challenges in medicine, energy and food production, environmental protection, and long-term sustainability. Currently, two landmark AI-driven developments stand out: large language models (LLMs) and AlphaFold's breakthrough in protein structure prediction—both available as open-source resources. In research, LLMs assist in literature screening, protocol synthesis, knowledge support across scientific fields, and generation of large datasets crucial for developing advanced AI/ML models. AlphaFold has revolutionized protein structure prediction, extending to complexes of proteins, nucleic acids, ligands, and ions—thereby accelerating target discovery, molecular docking, and macromolecular design. AI has also shown remarkable progress in food safety and quality assurance. Computer vision combined with hyperspectral imaging enables non-destructive classification of contaminants and spoilage, achieving accuracies above 90% in detecting mycotoxins such as aflatoxin—paving the way for real-time, in-line monitoring. Numerous studies highlight the efficiency of ML models in detecting anomalies across milk, oils, honey, and ready-to-eat (RTE) foods, while also supporting supply-chain traceability. In fermentation industries, reinforcement and active learning approaches optimize process parameters, and IoT-integrated ML systems provide real-time control, leading to "Digital Twin" production platforms. Generative models are now being applied to explore ingredient spaces (taste, texture, cost, carbon footprint) and to guide precision fermentation strategies, with early research targeting the upcycling of food waste into proteins. Landmark studies demonstrated individualized glycemic responses and benefits of algorithm-guided diets. In addition to reviewing AI's impact this work highlights key aspects of AI algorithms and emphasizes the urgent need to introduce AI fundamentals into undergraduate curricula to prepare the next generation of researchers and professionals.

Keywords:
AI, AlphaFold, LLM, Deep learning, Machine learning, Education

PFAS - A Widespread Emerging Class of Contaminants in the Environment and Food

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Per- and polyfluoroalkyl substances (PFAS) are a group of synthetic organic compounds that have been produced since the late 1940s and remain in use today. Due to their thermal and chemical stability, as well as their resistance to water and oils, they are also known as “forever chemicals”. These substances are used in a wide range of consumer and industrial products, including non-stick cookware, food packaging, firefighting foams, textiles, and cosmetics. The strong carbon–fluorine (C–F) bond makes PFAS highly persistent, resulting in their resistance to environmental degradation and subsequent accumulation in water, soil, plants, food, animals, and humans. Studies have linked PFAS exposure to various adverse health effects, including hormonal disorders, immunosuppression, thyroid dysfunction, liver and kidney diseases, and an increased risk of cancer. This project aims to determine the concentrations of approximately thirty PFAS compounds using ultra-high performance liquid chromatography tandem mass spectrometry (UHPLC–MS/MS). Target matrices will include marine and freshwater fish, shellfish, meat, eggs, and tissues from wild terrestrial species. The results will enable an assessment of human exposure and potential health risks relative to established toxicological thresholds, and establish the first national database on PFAS levels in Croatia. This database will provide a crucial foundation for risk assessment and regulatory decision-making.

Keywords:
Per- and polyfluoroalkyl substances (PFAS), UHPLC-MS/MS, Food of animal origin, Human exposure, Croatia

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From Sample to Patient: Microbiological Insights into Tissue and Cell Processing in Regenerative Medicine

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The increasing impact of regenerative medicine and personalized treatments is reshaping modern healthcare, positioning the Tissue and Cell Bank as a crucial interface between science and clinical application. Microbiological safety remains a critical requirement in the processing of tissues and cells intended for therapeutic use. This presentation will provide an overview of the department's core activities, focusing on microbiological quality control in the production of advanced therapy medicinal products (ATMPs). Special attention will be given to protocols for microbiological sampling during the cultivation of autologous keratinocytes for the treatment of severely burned patients, as well as the expansion of limbal stem cells for patients with limbal stem cell deficiency. The department is also licensed for tissue banking activities including the processing and storage of amniotic membrane and femoral head, all performed under high-level microbiological monitoring and in accordance with regulatory standards. Work with tissues and cells is carried out in a strictly controlled aseptic environment within cleanrooms classified according to EU GMP standards (class A in B, C, and D), which provide the appropriate conditions for the safe processing and cultivation of substances of human origin. Environmental microbiological sampling (including air, surfaces, equipment, and personnel) is regularly performed following validated protocols to ensure early detection of potential contamination risks. Additionally, ongoing validations and microbiological assessments, combined with contamination prevention measures, have demonstrated significant improvements in tissue safety over the years. Effective microbiological monitoring is essential not only to comply with regulatory standards but also to guarantee the safety and quality of regenerative therapies, ultimately ensuring the best outcomes for patients.

Keywords:
Microbiological monitoring, Advanced therapy medicinal products (ATMPs), Cleanroom, Tissue Banking, Quality control

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Determination of Genomic Pathogenicity Determinants of QX Strain of Infectious Bronchitis Virus

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Infectious bronchitis is a highly contagious, acute disease of poultry caused by infectious bronchitis virus (IBV). Although the virus was discovered more than 80 years ago, this disease still represents a major problem in poultry production worldwide, despite the numerous vaccines available. One reason for this is the great genetic diversity of IBV; currently over 50 different genotypes are known. The dominant genotype in Europe since the early 2000s is the so-called QX variant, the QX strain belonging to the GI-19 lineage. The most commonly used vaccines against IBV are live attenuated vaccines containing attenuated infectious bronchitis virus. In this research, attenuation of the wild-type infectious bronchitis virus, QX strain, was carried out. By comparing the whole genome sequence of the attenuated virus with the original strain, the determinants of pathogenicity of this IBV strain were investigated. Furthermore, the suitability of the attenuated virus strain as a vaccine strain for the production of a live attenuated poultry vaccine was examined through extensive safety and efficacy testing. The attenuated strain was further purified by plaque selection and compared with the original unpurified strain in terms of safety, efficacy, and growth kinetics. The results showed that the virus was successfully attenuated, that the passaging in chicken embryos resulted in 13 amino acid changes at the protein level, and that the purified virus was significantly less immunogenic than the original attenuated virus. In addition to the S gene, the replicase gene and genes E, M, and 5b were confirmed as determinants of pathogenicity.

Keywords:
Infectious bronchitis virus, Attenuation, Determinants of pathogenicity, Sequencing, Vaccination

Acknowledgements
This research has been conducted in Vaccines development lab of Genera Inc., Rakov potok, Croatia.

Choosing Sides: Strategic Yeast Engineering for Antimicrobial Pigments vs. Cosmetic Osmoprotectants

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Engineering robust, food-grade yeast chassis that can produce and secrete high-value molecules is the core of the croESTRO project, our initiative to couple synthetic biology with scalable bioprocesses. Here we present strategies developed for yeast Saccharomyces cerevisiae that address both complex intracellular and extracellular enzymatic reactions. As an archetype of multi-enzyme cytosolic biosynthesis, we constructed a chromosome-integrated pathway for producing violacein, an indole pigment with antimicrobial and anticancer properties. On the other hand, to make a natural osmoprotectant α-glucosyl-glycerol (αGG) from sucrose and glycerol, we expressed sucrose phosphorylase on the outer surface of the yeast cell wall. Such an extracellular route decoupled product formation from cytosolic homeostasis, facilitated downstream recovery, and tolerated high substrate and osmolyte loads. Together, these case studies point out the importance of choosing the "right side of the membrane" for each molecule: intracellular for multi-step pigments like violacein and extracellular for osmolytes like αGG. By unifying intracellular pathway refactoring with cell-surface biocatalysis, croESTRO advances sustainable yeast platforms for pigments, cosmetics ingredients, and nutraceutical precursors, aligning with the needs of the food and biotechnology sectors.

Keywords:
Saccharomyces cerevisiae, Microbial cell factory, Synthetic biology, Violacein biosynthesis, Yeast surface display, Sucrose phosphorylase

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Biotechnological Manufacturing in Hospira Zagreb d.o.o., a Pfizer Company

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Hospira Zagreb d.o.o., a Pfizer company, is a Biologics Drug Substance and Drug Product Manufacturing Site with End-to-End capabilities, excellence in technological transfers and discipline in execution. The company is dedicated to ensuring the highest quality standards in healthcare manufacturing, with a strong focus on patient safety, innovation, and regulatory compliance. Hospira Zagreb d.o.o. is engaged in manufacturing and packaging of biologically derived pharmaceutical products, including Covid-19 pDNA (starting material of biological origin), Nivestim/Nivestym (from Filgrastim Drug Substance), Nyvepria (from Pefilgrastim Drug Substance), Epoetin Zeta (Retacrit) and Anakinra (Kineret), supplying markets across the US, EU, Canada and the rest of the world. This presentation provides and overview of the company's history, organizational structure, production capabilities and employee development.

Keywords:
Hospira Zagreb d.o.o., Pfizer, Biotechnological manufacturing

Veterinary Drug Treatment on Farms and the Spread of Antibiotic Resistance in Bacteria

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Antimicrobial substances are used on farms for therapeutic, prophylactic or metaphylactic purposes. The use of antibiotics as growth promoters has been banned in the EU since January 2006. The consumption of food containing residues of veterinary medicines can lead to various disorders such as allergic reactions, an imbalance of the intestinal microbiota, the development of antibacterial resistance or possible toxic effects. Animal feed and food of animal origin often do not comply with legal requirements as they contain residues of veterinary medicinal products resulting from unintentional cross-contamination during feed production or on the farm, and from unauthorised use for prophylaxis and as growth promoters. Therefore, highly sensitive and selective multi-residue methods are required to detect possible veterinary drug residues. The Residue Control Laboratory, which is part of the Department of Veterinary Medicine and Public Health of the Croatian Veterinary Institute, has various methodologies for the detection of antimicrobial substances that are used both as part of the national veterinary drug monitoring plan and for scientific purposes. In order to achieve high sensitivity and selectivity, an ultra-high performance liquid chromatography method in combination with mass spectrometry (UHPLC-MS/MS) has been developed. The UHPLC-MS/MS multi-method covers twelve groups of antibiotics, namely penicillins, cephalosporins, quinolones, macrolides, phenicols, pleuromutilins, quinoxalins, tetracyclines, sulfonamides, glycopeptides, ketolides and polymyxins, most of which are used as representatives of unauthorised pharmacologically active substances for prevention and treatment. Particular attention is paid to antibiotic groups that are important for human medicine and are therefore not authorised for veterinary medicine. European legislation lays down measures for monitoring certain substances and residues in live animals and livestock. According to data collected by the European Food Safety Authority (EFSA), Member States reported 0.12% of samples as non-compliant in 2023, with the highest frequency of samples containing antimicrobial substances reported for honey (0.7%).

Keywords:
Antimicrobial substances, Residues, Food safety, Liquid chromatography, Mass spectrometry

Acknowledgements
The authors would like to thank the technical staff of the laboratory for carrying out the sample extraction for method validation and routine analysis.

Microbiome Profiling of Autochthonous Lactic Acid Bacteria Isolated from Donkey Milk

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Donkey milk is a rich source of bioactive macromolecules with antimicrobial activity and hypoallergenic, anti-inflammatory and antioxidant properties. Due to its nutritional and functional properties, donkey milk is very similar in composition to human milk and has long been used as an alternative for infants and patients with cow's milk protein allergy. In this study, the microbial profile of donkey milk was analyzed and the taxonomic diversity among lactic acid bacteria (LAB) strains and their functional probiotic properties were revealed. Hierarchical cluster analysis of RAPD-PCR (Random Amplified Polymorphic DNA-Polymerase Chain Reaction) electrophoresis profiles of 21 strains isolated from donkey milk revealed a total of 8 genetically distinct strains identified by 16S RNA sequencing. The functional probiotic properties of selected LAB isolates were characterized by the production of potential therapeutic biomolecules. Based on the "ropy" phenotype, only strain DM1 has the potential for exopolysaccharide production, while SDS-PAGE (Sodium Dodecyl Sulphate-Polyacrylamide Gel Electrophoresis) showed that none of the tested isolates produced S-layer proteins. Due to their antimicrobial and proteolytic activity, the autochthonous LAB strains DM1, DM2, DM4 and D12 have specific functional properties for use as starter cultures or bacteria with probiotic activity. The overall analysis of the donkey microbiome is a promising source of novel LAB strains expressing specific functional biomolecules.

Keywords:
Donkey milk, Microbiome profiling, Biomolecules, Lactic acid bacteria, Probiotic

Acknowledgements
This research was funded by the Croatian Science Foundation through the projects IP-2019-04-2237 and IP-2024-05-6548. The authors acknowledge the financial support from the University of Zagreb and project "Bioprospecting of the Adriatic Sea" (KK.01.1.1.01.0002), granted to the Scientific Centre of Excellence for Marine Bioprospecting at the Ruđer Bošković Institute.

Preliminary Concentrations of PFAS Compounds in Food of Animal Origin Collected in Croatia in 2024

Nina Bilandžić*, Ines Varga, Jelena Kaurinović, Maja Đokić, Ivana Varenina, Božica Solomun Kolanović, Marija Sedak, Bruno Čalopek, Natalija Džafić, Dijana Ostojić Mišetić, Kristina Kvrgić

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Perfluoroalkyl substances (PFAS) are a group of synthetic chemicals with a wide range of applications. They are characterized by chemical and thermal oxidation stability and are considered persistent organic pollutants due to their persistence and bioaccumulative properties. In humans, the primary sources of PFAS exposure are food, water, and ingestion of dust. Fish and eggs are the main dietary contributors to human exposure to these compounds. Four PFAS compounds—perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), perfluorononanoic acid (PFNA), and perfluorohexanesulfonic acid (PFHxS)—are the principal contributors to exposure within this group. Consequently, the European Union has established maximum levels for each individual compound and their sum in food of animal origin under Regulation 2023/915/EU. This study aims to preliminarily determine the concentrations of these four PFAS compounds in marine fish and shellfish from the Adriatic Sea, freshwater fish from fish farms, and eggs sampled in 2024. PFAS were analyzed using ultra-high-performance liquid chromatography combined with triple quadrupole mass spectrometry (UHPLC-MS/MS). PFOS was detected in all three marine fish species (hake, sea bream, and Atlantic mackerel), scallops, three freshwater fish species (catfish, zander, and grass carp), and eggs. The mean PFOS concentrations in the three marine fish species were similar (0.11–0.14 μg kg^{-1}). Among freshwater fish, the mean PFOS concentration in grass carp (0.12 μg kg^{-1}) was comparable to that in marine fish and higher than in catfish and zander (0.068 and 0.093 μg kg^{-1}). The highest mean PFOS concentration was found in eggs (0.38 μg kg^{-1}). PFOA and PFHxS were detected only in eggs, at concentrations of 0.045 and 0.035 μg kg^{-1}. PFNA was measured in hake, grass carp, and eggs, with concentrations ranging from 0.035 to 0.072 μg kg^{-1}. All mean values were below the maximum limits specified in Regulation 2023/915/EU. Only one egg sample exceeded the PFOS maximum limit of 1 μg kg^{-1}.

Keywords:
Perfluoroalkyl substances (PFAS), Perfluorooctanesulfonic acid (PFOS), Marine fish, Freshwater fish, Eggs, Food safety

Acknowledgements
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The Role of Mub1 in Regulating Cell Wall Formation and Proteasome Function in Yeast

Nada Šupljika[1*], Antonia Paić[1], Tea Martinić Cezar[1], Ana Novačić[1], Renata Teparić[1], Béatrice Vallée[2], Bojan Žunar[1], Igor Stuparević[1]

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Yeasts have evolved regulatory systems to maintain their cell wall, a crucial interface with the environment. However, the connection between this regulatory network and broader cellular processes is not well understood. This study focuses on Mub1 in *Saccharomyces cerevisiae*, an adaptor protein of the E3 ubiquitin ligase Ubr2, previously associated with proteasome gene regulation via the transcription factor Rpn4. Deletion of MUB1 (mub1Δ) results in significantly increased resistance to common cell wall stressors, such as heat, Calcofluor white, Congo red, and SDS, surpassing the sensitivity observed in wild-type strains. This enhanced tolerance is linked to the activation of multiple transcription factors that suppress cell wall remodeling, a process detrimental under persistent stress. Notably, Mub1 affects not only Rpn4 but also a wide spectrum of other transcription factors, positioning it as a novel regulatory hub that connects cell wall integrity with the ubiquitin-proteasome system. Bioinformatics and RNA-seq analyses reveal that Mub1 broadly influences gene networks beyond proteasome regulation, directly impacting cell wall robustness. Furthermore, overexpression of the transcription factors Mcm1 and Swi4 mitigates stress sensitivity, suggesting new strategies to enhance yeast stress tolerance for industrial applications.

Keywords:
Cell wall, Mub1, Ubiquitin proteasome system, *Saccharomyces cerevisiae*, Calcofluor white

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European Union – NextGenerationEU grant NPOO.C3.2.R2-I1.06.0024 The Croatian Science Foundation, grants No. IP-2022-10-6851, IP-2019-04-2891, IP-2024-05-5224, and DOK-2021-02-9672.

11th **International CONGRESS** of **Food Technologists**, **Biotechnologists** and **Nutritionists**

PROGRAM

Pre-Conference Day: Monday, December 8th

18:00 Tram Welcome Reception

Day 1: Tuesday, December 9th

Crystal Ballroom 1

8:30-9:30	**Registration**
9:30-11:00	**Opening**
9:30-10:30	Opening Addresses
10:30-11:00	**Plenary Speaker Antonio Starčević** AI Driven Biotechnology for a Healthier and More Sustainable World
11:00-11:30	Coffee and Posters
11:30-13:20	**Oral Presentations** Chaired by Antonio Starčević, Nikolina Čukelj Mustač
11:30-11:50	**Keynote Speaker Sanja Musić Milanović** Obesity & Nutrition: The Health Promotion View
11:50-12:10	**Keynote Speaker Martjin Noort** Will 3D Food Printing Re-shape the Food Industry?
12:10-12:30	**Keynote Speaker Adalberto Pessoa** Translating Research into Innovation: Biopharmaceutical, Biocosmetic, and Biobased Product Development from University to Market
12:30-12:50	**Keynote Speaker Robert Kourist** Insights into Black Boxes and Traveling Back in Time – Computer-Inspired Protein Engineering for the Synthesis of Natural Products and Fragrance Molecules
12:50-13:10	**Keynote Speaker Paul Long** FemTech Innovations: Prebiotics and the Path to Microbiome Rebalance
13:10-13:20	Sponsored Lecture TIM ZIP d.o.o.
13:20-14:20	Lunch and Posters
14:20-16:10	**Oral Presentations - Food Technology, Formulation & Functional Foods** Chaired by Florina Radu, Ivona Elez Garofulić
14:20-14:40	**Keynote Speaker Azzurra Stefanucci** Green Methods for the Recovery of Bioactive Compounds from Vegetable Matrices: Small Start, Big Wave
14:40-15:00	**Keynote Speaker Robert Brannan** From Niche to Notable: Food Science and Nutritional Perspectives on the Unique Asimina Fruit in Europe
15:00-15:15	**Gieun Yun** Coupling Residence Time Distribution and Heat Transfer Phenomena With Kinetics of β-Lg/κ-Casein Interactions During UHT Processing of Skim Milk
15:15-15:30	**Zuzana Slavíková** Impact of Drying Conditions on the Physicochemical Properties of Wheat Bran Protein
15:30-15:45	**Isabelle Santana** Dry Fractionation of Tucumã Oil (*Astrocaryum vulgare Mart.*) to Use in Food Industry
15:45-16:00	**Rajko Vidrih** Importance of Fruit Surface Biophysical Characteristics
16:00-16:10	Sponsored Lecture CROTECH d.o.o.
16:10-16:30	Afternoon Snack and Posters

Day 1: Tuesday, December 9th

Crystal Ballroom 1

16:30-17:55	**Oral Presentations - Food Technology, Formulation & Functional Foods** Chaired by Robert Brannan, Jelena Pejin
16:30-16:45	**Vid Vičič** Calcium Citrate Malate as a Source of Soluble Calcium for Food Supplements and Fortified Beverages: A Narrative Review
16:45-17:00	**Iva Čanak** Evaluation of Rosemary and Sea Fennel Extracts for the Biopreservation of Gilthead Sea Bream (*Sparus aurata*)
17:00-17:15	**Lucia Sportiello** Designing Healthier Indulgence: Exploring Dietary Fibers for Next-Generation Low-Fat Ice Cream
17:15-17:30	**Jose Angel Perez-Alvarez** Effect of Confitera Date Flour Addition on the Technological and Sensory Properties of Frankfurt-Type Sausages
17:30-17:45	**Ana Francesca Stama** No More Guesses: AI-enhanced Adaptive Design of Experiments for Smarter Process Optimization
17:45-17:55	Sponsored Lecture Heineken Hrvatska d.o.o. HEINEKEN

Crystal Ballroom 2

14:20-16:00	**Panel Discussion - in Croatian language** **Towards Sustainable Food Management: Synergy of Science, Industry and Consumers** Moderator Frano Ridjan Anet Režek Jambrak University of Zagreb Faculty of Food Technology and Biotechnology Sanja Kolarić Kravar Ministry of Agriculture, Forestry and Fisheries Jasmina Ranilović Podravka d.d. Iva Finderle Kod Fi doma Antonio Matušan CRUMBS TECHNOLOGY d.o.o. Sandra Budžaki Josip Juraj Strossmayer University of Osijek Faculty of Food Technology

SOCIAL PROGRAM

18:15-20:15	Advent City Tour

Day 2: Wednesday, December 10th

Crystal Ballroom 1

8:30-9:00	Registration
9:00-10:55	**Oral Presentations - Young Researchers** Chaired by Nikola Major, Aleksandra Vojvodić Cebin
9:00-9:20	**Keynote Speaker Grant Campbell** Reflections on an Academic Career in Cereal Science in the Age of GAI
9:20-9:40	**Keynote Speaker Sanja Babić Brčić** Developing as a Scientist: From Early Research Struggles to Funded Projects
9:40-10:00	**Keynote Speaker Ashkan Madadlou** Liquid-Liquid Phase Separation in Food Systems
10:00-10:15	**Sravan Kumar Neelam** Investigating the Impact of GOX, PGA, TG, and DATEM on Prefermented Frozen Dough and Bread Quality
10:15-10:30	**Lucija Sobotinčić** Ultrasound, Proteases, and Aging on Lees Affect Protein Stability and Nitrogenous Flavor-Related Compounds in Malvazija Istarska Wine
10:30-10:45	**Erik Matić** Influence of Ultrasound Treatments on the Concentrations of Vitamins in Malvazija Istarska Wines
10:45-10:55	Sponsored Lecture ACO Građevinski elementi d.o.o.
10:55-11:20	Coffee and Posters
11:20-13:25	**Oral Presentations - Young Researchers** Chaired by Ashkan Madadlou, Mia Kurek
11:20-11:40	**Keynote Speaker Valerie Guillard** The Benefice of Biodegradable Packaging for More Sustainability in the Food Chain
11:40-12:00	**Keynote Speaker Vittorio Capozzi** Microbial Innovation for a Sustainable Food Future: Lactiplantibacillus plantarum as Model
12:00-12:15	**Marianna Karava** Hydrogen-Driven Whole-Cell Biocatalysis Using Cupriavidus necator for Sustainable Production of Aldehydes and Alcohols
12:15-12:30	**Daina Eglīte-Antona** Comparative Analysis of Buckwheat Fermentation Using Mono- and Multi-Culture Approaches
12:30-12:45	**Toni Čvrljak** A LevelDB Approach to Organism-Specific Storage of Theoretical Peptides
12:45-13:00	**Gouri Nilakshika Atapattu** Optimizing Plant Growth-Promoting Bacteria from Irish Peatlands as Potential Nano-Biofertilizers for Sustainable Agriculture
13:00-13:15	**Luana De S. C. Carnaval** Extending Shelf-Life and Preserving Postharvest Quality of Strawberries Through an Innovative Edible Coating Designed from Fresh-Produce Waste
13:15-13:25	Sponsored Lecture Alca Zagreb d.o.o.
13:25-14:25	Lunch and Posters
14:25-16:20	**Oral Presentations - Young Researchers** Chaired by Maja Molnar, Maja Benković

Day 2: Wednesday, December 10th

Crystal Ballroom 1

14:25-14:40	**Nunnuth Jindapon** Preparation and Characterization of Bioactive Gelatin Hydrolysate from Seabass Scales (*Lates calcarifer*): Antioxidant and DPP-IV Inhibitory Properties
14:40-14:55	**Ana Martić** Beyond the Usual Targets: Supercritical CO_2 Extraction of Lipophilic Compounds from Blackcurrant Pomace
14:55-15:10	**Ana Peić** Presence of Pyrrolizidine Alkaloids (PAs) in Herbal Infusions from Croatian Markets
15:10-15:25	**Josefina Andrea Barrera Morelli** Prediction of Milk Composition from Mid-infrared Spectral Data: Comparing PLSR to Alternative Machine Learning Algorithms
15:25-15:40	**Tvrtko Karlo Kovačević** Integrative Metabolomic Insights Into Garlic's Adaptive Responses to Drought and Heat Stress
15:40-15:55	**Ana Milardović** The Polyphenolic Biodiversity of Wild Asparagus (Asparagus acutifolius L.) from the Istrian Peninsula
15:55-16:10	**Zişan Yalçınkaya** An Integrated System Design for Olive Growing Enabled by Artificial Intelligence Technology in Rural Areas of Med Regions Addressing Water, Soil and Energy Challenges
16:10-16:20	Sponsored Lecture Sika Croatia d.o.o.

Day 2: Wednesday, December 10th

Crystal Ballroom 2

9:30-10:55	**Round Table - in Croatian language** **Tradition, Innovation, and Sustainability – State, Potential, and Perspectives of the Food Industry in the Republic of Croatia** Moderator Tomislava Vukušić Pavičić Sven Perec OPG Perec Matija Žulj AGRIVI Jelena Đugum Croatian Chamber of Economy Aleksandra Samardžija Naturala d.o.o. Karlo Würth Zvijezda plus d.o.o. Robert Piskač Fragaria d.o.o.
11:20-13:00	**Oral Presentations - Young Researchers** Chaired by Daniela Čačić Kenjerić, Blaž Ferjančić
11:20-11:40	**Keynote Speaker Tena Niseteo** Beyond the Food: Functional Food for Infants
11:40-12:00	**Keynote Speaker Evgen Benedik** Hydration in Children and Adolescents
12:00-12:15	**Julien De Biasi** Colonic Absorption May Underlie Unchanged Faecal SCFAs After Prebiotic Inulin-Type Beta-Fructans Intake in Patients With Psoriasis: Project INGUTSKIN
12:15-12:30	**Jasmina Hasanović** How Social Determinants of Dietary Habits Drive Childhood Obesity: Insights From the CroCOSI Study
12:30-12:45	**Angelina Barić** The Interplay Between Ultra-Processed Food Consumption and Mediterranean Diet Adherence in Relation to BMI Among American Adults
12:45-13:00	**Marina Hardiyanti** Assessing the Nutritional Adequacy of Food-Rurplus Redistribution Menus in Yogyakarta, Indonesia
	Satellite Symposium Biotechnology in Croatia „Vera Johanides" - Co-Organized by the Croatian Academy of Engineering
13:00-13:15	**Registration**
13:15-13:45	"**Opening Addresses Prof. Vedran Mornar**, President of the Croatian Academy of Engineering **Prof. Ivana Radojčić Redovniković**, President of the Croatian Society of Biotechnology and Vice-Dean of UNIZG FFTB **Prof. emer. Zlatko Kniewald**, Co-Founder and Past-President of the Croatian Academy of Engineering and Croatian Society of Biotechnology: "Prof. Emer. Vera Johanides Founder of Biotechnology in Croatia" "
13:45-14:45	**Keynote Lectures**
13:45-14:05	**Keynote Speaker Božidar Šantek** Development of Biotechnological Sector in Croatia
14:05-14:25	**Keynote Speaker Dušica Vujaklija** Phosphoproteome Dynamics of Streptomyces rimosus during Growth and Antibiotic Production
14:25-14:45	**Keynote Speaker Želimir Kurtanjek** Future is Today: AI in Biotechnology, Food Technology and Nutrition
14:45-15:00	Coffee and Posters

Day 2: Wednesday, December 10th

Crystal Ballroom 2

15:00-16:45	**Oral Presentations**
15:00-15:15	**Ines Varga** PFAS – A Widespread Emerging Class of Contaminants in the Environment and Food
15:15-15:30	**Ivana Vrgoč Zimić** From Sample to Patient: Microbiological Insights into Tissue and Cell Processing in Regenerative Medicine
15:30-15:45	**Lana Ljuma Skupnjak** Determination of Genomic Pathogenicity Determinants of QX Strain of Infectious Bronchitis Virus
15:45-16:00	**Tea Martinić Cezar** Choosing Sides: Strategic Yeast Engineering for Antimicrobial Pigments vs. Cosmetic Osmoprotectants
16:00-16:15	**Leonarda Dukić** Biotechnological Manufacturing in Hospira Zagreb d.o.o., a Pfizer Company
16:15-16:30	**Ivana Varenina** Veterinary Drug Treatment on Farms and the Spread of Antibiotic Resistance in Bacteria
16:30-16:45	**Concluding Remarks**

SOCIAL PROGRAM

20:00-00:00	Congress Dinner

Day 3: Thursday, December 11th

Crystal Ballroom 1

8:30-9:00	**Registration**
9:00-10:55	**Oral Presentations - Valorization of Food Resources** Chaired by Raquel Lucas-González, Antonija Trontel
9:00-9:10	**Nina Deranja** World Food Forum Youth Chapter
9:10-9:25	**Roberta Tolve** Eco-Friendly Recovery of High-Value Carotenoids from Chlorella vulgaris Using Novel NaHDESs
9:25-9:40	**Joel Rivadeneira** Pectin Extraction from Saba Banana Peel Waste
9:40-9:55	**Pavel Divis** Wheat Bran Based Biorefinery – Proof of Concept
9:55-10:10	**Ines Essid** Optimizing Shrimp Shell Valorization: Comparative Study of Drying Methods on Nutritional and Functional Quality
10:10-10:25	**Iva Pastor** Valorization of By-Products in the Croatian Olive Sector: Practices, Barriers, and Opportunities
10:25-10:40	**María Emilia Brassesco** Biotechnological Valorization of Rice Okara for High-Protein Fruit Purées: From Protein Hydrolysis to Functional Food Prototypes
10:40-10:50	Sponsored Lecture Lach-Ner d.o.o.
10:50-11:20	Coffee and Posters
11:20-13:15	**Oral Presentations - Nutrition, Consumer Behavior & Health Implications** Chaired by Greta Krešić, Tomasz Sawicki
11:20-11:35	**Blaž Ferjančič** Fructan Content in Slovenian Food and Estimated Consumption of Fructans in Adult Population
11:35-11:50	**Ana Lúcia Baltazar** Caffeine Consumption Patterns and Mental Health in Higher Education Students: Insights from a Portuguese Population
11:50-12:05	**Roxana Gheorghita** Encapsulation of Probiotic Strains with Edible Biopolymers: Advantages for Targeted and Controlled Release of Bioactive Compounds
12:05-12:20	**Blaž Ferjančič** Leftover Challenge: From Play to Educated Changes
12:20-12:35	**Antonija Sulimanec** Body Mass Index and Puberty Onset in Croatian Boys
12:35-12:50	**Bertha Viviana Ruales Guzmán** Rethinking Dairy Quality: Implications of β-Casein for Human Health and Consumption
12:50-13:05	**Anna Danielewicz** Is Dairy Product Intake Related to the Short-Chain Fatty Acids Profile in Men with Asthenozoospermia?
13:05-13:15	Sponsored Lecture Croatian Agency for Agriculture and Food
13:15-14:15	Lunch and Posters

Day 3: Thursday, December 11th

Crystal Ballroom 1

14:15-15:30	**Oral Presentaions - Food Safety Risks & Quality Assessment** Chaired by Iva Čanak, Mario Ščetar
14:15-14:30	**Jelka Pleadin** Aflatoxin B1 in Cereals: A Growing Challenge for Food Safety and Public Health in the Last Decade
14:30-14:45	**Roxana Gheorghita** Advances in Analytical Techniques for Monitoring Physico-Chemical Parameters in Wastewater
14:45-15:00	**Ron Porat** Effects of Retail Packages on Retaining the Quality of Cucumbers During Shelf Life and Home Storage
15:00-15:15	**Sara Mikrut Vunjak** Consumers' Food Safety Awareness, Risk Perceptions and Related Behaviours in Croatia and EU: Insights From the Eurobarometer 2025
15:15-15:30	**Ivan Barišić** REACTION – Awareness, Alert and Response for CB Threats in Food Defence
15:30-15:40	Sponsored Lecture Mettler-Toledo d.o.o. METTLER TOLEDO
15:40-16:30	Closure
15:40-16:00	**Keynote Speaker Vali Marszalek** EU Food & Beverage Sector: Impacts, Risks, and Opportunities Reported in 2025
16:00-16:30	Awards and Closing Ceremony

Day 3: Thursday, December 11th

Maksimir Hall

9:10-12:45	**Worshop INTACTBioPack and EVOLVEPACK How to Reduce Food Loss and Enhance Health Benefits by Using Innovative Packaging Solutions?**
9:10-9:30	V. Guillard/M. Hariri, Project Coordinator Presentation of INTACTBioPack
9:30-09:50	MJ Fabra, Project Coordinator Presentation of EVOLVEPACK
09:50-10:20	Cointeractive Speech INTACTBioPack/EVOLVEPACK Case Study: Food Waste Prevention/The Role of Food Packaging in the Reduction of Food Waste
10:20-10:50	F. Configenez: GLOPACK Project Main Findings Case Study: How to Replace the Plastic/Current Food Packaging With the Biodegradable/Active?
10:50-11:20	Coffee and Posters
11:20-11:40	**Ana Pavičić-Kaselj (Grad Zagreb City Office for Economy, Environmental Sustainability and Strategic Planning)** Current Waste Management in the City of Zagreb and Croatia
11:40-12:00	**Miho Karoly (Kaligraf)**
12:00-12:45	Regulations on Food Packaging (PPWR, FCM)
	Round Table Regulation on Innovative Food Packaging and Utilisation of Food Waste

Maksimir Hall

14:00-15:40	**Worshop MedDietMenus4Campus - in Croatian language** **MedDietMenus4Campus: a case study from Croatia**
14:15-14:30	**Sanja Vidaček Filipec** MedDietMenus4Campus project and a "student bag“ concept
14:30-14:40	**Lucija Drobac** Availability of Mediterranean foods on the menus of student restaurants in Croatia
14:40-14:50	**Amalija Danjek** What do the Croatian students want?
14:50-15:00	**Ivica Faletar** Students and the Mediterranean Diet: an Analysis of Preferences in Student Canteens
15:00-15:30	"Round table - Is it too ambitious to aim for student meals to be 100% Mediterranean? Discussion on price, logistics, legislation, and student perception; Zvonimir Šatalić, moderator Participants · Representatives of Student Centers in Croatia · Students · Nutritionists"
15:30-15:40	**Marija Cerjak** From research to strategy: Social marketing plan to promote the Mediterranean diet among students

Advancements in
Food Technology
and **Biotechnology**

Food and
Water Safety
and **Quality**

POSTERS

Nutrition,
Consumer Behavior
and **Global Health**
Challenges

Vera Johanides
Symposium

POSTERS

Advancements in Food Technology and Biotechnology

AFTB_1 **Mariya Brazkova*, Zlatka Ganeva, Gabriele Adornato, Bogdan Goranov, Petya Stefanova, Denica Blazheva, Galena Angelova***
Growth Kinetics and Antimicrobial Profiles of Two Xylaria Species Isolated from Bulgaria

AFTB_2 **Leonarda Marinić, Lea Garac, Zdenka Pelaić, Branka Maričić, Zoran Zorić***
Total Phenolic Content and Antioxidant Capacity of Lavandula Extracts (*Lavandula x intermedia* 'Budrovka') Obtained by Ultrasound–Assisted Extraction

AFTB_3 **Petya Stefanova*, Boris Krastev, Bogdan Goranov, Mariya Brazkova, Denica Blazheva*, Galena Angelova**
Comparative Analysis of Culture Media Effect on the Mycelial Growth of Medicinal Mushroom Inonotus hispidus

AFTB_4 **Erika Dobroslavić*, Antonio Smrdelj, Mario Prečanica, Kruno Bonačić, Marina Brailo Šćepanović**
Optimization of Flocculant Application for Enhanced Biomass Harvesting and Biodiesel Production from *Phaeodactylum tricornutum*

AFTB_5 **Jelena Pejin*, Lenka Grubač, Milana Pribić**
Exploring the Brewing Potential of Triticale Malt: A Sustainable Alternative to Barley

AFTB_6 **Katarina Kanurić*, Mirela Iličić, Jovana Degenek, Vladimir Vukić, Dajana Vukić, Zorica Grujić**
Enhancing Functional and Sensory Properties of Cream Cheese Spread using Herbal and Vegetable Additives

AFTB_7 **Marija Jokanović*, Bojana Jakšić, Snežana Škaljac, Branislav Šojić, Vladimir Tomović, Nedeljka Spasevski, Dragana Šoronja-Simović, Jovana Delić**
Oxidative Stability of Pork Meatballs Formulated with Addition of Brewers Spent Grain

AFTB_8 **Milana Pribić, Lenka Grubač, Jelena Pejin***
Low-alcohol Beer Production with Congress Mash Method

AFTB_9 **Vedrana Pleš*, Elizabeta Zandona, Marijana Blažić, Bojan Matijević, Almir Abdurramani**
Innovative Perspectives on Olive Leaf, Thyme, and Green Walnut Husk Extracts in Dairy: A Review of Polyphenolic Composition and Antioxidant Efficacy

AFTB_10 **Sandra Pedisić*, Zdenka Pelaić, Ena Cegledi, Ana Martić, Sanja Lončarić, Maja Repajić, Verica Dragović-Uzelac, Ivona Elez Garofulić**
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