5th International Scientific and Professional Conference /
5. međunarodni znanstveno-stručni skup

FOOD INDUSTRY BY-PRODUCTS

BOOK OF ABSTRACTS / KNJIGA SAŽETAKA

10th and 11th June 2026
Osijek, Croatia

Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek / Sveučilište Josipa Jurja Strossmayera u Osijeku, Prehrambeno-tehnološki fakultet Osijek
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Moderators / **Moderatori:**
Jelka Pleadin, Marija Banožić

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***BioPHA-ComFPack – Workshop /* BioPHA-ComFPack – radionica**

***ONLY FOR REGISTERED PARTICIPANTS* /**
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***Workshop Leaders* / Voditelj radionice:**
Dajana Kučić Grgić

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PLENARY LECTURES /
PLENARNA PREDAVANJA

APPLICATION OF SUSTAINABLE STRATEGIES TO MICROPLASTIC CONTAMINATION IN SOIL, WATER, AND THE FOOD CHAIN

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plenary lecture

Plastic pollution arises not from the material itself, but from excessive use and inadequate waste management, leading to environmental leakage and risks to ecosystems and human health. The rapid increase in plastic use, particularly during the COVID-19 pandemic, has intensified microplastics (MPs) and nanoplastics contamination in both terrestrial and aquatic systems. These particles enter the food chain through water, soil, packaging, and processing, accumulate in organisms, and may biomagnify across trophic levels. Evidence confirms their presence in meat, seafood, beverages, and even drinking water, raising concerns about food safety and human health. This research examines the role of the Sustainable Development Goals (SDGs) and the circular economy as promising approaches to MPs reduction. A viable alternative to address waste management and the global MPs pollution challenge is the use of recycling and biodegradable plastics. MPs degradation refers to changes in the physical and chemical properties of MPs due to chemical or physicochemical processes. Several technologies, including advanced oxidation, coagulation, and flocculation, can be used to degrade MPs. It is essential to highlight alternative options and promote research and innovation aimed at reducing, reusing, recycling, and recovering plastics, as well as finding sustainable alternatives across all applied areas. However, significant research gaps remain in assessing ecological and human health impacts, enhancing removal efficiency, and evaluating the sustainability of proposed solutions across different exposure pathways. Global collaboration is necessary to urgently implement circular economy solutions to address the plastic and MPs pollution crisis.

Keywords: microplastics, contamination, water, soil, food chain

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CLOSING THE LOOP IN THE FOOD INDUSTRY: ADVANCED STRATEGIES FOR BY-PRODUCT UTILIZATION

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plenary lecture

The shift toward sustainable food systems needs a change from linear production models to circular strategies that maximize resource efficiency. By-products from the food industry, which are often seen as waste, hold valuable compounds, nutrients, and bio-based materials. These can be reused in the food chain and other industries. This presentation looks at strategies for closing the loop in the food industry by improving the use of by-products. We focus on new technological solutions like green extraction methods, non-thermal processing, biorefinery concepts, and Industry 4.0 tools. These help with efficient recovery, tracing, and optimizing resource flows. We include examples from industry that show how food processing leftovers can be turned into high-value ingredients, functional additives, and bio-based products. By combining new technology with circular bioeconomy principles, we can reduce environmental impacts, strengthen food system resilience, and create new economic opportunities in the agri-food sector.

Keywords: circular bioeconomy, food industry by-products, valorisation, biorefinery, Industry 4.0

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PHA-BASED PACKAGING FROM WASTE BIOMASS

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plenary lecture

The growing demand for sustainable materials has intensified interest in bio-based and biodegradable polymers as alternatives to conventional plastics in food packaging. This lecture presents recent advances in the production and application of polyhydroxyalkanoates (PHA) derived from waste biomass, with a focus on agro-industrial residues generated by Podravka d.d. PHA was produced via submerged fermentation (SmF) using both pure and mixed microbial cultures. Prior to fermentation, the agro-industrial waste was subjected to acid hydrolysis to release fermentable sugars, which were continuously fed into the bioreactor. Following cultivation, the biomass was harvested, lyophilized, and processed through extraction and purification steps to obtain PHA. The second part of the lecture focuses on the development of biodegradable and compostable packaging materials using commercially available PHA blended with other biodegradable polymers. These materials were developed at laboratory and pilot scales and evaluated under real application conditions through the packaging of broccoli soup. Additionally, the biodegradability and compostability of the materials were assessed in accordance with ISO 17556 and ISO 14855 standards. The presented results demonstrate the potential of converting agro-industrial waste into high-value biopolymers and their application in sustainable food packaging systems, contributing to circular economy principles and reduced environmental impact.

Keywords: agro-industrial waste, PHA, SmF, biodegradable and compostable materials

Acknowledgement: *This research was conducted as part of the project „Production and development of compostable packaging from waste biomass for the packaging of industrially processed food products" (NPOO.C3.2.R3-Il .04.0059) funded by National Recovery and Resilience Plan (funded by the European Union, NextGenerationEU).*

INVITED LECTURES /
POZVANA PREDAVANJA

GRAPE MARC, RETAIL-DISCARDED BLUEBERRIES, AND FALLEN ACORNS AS SOURCES OF BIOACTIVE COMPOUNDS: EXTRACTION, CHARACTERIZATION, AND APPLICATIONS

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invited lecture

The agri-food industry generates large volumes of by-products, which can account for 13-65% of the raw material used. These include foods discarded at the retail level for not meeting aesthetic standards, as well as by-products derived from industrial processing lines, such as underutilized agricultural resources. Overall, these by-products represent an underexploited source of high-value bioactive compounds. In this context, the present work compiles three case studies in which residual raw materials, grape marc (the main by-product of the winemaking industry), retail-discarded blueberries, and acorns collected after natural fall, are reintegrated into the value chain through the production of bioactive extracts rich in phenolic compounds. These extracts are proposed as functional alternatives for animal diet enrichment, improving food formulations, and promotion of plants health. The extracts are obtained using a patented technology based on *Medium-Scale Ambient Temperature* (MSAT) system, characterized by low energy requirements and ease of scaling up to an industrial level. The resulting extracts are characterized by ultra-high-performance liquid chromatography coupled with quadrupole time-of-flight mass spectrometry (UHPLC-QTOF). Through metabolomic analysis, a distinctive phenolic profile is revealed, along with the tracking of marker compounds from the by-products to their incorporation into animal and human diets. Overall, these results align with the objectives of the "Farm to Fork" strategy, contributing to improved animal nutrition, reduced antibiotic use in livestock production, decreased pesticide use for enhancing tree health in agroforestry systems, and the development of functional diets, while promoting the valorization of agri-food by-products.

Keywords: by-products, phenolics, animal nutrition, metabolomics, green extraction

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VALORIZATION OF BLACK ELDERBERRY POMACE AND FLOWER USING GREEN HIGH-PRESSURE TECHNOLOGIES

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invited lecture

Current approaches to managing fruit waste and by-products do not fully capitalize on their potential, as these materials often contain valuable compounds that can be recovered and utilized across various industries. Black elderberry (*Sambucus nigra* L.) press cake, a by-product of black elderberry juice production, is particularly rich in anthocyanins that can reduce neurological diseases and heart-disease risks, and exert an anti-inflammatory role related to obesity and diabetes. Elderberry flowers are edible and can be used in various culinary applications, yet they are mostly underused. Therefore, green high-pressure technologies are employed to valorize these feedstocks and underline their potential to be applied in various food matrices. Supercritical Fluid Extraction (SFE) and Particles from Gas-Saturated Solutions (PGSS) are both based on the use of supercritical fluids, most commonly carbon dioxide, and share several important features, including operation under high pressure, environmentally friendly processing without toxic organic solvents, and the ability to tune process conditions such as temperature and pressure to control product characteristics. Both techniques are widely applied in high-value industries such as food, pharmaceuticals, and cosmetics. However, they differ fundamentally in their purpose and mechanism, SFE is primarily used for the extraction of valuable compounds from solid or liquid matrices, where CO_2 acts as a solvent, while PGSS is used for the production of micro- and nanoparticles, where CO_2 is dissolved into the material and acts as an expansion agent during rapid depressurization. Consequently, SFE yields concentrated extracts, whereas PGSS produces solid particles with controlled size and morphology.

Keywords: elderberry pomace, elderberry flower, supercritical extraction, PGSS

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BIODEGRADABLE PACKAGING AS A SOLUTION TO THE GLOBAL PLASTIC POLLUTION: CURRENT STATUS, CHALLENGES, AND THE ROLE OF BY-PRODUCTS

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invited lecture

The food industry is the primary consumer of single-use plastic packaging, contributing significantly to the global issue of plastic pollution. Ironically, the most significant functional advantage of conventional plastics—their durability—is also their primary environmental drawback, leading to long-term persistence in ecosystems. This situation necessitates a shift toward more sustainable materials that can potentially match the performance of traditional polymers while ensuring environmental compatibility.The aim of this lecture is to provide a comprehensive overview of the current state-of-the-art in the development of biodegradable and compostable packaging, with a focus on a critical analysis of their functionality compared to fossil-based polymers. Special emphasis is placed on technological challenges, such as improving the barrier and mechanical properties of biopolymers, and the economic sustainability of their production. In this context, the integration of food industry by-products (e.g., lignocellulosic residues, proteins, and polysaccharides) represents a key strategy for reducing raw material costs and enhancing material properties through the development of biocomposites. The presentation will analyze contemporary trends, ranging from laboratory-scale research to industrial applications, and discuss the role of the circular economy in overcoming barriers to the widespread implementation of biodegradable solutions within the food sector.

Keywords: plastic, pollution, food packaging, biodegradable polymers, by-products

FOOD IS NOT WASTE!

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invited lecture

Food waste is a global problem that occurs at all stages of the food production and supply chain. According to the latest statistical data, in the Republic of Croatia, around 286,000 tonnes of food are wasted annually, of which the edible portion amounts to 106,000 tonnes. The results show that around 76% of food waste occurs in households, 14% in primary production, 5% in the hospitality industry, 3% in processing and manufacturing, and 2% in retail and other food distribution. The Republic of Croatia has made a significant step forward in preventing food waste through the implementation of measures and activities contained in the National Food Waste Prevention and Reduction Plan. The objective of the National Plan is to reduce food waste by 30% by 2028. The measures include encouraging and further improvements of the food donation system, promoting food waste reduction, fostering corporate social responsibility in the food sector, raising consumer awareness and knowledge about preventing and reducing food waste, monitoring food waste quantities, and investing in research and innovative solutions that contribute to food waste prevention. Efforts can be seen through the increase of the amounts of donated food. Last year's data compared to data from 2019, when official monitoring began, shows an increase of 20%. All of the mentioned activities and information on the topic can be found at the online platform for food waste prevention, launched by the Ministry of Agriculture, Forestry and Fisheries.

Keywords: consumer awareness, food waste, national plan, prevention, statistical data

ENHANCEMENT OF POLYPHENOL CONTENT AND ANTIOXIDANT ACTIVITY IN COCOA SPREAD ENRICHED WITH GRAPE SEED OIL AND ENCAPSULATED GRAPE SEED EXTRACT

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invited lecture

The aim of this study was to investigate the enhancement of polyphenol content and antioxidant activity in cocoa spread by replacing refined sunflower oil with cold-pressed grape seed oil and further utilizing grape pomace, a polyphenol-rich by-product of wine production, in the form of encapsulated grape seed extract on maltodextrin at two addition levels (10% and 15%, w/w).

The replacement of sunflower oil with grape seed oil alone resulted in an increase in both total polyphenol content and antioxidant activity compared to the control formulation. Further enrichment with encapsulated grape seed extract led to a progressive increase in both parameters, with the highest enrichment level showing approximately up to a two-fold increase in polyphenol content and a 1.5- to 2-fold increase in antioxidant activity.

From a structural perspective, formulation changes affected the particle size distribution, leading to an increase in the volume-weighted mean diameter, which nevertheless remained within the optimal range of 15–30 μm. Rheological properties were also affected, with an increase in yield stress and viscosity observed in enriched samples, suggesting a firmer and more structured system. The melting behavior remained unaffected by encapsulated extract addition, while hardness increased with higher enrichment levels.

From a quality perspective, no significant changes were observed in color, gloss, texture, or melting properties. However, grape seed oil contributed to a more pronounced aroma profile, while encapsulated extract improved sensory perception by reducing its intensity and sweetness perception.

Keywords: cocoa spread, grape seed oil, grape seed extract, polyphenols, antioxidant activity

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FROM TECHNOLOGY DEVELOPMENT CONTRIBUTIONS TO THE CREATION OF THE FINAL PRODUCT – APPLICATION OF INNOVATIONS IN THE TREATMENT OF BY-PRODUCTS, WASTE, AND WASTEWATER

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invited lecture

Contemporary challenges in the treatment of by-products, waste, and wastewater require flexible, efficient, and resource-sustainable technological solutions. Therefore, ensuring high-quality input data, directing activities toward research and development, and applying high-quality engineering and design are essential for the successful implementation of environmental technologies. This approach has proven highly effective in the development and implementation of industrial systems for the treatment of by-products, waste, wastewater, and leachate, as well as in processes for the energy recovery of biodegradable waste materials.

Applied research and engineering innovation play a key role in developing reliable and efficient environmental protection technologies and adapting them to various industrial applications. The presented approach integrates laboratory characterization and substrate analysis, process optimization, and engineering design into a unified development framework.

Special emphasis is placed on the development of modular and mobile treatment systems designed for rapid installation, flexible operation, and adaptation to different operating conditions. In addition, the integration of scientific methodology, field experience, and engineering practice is essential for achieving reliable, efficient, and scalable solutions.

Selected examples from the food-processing industry and mixed municipal waste treatment demonstrate how the complete development process—from laboratory analyses and prototype design to technology implementation—supports the creation of effective environmental protection systems and enables the transition from research concepts to commercially applicable technologies. Interdisciplinary collaboration and innovative engineering are therefore recognized as key factors in sustainable waste and wastewater management and in achieving circular economy objectives.

Keywords: environmental engineering, circular economy, sustainable treatment of by-products, waste and wastewater, development of innovative technologies

CONSUMER ACCEPTANCE OF UPCYCLED FOOD PRODUCTS – PSYCHOLOGICAL, SOCIAL AND REGULATORY ASPECTS

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invited lecture

Over the past fifteen years, the concept of upcycling has gained increasing prominence in scientific literature. The term originates from the idea of "value uplift," referring to enhancing or improving the value of materials or products in economic, environmental and social terms. In contrast, the primary goal of traditional recycling is material recovery, which often yields products of neutral or lower quality. Upcycled food products are already present in international markets, and current research demonstrates that a range of sociodemographic and psychological factors influence consumer acceptance of such foods. To strengthen credibility and product differentiation, manufacturers often adopt voluntary certification schemes, such as the U.S. "Upcycled Certified" label. In Croatia and the wider region, no specifically labelled upcycled food products are currently available. Whether the literal use of the term "upcycled" will be meaningful and intuitive to Croatian consumers, to what extent concerns about novel foods and product pricing may hinder purchasing habits, and which factors may act as effective adoption stimuli—these remain key questions for industry stakeholders who recognise innovation potential through the valorisation of food waste and by-products and the transition towards a circular supply chain model. How can academia and the public sector support this transition?

Keywords: upcycled food products, consumers, Croatia, circular economy

EXPLORING THE POTENTIAL OF PLANT PROTEINS IN CULTIVATED MEAT PRODUCTION

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invited lecture

As global population growth continues to drive increasing demand for sustainable protein sources, cultivated (lab-grown) meat has emerged as a promising alternative to conventional livestock production. These meat analogues are generated through the expansion, differentiation, and assembly of selected animal cell populations using methodologies derived from cell bioprocessing, biomaterials science, and tissue engineering. This production paradigm supports sustainability objectives by offering potential benefits for animal welfare, human health, and environmental impact reduction. Within this framework, edible plant-derived proteins obtained from agro-industrial byproducts represent an abundant, scalable, and cost-effective resource for cultivated meat technologies. Such proteins can be employed either as biomaterial constituents for scaffold fabrication to support cell attachment or as functional nutrient supplements in cell culture media. Scaffold-based systems provide mechanical integrity and instructive microenvironmental cues that promote cell adhesion, proliferation, differentiation, and self-organization into tissue-like structures. In parallel, plant proteins and their derivatives may partially substitute serum-derived components, such as fetal bovine serum, or expensive recombinant growth factors in culture media formulations. Although compositional variability and limited standardization of plant protein sources remain technical challenges, an expanding body of experimental evidence suggests that their functional and economic benefits may outweigh these limitations. This presentation provides a comprehensive overview of recent advances in the field and highlights original research findings on the utilization of flaxseed and pea proteins for myoblast and adipocyte cultivation, as culture media supplements or as scaffold components.

Keywords: plant proteins, sustainabile cultivated meat production, cellular agriculture

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ORAL PRESENTATIONS / USMENA PRIOPĆENJA

HEALTH EFFECTS OF FUNCTIONAL FOODS ENRICHED WITH AGRO-INDUSTRIAL BY-PRODUCTS

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oral presentation

The development of functional foods aims to improve quality of life by applying bioactive ingredients with potential preventive and therapeutic effects. In this context, agro-industrial by-products are recognised as a valuable source of polyphenols, dietary fibre, and other biologically active compounds. They also represent an important part of the concept of a circular economy and sustainable food production.
White wheat bread, although widely consumed, contains low levels of dietary fibre and bioactive compounds due to the use of refined flour. This has led to the development of functional products enriched with by-products from fruit, seeds, and nuts. Adding grape pomace and by-products from seeds (flax, chia, amaranth, quinoa) and nuts increases the content of fibre, protein, phenolic compounds, and antioxidant capacity, and may also reduce glycaemic index. Aditionally it can have beneficial effects on cardiometabolic health and the gut microbiome, although it may affect the sensory and technological properties of the product.
Fermented dairy products, especially yoghurt and kefir, provide a suitable matrix for incorporating plant by-products, as they increase the bioavailability of bioactive compounds. The addition of fruit pomace, nut skins, and citrus fibre improves antioxidant capacity and acts as a prebiotic. Furthermore, it enhances textural and functional properties. Whey, a by-product of the dairy industry, further contributes to nutritional value. In cheese production, plant by-products can also serve as natural preservatives, reducing oxidation and extending shelf life.
The use of agro-industrial by-products in developing functional foods is a sustainable approach that improves the nutritional profile of products and supports the circular economy. However, further optimisation of technological parameters and sensory properties is required.

Keywords: functional food, agro-industrial by-products, polyphenols, dietary fiber, health effects

EFFECT OF ULTRASOUND-ASSISTED VINIFICATION ON THE CHEMICAL COMPOSITION OF COLD-PRESSED MALVAZIJA ISTARSKA GRAPE SEED OIL

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oral presentation

The aim of this study was to evaluate the effect of prefermentative ultrasound treatments of varying amplitudes and durations on the chemical composition of Malvazija istarska grape seed oils. During the 2024 harvest, six vinification treatments were carried out: four prefermentative ultrasound treatments were applied on cooled cryomacerated mash (10 °C) using 70% amplitude for 80 and 160 minutes (US80-70% and US160-70%) and 100% amplitude for the same durations (US80-100% and US160-100%), a one-day cryomaceration treatment (CRIO), and a control treatment produced using standard white winemaking technology (C). The research was conducted using an industrial ultrasonic processor, UIP2000hdT-230 (20 kHz, 2000 W). Grape seeds were separated immediately after pressing using a custom-made seed separator, dried at 38 °C in a dehydrating chamber to 8–10% moisture, and cold-pressed using an HHP 20 S press (Herbas d.o.o.). Tocopherols were analyzed by HPLC-RID, fatty acid profiles by GC-FID, total phenolic content and antioxidant activity were determined by UV/VIS spectrophotometer. δ-tocotrienol was the predominant tocol in all treatments. No significant differences in total tocopherol content were observed between the control (C) and most ultrasound treatments, except for CRIO and US80-70%, which showed lower values. Linoleic acid was the predominant fatty acid in all treatments. Total saturated fatty acids were highest in CRIO and lowest in US160-70%. Monounsaturated fatty acids were highest in the control (C) and lowest in US160-70%, whereas polyunsaturated fatty acids showed the opposite pattern, with the highest levels in US160-70% and the lowest in C and CRIO. Total phenolic content was significantly higher in the C treatment compared to all ultrasound treatments. Antioxidant activity showed a similar trend, being highest in the control treatment compared to all other treatments.

Keywords: ultrasound treatments, tocopherols, fatty acids, total phenolic content, antioxidant activity, Malvazija istarska cold-pressed grape seed oil

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***ORAL PRESENTATIONS – BioPHA-ComFPack – Workshop* /**
USMENA PRIOPĆENJA – BioPHA-ComFPack – radionica

ANALYSIS OF POLYHYDROXYALKANOATES BY GC-MS

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oral presentation

The increasing global demand for sustainable and biodegradable materials has stimulated extensive research into biopolymers intended for environmentally friendly packaging applications. Among these materials, polyhydroxyalkanoates (PHAs), particularly poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (PHBV), have attracted significant attention due to their biodegradability, biocompatibility and favourable mechanical properties. Certain microorganisms are capable of synthesizing these biopolymers intracellularly, leading to the development of optimized production methods aimed at maximizing polymer yield from renewable and low-cost substrates, including food industry by-products. In addition to optimizing production processes, accurate characterization of the synthesized biopolymers is essential to ensure product quality, purity, and structural composition. This work focuses on the analytical determination of PHBV and related biopolymers using gas chromatography coupled with mass spectrometry (GC–MS). GC–MS has proven to be a highly sensitive and reliable analytical technique for the identification and quantification of biopolymer monomeric constituents. Prior to GC–MS analysis, the extracted polymer must undergo acid-catalysed metanalysis or hydrolysis, which depolymerizes the polymer into its corresponding monomer derivatives, such as methyl (R)-3-hydroxybutyrate, methyl (R)-3-hydroxyvalerate or methyl (R)-3-hydroxyhexanoate. The resulting compounds can then be separated and identified based on their chromatographic retention times and mass spectral characteristics, so this analysis enables precise determination of polymer composition and the relative proportion of hydroxybutyrate and hydroxy valerate units within the copolymer.
Overall, GC–MS represents an essential analytical tool for the characterization, monitoring, and quality assessment of different types of polyhydroxyalkanoates and other microbial biopolymers during production and downstream processing.

Keywords: biodegradation, PHA, GC-MS

Acknowledgement: *This research was conducted as part of the project „Production and development of compostable packaging from waste biomass for the packaging of industrially processed food products" (NPOO.C3.2.R3-Il .04.0059) funded by National Recovery and Resilience Plan (funded by the European Union, NextGenerationEU).*

BARRIER PROPERTIES OF COMPOSTABLE MATERIALS – CHARACTERIZATION AND IMPROVEMENT

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oral presentation

Rotoplast, a company specializing in flexible packaging, participated in a project to develop compostable packaging with the task of selecting the most suitable material and improving its barrier properties.
Five types of materials (FKIT 1, 1A, 2, 3 and 3A) produced by blown and cast extrusion were analyzed. Initial tests found that the materials FKIT 1, 1A and 2 were brittle and prone to deformation, while FKIT 3 and 3A showed better flexibility and mechanical resistance.
Standard measurements of foil properties such as thickness, width, surface tension, COF, sealing temperature and ink adhesion were performed. FKIT 3 and 3A had the best surface tension, good sealing properties and ink adhesion, so they were selected for further development.
Measurements of oxygen and water vapour permeability showed that the materials have the potential to be improved by using barrier coatings. The main challenge in applying the coatings was the small width of the reels, which required adaptations and improvisation for conversion on the existing machines. The first coatings did not give the expected results, but the second coating ("coating A") showed a significant reduction in oxygen permeability, provided that the surface of the material was corona treated. The best results were achieved on the material FKIT 3 produced by blown extrusion, where oxygen permeability was reduced by about 91%.
It was concluded that FKIT 3 represents the best basis for the development of high-barrier compostable packaging, while further optimisation includes improving thermostability and reducing the water vapour permeability.

Keywords: compostable packaging, oxygen permeability, water vapour permeability, barrier coatings

Acknowledgement: This research was conducted as part of the project „Production and development of compostable packaging from waste biomass for the packaging of industrially processed food products" (NPOO.C3.2.R3-Il .04.0059) funded by National Recovery and Resilience Plan (funded by the European Union, NextGenerationEU).

Special thanks to Kristina Kanižaj for her extraordinary dedication and the amount of time devoted to the management of this project.

FROM WASTE BIOMASS TO BIOPOLYMERS: OPTIMIZATION OF THE BIOPROCESS FOR POLYHYDROXYALKANOATE PRODUCTION USING PURE AND MIXED CULTURES

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oral presentation

As part of the final workshop, an overview of the research results obtained within the project "Production and Development of Compostable Packaging from Waste Biomass for Packaging of Industrially Processed Food Products" (NPOO.C3.2.R3-II.04.0059) will be presented. The results highlight significant progress in the valorization of agro-industrial waste as a sustainable resource for biopolymer production.

Particular emphasis will be placed on the processes used to obtain fermentable sugars from agro-industrial residues through pretreatment methods, including acid and enzymatic hydrolysis. These sugars were subsequently utilized as substrates for the production of polyhydroxyalkanoates (PHA), demonstrating their potential as an alternative carbon source in bioprocesses.

Furthermore, the workshop will present findings related to the optimization of PHA production via submerged fermentation in a 1 L bioreactor. The results include improved process parameters, enhanced yield, and insights into the efficiency of using mixed and renewable feedstocks. Overall, the project demonstrates a viable approach for converting low-value waste streams into high-value, biodegradable materials, contributing to circular economy principles and sustainable packaging solutions.

Keywords: PHA, biopolymer production, agro-industrial residues, fermentable sugars, submerged fermentation

Acknowledgement: *This research was conducted as part of the project „Production and development of compostable packaging from waste biomass for the packaging of industrially processed food products" (NPOO.C3.2.R3-Il .04.0059) funded by National Recovery and Resilience Plan (funded by the European Union, NextGenerationEU).*

REDEFINING SUSTAINABLE PACKAGING VIA PHBV-BASED SOLUTIONS FOR FOOD APPLICATIONS

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oral presentation

The growing demand for sustainable food packaging materials has positioned poly(3-hydroxybutyrate-*co*-3-hydroxyvalerate) (PHBV) as a promising biodegradable and compostable polymer. However, its broader application is hindered by brittleness and insufficient barrier properties, particularly with respect to water vapor. This study explores strategies to enhance PHBV performance. Initially, composites incorporating thymol, silver nanoparticles, chitosan, titanium dioxide were developed to introduce functional properties. However, these systems showed increased brittleness, reduced mechanical performance, and no significant barrier improvement. Subsequently, polymer blending was investigated. PHBV was combined with polylactic acid (PLA), thermoplastic starch (TPS), poly(butylene succinate) (PBS), and poly(butylene adipate-*co*-terephthalate) (PBAT). TPS was excluded due to moisture sensitivity and poor barrier properties, while PLA blends exhibited limited miscibility and low toughness. In contrast, PBS and PBAT blends significantly improved flexibility and mechanical performance, with PBS emerging as the most promising candidate. Comprehensive characterization, including morphological, thermal, mechanical, and barrier analyses, was conducted. Despite these advancements, achieving optimal phase homogeneity remains a challenge, currently addressed through the use of plasticizers and chain extenders (e.g., Joncryl). Biodegradation and compostability studies are ongoing to confirm environmental performance and end-of-life behavior. The results demonstrate that polymer blending, particularly with PBS, represents a promising strategy for advancing high-performance, sustainable PHBV-based packaging solutions for the food industry.

Keywords: PHBV, biodegradable packaging, polymer blends, barrier properties

Acknowledgement: *This research was conducted as part of the project „Production and development of compostable packaging from waste biomass for the packaging of industrially processed food products" (NPOO.C3.2.R3-Il .04.0059) funded by National Recovery and Resilience Plan (funded by the European Union, NextGenerationEU).*

IMPACT OF ECO-INNOVATIVE PACKAGING ON THE QUALITY OF A FOOD PRODUCT AND LIFE CYCLE ASSESSMENT OF POLYHYDROXYALKANOATE PRODUCTION FROM AGRO-INDUSTRIAL RESIDUES AT LABORATORY SCALE (BIOPHA-COMFPACK PROJECT)

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oral presentation

Within the BioPHA-ComFPack project (2024–2026), several eco-innovative polymer films were experimentally developed from blends of commercially available compostable components, with and without functional barrier coatings, intended for packaging an industrially processed food product with extended shelf life (dehydrated broccoli cream soup).
During Phase I, organoleptic properties of the soup packaged in films without barrier coatings were monitored over a period of four months under four different temperature conditions. Noticeable deviations in odor and color of both the dry product and the prepared soup were observed in comparison with the reference standard. Nevertheless, based on the obtained results, one film formulation exhibited comparatively lower deviations and was therefore selected for Phase II. In this phase, oxygen- and water-barrier coatings were applied to the selected film, produced using two different film extrusion processes: blown film extrusion and cast film extrusion.
The final workshop will present the comprehensive results of Phase II, including the evaluation of organoleptic quality of the soup packaged in coated blown and cast films, corresponding to a total monitoring period of six months of product stability.
In addition, the workshop will present the overall results of the life cycle assessment (LCA) of polyhydroxyalkanoate (PHA) biopolymer production from agro-industrial residues via submerged fermentation in a 1 L laboratory-scale bioreactor.

Keywords: compostable packaging, polyhydroxyalkanoates (PHA), life cycle assessment (LCA), industrial food product, shelf-life monitoring

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EXTRACTION AND PURIFICATION OF PHA: CHLOROFORM *VS.* GREEN SOLVENTS – FACTS, MISCONCENPTIONS AND CONTEMPLATIONS

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oral presentation

Even today, the cost-effective extraction and purification of polyhydroxyalkanoates (PHA) from microbial cells remains a significant challenge. Therefore, for the prudent planning of extraction and subsequent purification of PHA from microbial biomass, it is necessary to determine the key operational properties of PHAs. In this respect, the present study investigated some practical as well as economic aspects of polyhydroxybutyrate (PHB) and polyhydroxybutyrate-*co*-valerate (PHBV) extraction and purification using chloroform and four green solvents: anisole, cyclohexanone, dimethyl carbonate, and methyl ethyl ketone. The results revealed the superiority of chloroform over the examined green solvents in terms of PHB and PHBV solubility, stability in the solvent upon temperature decrease, and precipitation capability, as well as in extraction and purification costs, including solvent price and reusability costs. Based on current evidence, it is evident that chloroform remains the most cost-effective solvent for PHA extraction and purification.

Keywords: PHB, PHBV, extraction, purification, chloroform, green solvents

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POSTER PRESENTATIONS / POSTERSKA PRIOPĆENJA

INCORPORATION OF BERRY FRUIT POMACES IN SWEET SPREADS

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poster presentation

Siberian blueberry (*Lonicera caerulea* L.) and chokeberry (*Aronia melanocarpa*) pomaces are solid residues remaining after juice production. These by-products are valuable sources of bioactive compounds and nutrients, such as polyphenols, vitamins, minerals, and dietary fibre. The aim of this study was to evaluate the potential use of berry fruit pomaces in sweet spreads as a substitute for skimmed milk powder. Recipes containing 12%, 8%, 4%, and 0% (control sample) pomace were prepared. Sweet spreads were produced using a laboratory ball mill. Samples with the highest amount of pomace had the largest particle size, measured with a micrometer, due to the presence of dietary fibre. Total polyphenol content was determined spectrophotometrically, and results showed that polyphenol content increased with higher pomace content in the samples. In general, samples with Siberian blueberry pomace showed higher polyphenol content than those with chokeberry pomace. A similar trend was observed for antioxidant capacity, determined by the ferric reducing antioxidant power (FRAP) assay. The colour, measured with a chroma meter, also changed due to the substitution. Samples had lower work of shear values compared to the control sample, indicating better spreadability. Considering these findings, berry fruit pomaces are a promising by-product in the production of sweet spreads with improved nutritional value, thereby supporting the sustainability.

Keywords: sweet spreads, Siberian blueberry pomace, chokeberry pomace, by-product, polyphenols

Acknowledgement: The research was financed by Osijek-Baranja County through the project „Berry Fruit Pomace as a Raw-Material for the Sweet Spred Production”.

DES-MODIFIED BREWERS' SPENT GRAIN FOR DYE AND PHARMACEUTICAL REMOVAL FROM WATER

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poster presentation

Brewer's spent grain (BSG), the main solid by-product of the brewing industry, is rich in lignocellulose, proteins, and phenolic compounds, and is often considered a biorefinery feedstock, fitting into circular economy strategies that aim at full valorization of food industry by-products. Phenolic compounds make BSG an attractive source of high-value bioactives. Due to their biocompatibility, higher biodegradability and lower toxicity, deep eutectic solvents (DES) and their natural counterparts (NADES) have emerged as designed green solvents for the extraction of such bioactives from biomass. After extraction, lignocellulosic materials modified with DES/NADES have a potential to be used as biosorbents for the removal of pollutants from water. The aim of this preliminary research was to explore the possibility of using DES-modified BSG (DES-BSG), remaining after the extraction of phenolic compounds, as a biosorbent for the removal of the pharmaceuticals amoxicillin (AMX) and diclofenac (DF), as well as the synthetic dyes Congo Red (CR) and Methylene Blue (MB) from model solutions. After the extraction of phenolic compounds from lyophilized BSG using DES, the remaining solvent was removed from the BSG, which was subsequently dried and utilized as a biosorbent (DES-BSG). FTIR spectra of DES-BSG were recorded in order to detect the surface functional groups affecting the biosorption. The batch adsorption technique was used to screen the biosorptive removal efficiency of DES-BSG for AMX, DF, CR and MB. The results showed that DES-BSG was not effective in removing pharmaceuticals, but it was efficient in removing dyes, achieving over 70% removal of the initial dye concentration.

Keywords: brewers' spent grain, biosorption, extraction, DES, pollutants removal

Acknowledgement: *This work has been supported by the Ministry of Science, Education and Youth within the bilateral project (Scientific and technological cooperation with Slovenia) "Biosorption potential of brewers' spent grain treated with natural deep eutectic solvents for the removal of emerging contaminants from water" and Slovenian Research and Innovation Agency's code: BI-HR/25-27-032.*

APPLICATION OF FLAXSEED PRESS CAKE FLOUR IN ICE CREAM PRODUCTION: A PROMISING POSSIBILITY FOR BY-PRODUCT UTILIZATION

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poster presentation

The food industry generates considerable amounts of various by-products, encouraging research into their potential reuse as functional ingredients in food production. Cold-pressed cakes are valuable ingredients due to their favorable composition, including bioactive compounds, proteins, and fibers. This study investigated the use of flaxseed press cake flour as a partial substitute for skimmed milk powder in ice cream production and evaluated the effect of this replacement on the physicochemical properties of the final product. Ice cream samples were prepared by replacing skimmed milk powder with flaxseed flour at substitution levels of 25.0%, 37.5%, and 50.0%, with a formulation without flour serving as the control. In addition to the rheological properties of the ice cream mixtures, the physicochemical properties of the ice cream, including overrun, melting behavior, texture, and color characteristics, were determined.

The results showed that incorporation of flaxseed press cake flour affected several physicochemical properties of the ice cream. Changes in rheological parameters, such as increased viscosity, were observed with higher flour concentrations. For the sample with 50.0% skimmed milk powder replacement, overrun and melting rate decreased from 27.09% and 2.25%/min to 23.54% and 1.96%/min, respectively. Due to the fiber content in flaxseed flour, the hardness and gumminess of the ice cream samples increased with higher replacement levels. Furthermore, color parameters changed; samples with flaxseed flour were darker, and these changes were visible to the human eye. Overall, this study demonstrates that flaxseed flour can be used in ice cream production, contributing to the valorization of by-products while improving some ice cream properties.

Keywords: ice cream, by-products, flaxseed, press cake, physicochemical properties

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FROM BY-PRODUCT TO FUNCTIONAL BEVERAGE - WHEY VALORIZATION IN KEFIR AND A NOVEL FERMENTED DRINK PRODUCED FROM COW AND DONKEY MILK

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poster presentation

The valorization of dairy by-products represents an important strategy within the circular economy concept in the food industry. Among these by-products, whey has gained increasing attention due to its nutritional value and potential application in the development of innovative fermented beverages. The aim of this study was to investigate the effect of milk type and whey enrichment on the microbiological activity and compositional characteristics of kefir and a novel fermented beverage. Fermented samples were prepared using cow and donkey milk with the addition of whey as a functional ingredient. The physicochemical and microbiological properties of the beverages were evaluated by analyzing pH, lactic acid bacteria (LAB) counts, protein content, fat content, dry matter, lactic acid concentration, and sugar levels. Statistical evaluation was performed using one-way analysis of variance (ANOVA) followed by Tukey post-hoc testing. Relationships among the variables were examined using Pearson correlation analysis, while Principal Component Analysis (PCA) was applied to explore multivariate relationships among the samples and measured parameters. The results demonstrated that whey enrichment combined with different milk types significantly influenced fermentation dynamics and the compositional properties of the fermented beverages. Multivariate statistical analysis confirmed clear differentiation among the samples according to fermentation intensity and nutritional composition. From a sustainability perspective, the incorporation of whey represents an effective strategy for the valorization of dairy industry by-products within the circular economy framework. The development of whey-enriched fermented beverages not only contributes to reducing environmental waste but also enables the production of innovative dairy products with enhanced nutritional and functional properties.

Keywords: kefir, donkey milk, whey enrichment, lactic acid bacteria, fermentation

AMTPS-BASED RECOVERY OF CURCUMINOIDS FROM *Curcuma longa*: EXPLORING PACKAGING APPLICATIONS

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poster presentation

Downstream processing represents an essential stage in industrial production. Despite its importance, it is typically associated with high complexity, significant energy consumption, and substantial material use, often contributing up to 80% of total production costs. As industries move towards more sustainable and economically viable practices, there is a growing need to design improved downstream processing strategies that enhance efficiency without compromising productivity. To address this challenge, the present study proposes an environmentally friendly technique for the extraction of curcuminoids from *Curcuma longa* based on micellar solutions. The method integrates solid–liquid extraction (SLE) with liquid–liquid extraction (LLE) within a coordinated two-step process. The SLE solvent system, consisting of a buffer solution and a biodegradable surfactant, promotes the formation of an aqueous micellar two-phase system (AMTPS), which functions as a specific type of LLE. Through optimization of both extraction stages, a curcuminoid recovery rate above 95% was achieved in the surfactant-rich phase. In addition to its extraction performance, the system also shows promise for smart packaging applications. The surfactant-rich phase exhibits high stability, retaining its structural properties for over 50 hours when exposed to UV radiation, with only approximately 20% degradation observed. These results highlight the promise of this method for developing sustainable materials with practical industrial applications.

Keywords: AMTPS, green extraction, natural colorants, sustainability

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INNOVATIVE EXTRACTION TECHNIQUES FOR THE VALORISATION OF ARONIA POMACE AS A SOURCE OF BIOACTIVE PHENOLICS

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poster presentation

Aronia (*Aronia melanocarpa*) is a berry fruit well recognized for its high content of bioactive compounds such as phenolics, particularly anthocyanins, which contribute to its health-beneficial properties and wide application in different industries. After processing fruit into juice, the remaining pomace, as a main by-product, still contains high levels of these valuable bioactive compounds with significant potential for further valorization. This study aimed to investigate the phenolic and antioxidant potential of aronia fruit and its pomace by the application of two extraction methods: ultrasound-assisted extraction (UAE) (30 and 60 min) and microwave-assisted extraction (MAE) (5 and 10 min). The highest yield of total phenolics was found in the aronia extract prepared by MAE (2628 mg gallic acid equivalents/L) where prolonged extraction time resulted in a higher extraction yield, while the highest anthocyanin content was detected in the UAE sample (30 min). The pomace extracts, in all cases contained a lower yield of these compounds, as expected. Antioxidant activity results were consistent with the phenolic profile of the samples, but it can be noted that the reducing activity of the extracts, detected by the FRAP method, was significantly lower for UAE samples. These findings highlight that the applied extraction method affects the chemistry and related antioxidant potential of the extracts. The presented results support the fact that green extraction technologies, especially MAE could be effective in the exploration of aronia pomace as a main fruit-processing by-product.

Keywords: *Aronia melanocarpa*, ultrasound-assisted extraction, microwave-assisted extraction, phenolic compounds, antioxidant activity

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INTEGRATION OF RISK ASSESSMENT, VACCP AND TACCP APPROACHES IN THE DEVELOPMENT AND VALORIZATION OF BY-PRODUCTS IN THE FOOD INDUSTRY

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poster presentation

The development and valorization of by-products in the food industry play a crucial role in achieving sustainability and circular economy objectives. The utilization of by-products as secondary raw materials introduces additional complexities related to food safety, authenticity, and intentional threats. Therefore, the integration of risk assessment, VACCP (Vulnerability Assessment and Critical Control Points), and TACCP (Threat Assessment and Critical Control Points) approaches is essential for comprehensive risk management.

Traditional risk assessment based on HACCP principles focuses on the identification and control of unintentional hazards, including microbiological, chemical, and physical risks. In contrast, VACCP addresses economically motivated food fraud by identifying system vulnerabilities, such as opportunities for adulteration, supply chain complexity, and lack of transparency. TACCP complements these approaches by focusing on intentional contamination and food defense, assessing potential threats from malicious actors and system weaknesses.

By-products are particularly vulnerable due to their variable composition, insufficient standardization, and complex supply chains, which increase exposure to both fraud and deliberate contamination. An integrated framework combining HACCP-based risk assessment, VACCP, and TACCP enables a holistic evaluation of hazards, vulnerabilities, and threats throughout the product lifecycle. This approach enhances product safety, authenticity, and supply chain resilience, while strengthening consumer trust.

In conclusion, the combined application of risk assessment, VACCP, and TACCP represents a robust and comprehensive strategy for the safe, secure, and sustainable valorization of by-products in the modern food industry.

Keywords: risk, VACCP, food authenticity, by-products, TACCP

BIOACTIVE PROFILE AND ENCAPSULATION STRATEGIES OF POLYPHENOLS FROM ŽILAVKA AND BLATINA GRAPE POMACE

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poster presentation

In this study, the bioactive potential of grape pomace, a primary byproduct of winemaking, was investigated. Pomace was derived from the indigenous Herzegovinian cultivars, Žilavka and Blatina. The research first evaluated the efficiency of various extraction solvents, including water, ethanol solutions, methanol, and acidified methanol, in recovering phenolic compounds. Results indicate that the solvent polarity and acidity significantly influence the yield of total phenols, with acidified methanol often providing the highest extraction efficiency for complex flavonoid structures. However, these compounds are sensitive to degradation under environmental stressors. To ensure their stability, the extracts were subjected to encapsulation via freeze drying (lyophilization). This low-temperature dehydration process preserves the thermolabile polyphenols by converting the liquid extract into a stable powder form using suitable carrier agents.
The findings demonstrate that freeze-drying encapsulation effectively protects the bioactive profile of Žilavka and Blatina extracts, enhancing their shelf-life and facilitating their integration into functional foods and pharmaceutical products.

Keywords: byproducts, encapsulation, extraction, grape pomace

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GLUCOSINOLATE DIVERSITY IN BRASSICACEAE PLANTS AS A SOURCE OF BIOACTIVE COMPOUNDS FOR BIOMASS VALORIZATION

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poster presentation

Glucosinolates (GSLs) are sulfur-containing specialized metabolites characteristic of the Brassicaceae (cabbage family), known for their role in plant defense and the formation of biologically active hydrolysis products, namely isothiocyanates. Due to their diverse bioactivities, GSLs are increasingly recognized as valuable compounds for the recovery of high-value products from plant biomass. These species represent a rich source of structurally diverse GSLs, including methionine-derived (aliphatic), phenylalanine-derived (aromatic), and tryptophan-derived (indole) compounds, reflecting multiple biosynthetic pathways and high metabolic diversity. In this study, GSL profiles of selected endemic Brassicaceae species (*Aurinia sinuata*, *Aurinia leucadea* and *Resetnikia triquetra*) were investigated using liquid chromatography with tandem mass spectrometry (LC-MS/MS) analysis of desulfo derivatives. Among them, aliphatic GSLs predominated, particularly short-chain (C4–C5) methylsulfanylalkyl and methylsulfinylalkyl homologues, reaching up to 54 μmol/g dry weight depending on species and plant tissue. From the perspective of food industry by-products, these plant species represent a promising and underutilized source of bioactive compounds that can be recovered through appropriate extraction and processing strategies. The presence of structurally diverse GSLs highlights their potential application in functional foods, nutraceuticals, pharmaceuticals, and environmentally friendly plant protection systems. Overall, this study supports the concept of biomass valorization, highlighting the potential of Brassicaceae plants as sustainable sources of high-value GSLs.

Keywords: glucosinolates, Brassicaceae, LC-MS/MS, bioactive compounds, biomass valorization

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NATURAL PRODUCT-INSPIRED CHROMONE-2-CARBOXYLIC ACID LIGANDS FOR THE DEVELOPMENT OF BIOLOGICALLY ACTIVE COPPER(II) COMPLEXES

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poster presentation

Chromones are oxygen-containing heterocyclic compounds widely distributed in nature, particularly in plants, where they occur as secondary metabolites with diverse biological activities. Numerous chromone derivatives exhibit antioxidant, antimicrobial, anti-inflammatory and anticancer properties, making this structural motif highly attractive for the development of biologically active molecules. In addition, chromone derivatives containing carboxylic functional groups can act as versatile ligands for the synthesis of coordination compounds with transition metals, which may enhance their biological activity. In this study, two novel chromone-based compounds derived from chromone-2-carboxylic acid were synthesized using coordination chemistry approaches. The obtained compounds were structurally characterized by infrared spectroscopy (IR), nuclear magnetic resonance spectroscopy (NMR) and thermogravimetric analysis (TG), confirming the formation of the desired structures and providing insight into their thermal stability.
Since metal complexes containing chromone-derived ligands have attracted increasing interest as potential anticancer agents, the biological activity of the synthesized compounds was also investigated. Their antiproliferative effects were evaluated *in vitro* on human colorectal adenocarcinoma cell lines. The results indicate that chromone-2-carboxylic acid-based ligands represent promising building blocks for the development of biologically active coordination compounds. The combination of natural product-inspired chromone scaffolds with coordination chemistry therefore represents a valuable strategy for the design of new compounds with potential applications in anticancer research.

Keywords: chromone-2-carboxylic acid, chromone derivatives, coordination compounds, anticancer activity, colorectal adenocarcinoma cells

PILOT-SCALE SUPERCRITICAL CO_2 EXTRACTION AND VOLATILE COMPOUND PROFILE OF *Punica granatum* L. SEED EXTRACT

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poster presentation

Pomegranate (*Punica granatum* L.) cultivation for juice production in Croatia is growing and with it, the generation of large quantities of seed biomass left unutilized, posing a potential environmental issue when disposed of as waste. In this study, pomegranate seeds obtained from a commercial juice producer were subjected to supercritical CO_2 extraction on a pilot-scale extraction system, representing the first such application in Croatia, allowing for comparison with previous laboratory-scale data. Moreover, to our knowledge, this constitutes the first reported pilot-scale supercritical CO_2 extraction of pomegranate seeds. The resulting extract's volatile compound profile was determined using HS-SPME-GC-MS to identify compounds of interest for potential applications in food, nutraceutical and cosmetic formulations. This study demonstrates a scalable valorisation of pomegranate juice production by-products and contributes to the development of circular economy strategies in the regional food sector while providing insight into scale-dependent extraction variations.

Keywords: *Punica granatum* seeds, pilot scale, supercritical fluid extraction, HS-SPME-GC-MS

INFLUENCE OF INDUSTRIAL JUICE PROCESSING ON THE COMPOSITION AND FUNCTIONAL PROPERTIES OF APPLE POMACE

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poster presentation

In this study, the potential utilization of apple pomace obtained from different industrial apple juice production processes was investigated. Two types of pomace were comparatively analyzed: (1) pomace obtained after mechanical pressing of apples and (2) pomace produced after an additional technological step involving enzymatic treatment of the pressed apples with pectolytic enzymes followed by washing in order to improve juice extraction. The aim of this study was to compare the composition and selected physicochemical and functional properties of these two pomace types, as well as the flours produced from them using a technological process developed at the Institute of General and Physical Chemistry, Belgrade, Serbia. The chemical composition of the pomaces was determined, as well as color parameters of the flours, water activity (a_w), thermal stability, water-holding capacity (WHC), oil-holding capacity (OHC) and solubility. Pomace obtained solely by mechanical pressing retained significantly higher levels of residual sugars and polyphenolic compounds, which contribute to the characteristic apple flavor and natural sweetness, as well as to the presence of bioactive constituents. In contrast, pomace obtained after enzymatic treatment and washing was markedly richer in insoluble dietary fiber. Color parameters and water activity values suggested that both flours possess properties compatible with storage and incorporation into dry formulations, while thermal analysis demonstrated adequate stability within temperature ranges typical for food processing. Differences in WHC, OHC, and solubility further indicate distinct functional behavior of the two materials.

Keywords: apple pomace, production processes, chemical composition

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APPLICATION OF CIRCULAR ECONOMY IN HEALTH PROTECTION AND DISEASE PREVENTION

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poster presentation

The problem of waste is one of the key issues of modern society. Circular economy is a sustainable alternative to the established waste management model. Its goal is to reduce the amount of waste to the lowest possible level by applying certain principles and to alleviate the imbalance between accelerated economic growth and the increasing absence of raw materials and energy resources. Waste is not only an aesthetic issue that spoils the appearance of the landscape, but also a serious threat to human health. The paper was written as a review by searching relevant scientific and professional literature and the Pubmed database in the period from 2021 to 2026 according to the specified keywords. The aim of the paper is to highlight the importance of a circular economy that uses resources efficiently and contributes to the well-being of humanity. Increasing amounts of waste suffocate people and nature, and available resources are not used to their optimal potential. Circular economy directly improves health. Air, water and soil pollution is reduced through reduced production of waste and toxic substances. Inhalation of toxic gases contributes to the development of respiratory diseases such as asthma and chronic obstructive pulmonary disease, and soil and water contamination contributes to the development of gastrointestinal infections. The accumulation of waste also promotes the reproduction of pests that are carriers of infectious diseases. For the successful implementation of the above measures, a change in the way of thinking of individuals and close cooperation of all key services are necessary. Joint activities can ensure a healthier environment and a better quality of life.

Keywords: air pollution, asthma, circular economy, infectious diseases

PHENOLIC COMPOUNDS AND ANTIOXIDANT ACTIVITY OF WILD POMEGRANATE BY-PRODUCTS

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poster presentation

Wild pomegranate (*Punica granatum* L.) represents a valuable source of bioactive compounds, with particular potential found in its by-products (peel and pomace) which are generated during fruit processing. These parts contain significant amounts of phenolic compounds and contribute to antioxidant activity. This study investigated the phenolic composition and antioxidant potential of peel and pomace from wild pomegranate collected at three locations in Herzegovina. Samples were collected at full maturity, and phenolic compounds were extracted using organic solvents. Total phenols were determined by the Folin-Ciocalteu method, while individual compounds were analyzed using HPLC with UV-VIS detection. The contents of flavonoids and non-flavonoids were also determined, along with antioxidant activity using DPPH, FRAP, and ABTS assays. The results showed differences between samples, with peel containing higher concentrations of phenolic compounds compared to pomace. Variations among locations were also observed, indicating the influence of environmental factors. Naringin showed greater variability, while quercetin and kaempferol were more consistent. Antioxidant activity followed the trend of total phenols. The results confirm that wild pomegranate by-products represent a valuable source of bioactive compounds with potential applications in the food, pharmaceutical, and cosmetic industries, contributing to sustainable resource use and waste reduction. This further highlights the importance of their continued valorization in modern production systems.

Keywords: wild pomegranate, peel, pomace, phenolic compounds, antioxidant activity

MICROWAVE-ASSISTED EXTRACTION OF POLYPHENOLS AND ANTIOXIDANT ACTIVITY FROM FRESH WHOLE SEEDS OF WHITE GRAPE VARIETIES

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poster presentation

Grape seeds represent a major by-product of the grape processing industry. Although they contain valuable nutrients and contribute to wine production, consumers generally prefer seedless grape varieties for fresh consumption. Nevertheless, grape seeds are recognized as a valuable source of bioactive compounds that can be extracted and utilized in food products, cosmetics, and dietary supplements. In this study, grapes from six white grape varieties were collected from the experimental vineyard of the Faculty of Agrobiotechnical Sciences Osijek. The seeds were separated from the grapes and immediately extracted with water as the extraction solvent in a 1:5 fresh weight (FW) to solvent ratio. The samples were subjected to microwaves (500 W for 5 minutes followed by 250 W for 20 minutes, with a maximum temperature set to 40 °C). Drying and grinding were intentionally omitted to evaluate whether extracts obtained directly from fresh whole seeds could still exhibit notable polyphenol content and antioxidant activity. The obtained extracts were analyzed for total polyphenol content and antioxidant activity using the FRAP assay. This extraction approach proved effective in recovering measurable amounts of polyphenols, with total polyphenol content up to 147 mg gallic acid equivalents (GAE) per g of FW, and antioxidant activity up to 130 μmol Fe^{2+} equivalents per g of FW. These results suggest that using fresh grape seeds, without prior seed drying or grinding, may represent a simple, practical and low-energy approach for obtaining extracts suitable for antioxidant enrichment applications.

Keywords: grape seeds, microwave-assisted extraction, antioxidant activity

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BIOACTIVE POTENTIAL OF COFFEE SILVERSKIN: APPLICATION IN THE FORMULATION OF HERBAL INFUSIONS

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poster presentation

Coffee, the second most traded commodity after crude oil, is produced globally in large quantities and generates substantial by-products throughout the production chain, many of which remain underutilised. Coffee silverskin, a by-product formed during the roasting of coffee beans, is of particular interest due to its low fat and carbohydrate content and high dietary fibre, protein and polyphenols content. To explore its potential as a functional food ingredient and exploit its bioactive properties, the aim of the present study was to investigate the chemical and bioactive composition of coffee silverskin and its incorporation into herbal infusions prepared from chamomile, ground ivy and nettle. The chemical composition of silverskin was determined using standard AOAC methods, including the analysis of dry matter, protein, fat and ash content. The bioactive profile of silverskin and the prepared herbal infusions was evaluated by determining total phenolic and melanoidin content, as well as antioxidant capacity using spectrophotometric assays, while individual bioactive compounds were identified by HPLC-PDA analysis. Herbal infusions were prepared from silverskin, chamomile, ground ivy and nettle individually, as well as with silverskin added at 25, 50 and 75 % content. The silverskin contained 1.22 % fat, 15.61 % protein and 6.6 % ash on a dry matter basis (dmb). The detected bioactive compounds included caffeine (4.93 mg/g dmb) and chlorogenic acid (0.22 mg/g dmb). Among the 13 prepared infusions, the highest total phenolic content (179.10 and 141.60 mg GAE/L) and antioxidant capacity (0.68 and 0.62 mmol Trolox/L) were observed in chamomile and ground ivy infusions. The addition of silverskin enriched their bioactive composition, particularly through the presence of caffeine and increased chlorogenic acid content. Sensory evaluation also indicated improved overall acceptability of chamomile, ground ivy and nettle infusions enriched with silverskin. The most favourable sensory properties were observed in infusions containing 25 % silverskin, while the mixture containing 75 % chamomile achieved the highest overall sensory score.

Keywords: coffee silverskin, herbal infusions, polyphenols, sensory evaluation

Acknowledgement: This work was supported by the Croatian Science Foundation under the project: "Integrated approach to the valorization of coffee by-products by developing functional food ingredients" (IP-2025-02-6834).

ENCAPSULATION OF CHOKEBERRY POMACE POLYPHENOLS ON ALMOND AND RICE PROTEIN MATRICES

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poster presentation

Even though chokeberry pomace is a by-product of fruit juice production, it remains a valuable source of polyphenols. Currently, sustainability is a popular concept for addressing issues related to food industry waste. With this in mind, we used extracts of chokeberry pomace (CPE) as a base for the formulation of bioactive food ingredients (BFI). BFI were prepared by complexing CPE with almond or rice protein matrices, which served as carriers for the polyphenols in CPE. The adsorption capacities (AC) of the selected protein matrices were determined to assess their affinity for CPE polyphenols. The rice protein matrix exhibited higher AC for total polyphenols, proanthocyanidins, and monomeric anthocyanins than the almond protein matrix. The ACs for the rice protein matrix were 76%, 98%, and 76%, compared to 42%, 32%, and 51% for the almond protein matrix, respectively. The difference in ACs between the carriers is a consequence of the protein content in the matrices (rice contained approximately 85% and almond 50% of proteins) and differences in protein structure. IR screening was also conducted to assess changes in protein structure after adsorption of CPE polyphenols. This approach represents a green method for the formulation of BFI, which may have significant application potential. These BFI can be used as additives in various food products to enrich them with valuable compounds (both polyphenols and proteins), to increase nutritional value, improve stability, and modify colour of products.

Keywords: chokeberry pomace, rice proteins, almond proteins, bioactive food ingredients

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APPROACHES TO THE VALORIZATION OF BY-PRODUCTS GENERATED DURING LEGUME PROCESSING

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poster presentation

In recent decades, increased demand for high-quality, sustainable dietary protein has led to increased production and consumption of legumes such as beans, peas, lentils, soybeans, chickpeas, and peanuts. Legumes are a nutritionally valuable group characterized by high protein content and a favorable balance of complex carbohydrates, essential fatty acids, dietary fiber, and micronutrients. The increased production and processing of legumes results in the generation of significant amounts of by-products, such as pods, seed coats, damaged grains, and vegetative parts of the plant. Although often considered waste, these by-products are a valuable source of bioactive compounds, including polyphenols, carotenoids, and tocopherols. The presence of antinutritional compounds may limit their use in the food industry; however, they also possess favorable functional properties, such as foaming, emulsifying, and water- and oil-binding capacities. Due to these characteristics, they can be used in the production of various food products, for example, bakery products, plant-based beverages, sauces, and plant-based meat alternatives. The valorization of legume by-products through modern processing technologies and innovative product development enables the production of ingredients with high nutritional and technological value.

Keywords: legumes, by-products, antinutrients

NUTRITIONAL VALORIZATION OF HERZEGOVINIAN ĆUPTER ENRICHED WITH BREWER'S SPENT GRAIN: GLYCEMIC INDEX AND FUNCTIONAL FOOD POTENTIAL

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poster presentation

Herzegovinian ćupter is a traditional dessert from the Herzegovina region, prepared by cooking grape must from indigenous grape varieties with the addition of flour or semolina. Despite being free of refined sugar, its composition is predominantly simple carbohydrates. Recent studies have suggested the potential for nutritional enhancement by incorporating brewer's spent grain, a brewing industry by-product rich in dietary fiber, proteins, and polyphenols.

This study aimed to evaluate the impact of brewer's spent grain addition on postprandial glycemic response by determining the glycemic index (GI) and glycemic load (GL) of traditional ćupter and innovative enriched samples. Results indicated that traditional ćupter exhibits a low GI (54.7 ± 25.40), whereas enrichment with brewer's spent grain further reduced the GI of the modified samples (48.0 ± 19.73 and 48.7 ± 24.16).

The observed reduction in glycemic response is likely related to the high fiber and bioactive content of brewer's spent grain, which slows carbohydrate digestion and moderates blood glucose elevation. These findings emphasize the critical role of macronutrient composition in glycemic regulation and demonstrate the feasibility of transforming traditional ćupter into a functional food product suitable for individuals at elevated risk of metabolic disorders. Additionally, the valorization of brewer's spent grain aligns with principles of sustainable food production and circular economy, offering both nutritional and environmental benefits.

Keywords: ćupter, brewer's spent grain, glycemic index, glycemic load, functional food

VALORIZATION OF AROMATIC PLANT BY-PRODUCTS IN STRONG ALCOHOLIC BEVERAGES: A BIBLIOMETRIC AND NETWORK ANALYSIS VIA VOSviewer

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poster presentation

A structured bibliometric and science mapping analysis is conducted to examine research on aromatic plants and their applications in developing value-added products, with a particular focus on strong alcoholic beverages. A comprehensive dataset is retrieved from the Web of Science Core Collection using a refined search query that incorporates terms related to aromatic plants, by-products, distillation, and spirits. The analysis encompasses publication trends, citation performance, and thematic evolution over time. Science mapping is performed using VOSviewer to construct and visualise co-authorship, country collaboration, and keyword co-occurrence networks. This methodology facilitates the identification of leading authors, influential countries, dominant research clusters, and emerging topics at the intersection of plant-derived bioactive compounds and the production of innovative spirits. The analysis places particular emphasis on the valorisation of non-conventional raw materials and by-products of aromatic plants in distillation processes, with a focus on sustainability-oriented innovations. The results provide a comprehensive overview of the field's intellectual and geographical structure, informing future research strategies, technological advancements and economic opportunities related to the valorisation of aromatic plant by-products.

Keywords: aromatic plants, by-products, strong alcoholic beverages, valorisation, bibliometric analysis, Web of Science, VOSviewer, co-authorship, countries, keyword co-occurrence

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VALORIZATION OF MIXED AGRO-INDUSTRIAL WASTE HYDROLYSATE FOR CONTINUOUS PHA PRODUCTION USING *Cupriavidus necator*

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poster presentation

Plastic has become an indispensable material in modern society due to its wide range of applications. However, its high resistance to degradation has led to the accumulation of plastic waste and microplastic particles in the environment. To address this issue, polyhydroxyalkanoates (PHA) have been increasingly investigated as a sustainable alternative to conventional plastics. These biodegradable polyesters are synthesized intracellularly by various microorganisms, while nutrient-rich hydrolysates of agro-industrial waste are increasingly used as substrates for PHA production. In this study, a hydrolysate derived from mixed agro-industrial waste consisting of pepper, plum, eggplant, tomato, and chickpeas was used as the substrate. PHA synthesis was carried out by submerged fermentation (SmF). For substrate valorization, the prepared mixture was homogenized and characterized by physicochemical and microbiological analyses. Prior to fermentation, acid hydrolysis was performed to release reducing sugars. The fermentation process was conducted in a bioreactor at 30 °C and a pH between 6 and 7.5, with continuous feeding of the bacterial culture *Cupriavidus necator* and nutrients. During the three-week process, optical density, sugar concentration, pH, and dissolved oxygen were monitored. The produced biopolymer was extracted and quantified using GC–MS analysis. The results showed that the use of mixed agro-industrial waste hydrolysate combined with a continuous fermentation process represents an efficient approach for PHB production. Continuous cultivation enabled higher PHA yield and reduced operational costs compared to batch processes, since the reactor does not need to be sterilized after each batch, allowing prolonged and more economical production.

Keywords: PHA, agroindustrial waste, acid hydrolysis, SmF, *Cupriavidus necator*

This research was conducted as part of the project „Production and development of compostable packaging from waste biomass for the packaging of industrially processed food products" (NPOO.C3.2.R3-Il .04.0059) funded by National Recovery and Resilience Plan (funded by the European Union, NextGenerationEU).

FROM EFFLUENT TO ECOSYSTEM: ENVIRONMENTAL PATHWAYS OF SMALL BREWERY WASTE

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poster presentation

The rapid expansion of small breweries has increased interest in the valorisation of brewing by-products; however, the research on environmental implications of small brewery waste remain scarce. The present research synthesises current knowledge on the potential ecosystem-level effects focusing on aquatic, terrestrial, and atmospheric pathways. In aquatic environments, discharge of biodegradable organic matter can stimulate microbial respiration and increase biological oxygen demand, potentially leading to oxygen depletion. Under these conditions, microbial metabolism may shift towards anaerobic pathways, altering nutrient cycling and redox processes. These changes can affect aquatic food webs, reducing macroinvertebrate abundance, and (indirectly) affecting fish via habitat degradation and reduced prey availability. In terrestrial environments, the brewery by-products, e.g., spent grain, yeast, and trub can affect soil physicochemical properties. High organic inputs stimulate microbial activity, potentially generating temporary oxygen depletion, altering microbial community structure, and affecting soil fauna. Bioactive compounds originating from hops may further modify microbial and plant-soil interactions. Atmospheric impacts include fermentation-derived CO_2 emissions, odour formation during organic waste decomposition, and operational noise. While effects from individual small breweries are modest, cumulative effects may affect water, soil and air quality, subsequently impacting human well-being and sensitive wildlife. Improved waste management strategies, monitoring frameworks, and scale-appropriate regulatory guidance are therefore essential to support the sustainable development of the brewing sector within a circular bioeconomy.

Keywords: small breweries, brewery waste, environmental impacts, cumulative effects, aquatic ecosystems, soil ecology, circular bioeconomy

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CULTIVATION PERFORMANCE OF PLEUROTUS OSTREATUS ON LIGNOCELLULOSIC SUBSTRATES SUPPLEMENTED WITH MUNICIPAL SEWAGE SLUDGE

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poster presentation

The reuse of municipal sewage sludge (MSS) in biological production systems represents a promising approach within circular biomass management. In this study, the feasibility of incorporating MSS into lignocellulosic substrates for the cultivation of *Pleurotus ostreatus* was examined. Particular attention was given to mushroom growth response, fruiting potential, and the practical effects of sludge addition on substrate properties.

Substrate mixtures were prepared from oak sawdust, wheat bran, and gypsum, with MSS incorporated at different mass fractions ranging from 15 to 70 wt.%. Following pasteurization and inoculation, cultivation trials were performed in 700 mL glass containers under controlled conditions at 24 °C and 90% relative humidity. Mushroom production was assessed gravimetrically, while growth success was additionally evaluated through qualitative observation of fruiting body development.

The results showed that MSS can be successfully integrated into the cultivation substrate when applied at moderate levels. Additions of 15–30 wt.% promoted successful fruiting and resulted in higher yields than the control substrate without MSS. An important practical outcome was the disappearance of the characteristic persistent sludge odor after fungal colonization, indicating pronounced biological transformation of the substrate. In contrast, substrates containing 50 and 70 wt.% MSS supported colonization but did not produce fruiting bodies under the applied conditions.

Overall, the findings demonstrate that moderate MSS incorporation can improve the performance of *Pleurotus ostreatus* cultivation while contributing to substrate valorization. Although high sludge proportions were unfavorable for fruiting, the observed colonization suggests further potential for non-food or material-oriented applications.

Keywords: *Pleurotus ostreatus*, municipal sewage sludge, lignocellulosic substrates, circular bioeconomy

THE PRODUCTION AND STABILISATION OF COLD-PRESSED WALNUT OIL

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poster presentation

Walnut oil is used for preparing cold dishes and salads. The oil is a rich source of polyunsaturated fatty acids and alpha-linolenic acid (ALA). In this paper, the influence of walnut kernel pressing process parameters on the yield and quality of cold-pressed oil was investigated. During pressing, using a screw press with a thread depth of 8 mm, the following process parameters were varied: the cake outlet extension, the press head temperature, and the electric motor frequency. The basic quality parameters (peroxide number, free fatty acids, moisture content, insoluble impurity content) of the produced cold-pressed walnut oil were examined. The oxidative stability of walnut oil was then examined by adding various antioxidants (natural, synthetic) and synergists, using an oxidation stability test at 63 °C (Schaal Oven test). Based on the obtained results, it can be concluded that the pressing process parameters affect the yield of walnut oil. The basic quality parameters of cold-pressed walnut oil comply with the Ordinance. The results of oxidative stability testing of cold-pressed walnut oil showed that rosemary extract (type Oxy'Less® CS) exhibited the strongest antioxidant effect after 4 days of testing. Sea heather (*Satureja montana*) tea dust extract demonstrated better antioxidant protection of walnut oil compared to willow (*Epilobium angustifolium and Epilobium parviflorum*) and triscot oil (*Polygonum aviculare*).

Keywords: walnut oil, screw press, yield, antioxidants, oil quality

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ANTIOXIDATIVE AND ANTIMICROBIAL POTENTIAL OF BITTER ORANGE *Citrus aurantium* L.

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poster presentation

Bitter orange (*Citrus aurantium* L.) essential oil represents a valuable natural resource with significant antimicrobial and antioxidant properties, offering sustainable solutions for food preservation and agricultural waste reduction. The essential oil, extracted from leaves, ripe and unripe peels through hydro-distillation or supercritical CO_2 extraction, contains bioactive compounds predominantly composed of linalool and limonene, along with oxygenated and hydrocarbon monoterpenes. At 4.67 mg/ml essential oils of leef and unripe peel has minimum inhibitory concentrations (MIC) against pathogenic bacteria as well as the inhibiton of spoilage yeast *Saccharomyces cerevisiae* in orange juice. The antimicrobial activity increases with concentration and demonstrates time-dependent activity, making it suitable for food preservation applications. Additionally, the essential oil displays significant antioxidant capacity, particularly in young leaf extracts rich in ferulic acid, naringin, and naringenin, which contribute to oxidative protection and extended shelf life of food products. The utilization of bitter orange essential oil addresses critical waste management challenges in citrus processing industries, which generate thousands of tons of peel by-products annually. Advanced supercritical extraction technologies enable efficient recovery of bioactive components from agricultural residues, transforming waste materials into high-value natural preservatives. This sustainable approach aligns with circular economy principles, reducing environmental impact while providing safe alternatives to synthetic preservatives. The essential oils' activity against various foodborne pathogens, combined with antioxidant properties, positions them as promising natural preservatives for extending food shelf life and ensuring food safety.

Keywords: *Citrus aurantium*, antimicrobial activity, antioxidant properties, food preservation, waste valorization

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VALORIZATION OF FRUIT PIT FOOD INDUSTRY BY-PRODUCTS: EFFECT OF CARBONIZATION TEMPERATURE ON BIOCHAR YIELD AND FTIR-IDENTIFIED FUNCTIONAL GROUPS

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The increasing generation of agro-industrial waste poses both environmental and economic challenges, highlighting the need for sustainable waste valorization strategies. Fruit processing facilities produce significant amounts of fruit pits as by-products, which are often underutilized despite their high carbon content and potential as precursors for biochar production. Biochar produced from lignocellulosic biomass through carbonization represents a promising value-added material, with its physicochemical properties strongly influenced by process parameters, particularly carbonization temperature. The aim of this study was to investigate the relationship between carbonization conditions, biochar yield, and surface functional groups in order to assess its suitability for further environmental applications. Olive, cherry, and sour cherry pits were subjected to carbonization in a muffle furnace under oxygen-limited conditions at 400, 600, and 800 °C for 1 h. Increasing the carbonization temperature from 400 to 800 °C reduced the biochar yield from 49 to 24% (olive pits), 63 to 24% (cherry pits), and 66 to 24% (sour cherry pits), respectively. FTIR analysis indicated progressive structural changes with increasing carbonization temperature, including the loss of oxygen-containing functional groups and the formation of more condensed aromatic structures. The produced biochar will be further investigated as an adsorbent for the removal of Zn(II) from contaminated water. Such utilization of food industry by-products supports sustainable resource management and aligns with circular economy principles.

Keywords: fruit pits, food industry by-products, carbonization temperature, biochar yield, FTIR analysis

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VALORISATION OF AGROINDUSTRIAL BY-PRODUCTS FOR SUSTAINABLE BIODEGRADABLE AND COMPOSTABLE MATERIALS

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poster presentation

The urgent need to reduce dependence on fossil-based plastics, driven by escalating environmental concerns and increasingly stringent regulatory frameworks, has intensified the search for sustainable material alternatives. In this context, agroindustrial and food processing by-products, such as cereal husks, fruit residues, whey, and oilseed cakes are emerging as promising but still underutilized resources for the development of biodegradable materials. This review outlines current approaches to using side streams in biopolymer blends, with a focus on their role in supporting circular material use within agroindustrial sectors. Biodegradable polymers such as poly(hydroxybutyrate-*co*-valerate) (PHBV), polylactic acid (PLA), polybutylene succinate (PBS), poly(butylene adipate-*co*-terephthalate) (PBAT), and thermoplastic starch (TPS) can be enhanced through the incorporation of natural fillers, including lignocellulosic fibres, starch, chitin, chitosan, and bioactive compounds such as thymol. These natural fillers can improve mechanical and barrier properties while also introducing functionalities like antimicrobial activity. The paper also addresses key challenges, including variability in raw materials, the need for optimized pretreatment, processing efficiency, and ensuring reliable biodegradation under real world conditions. In addition, life cycle assessment (LCA) is highlighted as an important tool in evaluating these materials, particularly when considering trade-offs related to energy-intensive processing. Overall, agroindustrial by-products represent a valuable resource for developing sustainable materials, although further research and technological improvements are needed to fully realize their potential.

Keywords: by-products, biopolymers, natural fillers, life cycle assessment (LCA)

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VEGETABLE CONSUMPTION PATTERNS AMONG UNIVERSITY STUDENTS AND THEIR IMPLICATIONS FOR SUSTAINABLE FOOD SYSTEM TRANSITION

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poster presentation

The transition toward sustainable and circular food systems requires dietary shifts toward increased plant-based foods, particularly among young consumers who will shape future demand. This study aimed to assess vegetable consumption patterns among university students and compare findings with national dietary guidelines and WHO/FAO recommendations. A cross-sectional online survey was conducted among 234 students from 17 faculties of the University of Banja Luka. The questionnaire examined the frequency and portion size of vegetable intake and awareness of dietary guidelines. Data were analyzed using descriptive and inferential statistics. Average daily vegetable intake was 160 g, below the recommended 240 g (three portions) per day according to national guidelines, while WHO/FAO recommend at least 400 g of combined fruits and vegetables daily. Potatoes were most frequently consumed (47.44% more than twice weekly), though not included in these recommendations. Legume consumption varied across types. Beans were the most frequently consumed legume, eaten several times per month, while lentils were rarely consumed (75.64% never consumed them). Peas and green beans were eaten occasionally. These findings suggest legumes are present in student diets but are not a regular part of meals, indicating limited plant-based protein intake. Furthermore, 88.89% of students were unaware of WHO/FAO recommendations. Although 61.54% reported efforts to include vegetables, actual intake remained insufficient. These findings highlight the need for targeted nutrition education and supportive food strategies to encourage higher vegetable and legume consumption. Understanding student dietary behavior may support the development of acceptable plant-based and vegetable-derived products contributing to more sustainable and circular food systems.

Keywords: dietary guidelines, sustainability, vegetables, legumes, students

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ECO-FRIENDLY RECOVERY OF PHENOLICS FROM *Hibiscus sabdariffa* L. HERBAL DUST

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poster presentation

Hibiscus tea is a widely consumed herbal infusion prepared from the dried calyces of *Hibiscus sabdariffa* L., known for its rich content of bioactive compounds and health-promoting properties. During manufacturing, a considerable amount of herbal dust is generated through grinding and sieving of the plant material, and it is often discarded as waste. This study aimed to investigate the potential for valorisation of *Hibiscus sabdariffa* calyces herbal dust by extracting phenolic compounds using two environmentally friendly extraction methods: subcritical fluid extraction (SBFE) and ultrasound-assisted extraction (UAE) with a sonotrode. Three solvents (96 % ethanol, ethanol–water (50:50, v/v), and pure water) were used for the extractions, which were conducted at four temperatures for SBFE (120 °C, 140 °C, 160 °C, and 180 °C) and two extraction periods for UAE (3 and 10 minutes). The Folin-Ciocalteu assay was used to measure total phenolic content (TPC), while high-resolution LC-ESI-QTOF MS/MS was employed for qualitative analysis and HPLC-PDA for quantitative analysis. The results showed that ethanol-water (50:50, v/v) was the most effective solvent for extracting phenolic compounds in both techniques. Among SBFE extracts, the highest TPC was obtained at 140 °C, reaching 1061.43 mg GAE/L. For UAE, extraction time had a negligible effect, as similar TPC values were obtained after 3 and 10 minutes, yielding 1320.00 and 1319.29 mg GAE/L, respectively. The extracts were rich in phenolic acids, including neochlorogenic, chlorogenic, caffeic, and p-coumaric acids, as well as flavonoids such as myricetin and quercetin, which were quantified in all extracts. Overall, the results demonstrate that extraction technique and conditions strongly influence phenolic recovery and highlight hibiscus herbal dust as a promising resource for sustainable by-product valorisation.

Keywords: *Hibiscus sabdariffa*, phenolic compounds, subcritical fluid extraction, ultrasound-assisted extraction, herbal by-product valorisation

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IMPACT OF CHOKEBERRY POMACE ON QUALITY OF FOOD PRODUCTS

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poster presentation

Currently, the reutilisation of food industry waste is a prominent sustainability concept and the subject of extensive research due to global climate change and the accumulation of large quantities of industrial waste. Chokeberry pomace (CP) is a by-product of fruit juice production; however, it contains valuable compounds, particularly dietary fibres and polyphenols. These compounds are recognised for their potential health benefits; therefore, the use of CP as an additive in food products is a highly significant area. CP has most frequently been used as an additive in various bakery and snack products; however, meat and dairy products can also be fortified with it. When food products are enriched with CP in the form of extract, they are mainly supplemented with polyphenols to improve antioxidant and microbiological stability, as well as to modify colour. The dried form of CP provides additional enrichment with dietary fibres. However, it is important to bear in mind that while the addition of CP can enhance food products with dietary fibres and polyphenols, it can also affect the quality characteristics of the products. Changes in sensory characteristics can significantly influence consumer acceptance; therefore, balancing the fortification of foods with these bioactive compounds while maintaining desirable sensory qualities is crucial.

Keywords: chokeberry pomace, polyphenols, dietery fibers, food quality

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FROM WASTE TO VALUE: BIOACTIVE COMPOUNDS FROM MEAT BY-PRODUCTS

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Meat industry by-products represent a valuable yet underutilized source of biological components such as proteins, lipids, and minerals, whose efficient processing plays an important role in the development of sustainable production systems. This paper provides an overview of contemporary approaches for obtaining biopolymers and bioactive peptides from by-products such as skin, bones, blood, and connective tissues. Particular emphasis is placed on biotechnological methods including enzymatic hydrolysis and microbial fermentation, as well as the application of innovative "green" technologies such as high hydrostatic pressure and pulsed electric fields, which enable more efficient and environmentally friendly processing of raw materials. The obtained bioactive peptides exhibit a range of functional properties, including antioxidant, antihypertensive, and antimicrobial activities, making them promising ingredients for the development of functional foods, nutraceuticals, and active packaging systems. Biopolymers such as collagen and gelatin also have broad applications in the food, pharmaceutical, and cosmetic industries. Furthermore, modern analytical and bioinformatics approaches for peptide identification and characterization are presented, allowing a deeper understanding of their structure and biological activity. The integration of advanced technologies and interdisciplinary approaches enables effective valorization of meat industry by-products, contributing to waste reduction, improved resource efficiency, and the development of innovative high value-added products in line with the principles of the circular bioeconomy.

Keywords: meat industry by-products, bioactive peptides, biopolymers, circular bioeconomy, sustainability

LIFE CYCLE ASSESSMENT OF PHB PRODUCTION FROM AGRO-INDUSTRIAL WASTE: LABORATORY INSIGHTS AND SCALE-UP POTENTIAL

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poster presentation

PHB poly(3-hydroxybutyrate), owing to its biogenic origin and intrinsic biodegradability, represents a highly promising candidate for the development of sustainable packaging materials. The experimental process for producing PHB from by-products and waste streams of peas, apples, tomatoes, peppers, and plums—generated during industrial processing—comprises three major stages: acid hydrolysis, submerged fermentation, and solvent-based extraction. The system boundaries are defined with a functional unit of 50 g (FU), whereby a single laboratory batch yields 0.5–1 g of PHB. Preliminary, life cycle assessment (LCA) results at the laboratory scale demonstrate that the dominant source of CO_2 emissions is energy consumption (≈99%), primarily associated with the submerged fermentation stage, with lyophilization contributing the largest share (approximately 50% of total emissions), followed by fermentation itself and acid hydrolysis. A secondary contribution arises from the use of solvents (chloroform and petroleum ether) and the generation of solvent-containing waste in the final extraction step. A coarse estimation indicates that emissions amount to approximately 15.72 kg CO_2e per batch. Although substantial, such emissions are expected for laboratory-scale processes and do not imply that the industrial process would be economically or environmentally unviable. These preliminary findings for PHB production from agro-industrial waste highlight significant opportunities for efficiency improvements during industrial scaling, including the use of renewable electricity, heat recovery from fermentation, partial integration of solar thermal energy, and the application of bio-based solvents, among other strategies aimed at reducing the overall carbon footprint and enhancing process sustainability.

Keywords: PHB, sustainable packaging, agro-food waste, LCA

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IMPACT OF REDESIGNED EXPERIMENTAL COMPOSTABLE PACKAGING ON THE SENSORY ATTRIBUTES OF AN INDUSTRIAL FOOD PRODUCT: BIOPHA-COM FPACK (PHASE II)

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poster presentation

The second phase of evaluating the sensory attributes of a food product (of Cream of Broccoli Soup) packaged and stored in experimental compostable packaging within the BioPHA-ComFPack project consisted of redesigning the best-performing experimental compostable film from the first phase. In Phase II, surface coatings were applied to the selected film in order to improve its barrier properties required for packaging an industrial food product. After three months of storage in the redesigned experimental compostable packaging (Phase II), the sensory quality of both the dehydrated cream soup and the reconstituted, ready-to-consume cream soup was assessed and compared with soup packaged in standard fossil-based packaging. While no significant differences were observed in the dehydrated cream soup, the ready-to-consume cream soup packaged in the 'cast' packaging exhibited a statistically significant change in the overall difference score and in specific sensory attributes, including colour, aroma harmony, and broccoli aroma. In contrast, the cream soup packaged in the 'blown' packaging showed a significant overall difference, but only in the attribute of colour ($p < 0.05$). A comparative assessment of the sensory quality of soup packaged in the 'blown' packaging at months 1 and 3 of storage revealed no significant differences at any temperature, whereas soup packaged in the 'cast' packaging did exhibit significant differences, particularly at 30 °C and 37 °C (Tukey post-hoc test; $p < 0.05$).

Keywords: compostable packaging, food products, sensory attrubutes

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POTENTIAL FOR SUSTAINABLE PROCESSING OF VEGETABLE WASTE INTO FUNCTIONAL SPICE PRODUCTS

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poster presentation

Food waste has become a critical challenge in sustainable development. According to the Food and Agriculture Organization of the United Nations (FAO), 30 – 40 % of all food produced is not fully utilized, with a substantial portion consisting of fruit and vegetable residues. During industrial processing and culinary preparation, parts of plants such as peels, stems, leaves, and pulp are often discarded, despite containing valuable bioactive compounds.

Studies indicate that these by-products are rich in dietary fibers, vitamins, phenolic compounds, and natural aromatic components. For instance, carrot and onion waste is high in polyphenols and fibers, while celery leaves contain significant amounts of antioxidants and essential oils suitable for food flavoring. To preserve these functional properties, appropriate technological processes such as drying, milling, and preservation are essential. Hot air drying at controlled temperatures has been shown to effectively maintain bioactive compounds with minimal aroma loss.

Processing vegetable waste into spice blends represents an innovative approach that contributes to waste reduction, enhances nutritional quality, and creates added economic value. Successful implementation requires addressing challenges related to product stability, microbiological safety, uniformity of composition and flavor, and compliance with food safety regulations.

This study aims to explore the potential of valorizing vegetable waste through technological processes for the production of spice blends and to evaluate the environmental, health, and economic benefits of this approach within sustainable food production.

Keywords: vegetable waste, spice blends, bioactive compounds, sustainable nutrition, technological processes

REGULATORY FRAMEWORK OF THE EUROPEAN UNION AND GUIDELINES FOR THE UTILIZATION OF FOOD INDUSTRY BY-PRODUCTS

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Food industry by-products represent a significant raw material base for the development of the circular bioeconomy, the creation of innovative products, and the transformation of agri-food systems into sustainable and resilient systems. This paper provides an overview of the regulatory framework of the European Union (EU) and the Republic of Croatia (RH), defining the status of by-products as well as the conditions and possibilities for their valorization.
The regulatory framework encompasses a range of horizontal and sector-specific regulations across various domains, including food, feed, cosmetics, pharmaceuticals, medicine, agriculture, energy... Although these are autonomous frameworks, they are interconnected through a shared objective of achieving the highest standards of protection for human health and the environment.
Special attention is also given to strategic documents at both EU and national levels, which recognize by-products as key resources for achieving sustainability goals and reducing environmental burdens. Based on official statistical data, sectoral records, and standard conversion coefficients, a concise overview of the estimated quantities and types of by-products in several sectors in Croatia is provided, with a particular focus on the dairy industry, wine production, and olive oil production.
The possibilities for the valorization of food industry by-products through various technological processes are examined, applying the concept of Technology Readiness Levels (TRL). For effective valorization and utilization of food industry by-products, an interdisciplinary approach is emphasized as essential - integrating the regulatory framework, strategic objectives, scientific research, and industrial practice, and involving all stakeholders connected within the circular bioeconomy.

Keywords: by-products, circular bioeconomy, legislation, EU, RH

APPLICATION OF BUCKWHEAT-DERIVED BIOCHAR MODIFIED WITH $MgCl_2 \cdot 6H_2O$ FOR DICLOFENAC REMOVAL FROM WASTEWATER

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poster presentation

Trace amounts of pharmaceutical compounds persisting in aquatic systems have become an increasing environmental concern due to their potential long-term ecological effects and possible implications on human health. In this work, biochar produced from buckwheat husks (roasted at 220 °C) and chemically modified using magnesium chloride hexahydrate was investigated as a biosorbent for the removal of diclofenac (DCF) from both model solutions and synthetic wastewater. Batch biosorption experiments were performed to assess the influence of several operational parameters, including biosorbent dosage (2–12 g dm^{-3}), contact time (5–360 min), initial pollutant concentration (5–25 mg dm^{-3}), and solution pH (2–12).
The results showed that higher biosorbent dosages improved overall DCF removal efficiency, although the adsorption capacity per unit mass declined. Increasing the initial DCF concentration enhanced adsorption capacity, which can be attributed to a greater mass transfer driving force. Across the studied concentration range, removal efficiencies remained between 59 and 70%, likely due to the progressive occupation of active adsorption sites. The presence of additional constituents in synthetic wastewater reduced removal performance compared to model systems. Desorption studies indicated that ethanol solutions (50–70%) were capable of regenerating the biosorbent, achieving recovery efficiencies of up to 40%.
Equilibrium data were satisfactorily described by both Freundlich and Langmuir isotherm models, while the biosorption process followed pseudo-second-order kinetics. Overall, the findings suggest that biochar derived from buckwheat husks and activated with magnesium chloride hexahydrate represents a sustainable and effective material for removing pharmaceutical contaminants from aqueous environments.

Keywords: diclofenac, biosorption, wastewater, desoprtion

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AMINO ACID COMPOSITION OF PROTEINS FROM BOVINE SKIN AND HOUSE CRICKET: A COMPARATIVE STUDY

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poster presentation

In recent years, global food systems have increasingly emphasized sustainability, efficient resource utilization, and the development of nutritionally enhanced food products. One of the major challenges facing the food industry is the substantial amount of by-products generated during food processing. Many of these by-products still contain considerable amounts of valuable nutrients, including proteins, dietary fibers, minerals, and various bioactive compounds. Rather than being discarded or utilized for low-value applications, these materials can be valorized and incorporated as functional ingredients in the formulation of new food products. Such an approach supports the principles of the circular economy while contributing to more sustainable and efficient food production systems. This comparative study investigates the amino acid composition of three protein sources: one derived from bovine skin, which represents a by-product of the meat industry, and one obtained from the alternative protein source *Acheta domesticus*. The results obtained by HPLC analysis were promising, suggesting that these proteins could be utilized in various food systems.

Keywords: Acheta domesticus, protein, HPLC, amino acid composition

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OPTIMIZATION OF THE EXTRACTION OF ADHERENT EGG WHITE PROTEINS FROM EGGSHELL WASTE

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poster presentation

During the egg-breaking process in industrial plants, a small amount of egg white remains adhered to the inner part of the eggshells and is inevitably lost if the eggshell waste is discarded in landfills. This loss is significant because adherent egg white contains valuable proteins that can be used to produce fine biochemicals. In this regard, we examined the possibility of extracting these proteins from eggshell waste using water as a solvent. Extraction was performed at three different mass-to-volume ratios (1:5, 1:10, and 1:15) over three consecutive 20-minute cycles, with protein content determined every 5 minutes. The results revealed that three consecutive cycles were necessary for the complete extraction of adherent proteins, regardless of the ratio used. However, increasing the mass-to-volume ratio affected both the time needed for complete extraction and the distribution of proteins across the cycles. For complete extraction at a 1:5 ratio, three 20-minute cycles were needed; at 1:10, three 10-minute cycles sufficed; while at 1:15, 3×5 minutes was sufficient. The proportion of proteins recovered in the first cycle increased with the ratio, while it decreased in the second and third cycles. Specifically, the distribution for the 1:5 ratio was 92%, 6.7%, and 0.7%; for 1:10, it was 94%, 5%, and 0.5%; and for 1:15, it reached 95.8%, 3.3%, and 0.1%. Although the results show that a 1:15 ratio enables the fastest extraction, the resulting low protein concentration might pose a challenge for further purification. Therefore, mass-to-volume ratios of 1:5 and 1:10 are preferable for purification purposes, despite the longer extraction time.

Keywords: adherent egg white, eggshell waste, extraction, optimization, proteins

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INFLUENCE OF GRINDING AND PREHYDRATION OF CAROB FLOUR ON DOUGH RHEOLOGY AND BREAD QUALITY

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poster presentation

The aim of this study was to evaluate the effect of different treatments of carob flour on the rheological properties of wheat dough and the quality of bread. Part of wheat flour was replaced with carob flour (15% flour basis), and three formulations were prepared: untreated carob flour (serving as a control), ground carob flour and prehydrated carob flour. For the prehydration treatment, the optimal hydration time was determined to be 15 min, while the amount of water required for hydration was calculated based on the water holding capacity of carob flour (2.65 g/g). Grinding using a laboratory grinder reduced the volume–weighted mean particle diameter D[4,3] of carob flour by approximately 26%. The applied treatments differently affected dough rheology. Farinograph data showed a reduction of dough development time from 5 to 2 min in sample with prehydrated carob flour, while the degree of softening remained similar for all samples. Based on the results obtained using the Kieffer method, both treatments positively influenced dough resistance and extensibility, with prehydration having a stronger effect on resistance, while grinding more effectively enhanced extensibility. Consequently, bread volume increased in both treated samples, with grinding having a greater effect (~12%) compared with prehydration (~6%) relative to the control, while prehydration additionally had a pronounced effect in significantly reducing crumb firmness by 33.5% compared with the control. Sensory evaluation indicated that grinding improved crumb pore fineness, whereas prehydration had a more pronounced positive effect on crumb elasticity. Each treatment exhibited specific effects on distinct bread quality parameters, suggesting that combined application of grinding and prehydration could maximize the overall bread quality attributes.

Keywords: carob flour, particle size, prehydration, dough rheology, bread quality

SOME OF THE PHYSICO-CHEMICAL PROPERTIES OF ISOLATED FIBERS FROM SPELT BRAN

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poster presentation

Spelt bran is a by-product of spelt processing. It contains a certain amount of fibre that can be used as an additive in the production of nutritionally enriched food products. Therefore, the aim of this work was to investigate the process of extracting fibres from bran obtained by processing spelt with the addition of chemical reagents and enzymes, and to determine some of their physicochemical properties, such as colour, fat content, moisture content, dry matter content, and oil and water binding capacity. The fibres were extracted using the method proposed by Han et al. (2018) with minor modifications. The yield obtained with this fibre extraction method was 27.95%. A large difference (>6) is observed in the colour of the extracted fibres from spelt bran compared to spelt bran. Furthermore, the moisture content of the extracted fibres is 90.44%, the mass of the dry matter is 1.456 g and the protein content is 9.40%. The oil and water binding capacity was determined according to the procedure Ariyarathna et al. (2025) with minor modifications and amounts to 7.075 g water/g fibre and 4.5 g oil/g fibre, respectively. According to the results obtained, it can be concluded that the extracted fibre from spelt bran has the potential to enrich the content of food products.

Keywords: fibers, spelled seeds, physico-chemical properties

Acknowledgement: *This research was conducted as part of the project „Development of nutritive enriched spelt based eco-products (Int : 77.03_2104747)" (funded by the European Union).*

WILD ROSEHIP FROM HERZEGOVINA: PHYTOCHEMICAL CHARACTERIZATION AND POTENTIAL APPLICATIONS IN THE FOOD INDUSTRY

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poster presentation

The aim of this study was to determine the phytochemical profile and antioxidant capacity of fresh *Rosa canina* L. fruits collected from four locations in Herzegovina, and to evaluate the effect of drying on fruit composition and quality. Significant differences were observed among locations and drying methods for all analysed physico-chemical parameters. Fresh fruits exhibited high dry matter content (average 54.6%). The highest ascorbic acid content was recorded in fresh fruits from location L1 (112.20 mg/100 g fw), whereas drying reduced its concentration approximately 3.7-fold. Total phenolic content ranged from 1205.45 mg GAE/100 g fw in fresh fruits from location 1 to markedly lower values after drying (approximately 50% reduction). β-carotene content varied from 1.01 to 20.12 mg/100 g fw, with the highest level detected in fresh fruits from location 4, while lycopene ranged from 3.33 to 59.28 mg/100 g fw, with fresh fruits from location 1 showing exceptionally high values. Fresh fruits exhibited the highest antioxidant capacity (ABTS assay), while dried samples retained considerable activity, with significant location-dependent interactions between growing site and drying method. The results confirm that pedo-climatic conditions significantly shape the bioactive profile of rosehip fruits and highlight Herzegovinian rosehip as a valuable functional raw material with high antioxidant potential for food, nutraceutical, and pharmaceutical applications.

Keywords: wild populations, Mediterranean climate, phenolic compounds, antioxidant capacity, drying method

INNOVATIVE AND SUSTAINABLE POSTHARVEST PRESERVATION STRATEGIES FOR EDIBLE AND MEDICINAL MUSHROOMS

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poster presentation

Edible and medicinal mushrooms represent an important component of sustainable food systems due to their high nutritional value, distinctive sensory characteristics and the presence of numerous bioactive compounds. However, their high moisture content (typically above 85–90%) and intense metabolic activity after harvest lead to rapid physiological deterioration, microbial spoilage, and significant postharvest losses. These characteristics limit their shelf life and present challenges for storage, transportation and distribution within modern food supply chains. Conventional preservation methods, including drying, freezing and marination, are commonly used to extend mushroom shelf life. Consequently, increasing research attention has been directed toward the development of innovative postharvest technologies that maintain product quality while reducing food losses and improving sustainability. Emerging approaches such as cold plasma treatment, active and intelligent packaging systems, edible coatings based on natural biopolymers (e.g., chitosan, alginate and starch), antimicrobial photodynamic therapy and electrostatic treatments have shown promising results in inhibiting microbial growth, slowing enzymatic browning and preserving the sensory and nutritional attributes of mushrooms during storage. Within the framework of circular economy principles, the use of biodegradable packaging materials and natural preservatives derived from food industry by-products offers an additional strategy for environmentally responsible preservation. Furthermore, the integration of advanced monitoring and detection technologies enables improved quality assessment throughout storage and distribution. This review highlights recent advances in innovative preservation strategies for edible and medicinal mushrooms and their potential role in supporting sustainable and circular food systems.

Keywords: circular economy, edible and medicinal mushrooms, food loss reduction, innovative food technologies, postharvest preservation

Acknowledgment: This study was supported by the project "Studies of Bioactive Food Components with New Possibilities of Use for Healthy Nutrition and Nutritional Supplements" (BioActFood, NPOO 581-UNIOS-93), funded by the European Union -NextGenerationEU through the Recovery and Resilience Mechanism.

WATER–*D*ES INTERACTIONS GOVERNING STARCH DISSOLUTION AND EXTRACTION FROM POTATO PEEL WASTE

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poster presentation

The transition from fossil-based resources to renewable alternatives is an important step towards more sustainable industrial processes. Biomass has emerged as a promising feedstock for this transition, particularly materials rich in starch. However, efficient extraction of starch from complex biomass sources remains challenging due to structural limitations and limited solubility. Potato peelings, a by-product of the potato processing industry, contain considerable amounts of starch and present an interesting opportunity for valorisation. *Deep* eutectic solvents (*D*ES) have recently attracted attention as alternative solvents for biomass processing due to their tunable physicochemical properties. In particular, the selection of appropriate hydrogen bond acceptors and hydrogen bond donors can significantly influence solvent–solute interactions and promote the dissolution of poorly soluble biopolymers such as starch. In this work, *D*ES composed of generally recognised as safe (GRAS) compounds were investigated. The dissolution behaviour of starch in *D*ES systems was studied to better understand the mechanisms governing starch solubilisation, with particular focus on the role of water through the evaluation of both water-in-*D*ES and *D*ES-in-water regimes. Hansen solubility parameters were used to support the selection of suitable *D*ES compositions. The most promising systems were subsequently applied to the extraction of starch from potato peels, providing further insight into starch–*D*ES interactions and supporting the development of more sustainable extraction strategies.

Keywords: DES, potato peel waste, starch

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STORAGE STABILITY OF APPLE FLOUR GRANULATES FORMULATED WITH HYDROCOLLOIDS AND PROTEIN-BASED BINDERS

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poster presentation

Apple flour granulates structured with selected hydrocolloids (carboxymethyl cellulose, xanthan, guar) and protein-based binders (protein, gelatin) were produced using a fluidized-bed granulation process via top-spray of distilled water through a two-fluid nozzle at 1.8 bar. The binder flow rate ranged from 5 to 10 mL/min, while the air flow rate ranged from 35 to 40 m³/h. The granules were subsequently dried by fluidization at 40 °C for 15 min, during which the air flow rate was reduced to minimize granule disintegration caused by collision and attrition. The storage stability of the obtained formulations was then evaluated over a 12-month period. Physicochemical stability was assessed through instrumental color parameters (L*, a*, b*, chroma C*, and hue angle h°), while microbiological safety was estimated indirectly via water activity (a_w). After 12 months of storage, a slight decrease in L* values were observed, indicating limited non-enzymatic browning, likely associated with slow Maillard reactions and partial oxidation of residual phenolic compounds. However, changes in a*, b*, chroma, and hue angle were minimal across all formulations, suggesting negligible pigment degradation and preservation of the characteristic yellow-brown appearance typical of apple-derived powders. The stability of h° values confirms that no significant shift in the dominant color tone occurred during storage. Water activity increased moderately in all samples over 12 months, reflecting slight moisture adsorption from the environment. Despite this increase, all a_w values remained well below the critical limit for microbial growth (a_w < 0.60), indicating maintained low spoilage risk. Gelatin-containing formulations showed the smallest increase in a_w, suggesting improved moisture-binding capacity compared to polysaccharide-based systems.

Keywords: apple flour granulates, hydrocolloids, storage stability

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Agroproteinka d.d. je hrvatski lider u ekološkom zbrinjavanju nusproizvoda životinjskog podrijetla i biorazgradivog otpada. Poslovanje tvrtke temelji se na kružnom gospodarstvu gdje se nusproizvodi životinjskog i biljnog podrijetla, biorazgradivi otpad te otpadna jestiva ulja pretvaraju u korisne resurse u tri pogona.

Agroproteinka Energija, poznata i kao Biowatt je vodeće bioplinsko postrojenje u Hrvatskoj. Koristeći otpad iz kantina, kuhinja i prehrambene industrije, pretvaramo ga u električnu i toplinsku energiju. Ovo postrojenje koristi isključivo biorazgradivi otpad kao sirovinu, a restorani, kuhinje i druge institucije postaju ključni sudionici u našoj pozitivnoj ekološkoj priči.

Očuvanje prirode odgovornost je koju svakodnevno preuzimamo. U tvornici za kategoriju 1 i 2, SafeVet, prerađujemo opasne nusproizvode za zdravlje ljudi i životinja čime sprječavamo negativne posljedice lošeg gospodarenja otpadom, a sve što uđe pretvaramo u zelenu energiju te na taj način pridonosimo očuvanju okoliša.

Petprotein, naš najstariji pogon koristi nusproizvode i otpade iz klaonica, kosti, dijelove peradi itd., od čega dobivamo tri proizvoda; peradarsko brašno, životinjski protein i životinjsku mast.

Naši stručni timovi su uvijek na raspolaganju veterinarskim službama, farmerima, mesarima, maloprodajnim lancima, restoranima i široj javnosti. Sa sjedištem u Sesvetskom Kraljevcu, tri pogona za preradu i mrežom sabirališta diljem zemlje osiguravamo svježu sirovinu, a naši pogoni zadovoljavaju europske standarde što nas čini konkurentima na tržištu.

Ustrajemo u našoj misiji izgradnje održive budućnosti za sve te kao aktivni članovi zajednice doprinosimo izgradnji boljeg društva kroz razne humanitarne akcije, kulturne manifestacije i podršku sportskim klubovima. Posebnu pažnju posvećujemo najmlađima pružajući im pomoć i podršku.

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