Department of Functional Food Products Development
Wrocław University of Environmental and Life Sciences

PROCEEDINGS OF THE 11TH INTERNATIONAL CONFERENCE ON THE QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN

WROCŁAW
17–18 September
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Wrocław branch of The Polish Food Technologists' Society

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PREFACE

The 11th International Conference on the Quality and Safety in Food Production Chain was organized in Wrocław on 17–18 September 2026 by the Department of Functional Food Products Development with the Wrocław Branch of The Polish Food Technologists' Society (PTTŻ). The event was also a place to celebrate 70th anniversary of the Department, that covers an amazing history of hard and successful research and education in the area of animal products technology, quality and safety, as well as functional foods development and quality management. The Conference shared the program with BRIA Conference, which gave more opportunities to get new information in the area of applied biotechnology in agrifood sector. Our Conference, since 26 years, provides a high level scientific content focusing on the most crucial aspects and new trends in the whole food production chain "from farm to fork" and beyond. It also covers novel solutions in the frame of European Union Green Deal and smart agriculture, that put a special attention to a.o. closed cycle production, zero waste concept and precision farming. All of these aspects should be considered in light of improving functionality, quality and safety of food products, especially in case of climate changes, growing global population, as well as nutrition impacting human health and wellbeing, not to forget about consumer's needs and satisfaction. The Conference is a meeting place for the world class experts, scientists, researchers on each stage, including early stage researchers and food related industry representatives, business, entrepreneurs, analytics, chemicals and equipment providers, and much more, to share the knowledge and experience, as well as to strengthen ongoing cooperation and meet new colleagues to set fruitful contacts for future prospective collaboration to make our wonderful world better and more sustainable. The Conference organized in the year 2026 offered the following scientific and practical sessions:

1. New trends in food technology and packaging systems
2. Innovative food products and nutrition
3. Food analytics
4. Quality and Safety in food production chain in light of climate changes
5. Biotechnological aspects of food production

Moreover, two thematic sessions were organized during the Conference; first related to SUPRIM project „Sieć badawcza uczelni przyrodniczych na rzecz rozwoju polskiego sektora mleczarskiego – projekt badawczy" which focuses on research supporting innovations in milk and dairy sector with the highest respect to secure and safe production in light of climate changes; and second focused on meat science and technology supported by the Meat Technologist Section of The Polish Food Technologists' Society.

The Wrocław University of Environmental and Life Sciences together with The Polish Food Technologists' Society are developing very intensive and high quality research in the modern technologies including novel food, nutraceutical, biomedical products to improve the quality of life. The promotion of activities connected with the quality and safety of food within the whole production chain, participation in many national and european initiatives, close cooperation with researchers, medical and technical experts, industrial partners, entrepreneurs, business as well as logistic and social scientist are also all the time in motion and center of attention.

The organizers of the conference would like to wish all participants fruitful networking, discussions, constructive debates and a wonderful time in Wrocław. Looking forward to meet all of you on the next edition of our event.

dr hab. Małgorzata Korzeniowska, prof. UPWr

Chairman of the Conference Organizing Committee

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CORRELATIONS BETWEEN THE CONTENT OF FREE AMINO ACIDS AND BIOGENIC AMINES AND THE SENSORY EVALUATION OF DRY-AGED BEEF

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Keywords: dry-aged beef; free amino acids; biogenic amines

Abstract: Dry ageing is a meat aging process that enhances the sensory characteristics of beef, particularly flavour development, tenderness, and eating quality. The aim of this study was to determine the correlations between selected sensory attributes, namely palatability and overall acceptability, and the content of free amino acids and biogenic amines in commercially available dry-aged beef. Meat was obtained from 14 domestic companies specialising in dry ageing, in three independent experimental series. The material originated from rib-eye or sirloin primal cuts dry-aged for at least 21 days under producer-specific controlled conditions. For the determination of free amino acids and biogenic amines, one 2-cm-thick steak from each sample was analysed using liquid chromatography coupled with mass spectrometry. The sensory evaluation was carried out under laboratory conditions. Participants were recruited voluntarily from individuals who declared regular steak consumption. Significant negative correlations were found between the content of selected biogenic amines and steaks palatability, particularly for 2-phenylethylamine ($r = -0.59$) and spermidine ($r = -0.42$), indicating their role in shaping the sensory quality of grilled beef. Significant correlations were also observed for selected free amino acids; however, their generally lower coefficients indicate a less pronounced effect on steak palatability than that of biogenic amines.

Funding: This research was funded by the National Science Centre, Poland, grant number 2024/53/B/NZ9/01101.

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OPTIMIZATION OF THE GRINDING DEGREE OF THE VEGETABLE ADDITIVE APPLIED TO POULTRY SAUSAGE

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Keywords: meat products, brewery spent grains, particle size, quality

Abstract: The agrifood side streams valorization is constantly develop and improve chain of technological operations and analytical practices. It can definitively reduce the amount of waste released into the environment, as well as it can be a good source of a valuable component or group of substances in creation of new products. The brewer's spent grains can be successfully added into meat products improving their functionality, nutritional value and sensory properties. The objective of the study was to analyze the effect of the addition of brewer's spent grain of different particle size on the palatability and physicochemical properties of poultry meat sausage. The chicken meat and skin formulation differed in the addition of brewery spent grains (0–15 mg/kg) grounded into three particle sizes (0.2; 0.5 and 0.0 mm). The used brewery spent grains with different granulation was characterized by the particle size and chemical composition. The final cooked and chilled sausages were subjected to color, instrumental texture profile TPA and sensory (5-grade acceptance scale by the trained sensory panel) analyses. The advancement of oxidative changes was analyzed by the TBARS method. The three fractions of spent grain used differed in dry matter, ash, fat, and protein content, while the differences in dietary fiber content were not statistically significant ($p<0.05$). The produced poultry sausages with the addition of brewer's spent grains were well appreciated by sensory panel, while products with the addition of grains with a smaller particle size were characterized by higher desirability. The results of color parameters measured on the cross-section of the sausages showed that a gradual increase of the amount of brewer's spent grain decreased the brightness parameter L* compared to the control. The grinding and fractionation of brewery spent grain affected its basic composition and properties. A gradual increase in the amount of brewer's grain in the ground poultry sausages resulted in changes in the product's texture depending on the particle size of the spent grain used. The addition of spent grain with a particle size below 1.5 mm reduced the springiness, gumminess, chewiness, and cohesion values, while the addition of spent grain with a particle size below 2 mm did not significantly influence these values in relation to the control. In conclusion it can be stated that the addition of brewer's spent grain significantly changes the parameters of the texture of sausages – and the direction of these changes depends on the particle size of the added additive.

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INDICATORS OF THE LIPID PROFILE AND NUTRITIONAL QUALITY OF TWO-STAGE PRESSED RAPESEED OIL AFTER THE LOW-TEMPERATURE BLEACHING PROCESS

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Keywords: rapeseed oil; oil quality; oil pressing; low-temperature bleaching; lipid health indices; nutritional quality

Abstract: The global vegetable oil market plays a crucial role in the agri-food and industrial sectors. Rapeseed oil has gained significant attention due to its favorable fatty acid profile and health-promoting properties. However, limited data exist on the effects of the low-temperature bleaching processes on lipid health indices of two-stage pressed rapeseed oils. The aim of this study was to evaluate the impact of oil production methods (cold-pressed, hot-pressed, and mixed) and bleaching earth addition (1–5%) on the fatty acid profile and lipid health indices of rapeseed oil. Rapeseed oil samples were obtained from a commercial producer using a two-stage pressing system. The fatty acid composition was determined by gas chromatography, and various nutritional quality indices were calculated, including Σ PUFA *n-6*/*n-3*, Σ UFA/Σ SFA, Σ PUFA/Σ SFA, Σ DFA/ Σ OFA, h/H, NVI, AI, TI, and oxidizability indices (UI, PI, OI, Cox, OS). The obtained results were interpreted in the context of clinical studies reported in the scientific literature, in which rapeseed oil consumption or the replacement of SFA-rich fats with rapeseed oil-based fats has been associated with favorable changes in lipid-related cardiometabolic markers. Results demonstrated that the type of pressing method significantly influenced saturated fatty acid content and most lipid health indices, with cold-pressed oil exhibiting the most favorable nutritional profile. The oil production method significantly affected nutritional quality, with cold-pressed oil showing the lowest SFA content and the most favorable Σ UFA/Σ SFA, Σ PUFA/Σ SFA, Σ DFA/Σ OFA, h/H, and NVI values. In contrast, hot-pressed and mixed oils exhibited less advantageous and intermediate profiles, respectively. Across all experimental treatments, lipid health indices remained highly beneficial (Σ PUFA *n-6*/*n-3* = 2.1–2.4; AI ≈ 0.04–0.05; TI ≈ 0.08–0.09), and although oxidizability indices (UI, PI, Cox, OS) indicated a significant T × A interaction, bleaching-related changes were minor and did not materially impair oxidative stability. From a nutrition-science perspective, these findings suggest that low-temperature bleaching can be incorporated into rapeseed oil processing without materially compromising the dietary lipid quality for which rapeseed oil is valued.

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ROLE OF PROBIOTICS, PREBIOTICS, AND BIOACTIVE COMPOUNDS IN INFANT NUTRITION

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Keywords: human milk; infant formula; probiotics; bifidobacteria; lactobacilli; prebiotics; oligosaccharides; food supplements; synbiotic effect; antimicrobials

Abstract: The market for probiotics and prebiotics is growing alongside rising interest in the gut microbiome, with infant formula and food supplements accounting for a significant share. Although the range of probiotics and knowledge of their benefits continues to expand, probiotic strain selection for newborns and infants has clear limitations. It is desirable to target microbial species typical of the infant microbiome with the capacity to utilize or cross-feed human milk oligosaccharides (HMOs). These criteria are primarily met by some specific bifidobacterial species, such as *Bifidobacterium bifidum, B. breve, B. longum* subsp. *infantis*, and *B. longum* subsp. *longum*. In this regard, a specific position with limited functions is held by the commonly applied *B. animalis* subsp. *lactis* and lactobacilli (*Limosilactobacillus reuteri, Li. fermentum, Lacticaseibacillus rhamnosus,* and *La. casei*). More far-reaching developments have occurred in the field of prebiotics. Although infant formula still cannot fully replicate breast milk with its unique HMOs, human-identical milk oligosaccharides (HiMOs) are now commercially available. To date, only a few HiMOs and their combinations in defined amounts have been approved for use in the EU, such as 2'-fucosyllactose (2'-FL), 3'-sialyllactose (3'-SL), lacto-*N*-neotetraose (LNnT), and others. These HiMOs have largely replaced the previously dominant galactooligosaccharides (GOS) and fructooligosaccharides (FOS) used in a 9:1 ratio (8 g/L), whose selectivity was to some extent debatable. Furthermore, breast milk contains bioactive compounds such as lysozyme and lactoferrin, which offer significant antimicrobial potential for application in infant nutrition. When applying these substances and probiotic microbes to the gut microbiota, factors ranging from gestational age, mode of delivery and nutrition to individual health status and gut microbiome need to be considered. The goal is to identify suitable combinations to achieve a synergistic or complementary synbiotic effect, ensuring long-term colonization of the infant gut and ensure health benefits.

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METAL(LOID)S CONTENT, ARSENIC SPECIATION AND DIETARY EXPOSURE ASSESSMENT IN COMMERCIAL FISH AND SEAFOOD BROTHS

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Keywords: food safety, contaminants, minerals, quality, soup, ICP-MS, HPLC-ICP-MS.

Abstract: Commercial fish and seafood broths are widely used for their convenience and culinary value; they are typically made from fishery byproducts such as heads which contributes to the industry's sustainability. However, these byproducts can accumulate high concentrations of metal(loid)s, which may be transferred to the broth during processing. In this context, the objective of this study was to evaluate the metal(loid) content in commercial fish and seafood broths, determine the speciation of arsenic in samples with total As concentrations exceeding 500 ppb, and estimate dietary exposure using the tolerable weekly intake (TWI). Three batches of commercial broths purchased at supermarkets in the provinces of Alicante and the Region of Murcia (Spain) (n=12) were analyzed and classified according to their main ingredient into fish (n=4), seafood (n=4), and mixed broths (n=4). The samples underwent microwave-assisted acid digestion, and the metal(loid)s (As, Cd, Cr, Pb, Ni and Hg) were determined by ICP-MS. As speciation was performed by HPLC-ICP-MS on samples with total As concentrations greater than 500 ppb, allowing for the quantification of inorganic and organic As species. The results showed As concentrations of 416, 394, and 552 ppb in fish, seafood, and mixed broths, respectively. As for Cd, concentrations were 1.91, 18.8, and 5.04 ppb in fish, seafood, and mixed broths, respectively, with significant differences observed between the categories. The organic As fraction accounted for more than 98% of the total As in the analyzed samples. The estimated weekly intake represented up to 66.4%, 46.9%, and 0.60% of the TWI for Cd, Hg, and Pb, respectively, indicating exposure within established reference values. These results provide relevant information on the presence and speciation of metal(loid)s in commercial broths and contribute to the assessment of their food safety and the development of future mitigation strategies.

Funding: This research received no external funding.

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CAN AI KEEP FOOD SAFE? OPPORTUNITIES, CHALLENGES, AND PRACTICAL TOOLS

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Keywords: artificial intelligence; food safety; risk management

Abstract: This presentation explores how artificial intelligence is beginning to shape food safety, from data analysis and predictive tools to decision support and risk management. The talk will highlight practical applications of AI, discuss current limitations and challenges, and consider where these technologies can realistically add value to food safety programs.

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NEGLECTED CROPS IN SUSTAINABLE DIETS: AWARENESS AND ACCEPTANCE AMONG YOUNG ADULTS IN BULGARIA

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Keywords: neglected crops; plant awareness disparity; consumer choices, sustainable diets

Abstract: In middle- and high-income countries, including Europe, malnutrition is often manifested as a chronic deficiency of essential micronutrients (hidden hunger). Hidden hunger may coexist with overweight and obesity, because contemporary food systems provide energy-dense food that does not always supply the necessary amounts of vitamins and minerals. Their insufficient intake has negative effects on the immune system, cognitive development, work capacity and overall population health which results in economic losses, e.g. reduced productivity and increased health-care expenditure. A large proportion of the micronutrients essential to humans are of plant origin: secondary metabolites contained in fruit, vegetables, legumes and cereals. Therefore, good knowledge of edible plant biodiversity is key to healthy diets and sustainable consumer behavior. However, interest in plants is so limited that scientific terms like"plant blindness", and later on "plant awareness disparity" have emerged. They refer to people's tendency to overlook plants and underestimate their importance for life and ecosystems. Diversification of a food diet and increase of plant composition in it is a prerequisite for healthier food choices. Hence, we assess the knowledge of young adults about some neglected food crops we performed an online survey (n=100) from that evaluates how often consumers eat and how familiar they are with foods and beverages produced from neglected crops, such as rye, einkorn, emmer, millet, chickpeas, etc. A relatively high number of respondents stated that they did not recognize or were unfamiliar with the names of certain crops, particularly ancient cereals and underutilized legumes. The data suggest that limited public awareness and insufficient exposure to traditional crops remain significant barriers to their wider acceptance in modern diets; however, specific taste and aroma of some of the products also contributes to consumers' aversion from these products.

Funding: This research was conducted within the framework of the project КП-06-КОСТ/4/21.05.2024 (Bulgarian National Science Fund) and COST Action CA22146 DIVERSICROP.

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NUTRITIONAL QUALITY AND SAFETY OF ANCIENT AND MODERN CEREAL FLOURS: IMPLICATIONS FOR SUSTAINABLE FOOD PRODUCTION

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Keywords: ancient wheat; wholegrain flour; phenolic compounds; pesticide residues; pirimiphos-methyl; functional foods; wheat quality

Abstract Growing consumer demand for wholegrain, clean-label, and health-oriented foods has increased interest in the nutritional and safety characteristics of ancient and modern wheat species. This study compared the chemical composition and pesticide residues of flours obtained from modern wheat (*Triticum aestivum* and *Triticum durum*) and ancient wheat species (*Secale cereale* (rye), *Triticum monococcum* (einkorn), *Triticum dicoccum* (emmer), *Triticum turanicum* (kamut), and *Triticum spelta* (spelt)) to evaluate their suitability for functional food applications and assess potential consumer health risks. Twelve flour samples, including both wholegrain and refined types, were analyzed. Proximate composition (protein, lipids, carbohydrates, dietary fiber, and energy value) and total phenolic content were determined using standard analytical methods, while residues of 184 pesticides were analyzed by GC-MS/MS and LC-MS/MS. Wholegrain flours contained significantly higher levels of dietary fiber, protein, and total phenolic compounds than refined flours, confirming the superior nutritional value of less processed products. Emmer and einkorn flours exhibited the highest total phenolic content, indicating strong antioxidant and bioactive potential. Among the 184 pesticides analyzed, only pirimiphos-methyl, a post-harvest insecticide used for stored grain protection, was detected. Mean concentrations were 0.045 ± 0.023 mg/kg in wholegrain einkorn flour, 0.108 ± 0.054 mg/kg in wholegrain rye flour, and 0.048 ± 0.024 mg/kg in wholegrain kamut flour. All detected concentrations were below the levels considered acceptable according to the European Commission (2011). Nevertheless, minimizing pesticide residues through improved storage and grain management practices remains desirable. These findings demonstrate that both wheat genotype and milling degree significantly influence flour composition, highlighting ancient wholegrain flours, particularly einkorn and emmer, as promising

ingredients for the development of functional foods with enhanced nutritional and bioactive properties while maintaining a satisfactory safety profile.

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FATTY ACID PROFILE OF COMMERCIALLY AVAILABLE DRY-AGED BEEF IN POLAND

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Keywords: dry-aged beef; fatty acids; beef quality

Abstract: Dry-aged beef is a premium meat product valued for its distinctive flavour, tenderness, and sensory quality. Although many studies have focused on the physicochemical and sensory attributes of dry-aged beef, less attention has been paid to the fatty acid profiles of products available in real-world markets. The aim of this study was to characterize the fatty acid profile of commercially available dry-aged beef in Poland and to assess its variability. Beef was obtained from 14 domestic companies specializing in dry ageing, in three independent experimental series. The material originated from rib-eye or sirloin primal cuts dry-aged for at least 21 days under producer-specific controlled conditions. For fatty acid analysis, one 2-cm-thick steak from each sample set was divided into the dried outer layer, referred to as the crust, and the edible interior muscle tissue. The fatty acid profile of beef was determined by gas chromatography with flame ionization detection (GC-FID) after lipid extraction and transesterification to fatty acid methyl esters (FAMEs). Individual fatty acids were identified and quantified using a dedicated chromatographic column and a mixture of certified analytical standards. The fatty acid profile was dominated by saturated (SFA) and monounsaturated (MUFA) fatty acids. SFA accounted for 41.7–54.5%, MUFA for 41.9–54.2%, and polyunsaturated fatty acids (PUFA) for 1.4–5.6% of total identified fatty acids. Oleic acid was the predominant fatty acid, ranging from 33.5 to 42.2%, followed by palmitic acid (9.9–34.0%) and stearic acid (10.5–30.4%). Differences between the crust and interior fractions were observed, though the direction of these differences varied. These findings indicate that dry-aged beef available on the Polish market shows noticeable variability in lipid composition, which should be considered in its nutritional evaluation and quality characterization.

Funding: This research was funded by the National Science Centre, Poland, grant number 2024/53/B/NZ9/01101.

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APPLICATION OF REVERSE OSMOSIS AND DIAFILTRATION FOR WINE DEALCOHOLIZATION: A STUDY ON DRY AND SWEET TOKAJI HÁRSLEVELŰ WINES

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Keywords: wine dealcoholization, membrane processing, reverse osmosis, physicochemical properties, Tokaji Hárslevelű

Abstract: The growing demand for low- and reduced-alcohol beverages has increased interest in membrane-based technologies for wine dealcoholization, offering a non-thermal alternative to conventional alcohol removal methods while helping to preserve product quality. The aim of this study was to evaluate the applicability of reverse osmosis (RO) combined with diafiltration (DF) for the production of reduced-alcohol dry and sweet Tokaji Hárslevelű wines. Experiments were conducted using a reverse osmosis membrane system equipped with an X-20 membrane (TRISEP, USA). Two diafiltration cycles were applied through water addition to the retentate stream. The membrane had an effective filtration area of 0.18 m^2, while the operating pressure, recirculation flow rate, and process temperature were maintained at 20 bar, 500 $L \cdot h^{-1}$, and 22°C, respectively. Process performance and product quality were assessed by measuring permeate flux, alcohol content, total soluble solids, titratable acidity, pH, and total polyphenol content. The initial alcohol content of the dry and sweet wines was 12.5% and 10.5% (v/v), respectively. Following RO-DF treatment, alcohol concentration in the retentate decreased to 1.5% (v/v) for the dry wine and to 5.0% (v/v) for the sweet wine. The final permeate fractions contained 0.0% and 2.5% (v/v) alcohol, respectively. The application of diafiltration improved process stability and contributed to the mitigation of concentration polarization during membrane operation. Changes in physicochemical properties, including titratable acidity and total polyphenol content, were observed during processing, with different trends depending on wine type. The results demonstrate that reverse osmosis coupled with diafiltration can effectively reduce the alcohol content of Tokaji Hárslevelű wines. However, the extent of compositional changes depends on the wine matrix, highlighting the importance of balancing alcohol removal efficiency with the preservation of key quality attributes. These findings

support the potential application of membrane-based dealcoholization technologies in the production of reduced-alcohol wines that meet evolving consumer expectations.

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FREEZE-DRYING AS A STRATEGY TO PRESERVE THE PHYSICOCHEMICAL, ANTIOXIDANT AND TECHNO-FUNCTIONAL PROPERTIES OF WHOLE MAMEY (*POUTERIA SAPOTA*) FOR FUNCTIONAL FOOD APPLICATIONS

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Keywords: *Pouteria sapota*; freeze-drying; tropical fruit; antioxidant activity; techno-functional properties; functional ingredients.

Abstract: Mamey (*Pouteria sapota*) is a tropical fruit rich in carotenoids and phenolic compounds with considerable nutritional and functional value; however, its short postharvest shelf life considerably limits its commercialization. This study evaluated the effect of freeze-drying time (0, 6 and 24 h) on the physicochemical, antioxidant and techno-functional properties of whole mamey to assess its suitability as a sustainable functional food ingredient. Whole frozen mamey cubes were freeze-dried under controlled conditions, and changes in colour (CIELAB coordinates and reflectance spectra), moisture, water activity, proximate composition, antioxidant capacity (DPPH and FRAP), and techno-functional properties were determined using standardized analytical methods. Freeze-drying for 24 h reduced moisture to 9.45% and water activity to 0.395, ensuring microbiological stability while preserving the characteristic carotenoid reflectance profile. Colour remained relatively stable throughout processing, whereas lipid concentration increased due to water removal. Antioxidant activity measured by DPPH decreased during freeze-drying, while FRAP values recovered after 24 h, indicating different responses of antioxidant compounds depending on the reaction mechanism evaluated. The freeze-dried whole-fruit flour exhibited excellent techno-functional performance, particularly high water-holding capacity (4.66 g water/g sample), emulsifying activity (51.67%), and outstanding emulsion stability (98.79%), demonstrating its potential for food formulation. Overall, freeze-drying effectively preserves the technological functionality and a substantial proportion of the bioactive properties of whole mamey while producing a stable, value-added ingredient. These findings support the use of freeze-dried whole mamey as a promising natural ingredient for the development of

innovative functional foods and contribute to the valorization of tropical fruits with limited commercial shelf life.

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QUALITY–ENERGY OPTIMIZATION OF PILOT-SCALE CONTINUOUS FREEZE-DRYING FOR HIGH-ACCEPTABILITY STRAWBERRY SNACKS

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Keywords: continuous freeze-drying; strawberry snack; response surface methodology; energy consumption; bioactive compounds; sensory quality; optimization

Abstract: Freeze-drying is highly valued for producing premium dried fruit products with good retention of structure, color, flavor, and bioactive compounds. However, industrial application of conventional batch freeze-drying is limited by long processing time, low throughput, and high energy demand. This study evaluated, for the first time, the performance of a pilot-scale continuous freeze dryer for producing strawberry slice snacks with reduced specific energy consumption, preserved physicochemical quality, and high sensory acceptability. Strawberry slices were dried using a pilot-scale continuous freeze dryer (Hartimex, Warsaw, Poland) under different residence times (18–30 h) and shelf temperatures (56–85 °C). The effects of drying conditions on final moisture content, water activity, color change, specific energy consumption, phenolic compounds, antioxidant capacity, volatile compounds, texture, and sensory acceptability were evaluated. Response surface methodology and multi-response desirability optimization were applied to identify the best quality–energy compromise. Drying conditions strongly influenced both product quality and process efficiency. Specific energy consumption ranged from 5.34 to 8.25 MJ/kg water, with drying duration showing the strongest effect on energy demand. Increasing shelf temperature enhanced moisture removal and reduced water activity, but excessive temperatures (80–85 °C) increased brittleness and promoted color deterioration, losses of phenolic compounds and aroma-related volatiles, and reduced sensory acceptability. Mild-to-moderate drying conditions (particularly 24 h – 56 °C, 20 h – 60 °C, and 28 h – 60

°C) better preserved phenolic profile, antioxidant capacity, aroma quality, and sensory acceptability. Multi-response optimization identified an optimal operating point at 18.7 h and 66.6 °C, with predicted final moisture content of 6.0%, water activity of 0.316, specific energy consumption of 5.34 MJ/kg water, total quantified phenolic compounds of 980.66 mg/100 g d.m., ABTS and FRAP antioxidant capacities of 3.84 and 7.26 mmol Trolox/100 g d.m., respectively, aroma-related volatile compounds of 75.86 μg/g d.m., sensory acceptability of 7.75, and desirability of 0.70.

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EFFECTS OF RADIO FREQUENCY PROCESSING OF SESAME SEEDS ON MICROBIAL INACTIVATION, DNA DAMAGE, MEMBRANE INTEGRITY, AND COLOR STABILITY

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Keywords: Low-moisture foods; radio frequency heating; foodborne pathogens.

Abstract: Low-moisture foods, such as sesame seeds, can serve as vehicles for foodborne pathogens because microorganisms can survive for extended periods under low water activity (a_w) conditions despite limited growth. In addition, reduced a_w enhances microbial resistance to thermal treatments, making decontamination challenging. Radio frequency (RF) heating has emerged as a promising technology for the treatment of low-moisture foods due to its rapid volumetric heating characteristics. Therefore, this study evaluated the inactivation of *Listeria monocytogenes* and *Salmonella* Typhimurium inoculated in sesame seeds during RF processing and investigated associated sublethal injury, DNA damage, membrane integrity, and color changes. Inoculated sesame seeds were treated using a lab-scale RF system operating at 27.12 MHz. Microbial populations were enumerated to determine inactivation kinetics, while sublethally injured cells were quantified using selective and non-selective media. DNA damage was assessed through changes in qPCR threshold cycle (Ct) values, membrane integrity was evaluated using fluorescence staining with SYTO 9 and propidium iodide, and color changes were determined using the CIE Lab* color system. Approximately 6 log CFU/g reductions were achieved after 25 min and 40 min of RF treatment with a final temperature of about 100 °C for *L. monocytogenes* and *S.* Typhimurium, respectively. Sublethally injured *L. monocytogenes* cells represented approximately 20% of the surviving population before declining to undetectable levels after 20 min. In contrast, sublethal injury in *S.* Typhimurium was observed only during the first 5 min. Increased Ct values indicated DNA damage in both microorganisms, with a greater effect observed for *S.* Typhimurium. Similar reductions in fluorescence ratios suggested membrane disruption. Color changes increased with treatment time, with a noticeable overall color difference after 20 min of RF exposure. Overall, RF processing effectively re-

duced foodborne pathogens in sesame seeds, although the enhanced thermal resistance associated with low a_w required prolonged treatment times and elevated temperatures.

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A NEW METHODOLOGICAL APPROACH TO ANALYZING THE PHYSICAL PROPERTIES OF POWDERED DAIRY PRODUCTS

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Keywords: whey permeate; caking behavior; micro-CT; lactose recrystallization

Abstract: The physical properties of powdered dairy products are determined by logistics processes, which lead to unfavorable changes within the individual particles that make up the bulk. These changes lead, among other things, to caking. Whey permeate powders (WPPs) are dairy products particularly susceptible to this process. Caking represents a critical stability challenge for WPPs, frequently developing during storage and handling due to moisture-driven structural transformations within the powder bed. The aim of the study was to determine the basic physical properties of WPPs in the context of caking, taking into account a new methodological approach using X-ray micro-computed tomography (micro-CT). This study investigated the physical, morphological, and microstructural characteristics associated with caking in a limited set of industrial WPPs. Five commercial WPP samples differing in production date and storage conditions were characterized in terms of dry matter content, water activity (*aw*), particle size distribution (PSD), bulk density, porosity, color, and micro-CT attributes. The results revealed that dry matter contents were similar among samples (97.74–98.20% w.b.); however, significant differences were observed in aw, bulk density, porosity, and PSD between the caked sample (WPP2) and the free-flowing powders. WPP2 exhibited the highest *aw* (0.261), the lowest bulk density (676 kg/m3), the highest porosity (0.569), and a distinctly coarser PSD. In addition, WPP2 showed the highest yellowness index (44.45), suggesting altered light-scattering behavior associated with structural changes. Micro-CT analysis revealed the presence of enlarged particle clusters and extensive particle–particle solid bridging in WPP2, accompanied by a heterogeneous pore distribution and reduced void connectivity, indicating consolidation

of the powder bed. The study demonstrated the applicability of micro-CT as a powerful tool for the qualitative and quantitative characterization of powder microstructure.

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THE TROJAN HORSE EFFECT: MICROPLASTICS AS VECTORS FOR HEAVY METAL IN THE FOOD CHAIN

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Keywords: food; heavy metal; health; microplastic; sustainable agriculture

Abstract: Heavy metals (HMs) and microplastics (MPs) are two most threating contaminants of food. The existence of MPs and HMs in environment has raised concerns as their release into the aquatic and terrestrial environment can get easily accumulated via trophic transfer into food chain thereby adversely affecting human health. However, MPs are considered to be efficient carriers of HMs owing to their larger surface area, functional groups and enhanced hydrophobicity which facilitate their bioavailability and adsorption in food. Co-contamination of MPs and HMs in soil can alter soil physiochemical properties, hamper soil microbiota and impair soil ecological harmony eventually affecting crop health and productivity. MPs and HMs co-toxicity leads to overproduction of ROS and plummets antioxidant activities leading to loss of cell wall integrity and reduced growth, biomass. Therefore, several approaches have been explored to minimize HM and MP accumulation in essential cereal crops and aquatic organisms and inhibit transfer into food chain. However, there is a lack of comprehensive review regarding the sustainable strategies employed till date which can reduce potential environmental risks.

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ENZYMATIC MODIFICATION AND ULTRASOUND TREATMENT TO ENHANCE THE BIOACTIVE PROPERTIES AND IMPROVE THE QUALITY OF EGG YOLK

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Keywords: egg yolk safety and quality; enzymatic modification; ultrasound; bioactivity

Abstract: Proteolysis of egg yolk proteins was performed to enhance bioactive properties (antihypertensive ACE, antioxidant AO, and antidiabetic AD) and to improve the emulsifying and gelling properties of the yolk through the action of phospholipase or transglutaminase. The goal of ultrasonic treatment (US) was to lower the pasteurization temperature by 2°C. The raw material for small-scale (1000 kg) and industrial-scale (4000 kg) studies was liquid yolk (eggs from caged and free-range hens) treated with Protamex protease-YP (45', 55°C) or YTGA transglutaminase (30–50°C); and/or phospholipase 2-YPhos, (4 h,45°C), compared with the control YCon. The yolks were then ultrasonics treated (20 kHz,20') or not, pasteurized at 66 or 68°C, and stored refrigerated for 42 days. Chemical composition, fatty acid and volatile compound profile (GC/MS), TBARS oxidation, AO (ABTS radical), ACE (angiotensin-converting enzyme inhibition), AD (glucosidase inhibition) and technological properties: emulsion stabilitySE, sponge cake volumeV, gel strength, and microbial counts, were analyzed. ANOVA was used to analyze the results. The gel strength for YTGA was higher (12.3 N) than for the other yolks (10.2 N). The ES of YPhos was higher than other egg yolks (94% YPhos vs. 81–84%). Lowering the pasteurization temperature to 66°C and treating with US increased the gel strength, SE, and V of the dough. TBARS in YP egg yolks after ultrasonic treatment decreased (from 17 to 9 mg/kg), as did the amount of oxidized volatile compounds. The amount of free amino acids increased only by 2–3% but biological activity (AO, ACE, AD) increased at least two-fold. In the industrial experiment, enzymatic treatment and ultrasound reduced the number of microbes in egg yolk by at least 1 log. Enzymatic modification of egg yolk and ultrasound increase the bioactive properties and microbiological safety of the final product.

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DRY-AGED BEEF MICROBIOTA AS A DETERMINANT OF BIOGENIC AMINE CONTENT

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Keywords: dry-aged beef; biogenic amines; microbial counts; correlation analysis; Enterobacteriaceae; *Pseudomonas*

Abstract: Dry-aged beef is a premium meat product valued for its distinctive sensory qualities; however, ageing may lead to microbiological changes that affect its quality and safety. One important indicator of these changes is the content of biogenic amines (BAs), and their accumulation may be associated with the abundance of specific microbial groups. This study aimed to evaluate the relationships between selected microbial groups and biogenic amine content in the crust and interior of dry-aged beef. The raw material consisted of rib-eye or sirloin primal cuts dry-aged for at least 21 days under producer-specific controlled conditions. Meat was obtained from 14 domestic companies specializing in dry ageing, in three independent experimental series. Correlation analysis was performed for the counts of total mesophilic aerobic bacteria, psychrotrophic bacteria, lactic acid bacteria, Enterobacteriaceae, yeasts and moulds, *Brochothrix thermosphacta*, and *Pseudomonas* spp. in relation to the levels of histamine, cadaverine, putrescine, tyramine, agmatine, 2-phenylethylamine, tryptamine, spermine, spermidine, and the biogenic amines index in both product fractions. The strongest positive correlations were observed between the Enterobacteriaceae count and the levels of several biogenic amines, particularly in the interior, where correlation coefficients reached r=0.67 for putrescine, r=0.58 for tryptamine, and r=0.54 for 2-phenylethylamine. A clear positive relationship was found for *Pseudomonas* spp. count and agmatine level, both in the interior (r=0.51) and crust (r=0.61). The counts of yeasts and moulds were positively correlated with the levels of several amines, including histamine and agmatine. In contrast, total mesophilic aerobic, psychrotrophic, and lactic acid bacteria showed weaker and less consistent relationships. Based on the results obtained, it could be concluded that the microbiological profile of dry-aged beef is associated with biogenic amine formation, and the crust and interior may differ in the strength and direction of these relationships.

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ASSESSMENT OF NITRATE (V) CONTENT IN READY-TO-EAT INFANT MEALS AND CEREAL PRODUCTS FOR CHILDREN AVAILABLE ON THE POLISH MARKET – PILOT STUDY

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Keywords: nitrates (V); infant meals; cereal snacks

Abstract: Infants and young children are particularly vulnerable to excessive nitrate exposure. Although nitrates themselves are relatively low-toxic compounds, their reduction to nitrites may contribute to methemoglobinemia in infants and facilitate the nitrosation of biogenic amines, leading to the formation of potentially carcinogenic N-nitroso compounds. Moreover, excessive nitrate concentrations may adversely affect the nutritional quality of food by contributing to the degradation of selected vitamins, particularly vitamin A, provitamin A carotenoids, and B-group vitamins, and by impairing the utilisation of proteins and lipids. Therefore, the present study assessed nitrate (V) concentrations in selected ready-to-eat infant meals and cereal-based products intended for young children available on the Polish market. Findings were compared against the maximum permissible limit of 200 mg NO_3^-/kg, established by Commission Regulation (EU) 2023/915 of 25 April 2023 on maximum levels for certain contaminants in food. A total of 22 ready-to-eat meals and 36 cereal products (flakes, snacks, and biscuits) were analyzed. The analysis was conducted using a rapid reflectometric method with the RQflex® 20 reflectometer and dedicated Reflectoquant® test strips; results were subjected to ANOVA and Tukey's test ($p \leq 0.05$). Nitrate concentrations in infant meals ranged from 105.21 to 307.25 mg/kg, with 36% of products (8 out of 22) exceeding the legal limit. The highest concentration was found in a chicken and spinach dish, while the lowest occurred in a green pea, broccoli, and zucchini meal; notably, complex multi-ingredient dishes and soups contained significantly higher nitrate levels than simple vegetable purees. Regarding cereal products, exceedances of the 200 mg NO_3^-/kg threshold were observed in 8 of 15 cereal snacks. The highest nitrate concentration, 489.16 mg NO_3^-/kg, was recorded in organic corn puffs containing 3.9% dried carrot. Elevated concentrations were also found in multigrain snacks with carrot (403.70 mg NO_3^-/kg), fruit-flavoured corn balls (309.14 mg NO_3^-/kg), wheat–oat snacks containing tomato and carrot (293.94 mg NO_3^-/kg), and corn–millet snacks with apple and banana (284.49 mg NO_3^-/kg). These findings underscore the necessity for systematic moni-

toring of raw material quality and the rigorous selection of botanical ingredients in the production of food for the youngest consumers to ensure toxicological safety and compliance with EU regulations.

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FROM MONITORING TO MITIGATION: ESTABLISHING ALBANIA'S FIRST NATIONAL STRATEGY FOR ACRYLAMIDE CONTROL IN BAKERY PRODUCTS

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Keywords: acrylamide; bakery products; food safety; ELISA; LC-MS/MS; mitigation strategies; sensory evaluation; Albania

Abstract: Acrylamide is a process contaminant formed during the thermal processing of carbohydrate-rich foods through the Maillard reaction and is classified by the International Agency for Research on Cancer (IARC) as a probable human carcinogen. Although Commission Regulation (EU) 2017/2158 establishes mitigation measures and benchmark levels, Albania currently lacks systematic monitoring data on acrylamide occurrence in food products. This study presents the first national initiative to establish an integrated monitoring and mitigation framework for acrylamide in Albanian bakery products. A nationwide sampling campaign will include industrial and artisanal bread, cakes, and croissants collected from different regions of the country. Acrylamide concentrations will be determined using a dual analytical approach based on ELISA screening and LC-MS/MS confirmation. In parallel, controlled baking trials will investigate the influence of baking temperature, baking time, dough pH, and L-asparaginase application on acrylamide formation. The effectiveness of mitigation strategies will be assessed through both chemical analyses and sensory evaluation to ensure that product quality and consumer acceptance are maintained. The study is expected to generate the first national database on acrylamide occurrence in bakery products in Albania, identify critical technological factors affecting acrylamide formation, and evaluate the suitability of ELISA as a cost-effective screening tool for routine monitoring. The findings will provide evidence-based recommendations for the bakery industry, strengthen national analytical capacity, support alignment with European food safety legislation, and offer a transferable framework for process contaminant monitoring in other Western Balkan countries where similar surveillance systems remain underdeveloped.

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GELLING PROTEINS OBTAINED FROM BONE RESIDUE USING THERMAL METHOD AND THEIR IMPACT ON THE QUALITY AND SHELF LIFE OF PROCESSED MEAT PRODUCTS

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Keywords: gelling protein; bone residue; meat substitution; shelf life

Abstract: The aim of the study was to obtain gelling protein (GP) by thermal extraction (121°C) of collagen/gelatin and other proteins from pork bone residues – a by-product of the mechanical meat separation process, and to use GP as a meat substitute in processed products.

Bone residues were washed with 4% NaCl, KCl, and KCl and $MgCl_2$ solutions (1:1) to extract remaining myofibrillar and sarcoplasmic proteins and then separated using a belt separator. Next, thermohydrolysis of the bone residues was performed in a reactor (121°C – 30'). The studies were conducted on a small (1200 kg) and large scale (up to 4800 kg) of raw material. Meat protein in the model products was replaced with GP at 7.5% of the total protein in small scale experiments (50–250 kg) or 4 and 8% in large scale experiments (2200–2600 kg).

Total (Np) and non-protein nitrogen (Nn), collagen, fat, and ash using chemical methods or IRFoodScan, metals using AAS, amino acid profileAA accord. AOAC, total microbial count(CFU) and gel strength(GS) were analyzed.

The yield of GP in the small-scale process was 7.6 kg dw/100 kg of bone residue, with a protein content of 9.1%. The degree of thermohydrolysis (Nn/Np*100) of collagen reached 20%, and the gel strength was 183 g/s. Replacing 7.5% of the protein with GP in meat products reduced OLD by 1–2 log cycles and exogen. AA by less than 2%. K and Mg salts present in GP increased their content in meat products for nutritional claims. On an industrial scale, 7.2 kg of GP (dw)/100 kg of bone residue was obtained. Replacing meat with GP in smoked pork neck reduced of CFU number by 3 log cycles. In conclusion, thermohydrolysis of bone residue is an effective method for obtaining gelling proteins intended for meat replacement.

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HYBRID MEAT PRODUCTS – OPPORTUNITIES AND CHALLENGES FOR THE MEAT INDUSTRY

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Keywords: hybrid meat product, nutritional values, plant ingredients, plant protein

Abstract: With growing interest in sustainability, consumer health, and animal welfare, the food industry is faced with the need to adapt to changing market preferences. One innovative solution that is gaining increasing popularity is hybrid meat products. These combine meat with plant-based components or other non-animal protein sources, offering a compromise between traditional meat and its plant-based or cultured alternatives. According to an unofficial definition, hybrid meat products combine meat with plant-based ingredients in varying proportions, from approximately 25% to approximately 50%. By retaining a significant proportion of meat, hybrid products significantly better demonstrate the sensory attributes of conventional meat products compared to their plant-based counterparts. Such products provide a health-promoting properties (such as fiber, vitamins, minerals), which can result in products with functional properties. However, the addition of plant proteins to the formulation of hybrid meat products has been shown to introduce more complex protein-protein interactions, which can affect myosin gelation and alter gel structure. This, in turn, can consequently affect physicochemical characteristics such as texture. It is also clear that the composition of plant proteins contributes to the differential effects on texture of hybrid meat products. There has been a significant increase in research on innovative hybrid meat products (e.g. burgers, sausages, nuggets) made from various plant-based ingredients (including legume flours, textured proteins, protein isolates, by-products of the food industry). Hybrid meat products represent a real opportunity for the meat industry to adapt to a new market reality, where sustainability, health, and ethics are gaining importance. Despite significant technological and market challenges, the potential of this segment is significant, and its further development could play a key role in the transformation of the food sector. Hybrid products can represent a practical option that meets the needs of a growing group of consumers preferring a flexitarian diet. Available data shows that the flexitarian population in Europe is constantly growing; women and older people, primarily those with higher education, dominate the group of people limiting meat consumption. Furthermore, research shows that people who are aware of the impact of diet on health and want to reduce their meat consumption are reluctant to buy plant-based al-

ternatives to animal-based foods. This is due to unsatisfactory taste, lack of variety, and excessive price. Moreover, plant-based meat alternatives are not, in and of themselves, a healthier alternative to con-sciously consuming meat and meat products due to their nutritional value. Such products are often low in essential nutrients such as vitamins and essential amino acids (sulfur amino acids or lysine). Moreover, the fact that most of meat analogues are produced under heavy processing manufacture makes it limiting the environmental sustainability gain. In this context, hybrid meat products are emerging as an alternative to traditional meat products.

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FORMULATION OF FUNCTIONAL FOOD COMPOSITIONS BASED ON OAT FLAKES, FLAXSEED PRESS CAKE, AND HEMP PRESS CAKE USING CONSUMER RESEARCH

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Keywords: oat flakes; flaxseed press cake; hemp press cake; functional foods; breakfast cereals; antioxidant activity; dietary fiber; consumer acceptability

Abstract: The aim of this study was to develop functional breakfast cereal formulations based on oat flakes enriched with flaxseed and hemp press cakes, and to evaluate their nutritional value, antioxidant activity, and consumer acceptability. Fifteen formulations differing in the proportion of press cakes and the addition of freeze-dried fruits (apple, strawberry, banana, or cranberry) were prepared. Three levels of press cake incorporation were applied: 10% (7.5% flaxseed and 2.5% hemp press cake), 15% flaxseed press cake, and 20% flaxseed press cake. Proximate composition, total polyphenol content, and antioxidant activity (DPPH, FRAP, and ABTS assays) were determined, while consumer acceptability was assessed in a sensory study involving participants.

The formulations exhibited high nutritional value, with protein, fat, and dietary fiber contents reaching 20.58, 12.77, and 19.07 g/100 g, respectively. Increasing the proportion of flaxseed press cake resulted in higher protein, fat, ash, and dietary fiber contents, accompanied by a reduction in starch content. The highest total polyphenol content (129.18 mg GAE/100 g) and the strongest antioxidant activity measured by the FRAP (11.87 μmol Trolox equivalents/g) and ABTS (8.97 μmol Trolox equivalents/g) assays were observed in the formulation containing 20% flaxseed press cake with cranberry.

Most formulations achieved good consumer acceptability. The highest overall ratings were obtained for the formulations containing 10% mixed press cakes with strawberry and 15% flaxseed press cake with banana, whereas the formulation containing 20% flaxseed press cake with cranberry received the lowest scores due to its less preferred taste. These findings demonstrate that oat-based breakfast cereals enriched with flaxseed and hemp press cakes can provide high nutritional value and antioxidant potential while maintaining good consumer acceptance.

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SCREENING OF APPLE CULTIVARS FOR THE PRODUCTION OF FUNCTIONAL APPLE POMACE POWDER FOR COOKED POULTRY SAUSAGES

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Keywords: by-product; apple pomace; total dietary fiber; antioxidant activity; functional food product

Abstract: Apple pomace, a by-product of juice processing, is a promising functional ingredient for meat product development because of its high levels of dietary fiber and bioactive compounds. This study aimed to evaluate and select the most suitable apple pomace variety for producing a functional powder for use in cooked poultry sausages. Several Malus domestica cultivars (Aport, Renet Simirenko, Idared, Saltanat, Amerikanka, Golden Delicious, and Gala) were analyzed for their physicochemical and functional properties, including protein content, moisture, ash, pH, total dietary fiber (TDF), and antioxidant activity (DPPH, ABTS, FRAP). The results showed significant variation across the samples. The Renet Simirenko variety had the highest protein content (3.50%) and total dietary fiber (34.48%), along with a relatively low pH (3.30) and high antioxidant activity (DPPH=1.93 mMTrolox/g, ABTS=106.10 mMTrolox-/g, FRAP=24.07 mMFe2+/kg), indicating strong structural and functional potential. Saltanat exhibited the highest radical-scavenging activity (DPPH = 2.76 mMTrolox/g) and high ABTS values (114.25 mMTrolox/g), while Amerikanka showed high TDF (31.44%) and strong reducing power (FRAP=29.61 mMFe2+/kg). In contrast, Idaret had the lowest antioxidant activity (ABTS=88.48 mMTrolox/g), and Gala had the highest moisture content (11.07%), which may negatively affect storage stability. Overall, the findings indicate that Renet Simirenko offers the most balanced combination of technological and functional properties, making it the most suitable candidate for further application in meat systems. Saltanat and Amerikanka may serve as alternative ingredients depending on the targeted functionality, such as enhanced antioxidant protection or increased fiber content. These results provide a scientific basis for optimizing the formulation and dosage of apple pomace powder in cooked poultry sausage production.

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MODULATION OF OVALBUMIN IMMUNOREACTIVITY BY ENZYMATIC HYDROLYSIS: THE EFFECT OF *CUCURBITA FICIFOLIA* PROTEASE ACTIVITY

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Keywords: allergy, egg proteins, immunoreactivity reduction, enzymatic hydrolysis, non-commercial enzyme

Abstract: Allergy to chicken egg white is one of the most common food allergies detected among children and may involve IgE-mediated hypersensitivity reactions. Ovalbumin (OVA), the major egg white protein, is an important allergenic component and a target for strategies aimed at reducing protein immunoreactivity. Enzymatic hydrolysis (EH) changes protein structure potentially modifying antibody recognition and at the same time may generate peptides with functional properties. The aim of this study was to investigate the effect of EH of OVA using a plant protease isolated from *Cucurbita ficifolia* and commercial *Alcalase* on immunoreactivity and selected functional properties of OVA hydrolyzates. The substrate solution (1% OVA) was hydrolyzed using *C. ficifolia* protease at 50, 150 and 300 U/ml for up to 24 h and *Alcalase* at 25, 50 and 100 U/ml for up to 4 h at 37°C. The degree of hydrolysis (DH) was determined based on free amino groups. Immunoreactivity was assessed using the Egg Free Test immunochromatographic assay with a 3PR Mini reader (2–64 ppm), while antioxidant properties were evaluated using FRAP and ABTS assays. The *C. ficifolia* protease exhibited higher proteolytic efficiency toward OVA than *Alcalase*, with the highest DH (11.90%) obtained after 24 h at the dose of 300 U/ml. At the same time this hydrolysate exhibited the lowest immunoreactivity. Following 500–fold dilution, the immunoreactive signal was 2.06 ppm, compared with >64 ppm for native OVA. Most of the hydrolysates remained above the upper detection limit, indicating that extensive proteolysis was required to obtain a measurable reduction in immunoreactivity. The plant-derived protease also generated a more diverse peptide profile, suggesting that immunoreactive properties depended not only on the extent of hydrolysis but also on protease specificity. In contrast, *Alcalase* hydrolysates exhibited higher antioxidant activity, with the most pronounced effects observed in selected FRAP and ABTS assays. The EH modified both the immunoreactive and functional properties of OVA. *C. ficifolia* protease showed better potential for reducing OVA immunoreactivity, whereas *Alcalase* promoted the generation of hydrolysates with higher antioxidant activity. These findings highlight the potential of selecting proteases and hydrolysis conditions to tailor the biological properties of egg protein hydrolysates and support further investigation of plant-derived proteases for the development of food ingredients with reduced immunoreactivity and added functional value.

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MEAT QUALITY AND GROWTH PERFORMANCE IN CHICKENS AND PIGLETS DEPENDING ON THE FEEDING OF BLOOD PLASMA PREPARATIONS WITH INCREASED IMMUNOGLOBULIN IGY LEVELS

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Keywords: meat quality; immunoglobulin Y; poultry blood plasma; chicken and piglets feeding

Abstract: The aim of the research was to achieve high-quality meat and growth performance in chickens and piglets fed with IgY-rich blood plasma obtained during poultry slaughter. The experiments were conducted on a small-scale and industrial scale. Using the salting-out method combined with the membrane technique, plasma preparations with 24–61% IgY activity were obtained. The preparations were fed to chickens for 35 days at 1 or 2 g IgY /kg feed (small-scale experiment). In the industrial experiment (42 days of feeding), chicken and turkey plasma preparations with app. 20% or 40% IgY and a feed level of 1 g IgY/kg were used, or in the feeding of suckling and weaned piglets (60% IgY,2g/kg). The chickens were slaughtered after the production period, and breast muscles were collected for testing. The following were analyzed: IgY activity using radial immunodiffusion; growth rates of poultry and piglets; post-mortem pH (15min.,24 h); slaughter yield; meat color, texture and thermal drip as well as content of histidine dipeptides and taurine using HPLC. It was shown that feeding chickens 15–35 days of age with the grower formula resulted in a significant increase in chicken weight (even at 1g IgY/kg); but without changes in postslaughter yield. Feeding with an IgY at a level of 2g IgY/kg(ca20%IgY) was beneficial, reducing shear force and thermal drip from meat and maintaining high dipeptide and taurine levels. In a large-scale experiment, while improving chicken production indices, thermal drip from meat also decreased. For piglets, there was an approximately 10% improvement in production indicators and a significant reduction in mortality.

Conclusion: The use of poultry blood products with increased IgY levels in nutrition improves growth performance in chickens and piglets, as well as the quality of chicken meat.

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EFFECT OF A1 AND A2 MILK ON INFLAMMATION IN APOE/LDLR /- MICE

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Keywords: A1 and A2 milk, inflammation, animal study

Abstract: Diet is one of the major factors modifying the risk of atherosclerosis. Milk β-casein consists of 209 amino acids and occurs mainly in two variants, A1 and A2. These variants differ by a single amino acid at position 67: histidine is present in A1 β-casein, whereas proline is present in A2 β-casein. In the small intestine, A1 β-casein can be cleaved by digestive enzymes, resulting in the release of the peptide β-casomorphin-7 (BCM-7). In contrast, the proline residue at position 67 in A2 β-casein limits this cleavage, thereby reducing the potential release of BCM-7. A1 milk is therefore considered a rich dietary source of β-casomorphin-7, which can interact with μ-opioid receptors (MOR) in the body. Consequently, A2 milk has been suggested to exert fewer adverse effects on physiological functions in susceptible individuals. Recent studies indicate that consumption of A1 casein compared with A2 casein may differentially affect metabolic and inflammatory responses, which may be relevant to the development of atherosclerosis. The aim of the study was to evaluate the effect of A1 and A2 diets, in which A1 and A2 milk, respectively, have been used as the protein source, on cytokine levels in the plasma. Four-month-old mice were fed modified AIN-93G diets containing A1 or A2 milk for 5 weeks. Body weight was measured weekly. At the end of the experiment, blood samples were collected and a cytokine panel was determined using the Bio-Plex assay. No significant changes in body weight were observed in the experimental mice. The results indicated that the diet containing

A1 milk as the protein source induced a slightly stronger inflammatory response than the A2 milk diet. In the A1 group, levels of cytokines such as IL-1β, IL-6, and MIP-1α, which are involved in inflammatory processes and leukocyte recruitment, were increased. In the A2 group, levels of IL-10, an anti-inflammatory cytokine, were increased, indicating a potentially more anti-atherogenic cytokine profile. Compared with mice fed A1 milk, mice fed A2 milk exhibited a reduction in the size of atherosclerotic lesions in the entire aorta, measured *en face*, as well as in the heart, assessed by *cross-sectional* analysis. The cytokine profile indicated a potentially more atherogenic inflammatory response in mice fed the A1 diet, which was consistent with the histological observations. Further studies are needed to elucidate the mechanisms underlying these observed associations.

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HYPERSPECTRAL CAMERAS IN AGRICULTURE AND FOOD PROCESSING – WHAT CAN ACTUALLY BE MEASURED

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Keywords: hyperspectral imaging; non-destructive quality assessment; food quality control

Abstract: Hyperspectral imaging allows the composition and quality of a product to be assessed without contact and without destroying the sample. In agriculture, this enables the detection of water stress and nitrogen deficiency before they become visible, assessment of ripeness prior to harvest, and early identification of plant disease. In processing, it supports real-time monitoring of moisture, fat and protein content, foreign body detection, raw material sorting and freshness evaluation.

The paper discusses these applications through specific cases drawn from deployment practice — both those where the technology delivered measurable benefit and those where it proved excessive relative to cheaper alternatives. Particular attention is given to camera selection, presented not as a review of specifications but as a set of questions worth asking before purchase, so as to avoid acquiring an instrument unable to detect what it was intended to measure.

The paper is addressed to audiences considering the deployment of hyperspectral imaging in production environments. Its conclusions are application-oriented and intended to distinguish solutions that are operationally available today from those that remain at the research stage.

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VALORIZING INSECT FAT: SUPERCRITICAL CO_2 EXTRACTION AND QUALITATIVE PROFILING OF *TENEBRIO MOLITOR* LIPIDS

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Keywords: *Tenebrio molitor*; edible insects; supercritical carbon dioxide extraction ($scCO_2$); lipid fraction; fatty acids; volatile compounds; sustainable food systems

Abstract: The growing global population and the increasing environmental challenges associated with conventional food production underscore the need to find alternative sustainable sources of nutrients. Edible insects, traditionally regarded primarily as a source of high-quality protein, are also a valuable source of lipids with potential applications in the food industry and other bio-based industries. The aim of this study was to develop and optimize a process for recovering the lipid fraction from *Tenebrio molitor* larvae using supercritical carbon dioxide extraction ($scCO_2$) and to evaluate the effect of pressure (100–300 bar) and temperature (40–60°C) on extraction yield as well as chemical (fatty acid profile, volatile compounds, and FTIR-ATR) and thermal properties (differential scanning calorimetry – DSC) of the obtained fractions. The extraction yield increased significantly with increasing pressure and temperature, ranging from 14.24% (100 bar/50°C) to 94.79% (300 bar/60°C). The fatty acid profile remained relatively stable under all tested conditions, with monounsaturated fatty acids (MUFA) predominating (37.51–39.79%), mainly represented by oleic acid (C18:1n9; 35.88–38.38%), followed by saturated fatty acids (SFA; 42.60–45.20%) and polyunsaturated (PUFA; 17.09–17.74%). Analysis of volatile compounds showed that carboxylic acids were the most abundant group (44.93–62.54%), followed by pyrazines and alcohols, with their proportions influenced by extraction conditions. FTIR-ATR analysis confirmed the presence of characteristic functional groups associated with asymmetric stretching vibrations of methyl groups (2952^{-1}) and fatty acid esters (1740 cm^{-1}) in all lipid fractions. DSC analysis revealed two distinct endothermic peaks during melting and two exothermic peaks during crystallization of the obtained lipid fractions, indicating a heterogeneous thermal profile that can be altered by varying $scCO_2$ extraction pressure and temperature. Overall, $scCO_2$ extraction proved to be an effective and environmentally friendly method for recovering lipids from *T. molitor*, and the appropriate selection of process parameters allowed for control over the extraction yield as well as selected chemical and thermal properties of the obtained fractions.

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SUSTAINABLE PROTEIN RECOVERY FROM EDIBLE INSECTS: A BIOREFINERY APPROACH FOR ENVIRONMENTALLY SUSTAINABLE FOOD PRODUCTION

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Keywords: edible insects; insect protein; sustainable extraction; biorefinery; circular bioeconomy

Abstract: The increasing global population, climate change, and depletion of natural resources are driving the search for sustainable alternative protein sources. Conventional livestock production accounts for approximately 14.5% of global greenhouse gas (GHG) emissions and occupies 77% of agricultural land, while global protein demand is projected to increase by 70% by 2050. In this context, edible insects have gained attention as a resource-efficient and environmentally sustainable protein source. Their feed conversion ratios (FCR) range from approximately 1.1 to 3.0, depending on the species, while their production requires substantially less land and water than conventional livestock. Moreover, insect protein production can generate 72–97% fewer GHG emissions than milk, chicken, pork, and beef. These environmental advantages, combined with their nutritional value, have contributed to the growing interest in edible insects worldwide. More than 2 000 insect species are consumed in 113–128 countries. In the European Union, edible insects are regulated as novel foods under Regulation (EU) 2015/2283, with four species currently authorized for food use: *Tenebrio molitor*, *Locusta migratoria*, *Acheta domesticus*, and *Alphitobius diaperinus*. In addition to their environmental benefits, edible insects provide high-quality protein. For example, *T. molitor* and *A. domesticus* contain approximately 57–75% protein on a dry-weight basis and provide all essential amino acids. Despite this potential, efficient protein recovery remains challenging because of the chitinous exoskeleton and the high lipid content, which ranges from 2% to 50%. Conventional alkaline extraction generally achieves only 30–40% protein recovery and can compromise protein functionality. Therefore, more efficient and sustainable extraction methods are needed. Ultrasound-assisted extraction, enzymatic pretreatment, and deep eutectic solvent (DES)-based extraction show promise in improving protein recovery while reducing reliance on conventional chemical reagents and potentially preserving protein functionality. Furthermore, an integrated biorefinery approach can enable the sequential valorization of insect biomass. Recovered lipids can be used in animal feed, while chitin can be converted into chitosan for biodegradable food

packaging and edible coatings. This integrated valorization maximizes biomass utilization, minimizes waste, and supports circular bioeconomy principles, strengthening the potential of edible insects as sustainable resources for future food and feed systems.

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EFFECT OF ALGINATE-ENCAPSULATED ASCORBIC ACID PREPARED WITH COLD PLASMA-TREATED WATER ON OXIDATIVE STABILITY AND COLOUR OF BEEF BURGERS

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Keywords: beef burgers; ascorbic acid; sodium alginate; encapsulation; cold plasma-treated water; lipid oxidation

Abstract: Beef products are particularly susceptible to lipid oxidation during storage, which may lead to deterioration of their quality, including changes in colour. The combination of natural antioxidants with biopolymer-based delivery systems represents a promising approach to improving the oxidative stability of meat products. This study aimed to evaluate the effect of alginate-encapsulated ascorbic acid prepared using water subjected to indirect cold plasma treatment (IPTW) on lipid oxidation and colour of beef burgers during frozen storage. Five formulations were investigated: a control without ascorbic acid, burgers containing ascorbic acid solution prepared with deionized water (DW) or IPTW, and burgers containing alginate-encapsulated ascorbic acid prepared with DW or IPTW. The samples were evaluated after freezing and after two and four months of frozen storage. Lipid oxidation was determined using the thiobarbituric acid reactive substances (TBARS) assay and expressed as malondialdehyde (MDA) content, while colour was assessed using the CIE L*a*b* system. Lipid oxidation increased during storage in all formulations, although differences were observed depending on the form of ascorbic acid and the type of water used. After four months, burgers containing alginate-encapsulated ascorbic acid prepared with IPTW showed the lowest MDA content (approximately 1.1 mg/kg), compared with approximately 1.5 mg/kg in the control. Colour parameters changed during frozen storage, while the use of IPTW did not result in a consistent effect on burger colour. The results suggest that alginate encapsulation of ascorbic acid using IPTW may contribute to limiting lipid oxidation during long-term frozen storage without inducing consistent changes in the colour of beef burgers. This approach demonstrates the potential of cold plasma-treated water in the development of innovative delivery systems for natural antioxidants.

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EFFECT OF INDIRECT PLASMA-TREATED WATER ON THE EXTRACTION OF BIOACTIVE COMPOUNDS FROM TURMERIC

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Keywords: indirect plasma-treated water; turmeric; curcumin; extraction; phenolic compounds; antioxidant activity

Abstract: Indirect plasma-treated water (IPTW) has potential as an alternative extraction medium for bioactive compounds from plant materials. The aim of this study was to evaluate the effect of IPTW and extraction conditions on curcumin extraction, total phenolic content, and antioxidant properties of turmeric extracts. Turmeric was extracted using deionized water (DW) or IPTW at 20, 40, and 60 °C for 20 or 60 min. Curcumin content, total phenolic content (TPC), and reducing capacity using the FRAP assay were determined. The results were analyzed using ANOVA followed by Duncan's post-hoc test ($p < 0.05$). Extraction temperature strongly affected curcumin recovery, with higher temperatures generally resulting in increased curcumin content. However, the use of IPTW did not consistently improve curcumin extraction compared with DW. In contrast, IPTW enhanced the extraction of phenolic compounds under all investigated time and temperature conditions. The highest TPC was observed in extracts obtained with IPTW at 60 °C for 60 min. A particularly pronounced effect of IPTW was observed for reducing capacity. FRAP values were consistently higher for IPTW extracts than for the corresponding DW extracts and increased with extraction temperature. The highest reducing capacity was obtained using IPTW at 60 °C for 60 min. The results indicate that indirect plasma-treated water may enhance the extraction of phenolic compounds and the antioxidant properties of turmeric extracts. However, its effectiveness depends on the analyzed compound and extraction conditions, as no consistent improvement in curcumin extraction was observed.

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MODELLING THE QUALITY AND OXIDATIVE STABILITY OF TERNARY OIL BLENDS USING MIXTURE DESIGN

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Keywords: mixture design, oil blends, oxidative stability, peroxide value, p-anisidine value, free fatty acids, response surface methodology.

Abstract: The aim of this study was to assess the effect of the proportions of three oil components, designated as RO, AO, and WO, on selected quality indicators and oxidative stability of ternary oil blends. A mixture design comprising 10 formulations was applied, with component proportions ranging from 70.0 to 75.0% for RO, 20.0 to 25.0% for AO, and 5.0 to 10.0% for WO. Peroxide value (PV), free fatty acid content (FFA, expressed as oleic acid), and p-anisidine value (AnV) were used as response variables. The relationships between blend composition and the analyzed parameters were described using quadratic mixture regression models. Within the investigated composition range, PV varied from 2.247 to 8.360 meq/kg, FFA from 1.200 to 1.257%, and AnV from 0.103 to 1.180. The PV model showed a high coefficient of determination ($R^2 = 0.8769$; adjusted $R^2 = 0.7230$), although its overall significance was marginal ($F = 5.70$; $p = 0.0583$). WO had the highest positive linear coefficient, whereas the RO×AO interaction showed a negative, but statistically non-significant, effect on PV. The FFA model had limited predictive ability ($R^2 = 0.5215$; adjusted $R^2 \approx 0$) and was not significant ($p = 0.5686$), indicating that FFA content remained relatively stable across the studied formulations. In contrast, the AnV model showed excellent fit ($R^2 = 0.9944$; adjusted $R^2 = 0.9874$) and was highly significant ($F = 141.59$; $p = 0.000137$). All binary interactions significantly affected AnV. The RO×AO and AO×WO interactions reduced AnV, while the RO×WO interaction increased it. The lowest PV and FFA values were obtained for the blend containing 72.5% RO, 22.5% AO, and 5.0% WO, whereas the lowest AnV was recorded for the blend containing 70.0% RO, 22.5% AO, and 7.5% WO. These results demonstrate the usefulness of mixture design for identifying oil blend formulations with improved oxidative quality.

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ALGINATE-ENCAPSULATED *SPIRULINA PLATENSIS* AS A FUNCTIONAL INGREDIENT IN BEEF BURGERS

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Keywords: *Spirulina platensis*; sodium alginate; encapsulation; beef burgers; functional food; C-phycocyanin

Abstract: *Spirulina platensis* is a promising functional food ingredient due to its high nutritional value and content of bioactive compounds; however, its intense colour and characteristic sensory properties may limit its direct application in meat products. This study aimed to develop sodium alginate-based capsules containing *S. platensis*, characterize their selected properties and evaluate their potential application as a functional ingredient in beef burgers. Sodium alginate hydrosols containing 0, 2, 3 and 4% (w/v) spirulina were prepared and subjected to ionic gelation. Capsules containing 4% spirulina were subsequently incorporated into beef burgers at levels of 5, 10 and 15% (w/w). Increasing spirulina concentration modified the rheological properties of the hydrosols; at a shear rate of 5 s^{-1}, apparent viscosity increased from 0.012 Pa·s in the control to 0.023 Pa·s in the 4% spirulina formulation. Spirulina also markedly affected capsule colour, with L* decreasing from 63.69 in control capsules to 21.66 in capsules containing 4% spirulina. Under simulated intestinal conditions, C-phycocyanin release increased over time, reaching the highest value of 2.57 mg/g capsules after 240 min, corresponding to a maximum mean release of 20.54%. The addition of spirulina-containing capsules decreased the pH of cooked beef burgers from 5.84 in the control to 5.47 at the 15% addition level. Capsule incorporation increased burger hardness from 38.78 N in the control to an average of 55.88 N in supplemented samples and increased chewiness from 22.17 to 29.69 N, while no significant effect on water and fat cooking losses was observed. Sensory analysis showed that capsule addition primarily affected colour, whereas aroma, taste, texture, juiciness and overall acceptability were not significantly affected. Moreover, 90% of panellists declared willingness to purchase a burger containing spirulina. The results indicate that alginate encapsulation can protect spirulina-derived bioactive compounds under gastric conditions and enable their release under intestinal conditions while limiting the undesirable sensory impact of spirulina in beef burgers. However, optimization of product colour remains necessary to improve consumer acceptance.

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DIRECT OR ENCAPSULATED? EFFECT OF PLANT EXTRACT DELIVERY FORM ON THE QUALITY OF FROZEN BEEF BURGERS

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Keywords: beef burgers; plant extracts; sodium alginate; encapsulation; antioxidant capacity; frozen storage

Abstract: Oxidative deterioration and changes in physicochemical properties during frozen storage are important factors affecting the quality of meat products. Natural plant extracts are promising sources of antioxidant compounds; however, their effectiveness may depend on their botanical origin, delivery form and storage duration. This study aimed to evaluate the effects of paprika, turmeric and thyme extracts, incorporated either directly or encapsulated in sodium alginate, on the pH, colour, antioxidant capacity and mechanical properties of beef burgers during frozen storage. Samples were analysed after 0, 14 and 28 days of storage at −18°C. The delivery form and extract type significantly affected meat pH. Encapsulated extracts resulted in a lower pH than free extracts and the control (5.60 vs. 5.66 and 5.68, respectively), while turmeric produced the lowest pH among the investigated extracts (5.58). Storage time also significantly affected pH, which increased from 5.59 at day 0 to 5.69 after 14 days and subsequently decreased to 5.63 after 28 days ($p < 0.05$). Plant extracts markedly modified burger colour. In raw burgers, paprika produced the greatest increase in redness ($a^* = 19.11$ vs. 7.42 in the control), whereas turmeric increased yellowness ($b^* = 23.34$ vs. 13.41 in the control). Antioxidant capacity, assessed using TEAC and TEAP assays, was significantly influenced by interactions between storage time, extract type and delivery form ($p < 0.05$). The highest initial TEAC was observed for directly incorporated turmeric extract (approximately 26.7 mmol Trolox equivalents/kg dry matter). After 14 days, encapsulated thyme exhibited a higher TEAC value (approximately 20.3 mmol/kg) than its non-encapsulated counterpart (approximately 15.8 mmol/kg), whereas after 28 days turmeric maintained the highest antioxidant capacity among the investigated extracts. A time-dependent effect of encapsulation was also observed for TEAP; after 28 days, encapsulated turmeric reached approximately 4.75 mmol Trolox equivalents/kg dry matter compared with approximately 4.25 mmol/kg for its directly incorporated form. Finally, both storage time and delivery form influenced the mechanical properties of the burgers. Hardness decreased from 28.07 N at day 0 to 13.95 N after 28 days, while burgers con-

taining encapsulated extracts exhibited significantly lower hardness than those containing free extracts (16.93 vs. 22.71 N). No significant effect of delivery form was observed for springiness, gumminess, chewiness or cohesiveness. Overall, the results demonstrate that the effects of plant extracts on beef burger quality depend on their botanical source, delivery form and storage duration. Alginate encapsulation modified antioxidant capacity during frozen storage in an extract-dependent manner and affected selected physicochemical and mechanical properties, highlighting the importance of selecting an appropriate delivery system for a specific plant extract and desired product characteristics.

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INTERACTIONS BETWEEN MYOFIBRILLAR PROTEINS AND HERBAL EXTRACTS. IMPLICATIONS FOR PROTEIN GEL STRUCTURE AND FUNCTIONALITY

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Keywords: myofibrillar proteins, plant extracts, gelation, rheology, antioxidant activity, protein oxidation, protein-polyphenol interactions

Abstract: This study aimed to investigate the effects of herbal extracts, specifically *Centella asiatica*, *Melissa officinalis*, and *Salvia officinalis*, on myofibrillar protein (MP) gels, with a focus on their antioxidant, functional, and rheological properties. The results showed that the plant extracts modified the gelation process by lowering the gelation temperature and increasing the storage modulus (G'), with *C. asiatica* exhibiting the most pronounced effect, potentially associated with its triterpenoid saponins. Polyphenolic compounds present in *M. officinalis* and *S. officinalis* may have contributed to protein-ligand interactions through hydrogen bonding and π–π stacking. Scanning electron microscopy revealed extract-dependent differences in gel microstructure, with *S. officinalis* and *C. asiatica* producing more cohesive gel networks. Texture profile analysis demonstrated increases in gel strength, gumminess, and chewiness in the extract-containing gels. Antioxidant assays revealed extract-specific effects, with *C. asiatica* showing enhanced DPPH radical-scavenging activity, whereas *M. officinalis* exhibited higher FRAP values. Tryptophan fluorescence indicated protein-ligand interactions accompanied by partial conformational changes in the proteins. Although no significant differences in protein carbonyl content were observed, sulfhydryl and amino group contents were differentially affected by the extracts. Overall, the results indicate that plant extracts can modulate myofibrillar protein gelation, potentially through specific interactions between proteins and phytochemicals.

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DIFFERENTATION OF THE BIOLOGICAL VALUE OF DUCK EGGS

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Keywords: duck; origin; egg; physicochemical parameters

Abstract: The morphological composition and biological quality of farmed poultry eggs that shape their hatchability depend on, among other things, the origin (species, breed, pedigree, variety), age and nutrition of the birds, as well as environmental factors. The purpose of the study was to evaluate the effect of ducks genotype on physical and morphological composition of eggs. Eggs taken from three (3) breeding flocks of Pekin-type ducks were studied: P-9 (Pekin of French origin), K-2 Mini-duck, and LsA (Pekin of English origin – synthetic line). Ninety eggs were randomly selected for evaluation from each analysed duck flock, always up to 24 h after laying. A total of 270 duck eggs were analysed. Technological conditions during the birds' rearing were in accordance with general assumptions for this type of production. An electronic assembly Egg Quality Micro-Technical (England) has been used to determine the weight of the egg and its fractions (g), albumen height (mm), Haugh units (HU), as well as colour of the shell (% reflection) and its density (mg/cm^2). The texture analyser TA.XT PLUS (Stable Micro Systems) was used to determine the strength (N) of the shell and its elastic deformation (μm). The pH value of the egg white and yolk was determined using a Mettler Toledo pH meter. The method of determining and counting the pores was performed by the Tyler (1953). The thickness of the shell without subshell membranes was measured with the Mitutoyo micrometer (Japan), with an accuracy of 1 μm. The Paganelli et al. (1974) formula has been used to calculate the eggshell area (cm2), and the egg shape index was defined as the ratio of width to length of the egg (index, %). In the examined group of birds from LsA ducks demonstrated the highest weight (88.21 g), albument weigt (46.69 g), yolk egg (31.49 g) and eggshell (10.04 g). Moreover, eggs from this experimental group were distinguished by the largest surface area (93.76 %) and oblong shape (71.93 %). The albumen from eggs of Lsa ducks were characterized by the greatest albumen height (7.54 mm) as well as highest Haugh unit at the level of 79.26. In turn, the eggshell from eggs of P-9 ducks were characterized by the greatest thickness (411.8 μm), density (107.7 mg/cm^2), strength (50.89 N) and the lighest colour (71.68 %). The duck origin had a significant ($p \leq 0.05$) influence on the morphological parameters of the eggs.

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EFFECT OF DUCK ORIGIN ON THE LYSOZYME CONTENT IN EGG WHITE

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Keywords: duck; origin; egg; lysozyme

Abstract: The albumen of avian eggs contains many biologically valuable substances in its composition, including lysozyme – a valuable hydrolytic enzyme with strong antimicrobial activity. Belonging to biologically active proteins, it provides natural, primary protection of the embryo until the first antibodies are formed. The purpose of the study was to evaluate the effect of duck origin on the level and activity of lysozyme. Eggs taken from three (3) breeding flocks of Pekin-type ducks were studied: P-9 (Pekin of French origin), K-2 Mini-duck, and LsA (Pekin of English origin – synthetic line). Ninety eggs were randomly selected for evaluation from each analysed duck flock, always up to 24 h after laying. A total of 270 duck eggs were analysed. Technological conditions during the birds' rearing were in accordance with general assumptions for this type of production. The content and activity of lysozyme in the fresh albumen fractions were determined by spectrophotometry[22] based on the lysis of cell walls of *Micrococcus lysodeikticus* bacteria (Leśnierowski i in., 2021). In the case of thick albumen, the highest lysozyme content (0.14%) and its enzymatic activity (29.148 U/ml) were found in K-2 Mini-duck eggs. An inverse relationship was noted in LsA egg white, which had the lowest content of lysozyme (0.11%) and its lowest ezymatic activity (22.035). Also in the thin albumen, K-2 Mini-duck egg whites had the highest percentage and enzymatic activity of lysozyme, at 0.18% and 40038 U/ml, respectively and LsA egg white with its lowest values of 0.06 % and 34722 U/ml, respectively. Statistically significant differences were noted ($p < 0.05$). There was an effect of origin on the content and activity of lysozyme.

PILOT-SCALE PEF INACTIVATION OF A BEER SPOILAGE YEAST: EFFECT OF SPECIFIC ENERGY INPUT ON MICROBIAL INACTIVATION AND POST-TREATMENT STORAGE

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Keywords: pulsed electric field, microbial inactivation, non-alcoholic beer spoilage

Abstract: Non-alcoholic beer (NAB) is the fastest-growing category in the beer market. Lower ethanol content (0–0.5%) and the presence of residual sugars make NAB more susceptible to microbial spoilage. Although thermal pasteurisation is widely used to ensure product safety, it negatively affects sensory quality and increases energy consumption. This creates interest in alternative preservation methods that achieve microbial inactivation while maintaining product quality. Pulsed electric field (PEF) processing applies short (1–10 μs), high-voltage (20–80 kV/cm) electrical pulses, that induce electroporation of microbial cells. While previous studies have shown its potential for beer preservation, variations in processing conditions and the limited availability of pilot-scale studies make it difficult to draw consistent conclusions regarding microbial inactivation. The aim of this study was to investigate the inactivation of a relevant beer spoilage yeast using continuous-flow pilot-scale PEF in a simplified model liquid and to evaluate the effect of increasing specific energy input. Malt extract (40 g/L) was dissolved in 50 L of water and inoculated with *Saccharomyces cerevisiae* subsp. *diastaticus* (1×10^6 CFU/mL). Samples were treated at increasing specific energy inputs (W_{spec}) of 10, 15, 25 and 35 kJ/L while maintaining a constant electric field strength (24 kV/cm) and pulse width (8 μs). Following treatment, samples were stored at 4°C and 22°C to determine whether storage causes microbial regrowth or further inactivation. Microbial counts were determined right after treatment and on days 3, 7, 10 and 14 of storage. Microbial inactivation increased with W_{spec}, ranging from 0.82 to 2.15 log reduction, with the highest tested energy input (35 kJ/L) achieving 2.15 ± 0.18 log reduction. Storage at 22°C caused substantial microbial regrowth of 1.8–3.5 log CFU/ml, compared to post-treatment counts. In contrast, refrigerated samples remained stable, showing minor increases of 0.1–0.5 log CFU/ml. PEF-induced microbial inactivation was dependent on W_{spec}. However, the tested conditions caused limited inactivation, and surviving cells exhibited regrowth during storage at 22°C. Future studies will investigate higher energy inputs and optimise additional processing parameters to improve microbial inactivation and storage stability.

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COMPARISON OF PLANT-DERIVED SERINE PROTEASE WITH COMMERCIAL PROTEASES FOR WHEY PROTEIN HYDROLYSIS

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Keywords: whey protein concentrate; plant-derived protease; *Cucurbita ficifolia*; enzymatic hydrolysis; bioactive peptides

Abstract: Dairy industry generates major amounts of whey, by-product of cheese production. Due to its high protein content whey is a valuable substrate for the production of bioactive peptides through enzymatic hydrolysis . Since peptide composition and biological activity depend strongly on enzyme specificity, the search for novel proteases remains an important research objective. This study compared the hydrolytic efficiency and biological properties of whey protein concentrate (WPC) hydrolysates produced using three commercial digestive proteases (pepsin, trypsin and chymotrypsin) and novel serine protease isolated from *Cucurbita ficifolia* (CFsp). Hydrolysis was performed using a 2% WPC solution at E/S ratio of 1%. Hydrolysis progress was evaluated by free amino group content and by SDS-PAGE combined with densitometric analysis. The proteases exhibited distinct hydrolysis kinetics and generated hydrolysates with significantly different biological activities. Antioxidant capacity depended on both enzyme specificity and hydrolysis time. CFsp produced hydrolysates with the highest ABTS radical scavenging activity after 1 h (10.891 ± 0.03 mmol TE/mL) and maintained high activity throughout the process. Chymotrypsin showed the highestt ferric reducing capacity (756 ± 8 μmol TE/mL after 2 h), whereas pepsin exhibited the strongest DPPH radical scavenging activity after 0.5 h (2.163 ± 0.186 mmol TE/mL). CFsp hydrolysates exhibited consistent strong enzyme inhibitory properties, with α-glucosidase IC_{50} decreasing from 4.27 ± 0.02 to 1.52 ± 0.04 mg/mL during hydrolysis and DPP-IV IC_{50} reaching 1.07 ± 0.09 mg/mL after 3 h. The strongest ACE inhibition was observed for pepsin hydrolysates after 24 h (IC_{50} = 0.57 ± 0.02 mg/mL), while CFsp hydrolysates reached 1.02 ± 0.07 mg/mL. These findings demonstrate the potential of *C. ficifolia* serine protease as an alternative biocatalyst for the production of functional whey protein hydrolysates.

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HOW TO SUPPORT FOOD SAFETY MANAGEMENT IN THE CONTEXT OF CLIMATE CHANGE?

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Keywords: climate change; food safety; predictive microbiology

Abstract: Climate change has the potential to disrupt the food supply chain, which may lead to the proliferation of certain pathogens and an increase in microbiological risks. Consequently, food business operators and/or competent authorities must establish measures to mitigate and control microbiological risks. Here, we present tools that can facilitate food safety management in the context of climate change. The tools are illustrated with recent studies to make their applications more tangible. One tool is based on multi-criteria decision analysis, another one on predictive microbiology models. A third one is based on machine learning, it has been used to analyse big datasets and move towards early warning systems and climate-based surveillance strategies. These tools are discussed in terms of their complexity, data requirements, and level of maturity, with a focus on how they assist decision-makers in the area of food safety.

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SHELF-LIFE EXTENSION AND QUALITY PRESERVATION OF COLD-SMOKED SALMON BY MODERATE PRESSURE PASTEURIZATION

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Keywords: cold-smoked salmon; moderate pressure pasteurization; high-pressure processing; shelf life; food safety; quality kinetics; ready-to-eat seafood

Abstract: Cold-smoked salmon is a ready-to-eat seafood product with high commercial value, but its refrigerated shelf life and safety can be limited by microbial growth and quality deterioration during storage. This study evaluated the potential of moderate pressure pasteurization (MPP; 200 MPa for 5.2 days) as a milder alternative to conventional high-pressure processing (HPP; 600 MPa for 5 min) for improving the safety, quality, and shelf-life stability of cold-smoked sockeye salmon (*Oncorhynchus nerka*). Treated and untreated samples were stored for 28 days at 5, 15, and 25 °C and assessed for microbiological, physicochemical, and kinetic shelf-life responses. Both pressure treatments reduced initial mesophilic and psychrotrophic populations to the detection limit and effectively inhibited Enterobacteriaceae, mold, and yeast growth throughout storage. In contrast, untreated samples reached the 7 log CFU/g spoilage threshold within 7–28 days, depending on storage temperature. Shelf-life prediction using zero-order kinetics combined with the Arrhenius equation, and validated with a Q_{10} model, indicated microbiological shelf lives of up to 104 days for MPP and 97 days for HPP at 5 °C, representing a four- to five-fold extension compared with the control. Compared with HPP, MPP caused smaller changes in lightness, total color difference, hardness, and water-holding capacity under refrigeration, while maintaining better physical quality at its microbiological endpoint. These findings suggest that MPP can enhance microbial safety and extend shelf life while better preserving sensory-relevant quality attributes, supporting its application as a promising mild pasteurization strategy for ready-to-eat smoked fish.

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EFFECT OF PH AND PROTEIN CONCENTRATION ON THE RHEOLOGICAL PROPERTIES AND THERMAL DENATURATION OF WHEY PROTEIN ISOLATE (WPI) SOLUTIONS

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Keywords: Whey protein isolate (WPI), functional properties, thermal treatment, rheological properties

Abstract: Whey protein isolate (WPI) is utilized in the dairy and food industries due to its high nutritional value and valuable functional properties, such as gelation, water-binding capacity, and the ability to stabilize foams and emulsions. These properties depend on the rate of protein unfolding and association induced by heating. The rate and extent of these changes are influenced by the solution pH, which affects the onset temperature of gelation and the course of the process itself. Another significant factor is protein concentration; higher concentrations generally promote earlier gelation and stronger cross-linking, although this relationship is non-linear and can be modulated by pH and ionic strength.The aim of this study was to determine whether the pH of the WPI solution and protein concentration synergistically influence the aggregation and gelation of analyzed solutions during heating, and whether these factors affect rheological properties during the sol-gel transition.WPI containing 88% protein, was used to prepare the solutions. Whey protein isolate was dissolved in ultrapure water to concentrations of 0.5%, 2%, and 5% (w/v). Based on the analyses performed, a concentration of 5% (w/v) was selected for further studies, in which WPI was dissolved in Sørensen phosphate buffers at pH 4.8, 6.5, 7.0, 7.5, and 8.0. Hydration was carried out for 24 hours under constant stirring. The thermal stability of the buffers alone and the WPI solutions was assessed by measuring pH across the temperature range of 15–80°C.Thermal aggregation and gelation were monitored using small-amplitude oscillatory shear rheology with a HAAKE MARS rheometer. Samples were analyzed using a linear temperature gradient from 35°C to 99°C (heating phase) and after cooling back to the initial temperature. During the analysis, the storage modulus (G'), loss modulus (G"), dynamic (complex) viscosity (η), and loss factor (tan δ = G'/G") were determined as functions of temperature. A cone-and-plate measuring geometry was employed.

It was demonstrated that, under the analyzed conditions, pH and protein concentration influenced the thermal aggregation and gelation of WPI solutions, with pH exerting a more pronounced qualitative effect on the changes in dynamic viscosity during heating. Solutions closest to the isoelectric point (pH 4.8) gelled most rapidly and intensely, forming opaque, curd-like structures during the heating process itself; this indicates that minimal electrostatic repulsion favors rapid, extensive aggregation. In contrast, WPI solutions with higher pH values (ranging from 6.5 to 8.0) gelled more slowly and gradually, forming networks that were visually more transparent and became apparent only after cooling. Regardless of pH, heating caused a consistent, concentration-dependent drop in the pH of the WPI solutions; this effect was most pronounced between 70°C and 90°C, a temperature range corresponding to the denaturation of the major whey protein fractions. The results suggest that simple pH monitoring could serve as an indicator of the extent of denaturation in WPI systems. These findings demonstrate that pH and protein concentration together determine the rheological and macroscopic effects of heat treatment on WPI, offering clear practical implications for the formulation of heat-processed, protein-enriched foods and beverages where specific textural, transparency, or gel stability characteristics are desired.

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ONE SYSTEM, TWO WORLDS: W/O/W NANOEMULSIONS FOR SIMULTANEOUS DELIVERY OF HYDROPHILIC AND LIPOPHILIC CHOKEBERRY BIOACTIVES

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Keywords: *Aronia melanocarpa,* nanoemulsions, polyphenols, carotenoids, bioaccessibility

Abstract: Chokeberry (*Aronia melanocarpa* L.) is an exceptionally rich source of both hydrophilic polyphenols and lipophilic carotenoids. However, their simultaneous incorporation into a single food-grade delivery system remains challenging due to their contrasting physicochemical properties. This study aimed to develop water-in-oil-in-water (W/O/W) nanoemulsions enabling the co-encapsulation of chokeberry polyphenols and carotenoids and to evaluate their physicochemical characteristics and gastrointestinal behaviour. Nanoemulsions differing in extract concentration and external phase stabilizer were produced using a two-step emulsification process. Particle size and polydispersity index (PDI) were determined, while the gastrointestinal fate of polyphenols and carotenoids was assessed using an in vitro digestion model combined with dialysis.

The developed nanoemulsions exhibited mean particle sizes ranging from approximately 255 to 391 nm with PDI values below 0.40, indicating good colloidal stability. Increasing the concentration of encapsulated extracts resulted in higher amounts of both carotenoids and polyphenols released during gastrointestinal digestion. In the intestinal phase, the formulation containing higher extract concentrations showed approximately 2.4-fold higher xanthophyll levels and increased total polyphenol release compared with the lower-loaded system. However, this improvement was not reflected in the potentially bioavailable fraction. The formulation with lower bioactive loading exhibited greater transfer of both carotenoids and polyphenols across the dialysis membrane, suggesting more efficient micellar incorporation and diffusion. These findings indicate that increasing the concentration of encapsulated bioactives does not necessarily enhance their bioaccessibility and may even reduce their potential availability after digestion.

The proposed W/O/W nanoemulsion represents a promising platform for the simultaneous delivery of hydrophilic and lipophilic phytochemicals. The results further suggest that optimi-

zation of bioactive loading, rather than its maximization, is crucial for designing multifunctional delivery systems with improved nutritional performance.

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POULTRY MEAT PROCESSING AND QUALITY: PROGRESS, CHALLENGES, AND THE ROAD AHEAD

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Keywords: poultry industry; meat quality; processing technology

Abstract: Over the past five decades, the poultry industry has experienced sustained and substantial growth in both the United States and worldwide. Today, the global broiler industry produces more than 100 million metric tons of meat annually. This expansion has been driven by remarkable improvements in broiler growth efficiency, nutrition, genetics, and management practices, coupled with strong consumer demand for poultry products. Poultry remains a popular protein source due to its affordability, convenience, versatility, and perceived health benefits. Productivity gains combined with longer growout periods have enabled producers to grow birds efficiently to heavier weights in order to supply deboning operations, further processing, and value-added product markets. As a result, the average market weight of broilers in the United States has increased from approximately 1.7 kg to more than 3.0 kg over the past 50 years. Currently, the large-bird market segment (>2.7 kg) accounts for nearly 70% of broiler meat production on a weight basis. Similar production trends have been observed in Poland and other European Union countries; however, increases in market weight has been more moderate, reflecting a balance between growing demand for further processed products and traditional markets that continue to favor smaller carcasses. Alongside gains in productivity, poultry processing has undergone significant modernization over the past several decades. Research in poultry processing has contributed significantly to improvements in operational efficiency through automation, animal welfare, meat quality, food safety, and product development. Notable advances include the adoption of improved stunning technologies to enhance humane slaughter practices, the use of interventions such as electrical stimulation and marination to improve meat tenderness of early harvested muscle, and efforts to reduce quality defects, including pale, soft, exudative (PSE) meat and emerging muscle myopathies such as woody breast and spaghetti meat. Despite these achievements, opportunities remain for innovation, particularly in the intelligent automation of processing operations. Expanded automation could reduce labor dependence, improve processing efficiency, and strengthen food safety outcomes. Furthermore, data driven decisions in poultry processing can also improve operation efficiency and food safety. Continued research is also needed to address evolving consumer expectations related to clean-label products, sustainability, animal welfare, and consistent product quality.

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ARSENIC SPECIATION ANALYSIS VIA HPLC-ICP-MS

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Keywords: arsenic; inorganic arsenic; rice; infant food safety

Abstract: Arsenic is a ubiquitous metalloid whose health risk depends far more on its chemical form than on the total amount present: species such as arsenobetaine, common in seafood, are essentially harmless, while inorganic arsenic — the form that dominates in rice and in contaminated groundwater — is a recognised human carcinogen with no established safe threshold. Although drinking water remains the primary exposure route in many parts of the world, food, and rice in particular, has become the leading source of inorganic arsenic in European and North American diets, with infants and young children facing disproportionately higher risk. This talk traces arsenic from soil to infant bowl, using HPLC-ICP-MS speciation analysis as its analytical foundation. Rice's efficient uptake of arsenic from paddy soils leads to accumulation in the grain, with substantial variation depending on region and processing, and a meaningful share of commercial rice products failing to meet infant food safety limits. Evidence from infant cohort studies shows a marked rise in arsenic exposure biomarkers around the time of weaning, coinciding with a growing body of research linking early-life exposure to adverse neurodevelopmental outcomes. Existing regulation has measurably reduced arsenic levels in retail infant food, but compliance has often been achieved through product reformulation rather than reducing arsenic at the source. The talk closes with a field-to-plate One Health framework spanning agronomy, food processing, public education, and biomonitoring, and highlights speciation-based research and stronger infant cohort evidence as priorities for the field going forward

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FROM ELCHE 'CONFITERA' DATES (*PHOENIX DACTYLIFERA* L.) TO HIGH-VALUE FUNCTIONAL INGREDIENTS AND INNOVATIVE FOOD PRODUCTS: A CIRCULAR BIOECONOMY APPROACH

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Keywords: confitera fresh date; circular bioeconomy; food innovation; agro-food co-products; functional ingredients.

Abstract: Fresh Elche dates (*Phoenix dactylifera* L.), particularly the authoctonous 'Confitera' cultivar, represent an **undervalued and underexploited** agri-food resource with remarkable nutritional, technological, and functional potential. This work summarizes a multidisciplinary research strategy developed to promote the sustainable valorization of fresh dates through circular bioeconomy principles, transforming an undervalued local resource into high-value functional ingredients and innovative food products. The research integrates cultivar characterization, digital phenotyping based on computer vision and controlled image analysis, the identification of promising commercial cultivars, and the development of sustainable processing strategies for both fruits and their by-products. Functional ingredients obtained from date flesh and seeds were evaluated for their technological and biological properties, including antimicrobial activity, fermentation enhancement, dietary fibre enrichment, and sensory improvement. These ingredients were successfully incorporated into a wide range of innovative food formulations, including hybrid meat products, fermented sausages, healthy snacks, and other functional foods, while additional applications in cosmetics, biomaterials, and agricultural substrates were also investigated. The results demonstrate that fresh Elche dates and their by-products constitute versatile natural ingredients capable of improving food quality, functionality, and sustainability while reducing food waste and generating new value chains. Overall, this comprehensive approach highlights the potential of fresh Elche dates as strategic raw materials for the development of healthier, more sustainable, and market-oriented foods,

while contributing to the preservation of agricultural heritage and supporting the transition towards resilient and circular agri-food systems.

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EFFECT OF DAIRY-BASED RECIPE MODIFICATION OF CLASSIC BAKERY PRODUCTS ON ESTIMATED GLYCAEMIC INDEX, NUTRITIONAL COMPOSITION AND CONSUMER ACCEPTANCE

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Keywords: bakery products; recipe reformulation; dairy products; skyr; estimated glycaemic index; nutritional value; consumer acceptance

Abstract: Traditional bakery products are generally characterised by a high energy density, a considerable content of available carbohydrates and an unfavourable glycaemic profile. Recipe reformulation using dairy products rich in protein may improve their nutritional value; however, maintaining desirable sensory properties remains an important technological challenge. The aim of this study was to evaluate the effect of recipe modification of selected classic bakery products on their nutritional composition, estimated glycaemic index and consumer acceptance. Traditional wuzetka cake and cheesecake were used as model products. Their recipes were modified by incorporating high-protein dairy ingredients, including skyr, and by partially replacing selected conventional ingredients. The developed variants were compared with traditional control products. Protein, dietary fibre, dry matter and ash contents were determined, while carbohydrate content and energy value were calculated. The estimated glycaemic index and glycaemic load were determined indirectly based on the carbohydrate composition of the products. Consumer acceptance was assessed using a nine-point hedonic scale. Recipe modification resulted in considerable differences in the nutritional characteristics of the products. In the cheesecake study, the skyr-based variant had the lowest energy value, amounting to 242.57 kcal/100 g, the lowest available carbohydrate content of 12.74 g/100 g and the highest dietary fibre content of 6.55 g/100 g. This variant also showed the lowest estimated glycaemic index and glycaemic load. The high-protein cheesecake contained 15.63 g of protein per 100 g. Modified wuzetka variants also demonstrated a more favourable estimated glycaemic profile than the traditional product, although the extent of recipe modification affected consumer acceptance. The results indicate that dairy-based reformulation may improve the nutritional and glycaemic characteristics of traditional bakery products. Nevertheless, comprehensive recipe optimisation is necessary to achieve a balance between nutritional benefits and consumer acceptance.

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MICROBIOLOGICAL QUALITY AND CHEMICAL COMPOSITION OF YOGURTS CONTAINING VARIOUS BOTANICAL PARTS OF CHINESE MAGNOLIA VINE

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Keywords: *Schizandra chinensis*; yogurt; microbial quality; basic chemical composition; acidity; storage

Abstract: Chinese magnolia vine (*Schisandra chinensis*) is well known for its health-promoting properties. For this reason, yogurts have been developed with the addition of various botanical parts of this plant. The objective of the study was to determine the microbiological quality, nutritional value, and acidity of yogurts supplemented with various botanical parts of *Schisandra chinensis*. Plain yogurt (A) and yogurt with the following additions: 3.75% puree made from steamed fruit with 30% sugar (B); 2.5% leaves steamed with water and homogenized (C); 0.2% air-dried and ground stems (D); and 0.1% air-dried and ground seeds (E) were produced. The count of characteristic yogurt microflora, the number of yeasts and molds, the nutritional value and the level of pH were analyzed. There was no effect of the additive on the number of *Streptococcus thermophilus*. During the 21-day storage period, their number decreased significantly. However, differences were observed in the number of *Lactobacillus delbrueckii* subsp. *bulgaricus*, which was significantly lower in sample C compared to the other variants, and the highest in sample B. For this microorganism, its number increased during storage. The presence of yeasts and molds was detected only in stored sample D. There was almost no effect of the additive on the basic chemical composition of the yogurts. Only the addition of fruit puree caused a significant increase in dry matter content. It also lowered the pH value.

The study showed that the effect of the type of additive and storage time on the abundance of characteristic yogurt microflora depended on the microorganism in question. Moreover, the yeasts and molds were detected solely in stored samples with stems. Only fruit puree had an effect on the dry weight and acidity of the yogurts.

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RESPONSE OF 'MIRLO ROJO' APRICOT MINERAL CONTENT AND FOOD SAFETY PARAMETERS TO REGULATED DEFICIT IRRIGATION

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Keywords: *Prunus armeniaca* L.; food safety; mineral profile; ICP-MS; essential and non-essential elements; water scarcity

Abstract: Increasing water scarcity in Mediterranean regions is driving the adoption of deficit irrigation (DI) strategies in fruit orchards. However, their impact on the mineral composition and safety of the fruit requires a detailed evaluation. This study analyzed the effect of four irrigation levels (100%, 66%, 33%, and 0% of crop evapotranspiration, ETc) on the elemental profile of ‚Mirlo Rojo' apricot cultivated in southeastern Spain. A total of 12 fruit samples (4 treatments × 3 biological replicates) were analyzed via microwave-assisted acid digestion, followed by ICP-MS quantification of essential and non-essential elements. Analytical validation showed recoveries between 80% and 120%, confirming method accuracy and robustness. Seven elements (B, Cu, Fe, Na, P, Pb, and Rb) exhibited significant differences among treatments ($p < 0.05$), whereas K, Ca, Mg, Mn, and Zn remained stable. Potassium was the predominant element, reaching up to 18.200 mg/kg in the 33% ETc treatment. Arsenic remained below the limit of detection in all cases, and lead levels (0.11–0.13 mg/kg dry weight) stayed well within European regulatory thresholds. Non-monotonic responses and element correlations suggested complex soil-plant interactions under water restriction. The 66% ETc treatment effectively preserved key macronutrients, maintained Fe and Cu within appropriate ranges, moderated Na and P accumulation, and guaranteed food safety, while achieving an estimated 34% reduction in irrigation water. These results demonstrate that regulated deficit

irrigation can optimize water use efficiency without compromising the mineral quality or safety of the fruit, consolidating it as a sustainable agronomic strategy for fruit production under water-scarce scenarios.

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IMPROVING THE QUALITY AND FUNCTIONAL PROPERTIES OF HOMOGENIZED MEAT PRODUCTS THROUGH BUCKWHEAT HUSK INCORPORATION

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Keywords: meat products, buckwheat, dietary fibre, bioactive properties, food quality, agri-food by-product, sustainable production

Abstract: The optimization of food processing and the development of functional products are key strategies for enhancing quality throughout the food production chain. This study investigates the effects of incorporating milled buckwheat husk (at 1.0 g/100 g and 1.5 g/100 g) into the formulation of homogenized meat products, focusing on their dietary fibre content, oxidative stability, and health-promoting properties. The addition of buckwheat husk significantly improved the antioxidant profile of the meat products, showing a greater ability to scavenge ABTS radicals (472 and 497 μmol TE/100 g) compared with the control samples (250 μmol TE/100 g). From a food quality and shelf-life perspective, the incorporation of 1.5 g/100 g buckwheat husk effectively inhibited lipid oxidation in these homogenized products after 14 days of cold storage. Furthermore, this sustainable ingredient enhanced the nutritional value of the final products, yielding a high content of dietary fibre (26%). The homogenized meat products also demonstrated in vitro inhibitory activities against ACE (angiotensin-converting enzyme) and α-glucosidase, indicating their anti-hypertensive and anti-diabetic potential. In conclusion, using buckwheat husk as a functional additive represents a valuable approach to improving both the nutritional quality and storage stability of homogenized meat products within the contemporary food production chain.

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TOWARDS THE 'CLOSER TO ZERO' GOAL: ASSESSMENT OF METAL(LOID) LEVELS IN FISH-BASED BABY FOOD IN SPAIN

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Keywords: complementary feeding; soft foods; fish; environmental pollutants; food safety; infants; young children

Abstract: Childhood is a period of high biological vulnerability during which dietary exposure to environmental contaminants, such as heavy metals and metalloids, is of particular concern, as it may affect neurodevelopment, amongst other factors. The aim of this study was to establish a baseline for reducing the levels of these contaminants in fish-based pureed baby foods (FPBF), in line with the 'Closer to Zero' strategy. To this end, on the one hand, the levels of arsenic (As), mercury (Hg), cadmium (Cd) and lead (Pb) were determined in FPBF products marketed in Spain (15 types × 3 batches × 3 units) using multi-element analysis by ICP-MS; and, on the other hand, As speciation was carried out by HPLC-ICP-MS. The results showed that total arsenic concentrations varied widely (16.2–205 µg/kg), with arsenobetaine of marine origin predominating; all samples were found to be below the maximum limit for inorganic arsenic established in European legislation. Mercury levels were relatively low (10.4–22.0 µg/kg) due to the use of species at a low trophic level, complying with the limits established for the fish species used. The highest concentrations of cadmium (10.6–13.5 µg/kg) were found in samples containing both roots and tubers, with various agronomic factors also likely to have played a role. Lead was undetectable in 66.7% of the samples and, in the remainder, remained below the maximum legal limit (0.020 mg/kg). It is concluded that all the products analysed comply with current European legislation. However, the detection of these elements in such a vulnerable population highlights the need for rigorous selection of ingredients and processing operations, as well as continuous monitoring to minimise their presence as much as possible.

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COLORIMETRIC PHENOTYPING OF BRUISES IN BROILER CARCASSES UNDER COMMERCIAL SLAUGHTERHOUSE CONDITIONS

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Keywords: broiler chicken, bruise, CIE L*a*b*, colorimetry, slaughterhouse

Abstract: Bruise prevalence is commonly accepted as one method of evaluating welfare in broiler chickens, but it can often be difficult to determine the timeline and actions resulting in such wounds. It has been long accepted that the color of the bruise will change over time, but visualization with the naked eye only allows for the timing of the wound to be estimated, potentially leading to welfare issues causing these bruises to be overlooked. Therefore, in this study, bruises located on various anatomical regions of 79 Ross 308 broiler carcasses were measured using a 4mm measurement aperture under universal environmental conditions and CIE L*a*b* values were determined. From these measurements, R version 4.2.2 was used to calculate ΔE* and subsequently summarize the colorimetric parameters of samples from each anatomical region (wing, breast, or leg). The differences between bruise locations were evaluated via Kruskal-Wallis test and, in the event of statistical significance ($P < 0.05$), further Dunn's tests with Holm adjustments were performed for pairwise comparisons. Colorimetric parameters were Z-score standardized and each sample was assigned to one of three clusters, and cluster profiles were summarized as mean ± SD. It was found that different anatomical regions had significantly different a* and b* values, particularly between leg and wing bruises. Heatmap visualization corroborated these findings, with each cluster being mainly inhabited by samples from one particular location. Such results are more uniform than analysis via the naked eye and confirm that the majority of bruises in each anatomical location were obtained in a relatively short time period, indicating that handling procedures can be further modified to avoid such lesions.

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RAW MILK FERMENTATION AND ANTIMICROBIAL RESISTANCE: CHANGES IN BACTERIAL COMMUNITIES AND B-LACTAM RESISTANCE GENES

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Keywords: antibiotic resistance, qPCR, 16S rRNA sequencing, raw milk, fermentation, soured milk, fermented milk

Abstract: Antimicrobial resistance (AMR) is a major global public health concern, with food matrices considered potential reservoirs of antibiotic-resistant bacteria and antimicrobial resistance genes (ARGs). Fermentation may influence the survival of resistant microorganisms and the persistence of ARGs; however, these interactions remain insufficiently understood. This study evaluated the effect of raw milk fermentation under different experimental conditions involving *Lactiplantibacillus plantarum* ATCC 8014, an *Enterococcus* isolate showing phenotypic resistance to selected antibiotics based on the Kirby–Bauer disk diffusion assay, and penicillin G used as a selective pressure (15 mg/L) on bacterial population dynamics and the occurrence of selected β-lactamase genes (bla_{TEM}, bla_{SHV} and *ampC*). Milk fermentation was performed at 22°C for 48 h until visible curd formation. Samples were collected before and after fermentation, followed by DNA extraction and bacterial community analysis using 16S rRNA gene sequencing with the Oxford Nanopore MinION platform. The relative abundance of selected ARGs was determined by qPCR using the 16S rRNA gene as an internal reference. Sequencing analysis revealed a significant relative decrease in the *L. plantarum* population during fermentation across all experimental variants, whereas the abundance of the *Enterococcus* isolate varied with fermentation conditions. The bla_{TEM} gene was highly abundant before fermentation (relative abundance ranging from 0.00076 to 0.14212) and showed a substantial decrease (96–99%) after fermentation in all variants. The bla_{SHV} and *ampC* genes were initially detected at low relative abundance but increased during fermentation, particularly in variants supplemented with penicillin (4.1-fold and 2.7-fold, respectively). The results indicate that *L. plantarum* ATCC 8014 was unable to maintain dominance within the bacterial population after 48 h of fermentation. Raw milk fermentation may increase the relative abundance of selected resistance genes, particularly bla_{SHV} and *ampC*. Penicillin G used as a selective pressure, which simulated antibiotic residues, appeared to

have a stronger impact on ARG dynamics than the presence of the resistant *Enterococcus* isolate.

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POWDERS BASED ON MULTICOMPONENT OIL-IN-WATER FORMULATIONS DEVELOPED USING RASPBERRY JUICE, SEED OIL, AND OPTIONALLY LEAVES: CONTENT AND IN VITRO INTESTINAL AVAILABILITY OF SELECTED BIOACTIVE COMPOUNDS

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Keywords: emulsion-based powders, phenolic compounds, carotenoids, chlorophylls, *in vitro* digestion process

Abstract: Various parts of the red raspberry (*Rubus idaeus* L.), such as the fruits, seeds, and leaves, contain bioactive compounds, including phenols, carotenoids, and chlorophylls, which may exhibit multidirectional health-promoting potential. Unfortunately, these substances are highly susceptible to degradation upon exposure to various environmental factors, and their bioavailability is low. Therefore, research is currently underway to find ways to ensure their protection. Encapsulation, which involves coating the active ingredient with a carrier material, appears to be a promising approach. This process may increase the resistance of bioactive compounds to external factors and potentially allow larger amounts of them to reach the intestines during digestion. Emulsification, for example, can be used for this purpose. Therefore, the aim of this work was to obtain powders based on multicomponent oil-in-water formulations from various morphological parts of raspberries by freeze-drying. Four variants were created using raspberry juice and either unenriched raspberry seed oil or raspberry seed oil enriched with substances derived from raspberry leaves. The formulations were prepared using inulin or a 213:12 fructooligosaccharides/xanthan gum mixture. The mass ratios of juice, oil, and additive (80:5:15 *m/m/m*) and drying conditions were identical. Subsequently, the content of phenolic compounds, carotenoids, and chlorophylls in the created variants was examined, as well as the *in vitro* intestinally available amounts of these compounds, which were analyzed using a simulated digestion model. The studies showed that while the unenriched variant with inulin (JO-IN-FD) contained the highest concentrations of flavonols and flavan-3-ols, and its enriched counterpart (JLEO-IN-FD) contained the highest concentrations of anthocyanins, phenolic acids, carotenoids, and chlorophylls, these trends did not always translate to the results observed after simulated digestion. The findings emphasize that the assessment of the potential

bioaccessibility of bioactive compounds should become an integral part of food research, while future studies should further elucidate their bioavailability.

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FROM OCCURRENCE TO EXPOSURE: POTENTIALLY TOXIC ELEMENTS IN COFFEE, TEA AND COCOA

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Keywords: toxic elements; arsenic; lead; cadmium; coffee; tea; cocoa; dietary exposure; food;

Abstract: Coffee, tea and cocoa are widely consumed plant-derived beverages and foods from *Coffea L.*, *Camellia sinensis L.* and *Theobroma cacao L.* Although they are sources of desired chemical compounds, they can accumulate a number of potentially toxic elements such as cadmium (Cd), lead (Pb), mercury (Hg) and arsenic (As). Concentrations of these elements measured in raw materials or commercial products do not directly reflect consumer exposure. Environment, processing, preparation and bioaccessibility may substantially influence the amount of absorption. This critical review synthesizes recent peer-reviewed evidence on the occurrence, determinants, transfer and potential health significance of toxic elements in coffee, tea and cocoa. The reviewed studies were compared with respect to concentrations, geographical and environmental determinants, processing and brewing conditions, transfer to final products, bioaccessibility, dietary exposure and risk assessment. Cocoa products showed pronounced variability in Cd concentrations, with geographical origin and cocoa content. Coffee showed lower overall toxic element concentrations, with Cd and Pb transfer into brewed coffee reported as low risk under the investigated consumption scenarios. Tea presented a complex pathway of transfer of elements, involving environmental availability, time of plant uptake and subsequent transfer from leaves to infusions, influenced by tea characteristics and preparation conditions. Recent evidence on bioaccessibility indicates that total concentration of elements may provide incomplete conclusions for characterizing potential health risks.

The comparative evidence supports a shift from occurrence-based monitoring towards an integrated soil-to-consumer assessment including environmental sources, plant uptake, processing, preparation, bioaccessibility and consumption behavior. Such an approach may provide a more accurate basis for identifying critical control points, population risks and priorities for food-safety research.

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SODIUM AND POTASSIUM MONITORING AS A TOOL IN THE DEVELOPMENT OF REDUCED-SODIUM CHEESE

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Keywords: sodium reduction; potassium chloride; cheese brine; atomic absorption spectrometry; dairy technology

Abstract: The development of reduced-sodium cheeses has become an important objective for the dairy industry due to growing consumer awareness of the health risks associated with excessive sodium intake. In addition to technological modifications, such as the partial replacement of sodium chloride (NaCl) with potassium chloride (KCl), successful implementation of sodium-reduction strategies requires reliable analytical methods for determining sodium and potassium concentrations in cheese and brine systems. Such measurements are essential not only for process control but also for verifying compliance with regulatory requirements for nutrition claims, including „*reduced sodium*" and „*source of potassium*". The aim of this study was to review analytical methods available for sodium and potassium determination and to evaluate their suitability for supporting the development of reduced-sodium cheese technology. The review included reference laboratory techniques, such as atomic absorption spectrometry (AAS), inductively coupled plasma atomic emission spectrometry (ICP-AES), flame emission spectrometry and ion chromatography, as well as rapid methods based on ion-selective electrodes (ISEs) and portable measuring devices. The methods were compared with respect to analytical performance, accuracy, analysis time and applicability under dairy plant conditions. As part of preliminary research on reduced-sodium cheese technology, sodium and potassium concentrations were determined by AAS in cheeses produced using conventional and modified brining systems. Preliminary findings indicate that the mineral composition of cheese depends not only on brine composition but also on ion diffusion during salting and ripening and on the physicochemical properties of the cheese matrix. These observations highlight the importance of selecting appropriate analytical methods for monitoring sodium and potassium throughout the manufacturing process. Portable ISE-based devices appear to be promising tools for routine brine monitoring, whereas reference laboratory methods remain indispensable for accurate determination of these elements in cheese.

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EFFECT OF NEUTRAL ELECTROLYZED WATER AND SILVER IONS-CITRIC ACID FORMULATION AGAINST BIOFILMS FORMED BY FOODBORNE PATHOGENS

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Keywords: Biofilm, antimicrobial strategies, electrolyzed water, silver ion-citric acid formulation, foodborne pathogens, food processing environments

Abstract: Persistence of foodborne pathogens in food-processing environments is linked to their ability to form biofilms on surfaces. Biofilm control relies on conventional biocides, but several eco-friendly antimicrobial strategies have recently been proposed to complement existing sanitation protocols. Anyway, these approaches require preliminary *in vitro* evaluation against pre-formed biofilms. The aim of this study was to determine the minimum inhibitory concentrations (MICs) and the minimum biofilm eradication concentrations (MBECs) of neutral electrolyzed water (NEW) and a silver ions-citric acid formulation (SIs) against planktonic forms and biofilms of *Listeria monocytogenes*, *Staphylococcus aureus*, and *Salmonella enterica.* Three strains (one ATCC and two wild-type isolates) for each species were screened for their biofilm-forming ability employing the colorimetric micro-method assay (Stepanović et al., 2007). MICs were determined following the Clinical & Laboratory Standards Institute guidelines (CLSI, 2012). MBECs were determined using the MBEC Assay® Biofilm Inoculator with 96 Well Base (Innovotech Inc., Edmonton, AB, Canada). All targeted strains were classified as biofilm producers based on micro-method assay. For SIs, 12.5% MIC was recorded against *S. aureus* and *S. enterica*, while for *L. monocytogenes* the effect varied between the strains tested (MICs from 12.5% to 25%). NEW showed a MIC of 25% against *L. monocytogenes*, while no MICs were observed for the other pathogens. The results of MBEC assay showed a different situation for the antibiofilm action, since NEW was generally effective on adherent cells (MBEC of 25% for all tested pathogens). SIs were effective only against biofilms formed by *S. aureus*, with MBEC values from 12.5% to 25%. These preliminary outcomes demonstrated the antimicrobial and antibiofilm action of both the proposed technologies, even if a strain-dependent variability was observed. Future work will focus on evaluating these approaches under near-real conditions, in order to assess their applicability for controlling environmental contamination in the food industry.

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EFFECT OF PROCESSING CONDITIONS ON THE STABILITY OF PAPRIKA OLEORESIN ENCAPSULATED IN SODIUM ALGINATE HYDROGELS

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Keywords: encapsulation; hydrogel; paprika oleoresin; processing stability; sodium alginate

Abstract: Encapsulation of bioactive compounds has become an important approach for targeted delivery system in medicinal, pharmaceutical, cosmetic and food industries. This study aims to evaluate the stability of the sodium alginate hydrogels (1.5% and 2%) with paprika oleoresin (1%) under different processing methods: cooking, cooling, freezing, and microwaving. The encapsulation efficiency, weight loss, pigment retention, and variations in the chemical structure of the hydrogel were evaluated. The encapsulation efficiency in 1.5% sodium alginate hydrogel (58.97 ± 3.67%) was significantly higher than that of 2% sodium alginate hydrogels (46.47 ± 3.70%). Sodium alginate concentration and the presence or absence of paprika oleoresin did not significantly affect mass loss, which averaged 49.68% during processing. Significantly higher mass loss was identified during freezing (98.85 ± 1.80%) compared to the cooking, cooling, and microwave methods. In contrast, significantly lower mass loss was identified after cooking treatment (0 ± 0.0%). The concentration of sodium alginate did not influence ($p < 0.05$) (51.67 mg/g) the pigment retention during the processing techniques. However, during the cooking treatment, a significantly higher concentration of pigments was released while keeping the least amount (36.15 mg/g) in the hydrogel. The Fourier Transform Infrared Spectroscopy (FTIR) analysis showed changes in the O–H stretching band in the range of 3380–3340 cm^{-1} due to the presence of paprika oleoresin in the hydrogel, suggesting interactions between OH groups and the lipid components of the oleoresin. Encapsulation of paprika oleoresin in sodium alginate is a successful carrier method to preserve the paprika oleoresins. However, the quality of the hydrogels is strongly influenced by processing methods.

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THE STONE EXTRACT OF *CORNUS MAS × CORNUS OFFICINALIS* 'JERZY' DEMONSTRATES A HYPOGLYCEMIC EFFECT IN STREPTOZOTOCIN-INDUCED RAT MODEL OF DIABETES

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Keywords: type 1 diabetes; *Cornus mas* × *Cornus officinalis* 'Jerzy' cultivar; stone extract; hypoglycemic effect.

Abstract: Diabetes is a metabolic disease that affects 588,7 million people worldwide. The hyperglycemia is a hallmark of this disease. Phytochemicals constitute an alternative way in a treatment and prophylaxis of diabetes complications. Promising source of such phytochemicals is stones of *Cornus mas* × *Cornus officinalis*, because they possess combination of beneficial features of both species. Therefore, the study aimed to assess the hypoglycemic effect of the stone extract of *C. mas* × *C. officinalis* 'Jerzy'. The experiment was conducted on male Wistar rats that were divided into three groups: control group (intact animals), diabetic group (animals with diabetes) and treated group (animals with diabetes). Diabetes was induced by intraperitoneal injection of streptozotocin. The treated group was receiving the stone extract at a dose 20 mg/kg b.w. for 14 days while other groups were receiving water. To assess hypoglycemic effect of the stone extract we performed glucose tolerance test (GTT) and amylum tolerance test (ATT) and measured blood glucose and glycated hemoglobin (HbA1*c*). After 14 days of treatment with the stone extract the blood glucose level in the treated group lowered by 60% comparatively to the diabetic group. The level of HbA1*c* in the treated group significantly decreased than in the diabetic group and reached the level of the control group. The area under the curve (AUC) of GTT was 4 times greater in the diabetic group than in the control group and 2.7 times lower in the treated group than in the diabetic group. The AUC of ATT was 3,5 times greater in the diabetic group than in the control group and 1.9 times lower in the treated group than in the diabetic group. Our results suggest that the stone extract of *C. mas* × *C. officinalis* 'Jerzy' has hypoglycemic effect and outline the potential antidiabetic properties of this extract.

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CELLULOSE FROM SPENT COFFEE GROUNDS AS A SUSTAINABLE REINFORCEMENT IN BIOCOMPOSITES FOR THE FOOD INDUSTRY: REVIEW

Shima Vahedi, Żaneta Król-Kilińska, Łukasz Bobak, Dominika Kulig, Anna Krawczyk, Dilani Thilanka Hewa Pathiranage, Sebastian Szymański, Aleksandra Szmaja, Anna Zimoch-Korzycka

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Keywords: spent coffee grounds; cellulose; biocomposites; biodegradable polymers; food packaging; fat replacement; emulsification; aerogels; circular economy; lignocellulosic waste

Abstract: Global spent coffee grounds (SCGs) generation reaches 60 million tons annually. Current disposal methods cause significant environmental damage, but extracting SCGs cellulose for biocomposites, bioplastics, and porous aerogels offers a high-value circular economy alternative. Spent coffee grounds (SCGs) are an abundant lignocellulosic by-product generated in large volumes by the coffee industry. They contain significant amounts of cellulose, hemicellulose, and lignin, making them a promising renewable resource for the production of biocomposites intended for food-related uses. A biocomposite is a material in which a polymer matrix is strengthened by natural fibers or fillers. In this context, cellulose extracted from SCGs is combined with biodegradable polymers such as polylactic acid (PLA), polybutylene adipate terephthalate (PBAT), starch, or chitosan. The resulting materials offer a more sustainable alternative to conventional petroleum-based plastics while maintaining useful mechanical and functional properties. The transformation of SCGs into functional biocomposites follows a clear sequence. First, cellulose is isolated through appropriate extraction and purification steps. The purified cellulose is then incorporated into the chosen polymer matrix under controlled processing conditions. Finally, the composite is customized to meet the performance requirements of specific applications.

Recent studies indicate several promising directions for these materials in the food sector. They can serve as components of biodegradable packaging films and containers, act as: fat replacers, emulsifiers or stabilizers in food formulations, and be processed into lightweight aerogels with potential absorbent or carrier properties.

By converting a widely available waste stream into value-added materials, SCG-derived cellulose biocomposites support circular economy principles and help reduce the environmental footprint of the coffee and food industries. Continued research is needed to optimize ex-

traction yields, improve interfacial compatibility between cellulose and the polymer matrix, and evaluate long-term performance and safety under real food contact conditions. In general, these biocomposites represent a practical and environmentally responsible way toturn coffee waste into useful products for the food industry.

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PHYSICAL MODIFICATION OF CELLULOSE BY HIGH-PRESSURE HOMOGENIZATION

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Keywords: spent coffee grounds; cellulose; high-pressure homogenization; physical modification; food packaging

Abstract: The aim of the study is the preparation of nanocellulose through the physical modification of a commercially available methylcellulose. The biophysicochemical properties of the obtained material were evaluated to assess its technological applications as films or coatings. High-pressure homogenization (micro fluidization) was applied as the modification method. The methylcellulose solutions at various concentrations were subjected to single or double homogenization. The hydrosols obtained were examined for active acidity and viscosity. Such prepered solutions served as film-forming solutions. Films were characterized for mechanical performance (tensile strength), water solubility, moisture content, optical properties, and water-vapor permeability. On the basis of statistical analysis of data, it was concluded that the high-pressure homogenization is an effective physical method for modifying cellulose. Changes in solution viscosity and film properties depended on both polymer concentration and the number of homogenizations passes, enabling adjustment of mechanical strength, barrier performance and thermal stability without altering the chemical structure of the polymer. The use of high-pressure homogenization in the production of methylcellulose films with appropriate properties for use in food packaging design is demonstrated. Depending on the characteristics and future application of the packaging, it is possible to select the appropriate methylcellulose concentration and microfluidization process parameters to achieve the required packaging material characteristics. It has been demonstrated that the use of high-pressure homogenization for physical modification and the production of micro- and nano-forms of cellulose, and their use in the formation of protective films with specific properties in food packaging design, can be used. Depending on the characteristics of the resulting material and the future packaging application, it is possible to select the appropriate methylcellulose concentration and microfluidization process parameters to achieve targeted properties of the packaging material.

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VALORIZATION OF SPENT COFFEE GROUNDS-DERIVED CELLULOSE AND NANOCELLULOSE AS FAT REPLACERS AND EMULSIFIERS IN COMPANION ANIMAL NUTRITION

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Keywords: spent coffee grounds; cellulose; nanocellulose; cellulose nanocrystals; cellulose nanofibers; fat replacer; emulsifier; Pickering emulsion; pet food; companion animal nutrition; circular economy; agro-industrial waste

Abstract: Spent coffee grounds (SCG) represent a major agro-industrial residue, generated at more than six million tons annually. They contain 8–15 % cellulose together with residual lipids, proteins and polyphenols, yet remain largely under-utilised. Powdered cellulose is already an established feed ingredient in commercial pet foods, providing caloric dilution, improved stool quality, hairball control and texture modification. Nanocellulose forms–cellulose nanocrystals (CNC) and cellulose nanofibers (CNF)–offer additional advantages: high aspect ratio, large specific surface area and partial amphiphilicity enable them to stabilize oil-in-water Pickering emulsions, form networks that mimic the rheological behavior of fat, and modestly reduce lipid digestibility. These properties have been demonstrated in human-food systems, where 10–50 % fat replacement has been achieved while preserving texture and emulsion stability. Despite successful laboratory isolation of CNC and CNF from SCG, no peer-reviewed studies have evaluated coffee-derived cellulose or nanocellulose inside pet-food matrices. Critical gaps therefore persist: (i) absence of data on emulsifying capacity, texture and processing stability in companion-animal formulations; (ii) lack of direct comparison with commercial wood-derived cellulose; (iii) incomplete understanding of safety, digestibility and regulatory requirements for nanoscale cellulose under oral exposure in pets; and (iv) need for optimized food-grade extraction routes that maximize yield while removing residual caffeine and polyphenols that could affect palatability. The proposed research addresses these gaps through a structured laboratory programme. SCG will undergo sequential defatting, alkaline delignification, bleaching and controlled acid hydrolysis or TEMPO-mediated oxidation followed by mechanical fibrillation. Materials will be characterized for yield, crystallinity, morphology, surface chemistry and water-/oil-holding capacities. Functional performance will be quantified in model emulsions and pet-food batters at graded fat-replacement levels (10–50 %), using emulsion stability, droplet-size distribution, rheology and texture analysis, with commercial cellulose as refer-

ence. In-vitro gastrointestinal digestion models will assess free fatty-acid release. The resulting dataset will provide the first evidence base for the suitability of SCG-derived nanocellulose as a dual-purpose fat replacer and emulsifier in companion-animal nutrition, support subsequent in-vivo trials and regulatory discussions, and advance the circular valorization of a high-volume waste stream.

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QUALITY AND FUNCTIONAL POTENTIAL OF DEHYDRATED VEGETABLE POWDERS FOR WHEY-BASED FOOD PEARLS

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Keywords: dehydrated vegetables; whey valorization; functional ingredients; antioxidant capacity; natural pigments; food structuring; 3D food bioprinting; reverse spherification

Abstract: The valorization of dairy by-products and plant-derived ingredients represents an important direction for the development of sustainable and functional foods. This study aimed to preliminarily evaluate selected dehydrated vegetable powders as potential functional ingredients for future incorporation into whey-based food pearls obtained through food structuring technologies such as reverse spherification and 3D food bioprinting. Red onion, red cabbage and red beet were dehydrated under mild conditions (50 °C) and processed into fine powders. The powders were assessed in terms of color characteristics, selected bioactive compounds and antioxidant potential, with particular attention to their relevance for food structuring applications, including natural color contribution, functional value and suitability for dispersion in a dairy-based matrix. The preliminary results indicated distinct functional profiles among the investigated vegetable powders. Red beet powder showed potential as a natural coloring ingredient due to its betalain content, while red cabbage and red onion powders contributed through phenolic compounds and anthocyanin pigments. The antioxidant potential differed according to the botanical source and the class of bioactive compounds present. These findings support the use of dehydrated vegetable powders as promising ingredients for the development of innovative whey-based pearls with added functional value, natural color and possible applicability in dairy products, desserts, toppings and ready-to-eat foods. The study represents a preliminary step within a broader technological approach focused on whey valorization through structured functional food prototypes. Further research will address the incorporation of selected powders into whey-based matrices and the optimization of reverse spherification and 3D food bioprinting parameters.

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SOUS-VIDE PROCESSING OF WHITE KOŁUDA® GOOSE BREAST MEAT: EFFECT OF COOKING TEMPERATURE AND TIME ON FUNCTIONAL, SENSORY AND NUTRITIONAL QUALITY

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Keywords: goose meat; sous-vide cooking; cooking temperature-time combination; cooking loss; texture profile analysis; nutrient retention; sensory quality

Abstract: Sous-vide (SV) cooking, in which vacuum-packed raw material is heated at a precisely controlled water temperature, delivers a ready-to-eat product while limiting damage to heat-sensitive compounds, yet evidence for goose meat remains scarce relative to pork, beef and gallinaceous poultry. This work consolidates the SV findings of three studies on breast muscles (Pectoralis major, with and without skin) from 17-week-old White Koluda® geese, spanning cooking temperatures of 60, 70 and 80°C and holding times of 4, 6 and 12 h in thermostated water baths. Cooking loss (CL), moisture, pH, longitudinal and transverse shrinkage, CIE L*a*b* colour, shear force (SF), texture profile analysis, trained-panel sensory evaluation (ISO 8586:2012), proximate composition, energy value, total cholesterol, macro- and microelements and nutrient retention coefficients were determined. Cooking temperature influenced quality traits more strongly than holding time. CL was lowest at 60°C/4 h (19.1% without skin; 23.7% with skin), intermediate at 70°C/4 h (22.1% and 32.2%) and highest at 80°C/12 h (36.7% and 44.0%); the presence of skin consistently raised losses through rendering of subcutaneous fat, and longitudinal shrinkage exceeded transverse shrinkage, both increasing with temperature. Meat processed at 60°C retained higher L* and a* and lower b*, and showed a general trend towards lower SF and hardness, indicating greater tenderness, although SV60/12 departed from this pattern for both traits; among all variants SV60/4 gave the most favourable texture profile. All SV variants achieved extremely desirable overall palatability, with no significant differences between muscles with and without skin; sensory tenderness, however, was significantly affected by holding time and scored highest at 60°C/12 h ($P \leq 0.05$), diverging from the instrumental ranking. SV processing preserved nutrients efficiently, with cholesterol retention of 106.0%, ash retention of 93.6% and elevated Na and K, reflecting the absence of leaching into cooking water; these nutritional endpoints were es-

tablished at 70°C/4 h. Overall, 60°C/4 h proved optimal for water retention and instrumental texture rather than for every trait examined, and SV muscles without skin represented the most favourable dietary option, combining the lowest energy value and fat content with the highest retention of Mg, Ca and K.

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Note: This abstract summarises the sous-vide results of three previously published studies, where full methodology, tables and discussion are available: (1) Wereńska, M. Effect of different sous-vide cooking temperature-time combinations on the functional and sensory properties of goose meat. *Poultry Science* 2024, 103, 103701. https://doi.org/10.1016/j.psj.2024.103701 (2) Wereńska, M. Comparative study on the effects of sous-vide, microwave cooking, and stewing on functional properties and sensory quality of goose meat. *Poultry Science* 2023, 102, 103064. https://doi.org/10.1016/j.psj.2023.103064 (3) Wereńska, M.; Haraf, G.; Okruszek, A.; Marcinkowska, W.; Wołoszyn, J. The effects of sous vide, microwave cooking, and stewing on some quality criteria of goose meat. *Foods* 2023, 12, 129. https://doi.org/10.3390/foods12010129

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FOOD BIOFORTIFICATION – A WASTE OF TIME OR A CHALLENGE FOR EUROPE?

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Keywords: biofortification; agronomic biofortification; micronutrient deficiency

Abstract: Biofortification is the process of plant enrichment during their growth, usually with minerals and vitamins. It is carried out to reduce nutritional deficiencies and is recommended as one of the strategies that can be used in parallel with food supplementation and fortification. It is globally applied, but not in Europe. The method is cost-effective, scalable, and able to improve nutrition without changing eating habits. The most spectacular effects were achieved outside Europe: biofortification of sweet potatoes and rice with vitamin A, beans with iron, and wheat with zinc. In Europe, Finland has been biofortifying wheat with selenium through fertilization for many years. This strategy led to a significant increase in selenium levels across the entire population without altering consumers' diets. The trend of the use of agronomic methods (rather than GMOs) is being intensively researched and developed in Europe. However, it is still mainly at the project stage; it is a politically and structurally constrained tool. The European Union has restrictive regulations regarding new breeding techniques. Thus, is it worth using? We could replace food fortification with biofortification. Replace salt iodization with controlled soil fertilization; replace adding iron, zinc, and selenium at the food production stage by introducing these nutrients into plant materials during growth. Let us discuss the benefits, side effects, regulations, and ongoing research on this topic.

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DEVELOPMENT OF AN INNOVATIVE SNACK BASED ON FRUIT AND/OR FRUIT-AND-VEGETABLE PURÉE WITH YOGURT

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Keywords: functional food, fruit purée, yogurt, lactoferrin, shelf-stable, room temperature

Abstract: The objective of the research and development activities was to develop an innovative food product – a snack in the form of fruit and/or fruit-and-vegetable purée with the addition of yogurt, enriched with ingredients with targeted health-promoting properties, representing a new category of shelf-stable functional food. The product under development combined high nutritional and sensory quality with an extended shelf life at room temperature, without the need for refrigerated storage. The key technological challenges included ensuring microbiological stability and product safety throughout the entire storage period, maintaining high and consistent organoleptic quality, and designing a new technological process enabling distribution without refrigeration. The formulations were developed iteratively, based on sensory, technological, nutritional, and shelf-life criteria. Natural and lactose-free yogurt, fruit and vegetable purées, flavouring components, structure-stabilising systems, and bioactive ingredients were used, including lactoferrin, vitamins A, D, E and K, folic acid, lutein, melatonin, lycopene, calcium, and zinc. A comprehensive set of research methods was applied, including physicochemical and chemical composition analyses, determination of bioactive compounds, rheological and colour measurements, microbiological analyses, sensory evaluation, shelf-life studies, technological and validation testing, and consumer research. The work was carried out under laboratory and pilot-scale conditions, as well as at full production scale. As a result of the project, four product variants meeting the defined quality and functional requirements were developed and validated. For three variants, microbiological stability was confirmed for a minimum of 12 months of storage at room temperature following heat treatment at 95°C for 60 seconds (total bacterial count <100 CFU/g; absence of yeasts and moulds). The products were confirmed to contain biologically active ingredients at levels enabling nutritional claims, including vitamins A, D and E and zinc at ≥15% of the NRV per 100 g, as well as lactoferrin at a minimum level of 40 mg per 100 g of product. The developed technology was verified at pilot scale, achieving 75% of the target production capacity, confirming the readiness of the solution for implementation.

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MILK IS MORE THAN THE SUM OF ITS COMPONENTS

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Keywords: milk; dairy matrix; bioactive compounds; milk proteins; milk fat globule membrane; bioactive peptides; fermented dairy products; functional foods; human nutrition

Abstract: Milk is traditionally recognized as a nutrient-dense food providing high-quality proteins, lipids, lactose, minerals, and vitamins. However, an increasing body of scientific evidence indicates that its nutritional and physiological significance extends beyond the simple contribution of individual nutrients. Milk represents a highly complex biological system in which nutrients coexist with bioactive compounds and are organized within specific structural matrices that influence their digestion, absorption, bioavailability, and biological activity. Consequently, the health effects of milk and dairy products cannot be fully predicted from their nutrient composition alone. Milk proteins, particularly caseins and whey proteins, provide essential amino acids while also acting as precursors of bioactive peptides with potential antihypertensive, antimicrobial, immunomodulatory, antioxidant, and metabolic functions. The milk fat fraction comprise a broad spectrum of fatty acids and lipid-soluble bioactive components. Of particular interest is the milk fat globule membrane, a naturally occurring supramolecular structure containing phospholipids, sphingolipids, glycoproteins, and other components potentially involved in intestinal, metabolic, immune, and neurological functions. Milk also supplies minerals, especially calcium and phosphorus, within a unique physicochemical environment that may affect their bioavailability and physiological utilization. Importantly, the biological properties of dairy products are determined not only by their composition but also by the food matrix. Interactions among proteins, lipids, carbohydrates, minerals, and microorganisms, together with structural modifications induced by technological processing, influence nutrient release. Emerging processing technologies and targeted fractionation of milk components additionally provide opportunities to preserve, enhance, or selectively exploit these functional properties. Understanding milk as an integrated biological and food matrix rather than simply a collection of nutrients offers a more comprehensive framework for evaluating its role in human nutrition. This perspective is increasingly relevant for the development of functional and personalized dairy products, optimization of processing technologies, and evidence-based assessment of the relationship between dairy consumption and health. Thus, milk is more than the sum of its nutrients: its nutritional value emerges from the complex interactions between composition, structure, processing, digestion, and biological function.

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FERMENTATION PROFILES AND QUALITY PROPERTIES OF COW, GOAT, AND MIXED-MILK YOGURTS

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Keywords: cow milk, goat milk, yogurt, yogurt starter culture, fermentation pattern, texture, sensory analysis, volatile organic compounds

Abstract: The growing interest in goat milk and mixed-milk dairy products has increased the need to better understand how different milk sources influence yogurt fermentation, physicochemical characteristics, microbial stability, aroma development, and sensory quality. This study aimed to compare the fermentation behavior and quality attributes of yogurts produced from cow milk, goat milk, and mixtures of both milk types in different proportions. Yogurts were prepared from cow milk (A), goat milk (E), and mixed cow–goat milk at volume ratios (v/v) of 75:25 (B), 50:50 (C), and 25:75 (D). Fermentation performance, chemical composition, microbiological quality, water-holding capacity, syneresis, texture, and color parameters were evaluated. Volatile organic compounds (VOCs) were analyzed in milk before fermentation and in yogurts after production and during two weeks of refrigerated storage, while sensory attributes were assessed after the storage period. Increasing the proportion of goat milk in the blends shortened fermentation time and resulted in yogurts with greater lightness and whiteness. In contrast, a higher proportion of cow milk promoted better survival of lactic acid bacteria, improved water-holding capacity and textural properties, and reduced syneresis, indicating greater structural stability. Milk type also significantly influenced the chemical composition of the yogurts, with products containing more goat milk characterized by higher fat content and lower lactose content. Furthermore, increasing the proportion of goat milk promoted the formation of methyl ketones and aldehydes associated with characteristic fatty and goat-like aroma notes. Among the mixed-milk formulations, the yogurt containing 25% goat milk achieved the highest sensory acceptance, suggesting that a moderate addition of goat milk may improve product differentiation without negatively affecting consumer perception. Overall, the results demonstrate that combining cow and goat milk can provide a favorable balance between fermentation efficiency, physicochemical and textural stability, microbial viability, aroma profile, and sensory acceptance. These findings support the potential application of cow–goat milk

blends in the development of diversified fermented dairy products with desirable technological and sensory properties.

Funding: The research was conducted within a project funded under the designated subsidy of the Minister of Science, Republic of Poland, task entitled 'The Research Network of Life Sciences Universities for the Development of the Polish Dairy Industry – Research Project' (MEiN/2023/DPI/2875).

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EXPORT CONCENTRATION AND THE DOMESTIC CONSUMPTION GAP IN POLAND'S GOOSE MEAT AND OFFAL TRADE, 2020–2024

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Keywords: goose meat, foreign trade, export concentration, Herfindahl-Hirschman Index, domestic consumption, food system resilience

Abstract: Poland ranks among the world's leading exporters of goose meat and edible offal, alongside China and Hungary, yet domestic consumption remains marginal, revealing a structural imbalance between production and internal demand. This study provides a comprehensive economic assessment of Poland's foreign trade in goose meat and offal over 2020–2024, focusing on export concentration, price dynamics, and the domestic consumption gap. Trade flows were analysed using official data from the Central Statistical Office (GUS), Eurostat, UN Comtrade and the National Bank of Poland, disaggregated by Combined Nomenclature product codes, destination country and unit price; market concentration was quantified with the Herfindahl-Hirschman Index (HHI). Findings were complemented by an original consumer survey (CAWI, n = 1,036; 2022–2025) assessing attitudes, awareness and barriers to goose meat consumption in Poland. Export value rose from €53.5 million in 2020 to a peak of €118.0 million in 2022 before declining to €62.7 million in 2024, driven mainly by avian-influenza-related supply shocks and feed-cost inflation rather than by demand shifts. Germany absorbed 74–86% of export value throughout the period (HHI > 5,500), while export volumes showed limited responsiveness to sharp price increases and EUR/PLN exchange-rate fluctuations. Domestic consumption remained below 0.3 kg per capita annually; 66.6% of survey respondents reported never having eaten goose meat, citing high price, limited retail availability and lack of culinary familiarity as the main barriers. The study concludes that Poland's export-oriented goose meat model, while highly competitive internationally, is structurally vulnerable due to single-market dependence and an underdeveloped domestic market, and that long-term food system resilience requires diversification of export destinations, product innovation, and consumer education.

Note: A detailed account of this study, including full methodology, tables and discussion, is available in: Wereńska M., Michalczyk W., Okruszek A., 2026. Market Dynamics and Economic Drivers of Poland's Foreign Trade in Goose Meat and Offal. *Foods*, 15(8), 1353. https://doi.org/10.3390/foods15081353

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CONFERENCE PROGRAMME

THURSDAY 17.09.2026	
8.00–9.00	Registration
9.00–9.15	Opening Ceremony and Welcome prof. Małgorzata Korzeniowska and prof. Magdalena Wróbel-Kwiatkowska
9.15–9.45	***70th Anniversary of the Department of Functional Food Products Development***
Invited Lectures	
9.45–10.15	*Can AI keep food safe? Opportunities, challenges, and practical tools* – **Byron D. Chaves,** Rutgers, The State University of New Jersey, New Brunswick, USA
10.15–10.30	Coffee Break
Session 1 – Milk and Dairy SUP-RIM Project session	
Plenary Lectures	
10.30–11.00	*New trends in food technology – fractionation of milk components* – ***Justyna Żulewska**, UWM, Poland*
Short Communications	
11.00–11.10	*Microbiological quality and chemical composition of yogurts containing various botanical parts of Chinese magnolia vine* – **Agnieszka Pluta-Kubica**, Kraków Agricultural University, Poland
11.10–11.20	*A new methodological approach to analyzing the physical properties of powdered dairy products* – **Adam Figiel**, UPWr, Poland
11.20–11.30	*Effect of dairy-based recipe modification of classic bakery products on estimated glycaemic index, nutritional composition and consumer acceptance* – **Katarzyna Petka**, Kraków Agricultural University, Poland
11.30–11.40	*Comparison of plant-derived serine protease with commercial proteases for whey protein hydrolysis* – **Marcelina Maciejewska**, UPWr, Poland
11.40–11.50	*Yarrowia lipolytica as a platform for dairy sludge valorization* – **Katarzyna Kosiorowska**, UPWr, Poland
11.50–12.00	*From isolation to identification: native microorganisms of dairy processing sludge and their potential to grow on sludge as the sole nutrient source* – **Mateusz Szczepańczyk**, UPWr, Poland
12.00–12.10	*Effect of A1 and A2 milk on inflammation in apoe/ldlr /- mice* – **Renata B. Kostogrys,** Kraków Agricultural University, Poland
12.10–12.25	Coffee break

Session 2 – PTTŻ Meat technology Session	
Plenary Lectures	
12.25–12.55	*Innovations in meat quality evaluation* – **Casey Owens**, Arkansas University, USA
Short Communications	
12.55–13.05	*Screening of apple cultivars for the production of functional apple pomace powder for cooked poultry sausages* – **Aigerim Koishybayeva**, Ałmaty University of Technology, Kazakhstan
13.05–13.15	*Enzymatic modification and ultrasound treatment to enhance the bioactive properties and improve the quality of egg yolk* – **Wiesław Kopeć**, Basso Ltd., Poland
13.15–13.25	*Shelf-life extension and quality preservation of cold-smoked salmon by moderate pressure pasteurization* – **Alireza Mousakhani Ganjeh**, University of Aveiro, Portugal
13.25–13.35	*Effect of neutral electrolyzed water and silver ions-citric acid formulation against biofilms formed by foodborne pathogens* – **Muhammad Tauseef Ahmad**, University of Torino, Italy
13.35–14.15	Lunch
Session 3	
Plenary Lectures	
14.15–14.45	*Nutritionally enriched agro-based food/feed prepared by fungal solid-state fermentation* – **Milan Certik**, Slovak University of Technology in Bratislava, Slovak Republic
14.45–15.15	*Construction of the advanced yeast producers of bioethanol and high value chemicals from residues and wastes* – **Andrei Sybirny**, University of Rzeszów, Poland; Institute of Cell Biology NAS of Ukraine
Short Communications	
15.15–15.35	*Towards field-ready bacterial detection: Antibody-functionalized photonic crystals for rapid E. coli sensing* – **Weronika Zając-Bujacz**, Łukasiewicz Research Network – PORT Polish Center for Technology Development, Poland
15.35–15.45	*Biocontrol activity of newly isolated endophytic Fusarium strain and its impact on flax resistance to fungal pathogens* – **Mateusz Lipiński**, UPWr, Poland
15.45–15.55	*Tarsal arthrodesis and isolation of mesenchymal stem cells from bone tissue in a bengal tigress (Panthera tigris tigris) – a case report with translational perspective* – **Agata Małyszek**, UPWr, Poland
15.55–16.10	Coffee Break
Session 4	
Plenary Lectures	
16.10–16.40	*Arsenic speciation analysis via HPLC-ICP-MS* – **Antonio Signes Pastor**, University Miguel Hernández de Elche, Spain
16.40–17.10	*Hyperspectral cameras in agriculture and food processing* – **Jędrzej Kowalewski**, SCANWAY, Poland
Short Communications	
17.10–17.20	*Metal(loid)s content, arsenic speciation and dietary exposure assessment in commercial fish and seafood broths* – **Isabel Casanova Martinez**, University Miguel Hernández de Elche, Spain
17.20–17.30	Poland*Towards the ‚closer to zero' goal: assessment of metal(loid) levels in fish-based baby food in Spain* – **Ana M. Solivella-Poveda**, University Miguel Hernández de Elche, Spain
17.30–17.40	*Powders based on multicomponent oil-in-water formulations developed using raspberry juice, seed oil, and optionally leaves: content and in vitro intestinal availability of selected bioactive compounds* – **Martyna Szydłowska**, UPWr, Poland

17.40–19.00	e-poster session*
20.00	Banquet
FRIDAY 18.09.2026	
Session 5	
Plenary Lectures	
8.30–9.00	*Food biofortification – a waste of time or a challenge for Europe?* – **Magdalena Zielińska-Dawidziak**, Poznań University of Life Sciences, Poland
9.00–9.30	*Role of probiotics, prebiotics, and bioactive compounds in infant nutrition* – **Věra Neužil Bunešová**, Czech University of Life Sciences Prague, Czech Republic
Short Communications	
9.30–9.40	*Quality–energy optimization of pilot-scale continuous freeze-drying for high-acceptability strawberry snacks* – **Nesa Dibagar**, UPWr, Poland
9.40–9.50	*Application of reverse osmosis and diafiltration for wine dealcoholization: a study on dry and sweet tokaji hárslevelű wines* – ***Attila Csighy***, Hungarian University of Agriculture and Life Sciences (MATE), Hungary
9.50–10.00	*Freeze-Drying as a strategy to preserve the physicochemical, antioxidant and techno-functional properties of whole mamey (Pouteria sapota) for functional food applications* – **Jose Angel Perez Alvarez**, University Miguel Hernández de Elche, Spain
10.00–10.10	*Pilot-scale PEF inactivation of a beer spoilage yeast: effect of specific energy input on microbial inactivation and post-treatment storage* – **Sanja Ludoski**, BioTeC+ – Chemical and Biochemical Process Technology and Control, KU Leuven, Belgium
10.10–10.20	*Valorizing insect fat: supercritical co2 extraction and qualitative profiling of Tenebrio molitor lipids* – **Anna Krawczyk**, UPWr, Poland
10.20–10.30	*Physical modification of cellulose by high-pressure homogenization* – **Shima Vahedi,** UPWr, Poland
10.30–10.45	Coffee Break
Session 6	
Plenary Lectures	
10.45–11.15	*Microbial-Based biofertilizers, biostimulants and biocontrol agents: translating research into sustainable agricultural solutions* – **Paula Melo**, University of Porto, Portugal
11.15–11.45	*Integrating transcriptomics and metabolomics to study flax resistance to Fusarium oxysporum* – **Anna Kulma**, University of Wrocław, Poland
Short Communications	
11.45–11.55	*Apocarotenoids in the response of flax to Fusarium wilt* – **Aleksandra Boba**, University of Wrocław, Poland
11.55–12.05	*Effects of radio frequency processing of sesame seeds on microbial inactivation, DNA damage, membrane integrity, and color stability* – **Julian Espitia Perez**, BioTeC+ – Chemical and Biochemical Process Technology and Control, KU Leuven, Belgium
12.05–12.15	*Osmotic stress-induced changes in bioactive compound accumulation in Dronaea muscipula J Ellis in vitro cultures* – **Dawid Morawiec**, UPWr, Poland
Session 7	
Plenary Lectures	
12.15–12.45	*How to support food safety management in the context of climate change?* – **Jeanne-Marie Membré**, INRAE, France

12.45–13.15	*Plant nanotechnology for a sustainable bioeconomy and climate-resilient agriculture* – **Franklin Gregory**, Polish Academy of Science, Poland
	Short Communications
13.15–13.25	*Response of 'Mirlo Rojo' apricot mineral content and food safety parameters to regulated deficit irrigation* – **Marcos Rodríguez-Estrada**, University Miguel Hernández de Elche, Spain
13.25–13.35	*Nutritional quality and safety of ancient and modern cereal flours: implications for sustainable food production* – **Mihail Stoyanov Chervenkov**, Bulgarian Academy of Science, Bulgaria
13.35–13.45	*From occurrence to exposure: potentially toxic elements in coffee, tea and cocoa*, **Sebastian Szymański**, UPWr, Poland
13.45–14.15	Lunch
	Session 8
	Plenary Lectures
14.15–14.45	*Combating bacterial pathogens: are bacteriophages the game changer we need?* – **Marta Kuźmińska-Bajor**, UPWr, Poland
14.45–15.15	*From hidden symbionts to biofactories: endophytic fungi in drug discovery and nanotechnology* – **El-Sayed R. El-Sayed**, Nuclear Research Center, Egyptian Atomic Energy Authority, Egypt
	Short Communications
15.15–15.25	*Phage tail-like particles: A promising tool for plant pathogen control* – **Marta Sobolewska,** UPWr, Poland
15.25–15.35	*High-density production of biocontrol Metschnikowia pulcherrima biomass using potato starch wastewater and glycerol for plant-targeted delivery via electrospun mats*, **Xymena Połomska**, UPWr, Poland
15.35–15.55	*Advancing biotechnology through Horizon Europe: Funding pathways for research, innovation and industrial applications*, **Monika Ślęzak**, Łukasiewicz – PORT Polish Center for Technology Development, Poland
15.55–16.15	Closing of the conference

THURSDAY 17.09.2026	
POSTER SESSION 17.40-19.00	
1.	**CORRELATIONS BETWEEN THE CONTENT OF FREE AMINO ACIDS AND BIOGENIC AMINES AND THE SENSORY EVALUATION OF DRY-AGED BEEF** Lech Adamczak, Marta Chmiel, Elżbieta Hać-Szymańczuk, Tomasz Florowski, Danuta Jaworska, Dominik Popowski, Marek Roszko, Marcin Bryła Warsaw University of Life Sciences, Poland
2.	**OPTIMIZATION OF THE GRINDING DEGREE OF THE VEGETABLE ADDITIVE APPLIED TO POULTRY SAUSAGE** Aleksander Bara, Katarzyna Leicht, Małgorzata Korzeniowska Wrocław University of Environmental and Life Sciences, Poland
3.	**INDICATORS OF THE LIPID PROFILE AND NUTRITIONAL QUALITY OF TWO-STAGE PRESSED RAPESEED OIL AFTER THE LOW-TEMPERATURE BLEACHING PROCESS** Marta Bochniak, Monika Wereńska, Ewelina Książek, Weronika Wójcik Wrocław University of Economics and Business, Poland
4.	**NEGLECTED CROPS IN SUSTAINABLE DIETS: AWARENESS AND ACCEPTANCE AMONG YOUNG ADULTS IN BULGARIA** Mihail Chervenkov, Teodora Ivanova, Dessislava Dimitrova University of Forestry, Sofia, Bulgaria
5.	**FATTY ACID PROFILE OF COMMERCIALLY AVAILABLE DRY-AGED BEEF IN POLAND** Marta Chmiel, Lech Adamczak, Elżbieta Hać-Szymańczuk, Tomasz Florowski, Katarzyna Reder, Olga Bociankiewicz, Joanna Kanabus Warsaw University of Life Sciences, Poland
6.	**THE TROJAN HORSE EFFECT: MICROPLASTICS AS VECTORS FOR HEAVY METAL IN THE FOOD CHAIN** Nilanjana Ghosh, Rita Kundu, Adrian-Vasile Timar University of Oradea, Romania
7.	**DRY-AGED BEEF MICROBIOTA AS A DETERMINANT OF BIOGENIC AMINE CONTENT** Elżbieta Hać-Szymańczuk, Marta Chmiel, Lech Adamczak, Tomasz Florowski, Agata Żak-Kułakowicz, Edyta Juszczuk-Kubiak Warsaw University of Life Sciences, Poland
8.	**ASSESSMENT OF NITRATE (V) CONTENT IN READY-TO-EAT INFANT MEALS AND CEREAL PRODUCTS FOR CHILDREN AVAILABLE ON THE POLISH MARKET – PILOT STUDY** Gabriela Haraf, Estera Siedlaczek, Maciej Krupa, Zuzanna Goluch, Mirosława Teleszko, Monika Wereńska, Andrzej Okruszek Wrocław University of Economics and Business, Poland
9.	**FROM MONITORING TO MITIGATION: ESTABLISHING ALBANIA'S FIRST NATIONAL STRATEGY FOR ACRYLAMIDE CONTROL IN BAKERY PRODUCTS** Fatjon Hoxha, Alketa Shehaj, Ariola Morina, Kapllan Sulaj, Erjon Kamberi, Enkeleda Berberi Agricultural University of Tirana, Albania
10.	**GELLING PROTEINS OBTAINED FROM BONE RESIDUE USING THERMAL METHOD AND THEIR IMPACT ON THE QUALITY AND SHELF LIFE OF PROCESSED MEAT PRODUCTS** Katarzyna Huras, Anna Pudło, Natalia Deptuła, Katarzyna Leicht, Wiesław Kopeć Cedrob S.A., Poland; Wrocław University of Environmental and Life Sciences, Poland

11.	**FERMENTATION PROFILES AND QUALITY PROPERTIES OF COW, GOAT, AND MIXED-MILK YOGURTS** Agnieszka Jankowska, Maria Wachowska, Aneta Dąbrowska, Marika Bielecka, Józef Warechowski, Aleksandra Potaś University of Warmia and Mazury, Olsztyn, Poland
12.	**HYBRID MEAT PRODUCTS – OPPORTUNITIES AND CHALLENGES FOR THE MEAT INDUSTRY** Małgorzata Karwowska University of Life Sciences in Lublin, Poland
13.	**FORMULATION OF FUNCTIONAL FOOD COMPOSITIONS BASED ON OAT FLAKES, FLAXSEED PRESS CAKE, AND HEMP PRESS CAKE USING CONSUMER RESEARCH** Agnieszka Kita, Anna Czubaszek, Joanna Miedzianka, Joanna Kawa-Rygielska Wrocław University of Environmental and Life Sciences, Poland
14.	**MODULATION OF OVALBUMIN IMMUNOREACTIVITY BY ENZYMATIC HYDROLYSIS: THE EFFECT OF A CUCURBITA FICIFOLIA PROTEASE ACTIVITY** Magdalena Konofal, Anna Mandecka Wrocław University of Environmental and Life Sciences, Poland
15.	**MEAT QUALITY AND GROWTH PERFORMANCE IN CHICKENS AND PIGLETS DEPENDING ON THE FEEDING OF BLOOD PLASMA PREPARATIONS WITH INCREASED IMMUNOGLOBULIN IGY LEVELS** Kopeć Wiesław, Pobudkiewicz Bartłomiej, Jolanta Tomaszewska-Gras, Jerzy Stangierski, Jankowski Jan, Kozłowski Krzysztof, Lipiński Krzysztof, Katarzyna Leicht Deveris Polska LLC., Poland; Poznań University of Life Sciences, Poland; University of Warmia and Mazury in Olsztyn, Poland; Wrocław University of Environmental and Life Sciences, Poland
16.	**SUSTAINABLE PROTEIN RECOVERY FROM EDIBLE INSECTS: A BIOREFINERY APPROACH FOR ENVIRONMENTALLY SUSTAINABLE FOOD PRODUCTION** Anna Krawczyk, Łukasz Bobak, Dominika Kulig, Żaneta Król-Kilińska, Shima Vahedi, Dilani Thilanka Hewa Pathiranage, Aleksandra Szmaja, Anna Zimoch-Korzycka Wrocław University of Environmental and Life Sciences, Poland
17.	**EFFECT OF ALGINATE-ENCAPSULATED ASCORBIC ACID PREPARED WITH COLD PLASMA-TREATED WATER ON OXIDATIVE STABILITY AND COLOUR OF BEEF BURGERS** Żaneta Król-Kilińska, Dominika Kulig, Amelia Krystek, Łukasz Bobak, Aleksandra Szmaja, Anna Zimoch-Korzycka Wrocław University of Environmental and Life Sciences, Wrocław, Poland
18.	**EFFECT OF INDIRECT PLASMA-TREATED WATER ON THE EXTRACTION OF BIOACTIVE COMPOUNDS FROM TURMERIC** Żaneta Król-Kilińska, Dominika Kulig, Marika Klimaszewska, Łukasz Bobak, Shima Vahedi, Anna Krawczyk, Dilani Thilanka Hewa Pathiranage, Sebastian Szymański, Anna Zimoch-Korzycka Wrocław University of Environmental and Life Sciences, Poland
19.	**MODELLING THE QUALITY AND OXIDATIVE STABILITY OF TERNARY OIL BLENDS USING MIXTURE DESIGN** Ewelina Książek, Marta Bochniak, Weronika Wójcik Wrocław University of Economics and Business, Poland
20.	**ALGINATE-ENCAPSULATED SPIRULINA PLATENSIS AS A FUNCTIONAL INGREDIENT IN BEEF BURGERS** Dominika Kulig, Żaneta Król-Kilińska, Natalia Ukleja, Łukasz Bobak, Anna Zimoch-Korzycka Wrocław University of Environmental and Life Sciences, Poland

21.	**DIRECT OR ENCAPSULATED? EFFECT OF PLANT EXTRACT DELIVERY FORM ON THE QUALITY OF FROZEN BEEF BURGERS** Dominika Kulig, Żaneta Król-Kilińska, Łukasz Bobak, Shima Vahedi, Anna Krawczyk, Dilani Thilanka Hewa Pathiranage, Aleksandra Szmaja, Anna Zimoch-Korzycka Wrocław University of Environmental and Life Sciences, Poland
22.	**INTERACTIONS BETWEEN MYOFIBRILLAR PROTEINS AND HERBAL EXTRACTS. IMPLICATIONS FOR PROTEIN GEL STRUCTURE AND FUNCTIONALITY** Katarzyna Leicht, Paulina Nowicka, Łukasz Bobak, Małgorzata Korzeniowska Wrocław University of Environmental and Life Sciences, Poland
23.	**DIFFERENTATION OF THE BIOLOGICAL VALUE OF DUCK EGGS** Lidia Lewko National Research Institute of Animal Production, Kraków, Poland
24.	**EFFECT OF DUCK ORIGIN ON THE LYSOZYME CONTENT IN EGG WHITE** Lidia Lewko National Research Institute of Animal Production, Kraków, Poland
25.	**EFFECT OF PH AND PROTEIN CONCENTRATION ON THE RHEOLOGICAL PROPERTIES AND THERMAL DENATURATION OF WHEY PROTEIN ISOLATE (WPI) SOLUTIONS** Nowak Marek, Szołtysik Marek, Dąbrowska Anna, Mandecka Anna, Maciejewska Marcelina Wrocław University of Environmental and Life Sciences, Poland
26.	**EXPORT CONCENTRATION AND THE DOMESTIC CONSUMPTION GAP IN POLAND'S GOOSE MEAT AND OFFAL TRADE, 2020–2024** Andrzej Okruszek, Monika Wereńska, Wawrzyniec Michalczyk Wrocław University of Economics and Business, Wrocław, Poland
27.	**FROM ELCHE 'CONFITERA' DATES (PHOENIX DACTYLIFERA L.) TO HIGH-VALUE FUNCTIONAL INGREDIENTS AND INNOVATIVE FOOD PRODUCTS: A CIRCULAR BIOECONOMY APPROACH** José Ángel Pérez-Álvarez, Juana Fernández-López, Manuel Viuda-Martos, Concepción Obón-de Castro, Casilda Navarro-Rodríguez de Vera, Judit Rodríguez-Párraga, Raquel Lucas-González, María Estrella Sayas-Barberá Miguel Hernández University of Elche, Spain
28.	**EFFECT OF DAIRY-BASED RECIPE MODIFICATION OF CLASSIC BAKERY PRODUCTS ON ESTIMATED GLYCAEMIC INDEX, NUTRITIONAL COMPOSITION AND CONSUMER ACCEPTANCE** Katarzyna Petka University of Agriculture in Kraków, Poland
29.	**COLORIMETRIC PHENOTYPING OF BRUISES IN BROILER CARCASSES UNDER COMMERCIAL SLAUGHTERHOUSE CONDITIONS** Nicole Stanley, Aneta Jaszczyk, Patryk Sztandarski, Magdalena Solka, Jarosław O. Horbańczuk, Grzegorz Pogarzelski, Adrianna Szprynca, Jagoba Rey Gotxi, Magdalena Krawczak, Joanna Marchewka Institute of Genetics and Animal Biotechnology, Polish Academy of Sciences, Jastrzebiec, Poland
30.	**RAW MILK FERMENTATION AND ANTIMICROBIAL RESISTANCE: CHANGES IN BACTERIAL COMMUNITIES AND B-LACTAM RESISTANCE GENES** Łukasz Szala, Justyna Staninska-Pięta, Agnieszka Piotrowska-Cyplik Poznań University of Life Sciences, Poland
31.	**ONE SYSTEM, TWO WORLDS: W/O/W NANOEMULSIONS FOR SIMULTANEOUS DELIVERY OF HYDROPHILIC AND LIPOPHILIC CHOKEBERRY BIOACTIVES** Paulina Nowicka, Martyna Szydłowska, Kamil Haładyn, Aneta Wojdyło Wrocław University of Environmental and Life Sciences, Department of Fruit, Vegetable and Plant Nutraceutical Technology

32.	**SODIUM AND POTASSIUM MONITORING AS A TOOL IN THE DEVELOPMENT OF REDUCED-SODIUM CHEESE** Justyna Tarapata, Justyna Żulewska University of Warmia and Mazury in Olsztyn, Poland
33.	**EFFECT OF PROCESSING CONDITIONS ON THE STABILITY OF PAPRIKA OLEORESIN ENCAPSULATED IN SODIUM ALGINATE HYDROGELS** Dilani Thilanka Hewa Pathiranage, Żaneta Król-Kilińska, Anna Zimoch-Korzycka Dominika Kulig, Łukasz Bobak, Shima Vahedi, Anna Krawczyk, Aleksandra Szmaja Wrocław University of Environmental and Life Sciences, Poland.
34.	**THE STONE EXTRACT OF CORNUS MAS × CORNUS OFFICINALIS 'JERZY' DEMONSTRATES A HYPOGLYCEMIC EFFECT IN STREPTOZOTOCIN-INDUCED RAT MODEL OF DIABETES** Yurii Trach, Lidiia Vilchyk, Anna Moroz, Iryna Brodyak, Alicja Z. Kucharska, Nataliia Sybirna Ivan Franko National University of Lviv, Ukraine
35.	**CELLULOSE FROM SPENT COFFEE GROUNDS AS A SUSTAINABLE REINFORCEMENT IN BIOCOMPOSITES FOR THE FOOD INDUSTRY: REVIEW** Shima Vahedi, Żaneta Król-Kilińska, Łukasz Bobak, Dominika Kulig, Anna Krawczyk, Dilani Thilanka Hewa Pathiranage , Sebastian Szymański, Aleksandra Szmaja, Anna Zimoch-Korzycka Wrocław University of Environmental and Life Sciences, Poland
36.	**VALORIZATION OF SPENT COFFEE GROUNDS-DERIVED CELLULOSE AND NANOCELLULOSE AS FAT REPLACERS AND EMULSIFIERS IN COMPANION ANIMAL NUTRITION** Shima Vahedi, Nima Vahedi,Anna Zimoch-Korzycka, Żaneta Król-Kilińska, Wrocław University of Environmental and Life Sciences, Wrocław, Poland
37.	**QUALITY AND FUNCTIONAL POTENTIAL OF DEHYDRATED VEGETABLE POWDERS FOR WHEY-BASED FOOD PEARLS** Simona Ioana Vicaș, George Alin Opris, Iasmina Ioana Bustean, Cristina Adriana Rosan University of Oradea, Oradea, Romania;
38.	**REFORMULATION OF SESAME PRODUCTS THROUGH THE ELIMINATION OF ARTIFICIAL FLAVOURS AND THE USE OF NATURAL PLANT-BASED INGREDIENTS AS AN EXAMPLE OF FUNCTIONAL FOOD DESIGN.** Walczak Urszula Unitop sp. z o.o.
39.	**SOUS-VIDE PROCESSING OF WHITE KOŁUDA® GOOSE BREAST MEAT: EFFECT OF COOKING TEMPERATURE AND TIME ON FUNCTIONAL, SENSORY AND NUTRITIONAL QUALITY** M. Wereńska, G. Haraf, A. Okruszek, W. Marcinkowska, J. Wołoszyn Wrocław University of Economics and Business, Wrocław, Poland
40	**IMPROVING THE QUALITY AND FUNCTIONAL PROPERTIES OF HOMOGENIZED MEAT PRODUCTS THROUGH BUCKWHEAT HUSK INCORPORATION** Kacper Wiśniewski, Aleksandra Zambrowicz, Aleksandra Szmaja, Szymon Juchniewicz, Agnieszka Nawirska-Olszańska, Anna M. Salejda Wrocław University of Environmental and Life Sciences, Wrocław, Poland
41	**DEVELOPMENT OF AN INNOVATIVE SNACK BASED ON FRUIT AND/OR FRUIT-AND-VEGETABLE PURÉE WITH YOGURT** Justyna Stefańska Z.P.O.W. Milejów Sp. z o.o.