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2. **Sustainability in Nutrition, Leisure and Tourism**
3. **Food Chemistry, Oenology and Biotechnology in the Food Industry**

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SECTION I:
Food Engineering and Technology



BERRY PROCESSING BY-PRODUCTS: COMPOSITION, FUNCTIONAL PROPERTIES AND FOOD APPLICATIONS

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Introduction. Fruit-processing by-products represent valuable sources of nutrients and bioactive compounds that can be recovered and incorporated into food products to improve their nutritional and functional properties while supporting waste reduction and circular-economy principles. This work investigates the valorization of berry-processing by-products, particularly pomaces obtained from wild bilberry (Vaccinium myrtillus L.), blackberry (Rubus spp.), and blackcurrant (Ribes nigrum L.), and evaluates their potential as functional food ingredients.

Materials and methods. The dried pomace powders were analyzed for proximate composition, titratable acidity, fatty-acid profile, color characteristics, total phenolic, anthocyanin and flavonoid contents, individual phenolic compounds, and antioxidant activity. The functionality of these by-products was further demonstrated through their incorporation into corn-based extruded snacks and cookies.

Results and discussion. The analyses revealed distinct nutritional and bioactive profiles among the three berry pomaces. Blackberry pomace was particularly rich in dietary fiber, while bilberry showed the highest protein content, total phenolic content, and anthocyanin concentration. Berry pomace oils were dominated by unsaturated fatty acids, with polyunsaturated fatty acids accounting for approximately 72–77% of total fatty acids. Bilberry was especially rich in n-3 fatty acids and exhibited a favorable n-6/n-3 ratio. Bilberry and blackcurrant also demonstrated substantial antioxidant activity and contained important phenolic compounds, supporting their potential use as sources of natural antioxidants and pigments. Addition of bilberry pomace powder to extruded snacks increased fiber, phenolic content, and antioxidant activity while maintaining acceptable technological characteristics. The formulation containing 6% pomace achieved the highest overall sensory acceptability. In cookies, partial replacement of wheat flour with bilberry or blackcurrant pomace powders enhanced fiber, mineral, phenolic, and antioxidant contents and modified dough rheology, texture, color, and sensory characteristics. The 10% replacement level produced the highest overall acceptability for both pomace types.

Conclusions. Overall, berry pomaces are promising multifunctional ingredients for the development of nutritionally improved, antioxidant-rich, sensory-acceptable, and more sustainable food products, demonstrating an effective pathway for transforming fruit-processing residues into value-added functional ingredients.

Keywords: *berry pomaces; bioactive compounds; color; cookies; corn puffs; sensory analysis; texture*

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NOODLES WITH SPICY-VEGETABLE RAW MATERIALS

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Introduction. A practical way to improve the nation's health is to enhance the population's dietary structure. This can be achieved by enriching products that are regularly consumed by all segments of the population with biologically active substances. Grain-based products are the most common items in the Ukrainian consumer basket. Pasta, in particular, falls into this category. It appeals to consumers due to its long shelf life combined with quick preparation –factors that are important given the modern pace of life.

The aim of the study was to produce ribbon-shaped artisanal pasta with enhanced nutritional value.

Materials and Methods. Red beetroot juice, added to the formulation in place of water, and the aromatic spice sumac were evaluated as enriching agents. Thus, a colored product was obtained, and color is a key consumer characteristic that attracts buyers. At the same time, the addition of sumac, which contains food acids such as malic, citric, and tartaric acids, helps lower the pH of the mixture. This aids in preserving the product's color, which is primarily due to the presence of betalains – compounds that remain stable within a pH range of 3.0 to 7.0. This is important because betalains possess specific biological activity, and red beet is the sole source of them in the diet of the population in our climatic zone. Furthermore, sumac imparts a pleasant aroma and flavor to the product, masking the characteristic taste of beetroot.

The amount of sumac incorporated into the noodle formulation ranged from 1% to 5%. The resulting samples were dried to a moisture content specified for instant products, with the aim of maximizing the retention of biologically active components – derived from the added plant-based raw material, that are sensitive to high-temperature processing. A noodle sample without the addition of spice-vegetable ingredients served as the control. Organoleptic evaluation of the resulting products was conducted using descriptors such as appearance and surface condition, shape, color, taste and aroma, and the condition of the products after cooking. The results led to the conclusion that the experimental samples outperformed the control sample. The best among them was the sample containing 2% sumac.

Results and Discussion. Compared to the control sample, the noodles with beetroot and sumac were more elastic; the product retained its shape after cooking and had a soft, tender texture; the color was preserved, although it became somewhat lighter; and the noodles possessed the characteristic taste of flour-based products along with a pleasant aroma of spices. A comparison of the physicochemical properties of the control sample and the sample with added spice-vegetable ingredients demonstrated that the experimental sample outperformed the control in terms of the mass increase coefficient during cooking (1.98 vs. 1.63), acidity (2.6 vs. 0.6 °T). There was virtually no difference in moisture content between the samples. The biological activity of both types of additives – beetroot juice and sumac– is an integral value derived from a range of diverse substances present in the raw materials. Therefore, it was appropriate to compare the biological activity of the samples by measuring the reaction rate involving the coenzyme nicotinamide adenine dinucleotide (NAD). In terms of this indicator, the noodles with the added spice-and-vegetable supplement significantly outperform the control sample – 1.44 versus 0.82 arbitrary units, respectively.

Conclusion. Thus, the addition of spice and vegetable ingredients - beetroot juice and sumac - to craft noodles is advisable, enriches them with biologically active substances and makes them more appealing to consumers by improving their sensory characteristics.

Keywords: *pasta, beetroot, sumac, biological activity*

INCREASING THE EFFICIENCY OF THERMAL AGENT DISTRIBUTION IN TUNNEL DRYING INSTALLATIONS

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The food industry involves a wide range of processes applied to the transformation of raw materials, among which drying represents a fundamental thermal treatment for agro-food products.

Introduction. Food dehydration preserves quality and extends shelf life, but traditional tunnel-type drying installations suffer from exceptionally high thermal energy consumption. A primary driver of this inefficiency is uneven aerodynamic distribution inside the chamber, causing localized over-drying or under-drying of agro-food products. This study focuses on improving the thermal and aerodynamic uniformity within the drying chamber by designing a specialized mechanical airflow distribution device.

Material and Methods. A 3D model of the proposed distribution mechanism was engineered using SolidWorks software. Individual structural elements were designed within the "Part" environment, accounting for aerodynamic constraints, and subsequently compiled using the "Assembly" module to ensure structural integrity. The kinematic behavior, structural pathing, and mechanical clearances of the distribution mechanism were simulated and evaluated using the "Motion Study" integrated tool.

Results and Discussion. The developed 3D mechanism actively regulates airflow dispersal across the entire cross-section of the tunnel geometry. Dynamic control over the air stream is achieved by adjusting the relative geometric positions of the main connecting rod and the crank system. The simulation verified that the continuous motion of the mechanism prevents the formation of stagnant zones and boundary layers of humid air around the product trays. By modifying the kinematics of the system, heat agent velocity and volumetric flow rate are balanced evenly throughout the internal drying volume. This spatial homogeneity drastically reduces uneven drying rates across different sectors of the tunnel load. Consequently, optimizing the aerodynamic trajectory of the thermal agent minimizes the total processing time required to reach safe moisture thresholds, resulting in a calculated reduction of the installation's overall thermal energy demand.

Conclusions. The integration of a mechanical distribution device successfully solves the problem of thermal stratification in drying tunnels. Ensuring a uniform flow profile directly enhances the thermal efficiency of the dehydration process. This system contributes to the sustainable advancement of food preservation equipment by lowering energy footprints while maintaining strict product quality standards.

Keywords: *aerodynamics, dehydration, food preservation, kinematics, solidworks simulation, thermal energy*

Acknowledgments. The results described were obtained through research conducted within the project: 020405 “Optimization of food processing technologies in the context of the circular bioeconomy and climate change”.

INNOVATIVE MICROWAVE-ASSISTED DRYING PROCESS FOR SEA BUCKTHORN SEEDS IN A SUSPENED LAYER

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Introduction. Sea buckthorn seeds contain highly valuable, thermolabile bioactive oils that degrade rapidly under prolonged conventional thermal treatments. Standard stationary bed drying techniques often cause non-uniform moisture removal, resulting in localized heat damage and reduced nutritional quality. To address these industrial challenges, this research evaluates a novel processing technology combining aerodynamic fluidization with electromagnetic volumetric heating to achieve high uniformity, minimize operational duration, and preserve structural integrity.

Material and Methods. The experimental methodology utilizes a vertically oriented square-section tube configured to establish a stable suspended layer of oilseed matrices. Aerodynamic fluidization was initiated by deploying an air stream calibrated to a constant velocity of 9.6 m/s, yielding a volumetric flow rate of 360 m³/h. Volumetric heating was introduced via an integrated ultra-high frequency system. The multi-stage dehydration sequence was systematically monitored over discrete temporal phases to track mass reduction, moisture migration, and aerodynamic sorting behavior.

Results and Discussion. The combined dehydration process operates through three distinct, highly controlled functional stages. During Stage I, raw sea buckthorn seeds are introduced into the vertical square column, where the aerodynamic parameters successfully establish a continuous fluidized layer. In Stage II, the specialized microwave generator is activated at an operational power output of 350 W operating at a frequency of 2460 MHz for a duration of 140 minutes, which drastically accelerates internal moisture diffusion toward the outer boundary layers. Finally, Stage III governs automatic, density-driven material segregation. As moisture evaporates, the seed mass changes dynamically, causing automated separation based on specific gravity. Individual matrices with the lowest moisture and mass separate out first, followed sequentially by intermediate fractions. The final fraction, consisting of seeds with higher initial mass and moisture content, reaches terminal velocity and separates out after approximately 190 minutes. This multi-phase interaction guarantees exceptional drying homogeneity while significantly reducing the total thermal exposure time compared to conventional systems.

Conclusions. The integration of a combined aerodynamic suspended layer and electromagnetic fields solves the technical challenges of oilseed processing. This combined technology optimizes overall energy efficiency, ensures precision process control, and prevents thermal degradation. The system offers a promising, highly scalable engineering solution for modern high-efficiency processing applications in the functional food sector.

Keywords: *aerodynamic fluidization, automatic segregation, biomaterial quality, electromagnetic volumetric heating, oilseed matrices*

Acknowledgments. The results described were obtained through research conducted within the project: 020405 “Optimization of food processing technologies in the context of the circular bioeconomy and climate change”.

INNOVATIVE STRATEGIES FOR GLUTEN-FREE BAKERY PRODUCTS

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Introduction. Celiac disease is one of the most common autoimmune disorders, with an estimated global prevalence of approximately 1% of the population. Strict adherence to a gluten-free diet currently represents the only effective therapeutic strategy. However, the elimination of gluten from bakery products gives rise to technological challenges related to dough structure formation, gas retention, volume, texture, and sensory quality, thereby requiring the use of raw materials and structuring systems capable of compensating for the technological functions of gluten.

Materials and Methods. One strategy involves the use of pseudocereals, which have considerable potential for improving the nutritional profile of gluten-free bakery products. Buckwheat is characterized by its protein content (5.7–16.4 g/100 g), dietary fibre content (10.0–21.5 g/100 g), mineral content (1.8–2.5 g/100 g), and bioactive compounds, whereas amaranth is distinguished by the biological value of its proteins (12–22 g/100 g) and its favourable amino acid profile, particularly its lysine content (≈ 5.7 g/100 g protein), as well as its dietary fibre content (9–14 g/100 g). Soriz complements these pseudocereals by providing an important component of the starch-based matrix (65.2–82.0 g/100 g). The combination of these three flours therefore enables the development of flour blends with complementary nutritional and technological properties.

In the absence of gluten, one of the strategies employed to improve the structure of gluten-free products involves the use of hydrocolloids, owing to their ability to partially compensate for structural deficiencies through water retention, increased viscosity, and matrix stabilization. In this regard, agar-agar, gums, psyllium, and pectin are of particular interest, with their effectiveness being influenced by the type of flour, the concentration used, and the hydration level.

Another strategy with innovative potential is the use of bigels, structured systems resulting from the combination of a hydrogel and an oleogel.

Results and Discussion. Their application in gluten-free products remains insufficiently investigated; however, they are of considerable interest due to their potential to simultaneously structure both the aqueous and lipid phases. In particular, structuring the lipid phase may facilitate the partial replacement of conventional solid fats with vegetable oils while maintaining appropriate textural properties. The combination of bigels with hydrocolloids and gluten-free flour blends thus provides new opportunities for controlling the rheological and structural properties of these products.

Conclusion. Therefore, the combination of buckwheat and amaranth flours with soriz, complemented by the use of hydrocolloids and bigels, enables the simultaneous consideration of the major nutritional, structural, and lipid-related challenges associated with gluten-free products. The integration of these components represents a promising approach for the development of bakery products with improved technological, nutritional, and sensory properties.

Keywords: *amaranth flour, bigels, buckwheat flour, celiac disease, hydrocolloids, soriz flour*

Acknowledgments. The research was supported by the Institutional Project, subprogram 020405 "Optimization of Food Processing Technologies in the Context of Circular Bioeconomy and Climate Change," Bio-OpTehPAS, implemented at the Technical University of Moldova.

IMPACT OF HYDROCOLLOIDS ON PARTIAL EGG REPLACEMENT IN MUFFIN TECHNOLOGY

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Introduction. Flaxseeds are a valuable source of dietary fiber, essential fatty acids, lignans, proteins, and other bioactive compounds, making them promising ingredients for the development of functional foods. Flaxseed mucilage, in particular, exhibits high water-binding, thickening, and emulsifying properties, supporting its potential use as a partial egg substitute in bakery and confectionery products [1, 2].

Materials and Methods. This study aimed to evaluate the effect of gradual egg replacement (10, 20, 30 and 40 %) with flaxseed mucilage on the rheological and quality characteristics of muffins. The mucilage was extracted by macerating flax cake, obtained after cold pressing flaxseed oil, in distilled water for 24h at a 1:20 (m/v) ratio. The muffins were evaluated in terms of specific volume, height-to-diameter ratio, texture, and crumb characteristics. Texture profile analysis was performed using a Stable Micro Systems TA.HDplus analyzer.

Results and Discussion. Results and Discussion. The results showed that partial egg replacement at levels of 10–20 % had the lowest impact on product quality, maintaining a high specific volume and a fine crumb structure. At a 30 % replacement level, the muffins retained acceptable elasticity and structural characteristics, representing a suitable balance between egg reduction and product quality. Higher replacement levels (40 %) resulted in increased batter viscosity, reduced specific volume, a denser and slightly gummy crumb, and increased firmness. Cohesiveness also decreased at replacement levels above 30 % [3].

Conclusions. The results indicate that flaxseed mucilage can effectively replace up to 30 % of the egg content in muffins while maintaining acceptable technological and textural properties. Its high water-binding capacity and functional properties make it a promising ingredient for the development of fiber-enriched and partially egg-free bakery products.

Keywords: *Flour confectionery products, crumb characteristics, flaxseed mucilage, textural properties*

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WHEAT GRAIN PRODUCTION AMIDST CLIMATE CHANGE AND WARTIME RISKS

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Introduction. The grain sector is of strategic importance to Ukraine's economy: it ensures food security, generates foreign currency earnings from exports, provides income for agricultural producers, and fosters rural development.

Wheat is Ukraine's primary food crop; it ranks first in terms of sown area and makes a decisive contribution to the nation's food supply and export potential.

The aim of this study is to analyze the dynamics of wheat production across various regions of Ukraine amidst climate change and wartime risks, and to visualize these changes. The study also seeks to identify key trends and the factors influencing them.

Materials and Methods. Climate change has significantly impacted the efficiency of agricultural production in Ukraine. Key trends include rising average annual temperatures and uneven precipitation, leading to fluctuations in the yields of major crops. Furthermore, the increasing frequency of droughts, floods, and hailstorms negatively affects both crop quality and volume. The southern steppe regions are particularly vulnerable to climate change, as summer precipitation deficits significantly reduce yields. At the same time, the implementation of adaptation measures-such as using drought-resistant varieties, modernizing irrigation systems, optimizing crop rotations, and applying modern agricultural technologies-helps stabilize production and minimize losses. Current conditions have resulted in a distinct regional differentiation across Ukraine based on yield levels, as well as security and climatic factors.

Another aspect of wheat production in Ukraine in recent times involves war-related risks and economic factors. The Russian Federation's full-scale invasion in 2022 significantly impacted the crop production sector, particularly wheat cultivation. Sowing areas have decreased, while difficulties in accessing fertilizers and fuel have led to lower yields. The blockade of seaports caused a marked decline in export volumes.

Results and Discussion. Analysis indicates that wheat cultivation in Ukraine is taking place under the simultaneous influence of climate change and war-related risks, which are significantly transforming regional production conditions.

Shifting temperature patterns and uneven precipitation are altering the agro-climatic suitability of various regions. The traditionally major grain-producing regions of the South and East are increasingly facing moisture deficits and droughts, whereas relatively more favorable conditions for wheat cultivation are emerging in the central, northern, and parts of the western regions. Hostilities exacerbate the negative impact of natural and climatic factors by reducing sown areas, damaging production and logistics infrastructure, and complicating grain storage and exports.

Conclusions. Thus, adapting grain production to climate change and wartime risks is a necessary condition for preserving Ukraine's production potential, food security, and position in the global grain market.

Keywords: *wheat, grain production, climate change, war risks, yield, sown areas.*

VALORISATION OF ULTRASONATED SEA BUCKTHORN JUICE AS A FUNCTIONAL INGREDIENT IN THE DAIRY INDUSTRY

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Introduction. Sea buckthorn juice is a valuable functional raw material with high potential as an ingredient in innovative dairy products. However, preserving its temperature-sensitive bioactive compounds, ensuring microbiological safety, and maintaining physical stability remain major technological challenges. This study aimed to optimize laboratory-scale ultrasonic parameters to obtain a microbiologically safe, physico-rheologically stable raw material with enhanced functional properties.

Materials and Methods. The study applied the response surface methodology (RSM) and an experimental D-Optimal design (24 experiments). Four processing factors were evaluated: Amplitude (20–100%), ultrasonic time (10–30 min), temperature (20–50 °C) and frequency (25 and 45 kHz). The changes were monitored by 13 response parameters covering physico-chemical, rheological, bioactive and microbiological properties. The mathematical models obtained were statistically significant ($p < 0.001$), with determination coefficients R^2 between 0.77 and 0.95 and an insignificant lack of matching ($p > 0.05$). The optimal ultrasonic conditions identified by numerical optimization were: Amplitude 97.64%, time 10 min, temperature 50 °C and frequency 45 kHz.

Results and Discussion. Under these conditions, sea buckthorn juice has ideal characteristics for use as a raw material in dairy products: 1. Bioactive enrichment and antioxidant potential: The optimized juice showed high vitamin C (366.52 mg/L), total polyphenols (150.90 mg/100 ml), quercetin (9.21 mg/L), DPPH antioxidant activity (92.34%), and carotenoids (25.28 mg/L), supporting natural fortification of dairy products (clean label). 2. physical stability and phase separation prevention: The sedimentation index decreased from 2.13% (M1) to 1.28%, being comparable to pasteurized M2 (1.30%). High turbidity (119,085 NTU) indicates fine particle dispersion, helping prevent layer separation and deposits in liquid or semi-solid dairy products. 3. Rheological compatibility: The viscosity of the optimized juice maintained at 56.56 Pa·s (similar to 56.83 Pa·s in M1 and 56.22 Pa·s in M2), ensuring compatibility with the structure and consistency of the dairy products. 4. Microbiological biosecurity: The treatment reduced the total number of microorganisms from 24.00 CFU in M1 to 0.63 UFC, approching the efficiency of M2 (0.00 CFU), thus providing a safe ingredient for dairy processing and fermentation. 5. Physico-chemical stability: the pH (3.68), soluble solids (5.68 °Brix) and titratable acidity (1.76 g citric acid/100 g) confirm the maintenance of the physico-chemical balance of the raw materials.

Conclusions. In conclusion, optimized ultrasonic processing transform sea buckthorn juice into a functional, microbiologically safe and physically stable raw material, creating opportunities for innovative and fortified dairy products.

Keywords: *sea buckthorn juice, functional raw material, dairy products, ultrasonication, bioactive compounds, food safety*

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INFLUENCE OF MICROENCAPSULATED JOSTA EXTRACT ON THE SAUSAGES PHYSICOCHEMICAL AND CHROMATIC PARAMETERS

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Introduction. Josta represents an important source of biologically active compounds, particularly phenolic compounds, vitamins, and other substances with antioxidant potential. To protect these compounds and facilitate the incorporation of the extract into food products, the extract was incapsulated in biopolymer matrices based on maltodextrin and pectin or sodium alginate, followed by freeze-drying [1].

Materials and Methods. The study involved the development of five samples of sausage: a control sample (CS), without microcapsules, and samples P0.5, P1.0, P1.5, and P2.0, containing Josta microcapsules at concentrations of 0.5, 1.0, 1.5, and 2.0%, respectively. Quality evaluation revealed variations in the main parameters depending on the level of microcapsule incorporation. The physicochemical parameters remained within the limits established by the current regulatory requirements applicable to meat products. Regarding color parameters, changes were observed with increasing microcapsule concentration. As the concentration of microcapsules increased, L* decreased progressively, by a maximum of 3%.

Results and Discussion. Thus, the incorporation of microcapsules above 0.5% resulted in a reduction in lightness, with the product becoming slightly darker. This effect may be associated with the pigments, and phenolic compounds present in the microencapsulated Josta extract. The addition of microcapsules also affected the a* parameter; however, the values remained positive for all samples, ranging from 5.07 in P0.5 to 6.62 in P2.0, indicating the predominance of the red component. The b* parameter showed a continuous decrease with increasing microcapsule concentration, from 25.02 in CS to 22.34 in P2.0. This trend indicates a reduction in the yellow component and, consequently, a shift in the product hue towards less yellowish tones. Hue increased slightly and progressively, from 18.76 in CS to 19.93 in P2.0. The increase in this parameter indicates a gradual shift in hue with increasing microcapsule incorporation. However, the magnitude of this change was relatively small, suggesting that the addition of microcapsules did not substantially alter the overall hue of the sausage samples. Chroma exhibited a clear decreasing trend. Its value decreased from 4.20 in CS to 3.71 in P0.5, 3.61 in P1.0, 3.59 in P1.5, and 3.06 in P2.0. This indicates a progressive decrease in color intensity with increasing microcapsule concentration.

Conclusions. Overall, the microencapsulation of Josta extract enables controlled modification of the chromatic profile of sausages samples, with the effect becoming more pronounced at microcapsule concentrations of 1.5–2.0%.

Keywords: *color parameters, jostaberry, meat products, microencapsulation, quality indices*

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INACTIVE RYE SOURDOUGHS: EFFECTS ON TEXTURE AND ACCEPTABILITY OF SALT-FREE BREAD

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Introduction. Reducing sodium in bakery products remains a central objective in developing healthier staple foods, especially as public health recommendations increasingly emphasize lowering salt intake [1].

Materials and Methods. In this context, the present study investigates the technological and sensory impact of incorporating two inactive rye sourdoughs, Sapore Othello (SO) and Sapore Traviata (ST) at levels of 1-4% into a standard wheat bread formulation produced entirely without added salt. The goal was to determine whether these ingredients could compensate for the absence of salt by enhancing flavor perception and improving structural attributes. Bread samples were produced under controlled mixing, fermentation, and baking conditions to ensure consistency. Sensory evaluation using a 9-point hedonic scale showed a clear increase in acceptability for all sourdough-containing samples compared with the salt-free control. The highest overall liking score was obtained for ST_4 (8.20), followed closely by ST_1 and SO_1 (8.17).

Results and Discussion. Improvements were most evident in taste and flavor, indicating that aromatic compounds naturally present in fermented rye can enrich the sensory profile and partially replace salt's flavor-enhancing role. Across concentrations, ST displayed slightly superior hedonic performance, likely due to subtle compositional differences such as organic acid levels or fermentation-derived volatiles. Texture Profile Analysis revealed a dose-dependent effect. At low inclusion levels (1-2%), both sourdoughs produced noticeable crumb softening and a modest increase in cohesiveness, effects associated with arabinoxylan-driven water retention. At higher levels (3-4%), firmness increased, suggesting gluten dilution and intensified competition for water. ST generated the strongest softening effect at low levels, highlighting functional distinctions between the two sourdoughs.

Conclusions. Overall, the findings clearly demonstrate that inactive rye sourdough, particularly when used at low inclusion rates can significantly improve both sensory and textural attributes of salt-free bread. This makes it a practical and effective strategy for sodium reduction, allowing manufacturers to maintain product quality and consumer acceptability while aligning with modern nutritional recommendations.

Keywords: *bakery products, sensory attributes, sodium reduction, textural parameters*

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EVALUATION OF SENSORY PROPERTIES OF SORBET WITH ADDED ALFALFA PROTEINS

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Introduction. Sorbet, due to its low caloric content and fat, represents a suitable matrix for enrichment with plant-based proteins. Alfalfa is a sustainable source of proteins and bioactive compounds, while alfalfa protein concentrate (APC) may contribute to the development of a functional apple sorbet with improved nutritional value and technological potential [1].

Materials and Methods. The aim of the study was to evaluate the influence of APC incorporation on the sensory characteristics and overall acceptability of apple sorbet. Five formulations containing 0%, 2.5%, 5%, 7.5%, and 10% APC were evaluated based on taste and odor, appearance, consistency, color, sensory profile, and total average score.

Results and Discussion. The sensory evaluation demonstrated a generally high level of acceptability for all analyzed samples. The total average score, calculated considering the importance factors, ranged from 18.67±0.31 points for the sample containing 10% APC to 20.00±0.0 points for the samples containing 2.5%, 5%, 7.5% APC. The control sample (CS) obtained 19.55±0.13 points, being statistically lower than the samples containing 2.5–7.5% APC, but higher than the 10% APC formulation. The average sensory profile score followed a similar pattern, reaching 5.00±0.0 points for the samples containing 2.5–7.5% APC, compared with 4.88±0.07 points for CS and 4.66±0.04 points for the 10% APC sample. These results indicate that moderate APC incorporation did not impair sensory quality and, improved the overall sensory perception of the product. Taste and odor were highly appreciated in CS and in the samples containing 2.5–7.5% APC, all receiving 5.00±0.0 points. At 10% APC, however, the score decreased significantly to 4.50±0.03 points, suggesting that the higher concentration of APC may introduce sensory characteristics that negatively affect flavor and aroma perception. Appearance was not influenced by APC addition, all samples receiving the maximum score of 5.00±0.0 points, indicating that APC incorporation did not cause undesirable changes in the visual characteristics of the sorbet. Consistency was also evaluated most favorably in the samples containing 2.5–7.5% APC, which received 5.00±0.0 points, compared with 4.55±0.04 points for CS and 4.50±0.02 points for the 10% APC formulation. This suggests that moderate APC levels may provide a favorable consistency, whereas excessive incorporation may negatively affect the perceived texture of the product. Similarly, the color of samples containing up to 7.5% APC was rated at 5.00±0.0 points, while the 10% APC sample received 4.65±0.04 points, indicating a less favorable color perception at the highest concentration.

Conclusions. Overall, the results demonstrate that APC addition at levels of 2.5–7.5% enabled the production of apple sorbet with very good sensory characteristics and high consumer acceptability, representing the most favorable range for achieving a balance between protein enrichment and sensory quality.

Keywords: *alfalfa protein concentrate, apple sorbet, protein enrichment, sensory evaluation*

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MULTIVARIATE ANALYSIS OF DOUGH RHEOLOGYAND BREAD QUALITY WITH RYE SOURDOUGH ADDITION

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Introduction. Rye sourdough incorporation significantly changes dough rheology and bread physical characteristics due to its biological acidification and non-starch polysaccharide interactions. The solubilization of rye arabinoxylans (pentosans) compensates for acid-induced gluten depolymerization, enhancing water absorption and gas retention capacity during proofing.

Materials and Methods. Two rye sourdough types from Puratos, Sapore Othello (SO) and Sapore Traviata (ST), were incorporated into wheat flour type 650 at substitution levels of 0–4%. The effects of sourdough addition on dough pH, rheological properties and bread quality were evaluated. Dough properties were assessed using a Rheofermentometer and Alveograph according to ICC Standard Method No. 121, while bread quality was characterized in terms of crumb and crust color (L*, a*, b*), texture (hardness, springiness, cohesiveness, and chewiness), physical characteristics (porosity, elasticity, and loaf volume), sodium concentration, and sensory values. Dough pH was measured using a Hach HQ30d portable digital multimeter. Bread color was determined using a CR-400 colorimeter based on the CIELAB system, and texture was measured with a TA.HD plus texture analyzer. Physical characteristics were determined according to SR 91:2007, sodium concentration by Flame Atomic Absorption Spectrometry, and sensory attributes using a 9-point hedonic scale. Principal Component Analysis (PCA) was applied to the standardized dataset to identify relationships among dough and bread quality parameters and to discriminate the samples according to sourdough type and substitution level. Principal Component Analysis explained 74.00% of total variance across the first two dimensions (PC1: 44.97%, PC2: 29.03%).

Results and Discussion. The control sample (CS) separated distinctly in the upper-left quadrant, characterized by baseline dough strength, high extensibility and high initial pH value. Increasing rye sourdough substitution levels shifted samples progressively rightward along PC1 axe. High SO additions moved to the positive PC1 domain, strongly correlated with increased crumb redness, higher Alveograph configuration ratio value and increased crumb hardness and chewiness. In contrast, ST formulations remained primarily in the negative PC1 domain, exhibiting higher crust, crumb lightness and higher coefficient of retention values relative to SO. Along PC2 axes, both sourdough types loaded negatively due to strong positive correlations with Rheofermentometer total gas production, gas retention values, maximum fermentation height and sensory acceptability.

Conclusions. Multivariate analysis indicates distinct behavior for the samples with the two rye sourdough ingredients. ST preserves crumb lightness while enhancing fermentation volume and gas retention, whereas SO drives pronounced crumb color darkening and textural firmness at higher addition levels (3–4%). Optimal overall acceptability was achieved at lower-to-moderate substitution levels (1–2% SO and 1–4% ST).

Keywords: *principal component analysis, Alveograph, dough fermentation, bread quality*

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RESEARCH ON REPLACING CHEMICAL LEAVENING AGENTS WITH EGG WHITE AND THE IMPACT ON THE QUALITY OF FLOUR AND PASTRY PRODUCTS

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Introduction. Functional egg proteins play a crucial role in improving batter stability, gas retention, and structural integrity of baked goods.

Materials and Methods. This study evaluated the effect of replacing egg ingredients with egg white powder at 1.3% (P1) and 1.6% (P2) levels in pound cake recipes based on wheat flour type 550, compared to a control sample (0% egg white powder), aiming to enhance structural quality potential without impairing sensory attributes

Volumetric and dimensional profiling were performed using a Volscan Profiler 3D laser scanner to determine specific volume, density, total surface area, maximum height, and cross-sectional middle slice parameters. Visual and organoleptic evaluations were conducted on whole cakes and cut slices to assess dome curvature, crust uniformity, and crumb cell structure.

Results and Discussion. Laser scanning revealed a progressive modification in physical indicators with higher substitution rates. Specific volume slightly decreased from 2.22 mL/g (Control) to 2.19 mL/g for P1 (1.3%) and 2.08 mL/g for P2 (1.6%), corresponding to an increase in density from 450.78 kg/m³ to 481.60 kg/m³. Maximum product height remained stable at 1.3% addition (121.2 mm vs. 121.9 mm Control), whereas 1.6% caused a noticeable reduction to 103.0 mm (-15.5%). Organoleptic assessment showed that 1.3% egg white powder promoted a highly uniform, fine crumb porosity and intact dome, creating a cohesive matrix favorable for moisture retention and staling delay. Conversely, 1.6% addition led to an over-densified crumb and dome flattening

Conclusions. Incorporating 1.3% egg white powder represents the optimal formulation level. It refines crumb cell morphology and reinforces matrix cohesion—key factors for product geometry and visual sensory appeal

Keywords: *baked goods, crumb porosity, laser scanning, quality optimization, volume yield*

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THE IMPORTANCE OF THE HARVISTA™ 1.3 SC PLANT GROWTH REGULATOR AT THE APPLE PRE-HARVEST STAGE

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Introduction. This paper investigates the pre-harvest application of the plant growth regulator 1-methylcyclopropene (1-MCP) in apple production. 1-MCP functions by blocking ethylene receptors, thereby delaying the ripening process and preventing premature fruit abscission. As apples mature, increased endogenous ethylene production triggers irreversible physiological changes affecting fruit color, texture, and aroma, while also elevating the risk of pre-harvest drop.

Material and Methods. The study aimed to determine the optimal timing for 1-MCP application to preserve fruit firmness, enhance cultivar-specific coloration, and minimize both pre-harvest fruit drop and watercore development. Research was conducted using literature analysis combined with experimental field data from the Champion apple cultivar treated with Harvista™ 1.3 SC (1-MCP) in a commercial orchard in the Republic of Moldova. Quality metrics were evaluated in accordance with international standards (ISO 2173, ISO 750, ISO 874) and the OECD Guidelines on Objective Tests for Determining Quality of Fruit and Vegetables.

Results and Discussion. Key quality parameters monitored included starch conversion index (1–10 scale, CTFEL), firmness (kg/cm²), soluble solids content (%), titratable acidity (%), surface coloration, and fruit size. Timely pre-harvest application of 1-MCP effectively suppressed ethylene production, resulting in enhanced retention of fruit firmness and titratable acidity alongside a significant reduction in fruit abscission. These findings demonstrate that pre-harvest 1-MCP treatment offers a sustainable practice for preserving fruit quality through both the pre-harvest and post- harvest phases.

Keywords: *apples, Champion cultivar, 1-methylcyclopropene (1-MCP), fruit firmness, pre-harvest drop, ethylene inhibition*

EVALUATION OF THE SENSORY CHARACTERISTICS OF ICE CREAM WITH SEA BUCKTHORN EXTRACT

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Introduction. The valorization of by-products generated during fruit processing represents a promising direction for the development of value-added foods. Sea buckthorn pomace is a potential source of bioactive compounds and can be used in the form of a water-soluble extract for food product formulation [1]. The aim of this study was to evaluate the influence of a water-soluble sea buckthorn pomace extract on the sensory characteristics of ice cream.

Materials and Methods. Seven ice cream samples, including a control sample, were investigated, with the addition of a water-soluble sea buckthorn pomace extract at concentrations of 0.5, 1.0, and 1.5%. Sensory evaluation was performed using the scoring method on a 9-point scale, with a panel of 10 trained assessors. Five sensory characteristics were evaluated: external appearance, color, consistency, odor, and taste.

Results and Discussion. The samples containing the extract demonstrated good sensory acceptability. External appearance and odor received the maximum score of 9.0 points, indicating product uniformity and the absence of undesirable sensory changes. Color also received maximum scores, with its modification being associated with the presence of natural pigments from sea buckthorn, particularly carotenoids. Regarding consistency, samples P2 and P3 obtained scores of 8.6 and 8.7 points, respectively, demonstrating the maintenance of an appropriate texture. Taste was rated at 8.6 points for P2 and 8.5 points for P3, indicating good sensory acceptability and the expression of the characteristic sea buckthorn flavor. At higher extract concentrations, an intensification of the characteristic sea buckthorn profile was observed, possibly associated with a slight astringent sensation.

Conclusions. The addition of a water-soluble sea buckthorn pomace extract allows the production of ice cream with favorable sensory characteristics, without significantly affecting its appearance, color, consistency, or odor. Moderate extract concentrations provide a favorable sensory balance, highlighting the potential of using this by-product as a value-added ingredient in the development of food products.

Keywords: *acceptability, aroma, flavor, trained assessors, texture, taste*

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SEA BUCKTHORN JUICE AS A FUNCTIONAL INGREDIENT IN DEPROTEINIZED WHEY-BASED BEVERAGES

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Introduction. Growing consumer interest in functional foods and the sustainable valorisation of food industry by-products has stimulated the development of novel products with enhanced nutritional value. Deproteinized whey represents a promising raw material due to its lactose, vitamin, and mineral content, while sea buckthorn is a rich source of bioactive compounds, particularly vitamin C, carotenoids, and polyphenols.

Materials and Methods. This study aimed to evaluate the effect of sea buckthorn juice addition on the physicochemical and sensory properties of a deproteinized whey-based beverage. Several formulations containing different proportions of deproteinized whey and sea buckthorn juice were developed and analysed.

Results and Discussion. The results showed that the addition of sea buckthorn juice significantly affected the physicochemical and sensory characteristics of the beverages. Increasing the proportion of sea buckthorn juice led to a decrease in pH and an increase in titratable acidity, reflecting the contribution of organic acids naturally present in the fruit. Higher levels of sea buckthorn juice also increased dry matter content and turbidity, indicating an enrichment of the beverages with nutrients and bioactive compounds. Colorimetric analysis revealed a progressive intensification of the characteristic colour of the beverages with increasing sea buckthorn juice quantity, mainly due to the high carotenoid content of the fruit, thereby enhancing the visual appeal of the product. Sensory evaluation indicated that all tested formulations were generally well accepted. However, the formulation containing 70% deproteinized whey and 30% sea buckthorn juice with honey achieved the highest scores for taste, aroma, overall appearance, and overall acceptability, providing the most favourable balance between sensory quality and functional characteristics. Overall, the findings demonstrate that sea buckthorn juice can be successfully incorporated into deproteinized whey-based beverages to obtain nutritionally valuable and sensorially acceptable functional products.

Conclusions. The proposed formulation offers a promising approach for the simultaneous valorisation of dairy by-products and sea buckthorn, supporting the development of innovative beverages aligned with current consumer demand for health-oriented and sustainable food products.

Keywords: *bioactive compounds, sustainable food products, valorisation*

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RHEOLOGICAL BEHAVIOR AND STRUCTURAL RECOVERY OF PÂTÉ MASSES UNDER MECHANICAL LOADING

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Introduction. The study of the rheological behavior and structural recovery of pâté masses is a critical step in optimizing technological processes such as cutting, pumping, and packaging. In this work, rotational rheometry was applied to evaluate the effect of amaranth addition on the structural-mechanical characteristics and thixotropic properties of the protein-fat matrix.

Material and Methods. Measurements were performed on a Kinexus pro+ rotational rheometer (NETZSCH) equipped with rSpace software at a temperature of 25.0 °C. To minimize the risk of wall slip, a PU40 Serrated L3884 SS geometry (a serrated parallel plate with a diameter of 40 mm) was used, with a working gap of 2.0 mm during testing.

Results and Discussions. To study the structural and mechanical properties of the pâtés and their ability to regenerate after mechanical loading, a three-step thixotropic test was conducted. This method allows simulating real technological processes: a state of rest, intensive breakdown of the internal structure (for instance, during bowl chopping, pumping, or extrusion), and subsequent relaxation of the system. At the initial stage, under a shear rate of $\dot{\gamma}$= 0,1 c^{-1}, the initial structure of the pâtés exhibits high dynamic viscosity (η) values, indicating the presence of a well-formed network. At the end of the first step, the quasi-stationary viscosity of the control sample was 4153 Pa .s, whereas for the sample with amaranth, this value was lower, reaching 3301 Pa. s. This agrees with the frequency sweep results and confirms that the addition of amaranth forms a slightly less rigid protein-fat matrix. The second step involves structural breakdown at a shear rate of $\dot{\gamma}$=30 c^{-1}. The transition to high shear rates caused a sharp, almost step-like drop in η values to 10 Pa. s for both systems. Such pronounced shear-thinning (pseudoplastic) behavior indicates intensive destruction of intermolecular bonds, restructuring of macromolecules, and their orientation in the flow direction under shear stress. The third step represents recovery and relaxation at a shear rate of $\dot{\gamma}$= 0,1 c^{-1}. Upon removal of the intensive load, a typical thixotropic response was observed: a rapid initial viscosity buildup followed by a gradual approach of the curves toward a new stationary level. Over 600 seconds of relaxation, the degree of initial structure recovery was 34.5% for the control and 36.5% for the experimental sample with amaranth. Thus, the obtained results confirm that while the amaranth-enriched pâté is characterized by a lower initial viscosity, its thixotropic recovery capacity (reconstitution of the structural matrix) after intensive mechanical action is slightly higher, ensuring proper consistency restoration and shape retention of the finished product after packaging.

Conclusions. Taken together, the results allow considering amaranth as a structure-modifying ingredient that shifts the pâté into a softer and more plastic state without compromising its viscoelastic properties.

Keywords: *amaranth, rheological behavior, thixotropy, compliance and deformability, pate*

EFFECT OF SEA BUCKTHORN POMACE BIOACTIVE COMPOUNDS ON THE COLOR CHARACTERISTICS OF PLANT-BASED MAYONNAISE

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Introduction. Color is an important sensory characteristic of food products and is associated with consumers' perception of product freshness, quality, and acceptability. In plant-based mayonnaise, the absence of egg results in a white-creamy or pale appearance, unlike traditional mayonnaise, in which carotenoids from the egg yolk contribute to its characteristic color. In this context, the present study aimed to evaluate the effect of using a liposoluble extract obtained from sea buckthorn pomace, based on sunflower oil, on the color characteristics of plant-based mayonnaise.

Materials and Methods. Four mayonnaise samples were prepared: one control sample (PM), formulated with 100% refined oil, and three samples formulated with sunflower oil fortified with bioactive compounds (BACs) extracted from sea buckthorn pomace, cultivar Mara, at proportions of 35%, 53%, and 65%. The color of the samples was evaluated using the CIELab colorimetric system by determining the L*, a*, and b* parameters, as well as the total color difference (ΔE), chroma (C), and yellowness index (YI). The determinations were performed in four replicates, and the results were expressed as mean values.

Results and Discussion. Colorimetric analysis revealed clear differences between the control sample and the samples formulated with oil fortified with BACs from sea buckthorn pomace. The L* value was 75.59 for PM and ranged from 51.16 to 75.51 for the fortified samples, indicating changes in lightness. The b* parameter showed values of 14.76 for PM, 57.18 for PM1, 53.46 for PM2, and 40.39 for PM3, indicating an intensification of yellow hues in the fortified samples. The yellowness index (YI) increased from 27.90 for PM to 108.14, 125.43, and 112.78 for PM1, PM2, and PM3, respectively. The ΔE values of 42.64, 41.59, and 35.67 for PM1, PM2, and PM3, respectively, confirm visible color differences compared with the control sample. Overall, the use of fortified oil resulted in changes in the color characteristics of the mayonnaise, particularly through the intensification of yellow hues and a reduction in lightness.

Conclusions. Sunflower oil fortified with bioactive compounds from sea buckthorn pomace, cultivar Mara, demonstrated potential for the natural modification of the color characteristics of plant-based mayonnaise. The results confirm the influence of fortified oil on the L*, b*, and YI colorimetric parameters and highlight the possibility of valorizing sea buckthorn pomace as a source of bioactive compounds for food applications.

Keywords: *bioactive compounds, CIELab, colorimetry, plant-based mayonnaise, sea buckthorn pomace*

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TECHNOLOGICAL POTENTIAL OF PLANT PROTEINS AS NATURAL EMULSIFIERS FOR FOOD EMULSIONS

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Introduction. Pea proteins represent functional ingredients with potential for use in food emulsion systems due to their hydration and emulsifying properties. These properties are influenced by the extraction method, which may induce changes in protein structure, solubility, and interfacial behavior. The aim of this study was to evaluate the technological properties of pea proteins obtained using different extraction methods and to assess their potential for use in emulsion systems [1, 2].

Materials and Methods. Three pea protein samples obtained by wet extraction, dry extraction, and microorganism-assisted extraction were analyzed. The technological properties were evaluated by determining water-holding capacity, oil-holding capacity, emulsifying activity (EA), emulsion stability (ES), and approximate density. All determinations were performed in triplicate, and the results were expressed as mean ± standard deviation.

Results and Discussion. The extraction method influenced the functional properties of the pea proteins. The highest water-holding capacity was recorded for the protein obtained by wet extraction (2.62 ± 0.04 g H_2O/g sample), whereas the highest oil-holding capacity was observed for the protein obtained by dry extraction (1.77 ± 0.09 g oil/g sample). Emulsifying activity was highest for the protein obtained by microorganism-assisted extraction (60.33 ± 0.73%), while the highest emulsion stability was recorded for the protein obtained by dry extraction (59.87 ± 0.23%), followed by that obtained by wet extraction (58.37%). The results demonstrate functional differences among the protein samples associated with the extraction method and indicate the favorable potential of pea proteins for use in emulsion systems.

Conclusions. Pea proteins exhibited favorable technological properties for use as functional ingredients in emulsion systems. The protein obtained by wet extraction demonstrated a balanced functional profile, characterized by high water-holding capacity, good emulsifying activity, and high emulsion stability, indicating promising potential as a natural emulsifier.

Keywords: *emulsion stability, extraction, functional properties, pea protein, water-holding capacity*

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THE USAGE OF HYDROCOLLOIDS IN GLUTEN-FREE BAKERY PRODUCTS

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Introduction. The production of gluten-free bakery products is becoming increasingly popular due to growing public awareness of gluten-related disorders and the increasing demand for such products. The main diseases arising from the consumption of products containing the gluten complex include coeliac disease, wheat allergy and non-coeliac sensitivity. It is precisely to reduce such negative reactions of the body that it is necessary to expand the food market with special products that do not contain gluten. At the same time, scientific research has shown that the production of gluten-free bakery products requires compensation for the functional role of gluten, the absence of which may adversely affect dough structure and the quality of the finished products. As a result, such products may have a lower volume, a denser crumb, and altered textural properties compared with conventional bakery products. In light of this, the development of gluten-free flour-based bakery products that provide dough rheological properties and sensory and textural characteristics comparable to those of conventional bakery products is becoming increasingly important.

Materials and Methods. One possible solution is to incorporate structure-forming components, such as hydrocolloids, into the formulation. Hydrocolloids are, in most cases, high-molecular-weight polymers with long chains which, when interacting with water, form viscous dispersions and/or gels [1]. These properties make hydrocolloids particularly relevant to the development of gluten-free bakery products, and their use has therefore been investigated in numerous studies, including the application of guar gum, pectin, xanthan gum, psyllium, and other structuring agents. Their effects on water absorption capacity, dough viscosity, specific volume, crumb structure and hardness have also been investigated, along with the identification of optimal concentrations for certain gums.

Results and Discussion. On this basis, it was established that the production of high-quality gluten-free products requires a comprehensive approach involving the selection of suitable gluten-free flours, assessment of their interactions with hydrocolloids, determination of appropriate hydrocolloid concentrations, and evaluation of the overall acceptability of the final product.

Conclusions. Thus, the effectiveness of hydrocolloids depends not only on their individual functional properties, but also on the characteristics and proportions of the raw materials and their interactions within the product matrix. These factors should therefore be considered when developing and optimizing gluten-free bakery products.

Keywords: *concentration, flour, gluten, hydrocolloid, protein, structure, quality*

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MUTUAL INFORMATION FOR EVALUATING EXTRACTION FACTORS AND QUINCE POMACE PECTIN QUALITY

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Introduction. Mutual information (MI), an information-theoretic measure introduced by Shannon, quantifies the dependence between variables without assuming linearity or a specific functional relationship.

Materials and Methods. MI analysis was used to evaluate the relationships between experimental factors—pH (1.5, 2.0, 2.5), ultrasound treatment duration (15 and 30 min), and microwave power (180 and 450 W)—and the properties of pectin extracted from quince pomace (QP-P) and pretreated quince pomace (PQP-P). The evaluated responses were pectin yield (PY), equivalent weight (EW), methoxyl content (MeO), anhydrogalacturonic acid (AUA), degree of esterification (DE), total polyphenol content (TPC), and antioxidant activity (DPPH AA).

Results and Discussion. Higher MI values indicate stronger dependence, with $p < 0.05$ considered statistically significant. Among the experimental factors, pH showed the broadest and most consistent influence. In QP-P, all responses were significantly associated with pH, particularly DPPH AA (0.990 bits), MeO (0.984 bits), and TPC (0.978 bits). In PQP-P, the strongest dependencies were observed for EW (0.995 bits), MeO (0.902 bits), and DE (0.832 bits), whereas PY showed no dependence (MI = 0.0 bits). Overall, pH primarily affected pectin chemical composition and the co-extraction of bioactive compounds rather than extraction efficiency.

The effect of ultrasound duration was strongly material-dependent. In QP-P, AUA showed the highest dependence (0.993 bits), followed by TPC, EW, DPPH AA, and PY, while DE was unaffected. Conversely, in PQP-P, DE (0.998 bits), EW (0.997 bits), and DPPH AA (0.987 bits) were strongly influenced, whereas MeO, AUA, and TPC showed weak dependence and PY remained unaffected. Thus, ultrasound treatment mainly modified specific structural properties, with limited influence on extraction yield. Microwave power produced a more selective response. In QP-P, TPC and DPPH AA showed the strongest dependence (both 0.998 bits), followed by MeO (0.936 bits), whereas PY and DE were unaffected. In PQP-P, microwave power significantly influenced mainly EW (0.670 bits) and MeO (0.832 bits), with no detectable dependence for the other responses.

Conclusions. These differences indicate that microwave effects depend on the intrinsic characteristics of the plant matrix. Overall, MI analysis identified pH as the primary factor governing pectin quality. Ultrasound duration produced intermediate, material-dependent effects, while microwave power selectively influenced specific structural and functional properties. Therefore, the magnitude and nature of processing effects depend on both raw material pretreatment and extraction conditions.

Keywords: *antioxidant activity, microwave-assisted processing, physicochemical properties, ultrasound-assisted processing*

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HYBRID MICROWAVE-CONVECTIVE DRYING OF GRAPE POMACE

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Introduction. Grape pomace is a moisture-rich wine-industry by-product containing dietary fibre and phenolic compounds. Rapid stabilization is required to limit microbial and chemical degradation before its use as a food ingredient or as a source of bioactive compounds. This review assesses the evidence supporting microwave-convective drying of grape pomace and identifies the process variables and research gaps relevant to future experimental work.

Material and Methods. A structured narrative analysis of peer-reviewed publications addressing convective drying of grape pomace, microwave-based drying of pomace and hybrid microwave-convective drying of plant materials was conducted. The evidence was compared in terms of air temperature and velocity, microwave power and application mode, product loading, layer thickness, moisture ratio, drying rate, effective moisture diffusivity, specific energy consumption, model performance and quality retention.

Results and Discussion. Conventional hot-air drying provides controllable operating conditions but is limited by slow internal moisture transport and prolonged thermal exposure. In a recent microwave-vacuum study, grape-pomace moisture was reduced from 79% to 5% wet basis within 20-50 min, with average drying rates approximately tenfold those obtained by hot-air drying at 60 °C [1]. Effective moisture diffusivity ranged from 1.1×10^{-7} to 3.4×10^{-7} m²/s, while the Page model provided adjusted R^2 values of 0.992-0.998. Evidence from different food materials indicates that combining microwave volumetric heating with convective moisture removal can shorten drying time and improve process efficiency; however, non-uniform electromagnetic heating, local overheating and scale-up remain important challenges [2]. Temperature, air velocity, specific microwave power, product loading, layer thickness and continuous or intermittent microwave application are the main control variables. Newton, Page, Henderson-Pabis, logarithmic and Midilli-Kucuk equations are among the most applicable thin-layer models. Few studies have investigated grape pomace under simultaneous microwave-convective operation while jointly evaluating kinetics, energy consumption and retention of bioactive compounds.

Conclusions. Hybrid microwave-convective drying is a promising route for stabilizing grape pomace and supporting its valorization in the food industry. Controlled factorial experiments and multi-criteria optimization are required to balance drying time, energy demand, heating uniformity and product quality.

Keywords: *bioactive compounds, circular economy, energy efficiency, mathematical modelling, wine by-products*

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VALORIZATION OF SEA BUCKTHORN BY-PRODUCTS IN THE PRODUCTION OF A FUNCTIONAL YOGURT

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Introduction. Yogurt - alongside kefir, sana, sour cream, and cheeses - is the most popular fermented dairy product; it is produced from milk and live lactic acid bacterial cultures. The type of milk used (cow, goat, sheep, or buffalo) influences the taste, consistency, and nutritional value, while the fat percentage directly affects texture (resulting in a fluid, watery consistency at low fat levels and a creamy, firm texture at high fat levels). Incorporating other ingredients into the yogurt formulation, such as sea buckthorn pomace, can enhance specific physicochemical and textural properties. Sea buckthorn (Hippophae rhamnoides L.) pomace is a highly valuable byproduct containing numerous bioactive compounds, including tocopherols and vitamin C.

Materials and Methods. This study aimed to evaluate the nutritional value, stability, texture, color, and rheological characteristics of a yogurt made from cow's milk with added sea buckthorn oil and pomace. The physicochemical stability of a newly formulated product is crucial and is typically investigated at the laboratory scale prior to large-scale production. Sea buckthorn berries were sourced from a local producer; the juice was extracted, and the remaining pomace was retained for further utilization. Sea buckthorn oil is inherently one of the most valuable vegetable oils; in addition to essential nutrients, it contains Omega-3 and Omega-6 fatty acids that support healthy bodily function. This study proposes using the oil and pomace derived from sea buckthorn juice production in yogurt manufacturing, thereby contributing to a sustainable food system and helping to reduce waste in the industry. Yogurt was prepared from skimmed milk with the addition of sea buckthorn oil by inoculating the mixture with 2% lactic cultures and adding up to 5% sea buckthorn pomace; the samples were then incubated at 45°C until reaching a pH of 4.4. Subsequently, the samples were refrigerated until analysis.

Results and Discussion. Preliminary results showed that the added fat positively influenced the yogurt's texture, whereas the pomace caused an increase in titratable acidity proportional to the amount added - a factor that could negatively affect the yogurt's stability over time. From the rheological standpoint, the elastic and viscous modulus varied in proportion to the increasing pomace concentration; the samples became significantly more viscous and exhibited solid-like behavior. Hardness and cohesiveness also increased compared to the control sample, while lightness decreased as the proportion of added pomace increased.

Keywords: *sea buckthorn, yoghurt, pomace, oil, prebiotics*

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THE NEW RAW BERRY MATERIALS OF THE NORTH-BLACK SEA REGION USAGE IN THE TECHNOLOGIES OF SWEET DISHES

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Introduction. The article is dedicated to the studies of new raw berry materials of the North-Black Sea region in order to determine the balance of its chemical composition, sensory and technological characteristics in the light of use in technologies of sweet dishes. The research purpose is a scientific justification and development a new recipe compositions and technologies of jelly production from jostaberry with improved nutritional value. Also the new prophylactic dish development – feijoa granola with increased iodine content.

Material and Methods. The subject of studies of desserts with high nutritional value development was selected new raw materials, namely: Feijoa, Actinidium and jostaberry, which are rich in chemical composition. All three selected samples of the raw materials studied in the work are berries of the gooseberry family, therefore, due to many similarities (texture, consistency, etc.) they will give a good combination. While the new sweet dish technology development, in a jelly was added jostaberry adding in the amount of 5–15% to the mass of the product, with a complete gelatin replacement. For the whole quality control of the new product, a complex of its properties was studied: organoleptic and physical properties of the jelly mass. There were also studied some changes of its structural and mechanical properties. To determine the density of samples, a picnometric method was used. Structural-and-mechanical properties of the dough quality were determined with the help of the penetrometer of firms "Labor" of the OV-2G5. The study of surface rheological characteristics of jelly masses was carried out on an adhesive, which was developed at the ONTU.

Results and Discussion. It has been shown that due to the high content of pectin (0,8-1,5 g per 100 g of raw matter), jostaberry is a promising raw material for the structured sweet dishes production, such as jelly. Here are presented the research results of jostaberry jelly structural and mechanical parameters. The study's results have shown, that the jostaberry introduction in jelly allows to eliminate gelatin from recipe without significant changes of product's rheological characteristics and to obtain jelly with the necessary structural properties.

The article substantiates the feasibility of producing and introducing innovative dry-breakfast production technologies, including granola, using iodine-containing plant components, namely candied feijoa (iodine dose 70…100 μg/100 g), since this will solve an important problem of the iodine deficiency and other important essential nutrients in diets, which will improve the population health. It has been proved that the candied feijoa granola addition in the formulation allows the product to be substantially enriched with iodine. Thus, iodine content in candied feijoagranola is 26 μg/100 g.

Conclusion. New ingredients from plants of Ukraine's Southern region, such as fejioa, actinidia and jostaberry are prospective for broadening the range of sweet dishes with improved nutritional value.

Keywords: *Actinidia, Feijoa, Granola, Jelly, Jostaberry, Restaurant establishments*

ASSESSMENT OF THE FEASIBILITY OF USING SUNFLOWER PROTEIN CONCENTRATE IN SEMI-FINISHED MEAT PRODUCTS

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Introduction. The contemporary food industry is increasingly focused on identifying alternative protein sources capable of partially replacing animal-derived raw materials without compromising the quality and consumer acceptability of finished products. Thus, the incorporation of plant-based protein ingredients into semi-finished meat products offers several potential advantages, including enrichment with functional components, reduction in production costs through partial substitution of meat raw materials, and improvement of the structural and technological properties of minced meat systems. In this context, sunflower protein concentrate represents a promising alternative ingredient for enhancing the nutritional and functional value of comminuted meat semi-finished products while promoting the efficient utilization of by-products generated by the vegetable oil industry.

Material and methods. The objects of the study were model minced meat systems based on beef and pork, into which sunflower protein concentrate was incorporated at concentrations of 2, 4, 6, and 8% of the mass of the principal raw materials, partially replacing the minced meat component. A semi-finished meat product without the addition of the plant-derived ingredient was used as the control sample.

Results and Discussion. The results demonstrated that the incorporation of sunflower protein concentrate at a level of 6% increased the water-holding capacity of the model minced meat system by 18–22% compared with the control sample. The obtained data indicate that the highest values of both water-holding and fat-holding capacity were achieved at a 6% concentration of the additive, whereas a further increase to 8% resulted in a slight decline in these parameters. This effect may be attributed to oversaturation of the protein matrix of the minced meat system and disruption of its uniform distribution within the product structure. Excessive levels of the additive may impair the homogeneity of the minced meat matrix and reduce its ability to retain moisture effectively.

The sensory evaluation showed that the addition of sunflower protein concentrates at levels of up to 6% did not cause any statistically significant deterioration in the evaluated quality attributes. The taste and aroma of the finished products remained characteristic of meat products, with no perceptible off-flavours. The texture became slightly firmer than that of the control, which was positively evaluated by the sensory panel. However, at incorporation level of 8% some panelists detected a slight off-flavour, resulting in a modest reduction in the overall sensory score, although the values remained within the acceptable range.

Conclusions. The study provides scientific evidence supporting the feasibility of incorporating sunflower protein concentrate into comminuted meat semi-finished products at levels of up to 6% of the mass of the principal raw materials. This concentration provides an optimal balance between the water-holding and fat-holding capacities of the minced meat system without adversely affecting its sensory characteristics. Increasing the concentration to 8%, however, is associated with a deterioration in functional and technological properties and the development of off-flavours. Moreover, these findings indicate the need for further research into the combined use of different plant-based protein ingredients in order to achieve a synergistic effect and further improve the quality characteristics of the finished products.

Keywords: *alternative protein sources, meat semi-finished products, functional properties*

STUDY OF THE QUALITY CHARACTERISTICS OF FUNCTIONAL SAUCES DURING STORAGE

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Introduction. During the storage of food products, various biochemical processes can occur, potentially altering their functional properties and, consequently, the physiological effects they elicit. Therefore, a crucial stage in the development of food products – particularly those with therapeutic and preventive properties – is the study and predictive assessmenz of their behavior during storage.

The aim of this work was to develop a technology for a functional red base sauce, involving the complete replacement of flour with a plant-derived polysaccharide and the partial replacement of animal fat with a plant-based phospholipid complex.

Materials and Methods. The research methodology and objects encompass the study program as well as both traditional and novel organoleptic, structural-mechanical, and physicochemical methods for assessing the quality of ingredients and finished sauces. Functional sauces prepared with either a 50% or a complete replacement of flour with a polysaccharide were investigated.

Results and Discussion. It was determined that at a temperature of 50°C, the highest viscosity was exhibited by the sauce in which flour was completely replaced by a polysaccharide-based structuring agent (replacing 50 g of flour with 25 g of polysaccharide). The content of the polysaccharide structuring agent makes the decisive contribution to the effective viscosity of the sauces under study. Effective viscosity also depends on the concentration of the phospholipid component, although the contribution of phospholipids to the effective viscosity value is minor. Based on the effective viscosity of the functional sauces, it was demonstrated that the most rational approach is the complete replacement of flour with a plant-derived polysaccharide, combined with a partial (20 g) replacement of animal fat with a plant-based phospholipid complexT.he functional and technological properties of food products depend to a significant extent on their ability to form emulsions and foams.The functional properties of the developed sauce significantly surpass those of the standard red sauce, indicating superior technological suitability compared to the control sample. The functional sauce's water- and fat-binding capacity enables its use in meat processing, as well as in flour-based, confectionery, pasta, and other food products.The results of the study on changes in the antioxidant activity (AOA) of the sauce during storage show that, over eight hours of storage, its activity decreased by 35%, whereas the control sauce lost its activity completely; this demonstrates the high stability of the obtained product.

Conclusion. It was shown that the functional sauce exhibits the most significant synergistic effect in inhibiting oxidation processes; this is likely because one of the inhibitors terminates oxidation chains while the other decomposes peroxides. These findings demonstrate the suitability and effectiveness of combining the studied components into a single formulation, as well as the product's high storage stability

Keywords: *flour, phospholipids, polysaccharide, slime*

INFLUENCE OF STORAGE DURATION ON THE MICROBIOLOGICAL INDICATORS OF BUTTER

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Introduction. Yeast count is an important microbiological parameter used to assess the quality and safety of dairy products, including butter [1]. Although refrigeration slows microbial growth, certain yeasts are able to grow at low temperatures, which may contribute to the microbiological spoilage of butter during prolonged storage. Sea buckthorn extracts, rich in bioactive compounds with antimicrobial properties, may offer a promising approach to improving the microbiological quality and safety of dairy products, including butter [2]. The aim of this study was to evaluate the effect of sea buckthorn liposoluble extract on the microbiological quality of butter.

Materials and Methods. Experimental butter samples containing different concentrations (0.5, 1.0, 1.5, 2.0, and 2.5%) of sea buckthorn liposoluble extract were analyzed, along with a control sample without sea buckthorn extract. Yeast and mould counts were determined using the serial dilution method followed by plating on Sabouraud agar. The results were expressed as colony-forming units per gram (CFU/g). All determinations were performed in triplicate, and the results were expressed as mean ± standard deviation.

Results and Discussion. After 10 days of storage at 4 °C, the yeast and mould count in the control sample increased from 3.02 to 3.26 log CFU/g, exceeding the acceptable level and resulting in the rejection of the butter based on both microbiological and sensory quality. In the samples containing sea buckthorn liposoluble extract, substantially lower yeast and mould counts were recorded. After 10 days of refrigerated storage, the counts were 1.95 log CFU/g for butter containing 0.5% extract, 1.85 log CFU/g for 1.0% extract, 2.06 log CFU/g for 1.5% extract, 2.16 log CFU/g for 2.0% extract, and 2.60 log CFU/g for 2.5% extract.

Conclusions. The results demonstrated that the addition of sea buckthorn liposoluble extract contributes to maintaining the microbiological safety of butter during refrigerated storage, with the highest effectiveness observed at a concentration of 1.0%.

Keywords: *butter, sea buckthorn, liposoluble extract, yeast and moulds, antimicrobial activity*

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USING PLANT BY-PRODUCTS TO PRODUCE DIFFERENT TYPES OF CAKES

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Introduction. Flour-based confectionery products enjoy significant consumer demand. Given the shift of consumer preferences toward the "clean label" products with improved nutritional profiles, there is a need to optimize the composition of these products, particularly cakes. One promising approach to enhancing nutritional value involves using plant-based ingredients with valuable chemical composition: specifically, by-products from oilseed processing and viticulture. These ingredients offer a concentrated source of physiologically important substances, such as dietary fiber, proteins, beneficial fats, and micronutrients. Utilizing these ingredients also helps reduce food waste and supports a circular production model, aligning with sustainable development principles.

Materials and Methods. The object of the study was cakes produced using three different leavening methods: chemical leavening agents, yeast, and without leavening agents. The products were made using flaxseed pomace flour (FPF) and grape powders (GP). Standard methods were used to analyze the properties of the cake dough and the quality of the finished products.

Results and Discussion. The aim of the study was to determine the impact of flaxseed pomace flour and grape powders on the technological process, the properties of the dough, and the quality of different types of cakes. Flaxseed pomace contains soluble and insoluble dietary fiber, essential omega-3 and omega-6 polyunsaturated fatty acids, protein with a balanced amino acid profile, vitamins, and minerals. Grape pomace and seed powders are valuable ingredients due to their high content of dietary fiber, pectins, tannins, and antioxidants (specifically polyphenols and tocopherols). It has been established that the optimal conditions and dosage for incorporating these plant-based ingredients depend significantly on the leavening method used. For instance, replacing more than 20% of wheat flour with flaxseed pomace in yeast-leavened cakes reduces gas formation in the dough. Adding grape by-products to cakes containing flaxseed pomace helped intensify the process, shorten fermentation time, and lower the sugar content by allowing a 30% reduction in the recipe's sugar quantity. For cakes leavened with chemical agents, the optimal replacement level of wheat flour with flaxseed pomace was determined to be no more than 30–45%, as its high water-absorption capacity increases dough viscosity. Given the thickening properties of flaxseed pomace and the foaming ability of its polysaccharides, the feasibility of using it to improve the quality of rice flour cakes made without leavening agents was investigated. It was found that rice flour cakes containing up to 30% flaxseed pomace exhibited greater volume and a well-developed, porous crumb structure.

Conclusions. Studying the effects of the plant-based processing by-products allowed to develop technological measures for their effective use in the production of various groups of cakes, resulting in high-quality, value-added products.

Keywords: *flaxseed pomace, grape powders, fermentation, dough properties, quality, cakes*

PRODUCTION OF FISH FEED USING INSECTS

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Introduction. The development of aquaculture is driving an increasing demand for complete and balanced compound feeds. Traditional sources of protein and lipids, including fishmeal, fish oil, and soybean meal, have certain resource, economic, and environmental limitations. This stimulates the search for alternative feed raw materials. The use of insect-processing products, particularly black soldier fly (Hermetia illucens) larvae, is a promising approach. These products are characterized by a significant content of protein, lipids, and biologically active compounds, creating opportunities for the partial replacement of traditional protein components in fish feeds.

Material and Methods. The research materials included insect-processing products, particularly Hermetia illucens larvae meal, as well as traditional fish feed ingredients. During feed formulation, the contents of protein, lipids, amino acids, minerals, and the energy value of the raw materials were taken into account. The technological process included raw material preparation and quality control, grinding, dosing, mixing, conditioning, and extrusion of the feed mixture. The extrusion parameters were adjusted depending on the formulation and the inclusion level of insect-derived ingredients. The quality of the finished product was assessed based on the physical and technological properties of the pellets, including density, buoyancy, and water stability.

Results and Discussion. It was established that insect-processing products can be used in fish feed formulations as sources of protein and lipids. Defatted meal obtained from Hermetia illucens larvae has an increased protein concentration, making it a promising ingredient for the partial replacement of fishmeal. When optimizing feed formulations, it is necessary to consider the amino acid profile of insect protein, particularly the levels of lysine, methionine, threonine, and tryptophan. The presence of chitin may affect nutrient digestibility; therefore, the inclusion level of insect-derived ingredients should be determined with regard to the fish species and age. In addition, due to the specific fatty acid composition of insect lipids, their combination with other fat sources rich in omega-3 polyunsaturated fatty acids is advisable. The use of extrusion ensures the formation of pellets with the required size and density. At an inclusion level of insect larvae processing products exceeding 20%, changes occur in the structural and mechanical properties of the feed mixture, degree of expansion, water stability, and pellet buoyancy, requiring adjustment of the technological process parameters. The application of post-extrusion coating with fat components makes it possible to further regulate the properties of the finished feed. The obtained pellets maintained their integrity in water for 25 minutes, which is sufficient for consumption by fish and contributes to reducing nutrient losses into the aquatic environment.

Conclusions. Insect-processing products, particularly Hermetia illucens larvae, are promising alternative raw materials for fish feed production. Their use requires optimization of feed formulations in terms of amino acid and fatty acid profiles, determination of appropriate inclusion levels, and adjustment of extrusion parameters. The results indicate the feasibility of producing pelleted feeds with adequate water stability, contributing to improved resource efficiency and sustainability in aquafeed production.

Keywords: *insects, compound feed, technology, extrusion, nutritional value, quality, fish*

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IDENTIFICATION AND QUALITY CONTROL OF OXYGEN ABSORBER FOR FOOD STORAGE DOYPACK PACKAGING

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Introduction. Oxygen absorbers / scavengers are used in the food industry to extend product shelf life. Oxygen scavenging technology can reduce oxygen levels in sealed containers to below 0.01%. They function by removing oxygen from a sealed container, thereby preventing spoilage, discoloration, and the growth of bacteria and fungi. Given their direct contact with food products, it is essential to monitor their quality and safety.

Materials and Methods. Optical microscopy, X-ray fluorescence spectroscopy, and infrared spectroscopy were used to study the composition and structure of the oxygen absorber sachets included in the packaging of "Ledova" brand freeze-dried cocked rice porridge with berries. The porridge with berries and the oxygen absorber sachet were inside a multilayer doypack, hermetically sealed with a zip-lock. The doypack made from multi-layer film (polyethylene terephthalate, aluminum foil, polyethylene) in order to block out light, moisture and oxygen.

Results and Discussion. Control of the organoleptic indicators of the sachet showed that the package is flat, tightly sealed, tear-resistant, the surface of the package is uncontaminated, the components of the oxygen absorber do not fall out when the package is shaken, and there is no extraneous smell.

The sachet has a multi-layered structure of synthetic polymers, paper and aluminum foil with a thickness of about 90 microns and small holes up to 200 microns. The presence of holes allows the penetration of gases, including oxygen, from the volume of doypack into the middle of the sachet with the components of oxygen absorber.

It was established by the methods of optical microscopy, X-ray fluorescence spectroscopy, and infrared spectroscopy that the components of the oxygen absorber are iron particles, sodium chloride granules as catalyst, foamed mineral vermiculite (hydrous sheet silicates). The weight of the oxygen absorber in one sachet is about 3 g. In the process of use, the surface of iron particles is covered with brown particles of iron oxides:

$$4Fe^0 + 3O_2 + 6H_2O \rightarrow 4Fe(OH)_3 \rightarrow 2(Fe_2O_3\ 3H_2O).$$

After the shelf life, the product retains its organoleptic properties. There is no rancidity of food product.

Conclusion. Thus, technological packaging solutions using an oxygen absorber allow to preserve appearance, color, flavor of rice porridge with berries, prevent rancidity, as well as the growth of mold, without the use of preservatives.

Given its established chemical composition, the oxygen absorber can be considered a potential source of ferromagnetic impurities. Therefore, incoming quality control regarding the surface condition and seal integrity of the sachets is required.

Keywords: *food preservation, food packaging, oxygen-scavengers*

EFFECT OF EGG REPLACEMENT WITH LEGUME AQUAFABA ON THE COLOR CHARACTERISTICS OF SPONGE CAKE

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Introduction. Color is an important quality attribute of sponge cake, strongly influencing its appearance and consumer acceptability. The replacement of egg with plant-based alternatives such as aquafaba may significantly affect the color characteristics of the final product. During baking, changes in ingredient composition can influence non-enzymatic browning reactions and consequently modify the overall color profile of sponge cake.

Materials and Methods. This study aimed to evaluate the effect of progressive egg replacement with aquafaba on the color characteristics of sponge cake and to determine the changes in instrumental color parameters associated with increasing aquafaba levels in the formulation. Sponge cake samples were prepared using different levels of egg replacement with aquafaba (25, 50, 75% replacement), ranging from a control sample (0% replacement) to a fully substituted formulation (100% aquafaba). Color was instrumentally evaluated using the CIELab color system. The parameters L* (lightness), a* (green–red coordinate), and b* (blue–yellow coordinate) were determined. Chroma (C*) and hue angle (h*) were calculated, and total color difference (ΔE*) relative to the control sample were subsequently assessed.

Results and Discussion. Increasing the level of egg replacement with aquafaba resulted in a progressive decrease in L*, indicating a darker appearance of the sponge cake. This effect may be associated with enhanced non-enzymatic browning, particularly Maillard reactions and caramelization during baking, promoted by reducing sugars present in aquafaba and the subsequent formation of brown-colored compounds. The a* coordinate shifted from negative to positive values, demonstrating a transition from lighter greenish tones toward reddish-brown shades and indicating increased formation of browning pigments. The b* parameter remained positive but showed a slight decrease with increasing aquafaba content, suggesting a reduction in yellow tones associated with egg-yolk carotenoids and their partial replacement by amber-brown shades. C* decreased moderately, indicating a reduction in color saturation, while the decrease in h* confirmed a shift toward warmer yellow-orange and caramel-brown tones. Furthermore, ΔE* increased progressively with the level of egg replacement, demonstrating increasingly perceptible color differences compared with the control. Replacement levels above 50% resulted in a distinctly modified color profile. Progressive egg replacement with aquafaba significantly affected the instrumental color characteristics of sponge cake. Higher aquafaba levels reduced lightness and promoted warmer, darker, caramel-brown tones.

Conclusions. These findings demonstrate that aquafaba can substantially modify the visual properties of sponge cake, particularly at higher egg-replacement levels, contributing to a distinctive appearance of the final product.

Keywords: *browning reactions; caramelization; CIELab; Maillard reaction; total color difference*

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A CLUSTERING ALGORITHM IN THE DESIGN JUSTIFICATION OF A FOR STUFFING MACHINES

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Introduction. When designing a modern filling and injection moulding machine, the designer is faced with a multi-criteria problem of selecting one of the possible designs for the functional modules – the injection unit, the air removal unit and the moulding unit. The properties of the target product are decisive here; this product is characterised as a visco-plastic material, as is the case with the injection moulding of both dairy and meat products.

Material and Methods. The search for the most appropriate combination of functional modules for a liver sausage filling syringe was carried out using morphological analysis, by decomposing the syringe's structure into individual functional elements and constructing a morphological matrix to synthesise the optimal solution. A distinctive feature of this work, compared with similar studies by other authors, is the use of the DBSCAN (Density-Based Spatial Clustering of Applications with Noise) clustering algorithm. This algorithm was chosen due to its ability to detect clusters of any geometric shape and automatically identify anomalous technical solutions (technological noise) without prior specification of the expected number of groups, thereby minimising the subjective factor during the design process.

Results and Discussion. Two objective functions were considered: the accuracy of portion dosing of mass directly into the casing (the criterion for minimising the mass error of the sausages during moulding) and air content (minimum air inclusions). The initial matrix contained five functional modules; subsequently, solutions that were deemed in advance to be ineffective or technically incompatible for liver mixtures were removed. The key components, which strictly dictate the configuration and physical limits of the other elements, are the Injection System and the Air Removal Device. Using a density-based clustering method, three clearly defined clusters of designs, homogeneous in terms of their technical and economic characteristics, were formed from an unordered set, and isolated deviations were identified. Items within cluster 1 are characterised by moderate accuracy in portion-sized mass dosing and an average or low level of air removal from minced meat. This is a group of general-purpose equipment suitable for basic technological processes. Items within Cluster 2 are distinguished by a high degree of air removal from the minced meat and are a suitable choice for the production of cooked sausages, where the absence of pores and voids in the finished product is crucial. Machines within Cluster 3 demonstrate the best precision in portion dosing, but have a lower degree of air removal. This group of fillers is designed for high-speed casing filling with minimal weight deviation.

Conclusions. It is proposed to design equipment for filling casings, with a view to its potential use for low-viscosity liver pastes, based on the following functional models: a hopper with spiral feed – a rotary-blade injection system – a vacuum circuit for the injection zone – a high-dynamic servo drive – a clipping device. This requires modifications to the conventional vacuum system configuration.

Keywords: *cluster analysis, equipment for filling casings, morphological analysis, rotary vane blower, visco-plastic food mass*

OPPOSITE COLOUR RESPONSES OF CRUST AND CRUMB IN GLUTEN-FREE SORYZ MUFFINS WITH WAX-BASED OLEOGELS

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Introduction. Wax-based oleogels are a leading clean-label strategy for delivering solid-fat functionality while retaining an unsaturated lipid profile. In gluten-free bakery, their effect on colour – the primary driver of first-impression quality and consumer acceptance – remains poorly documented. This study evaluated how complete replacement of liquid rapeseed oil (RO) by RO oleogels structured with three natural waxes affects the crust and crumb colour of gluten-free soryz muffins.

Materials and Methods. Muffins were formulated with soryz (Sorghum orysoidum) flour. In the control (CS) the fat phase consisted solely of RO, whereas in nine test formulations it was fully replaced by RO oleogels containing 4, 6 or 8% beeswax (BW), carnauba wax (CW) or rice bran wax (RW). As the same oil was used throughout, differences reflect oil structuring rather than lipid composition. Crust and crumb were analysed separately by CIELab colorimetry (L*, a*, b*); total colour difference (ΔE*), hue angle (h°), chroma (C*), yellowness index (YI) and browning index (BI) were calculated.

Results and Discussion. All oleogel muffins differed visibly from CS (ΔE* 8.9-23.2), yet crust and crumb responded in opposite directions. The crust became markedly lighter (L* +7.9 to +20.9 units), less red (a* −11 to −49%) and less browned (BI −41 to −52%; YI −27 to −34%), indicating attenuated surface Maillard browning and caramelisation. Lightening and browning reduction intensified with wax concentration and followed the order BW > CW > RW (crust ΔE* 20.2-23.2, 12.5-15.0 and 8.9-11.4, respectively); BW and CW also shifted the crust hue toward yellow (h° 63-75° vs. 59.7°), whereas RW preserved the original hue (h° 59.3-60.2°). In the crumb the trend reversed: b* rose by 42-54%, YI by 45-61% and C* by 42-53%, while a* (2.4-3.0) and L* (decrease ⩽ 4.2 units) remained close to CS. This golden, non-reddish shift, largely independent of wax type and concentration (ΔE* 10.9-14.1), points to a structural and optical effect of the gelled fat phase rather than to thermally driven browning.

Conclusions. Oil structuring alone, at identical lipid composition, redistributes colour in gluten-free soryz muffins – suppressing crust browning while imparting a golden crumb – with wax type as the dominant factor. RW oleogels most closely reproduce the reference appearance, whereas BW and CW yield lighter, less browned crusts, advantageous where excessive crust darkening is undesirable. Wax selection is thus a practical tool for tailoring the appearance of gluten-free bakery products.

Keywords: *bakery products, CIELab, Maillard browning, soryz flour, structured lipids, yellowness index*

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PHISICOCHEMICAL AND SENSORY CHARACTERISTICS OF WHEAT BREAD AS AFFECTED BY APPLE POMACE FORTIFICATION

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Introduction. Apple pomace is a valuable source of bioactive compounds and dietary fiber, and its incorporation into bakery products represents a promising approach for the sustainable valorization of fruit-processing by-products. This study investigated the effect of partial wheat flour substitution with apple pomace powder on the physicochemical, functional, textural, and sensory characteristics of wheat bread.

Materials and Methods. Apple pomace powder was incorporated at substitution levels of 5%, 10%, and 15%, and the resulting breads were compared with a control produced exclusively from wheat flour. The samples were evaluated for CIELab color parameters, moisture, titratable acidity, specific volume, porosity, baking loss, total phenolic content, antioxidant activity, texture parameters, and sensory characteristics.

Results and Discussion. Increasing the apple pomace substitution level resulted in a progressive increase in titratable acidity, whereas bread specific volume, porosity, and baking loss progressively decreased. Moisture content and bread weight increased at 5% and 10% substitution but decreased at 15%, while remaining higher than those of the control. Apple pomace fortification enhanced the functional properties of bread, with total phenolic content increasing from 35.18 to 44.28 mg GAE/100 g and DPPH radical scavenging activity from 0.069 to 0.108 mmol Trolox/100 g as the substitution level increased. Texture analysis showed a progressive increase in hardness and gumminess with increasing apple pomace incorporation, while resilience increased at the 5% substitution level and subsequently decreased at higher levels, although remaining above the control value. Sensory evaluation indicated good acceptability of bread containing 5% apple pomace, whereas higher substitution levels resulted in progressively lower sensory scores. Conclusions. Overall, the findings demonstrate the potential of apple pomace powder as a functional and sustainable ingredient for wheat bread fortification. Among the tested formulations, substitution of 5% wheat flour with apple pomace powder provided the most favorable balance between enhanced functional properties and acceptable physicochemical, textural, and sensory characteristics. Higher substitution levels further increased the total phenolic content and antioxidant activity but adversely affected bread structure, texture, and sensory acceptability.

Keywords: *apple pomace powder, color, porosity, sensory analysis, specific volume, texture*

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INFLUENCE OF TRITICALE FLOUR ON THE QUALITY CHARACTERISTICS OF BISCUITS

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Introduction. The use of triticale flour in bakery products represents a promising approach to diversifying cereal-based raw materials and developing products with specific technological and sensory properties. The particular composition of triticale may influence the physicochemical, textural, and sensory characteristics of the final products. This study aimed to evaluate the influence of replacing high-quality wheat flour with whole-grain flour from the triticale variety Ingen 33 on the sensory, physicochemical, and textural characteristics of sugar, semi-sweet, and short-dough biscuits.

Materials and Methods. Three types of biscuits were produced using high-quality wheat flour as the control and whole-grain Ingen 33 triticale flour as the alternative raw material. Sensory evaluation was performed by eleven panelists who assessed shape, surface appearance, color, cross-sectional appearance, taste, and aroma. Physicochemical analyses included moisture content, alkalinity, swelling capacity, and water activity, while texture was evaluated in terms of hardness. Biscuits produced with Ingen 33 triticale flour exhibited favorable sensory characteristics, with overall scores of approximately 4.9–5.0 points.

Results and Discussion. Compared with wheat-based samples, triticale biscuits showed a characteristic brownish color with visible bran particles, while maintaining a pleasant taste and aroma and a uniform cross-sectional appearance. Moisture content ranged from 5.35 to 10.80%, whereas water activity varied between 0.302 and 0.555 c.u. The alkalinity of all samples remained below 2 degrees. Swelling capacity ranged from 147.05 to 347.75%, with sugar biscuits exhibiting the highest values, indicating a greater ability to absorb water. These results demonstrate that flour type and biscuit formulation influenced water retention and interactions within the product matrix. Replacing wheat flour with Ingen 33 triticale flour also resulted in substantial changes in texture. The hardness of sugar biscuits increased from 554.98 to 1663.23 g, whereas that of semi-sweet biscuits decreased from 1539.06 to 649.49 g. Short-dough biscuits exhibited smaller differences in hardness. These findings indicate that the effect of triticale flour on mechanical properties was dependent on biscuit formulation, reflecting differences in the structural organization of the product matrix.

Conclusions. In conclusion, whole-grain Ingen 33 triticale flour can be successfully used in different types of biscuits while maintaining high sensory acceptability. Its use modifies physicochemical and textural properties, with the magnitude and direction of these changes depending on the biscuit type. These findings highlight the potential of Ingen 33 triticale as an alternative cereal raw material for developing diversified bakery products with distinctive sensory and technological characteristics.

Keywords: *alternative cereals, baking quality, hardness, sensory acceptability, swelling capacity, water activity*

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RAPESEED OIL-BASED OLEOGELS STRUCTURED WITH XANTHAN GUM: PHYSICOCHEMICAL AND RHEOLOGICAL CHARACTERIZATION

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Introduction. The structuring of vegetable oils using biopolymers represents a promising research approach for the development of innovative lipid systems with improved physicochemical and functional properties.

Materials and Methods. The aim of the present study was to develop and characterize the physicochemical and rheological properties of structured lipid systems based on rapeseed oil and xanthan gum incorporated at concentrations of 2, 4, 6, and 8% (w/w). The samples were prepared using an indirect structuring method involving the preliminary hydration of xanthan gum in distilled water, the gradual incorporation of rapeseed oil through homogenization, and the subsequent removal of the aqueous phase by controlled drying. Physicochemical characterization focused on evaluating the main quality parameters and structural properties of the resulting systems, while rheological analysis aimed to investigate their flow behavior and viscoelastic characteristics. Apparent viscosity was evaluated as a function of shear rate, whereas viscoelastic properties were assessed by determining the storage modulus (G'), loss modulus (G''), and loss factor ($\tan \delta$). A comparative analysis of the formulations was conducted to investigate the influence of xanthan gum concentration on internal structural development, resistance to deformation, and the stability of the lipid systems.

Conclusions. This study provides an experimental approach for investigating the potential of xanthan gum in the indirect structuring of rapeseed oil and identifying formulations with technological properties suitable for applications in the food industry.

Keywords: *rapeseed oil, xanthan gum, oleogels, indirect structuring, physicochemical characterization, rheological properties*

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MICROWAVE PENETRATION DEPTH MODELING IN THE DEHYDRATION OF CAPILLARY-POROUS MEDIUM

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Drying is a widely utilized technique for food preservation, typically involving the transfer of thermal energy to the product's surface via convection, conduction, or radiation.

Introduction. Traditional surface-heating techniques suffer from internal mass transfer resistance and low thermal gradients, causing prolonged drying cycles. Among alternative configurations, volumetric electromagnetic heating has emerged as an effective tool. However, the sophisticated physics of energy absorption, governed by ionic conductivity and dipole relaxation, frequently results in non-uniform heat distribution. Developing a mathematical model for capillary-porous bodies under dielectric field propagation is essential to quantify localized energy dissipation and ensure system efficiency.

Material and Methods. A deterministic mathematical model was formulated to analyze the propagation of the electric field within high-moisture dielectric media where dipole relaxation represents the dominant mechanism. Analytical solutions were derived by coupling Maxwell's equations with energy conservation laws. Boundary conditions were established for a representative capillary-porous matrix characterized by an initial raw moisture content of 40%. The numerical solution targeted parameters including electric field strength, processing duration, and attenuation characteristics to map energy gradients.

Results and Discussion. The developed mathematical framework successfully determines how critical electromagnetic parameters impact overall processing intensity. Attenuation modeling confirmed that wave propagation dynamics are highly sensitive to moisture-dependent dielectric properties. For a raw matrix evaluated at 40% moisture content, quantitative modeling and numerical calculations situated the actual wave attenuation threshold strictly between 2 cm and 6 cm. This localized span marks the boundary where field strength drops significantly, directly controlling spatial heating uniformity. The resulting numerical solution acts as an analytical benchmark for evaluating the structural accuracy of alternative theoretical models, ensuring that industrial equipment can prevent interior cold spots or localized charring.

Conclusions. The numerical solution derived for attenuation constraints represents a critical factor in optimizing the dehydration of capillary-porous materials. Quantifying the internal heating boundaries establishes a reliable theoretical framework for industrial scale-up. This modeling approach enables the design of advanced dielectric processing systems that maximize moisture extraction while preserving structural and qualitative attributes of food matrices.

Keywords: *attenuation threshold, dielectric heating, dipole relaxation, mathematical simulation, moisture content*

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TECHNO-FUNCTIONAL AND SENSORY ACCEPTABILITY OF SOURDOUGH MINI-BAGUETTES FORTIFIED WITH LAVENDER PETAL POWDER

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Introduction. Lavender, belongs to the genus Lavandula of the Lamiaceae family, is an "edible homologous" plant with medicinal and economic value, widely cultivated worldwide.

Materials and Methods. The aim of this study was to develop sourdough mini-baguettes (SMBs) fortified with lavender petal powder (LPP) and to examine the role of sourdough fermentation on their physical, antioxidant characteristics, as well as consumer acceptability. Particularly, four formulations were prepared: SMBs without LPP (SMB-0), SMBs with 2.5% of LPP (SMB-2.5), SMBs with 5.0% of LPP (SMB-5), and SMBs with 7.5% of LPP (SMB-7.5). The total polyphenol content ranged between 49.51 and 237.87 mg GA/100g, total flavonoid content varied between 51.34 and 225.47 mg GA/100g, and total anthocyanin content reached 14.87 and 41.37 mg CGE/100g in fortified formulations.

Results and Discussion. The highest DPPP radical scavenging activity was attested in SBM-7.5 (87.53%) in comparison with SMB-0 (8.07%). The sourdough fermentation enhanced antioxidant potential through acidification, while also interacting with technological and sensory quality. The highest acidity, ΔE, hardness, belonged to SMB-7.5. The overall acceptability results clearly showed that the addition of lavender at a concentration of 7.5% caused significantly decreased overall acceptance due to intense smell and taste. LPP fortification may decrease the porosity, which is an important quality attribute of SMBs. Slight variations were found in baking loss parameters. The incorporation of LPP at 2.5% in SMB formulation extended the shelf-life for one day. Delays in SMBs molding and the lowest mold count in fortified SMBs are due to ability to produce a variety of antimicrobial compounds in dough during fermentation. SMBs fortified with lavender exhibited promising characteristics, suggesting its potential as an aesthetic and nutritional impact on bakery product.

Keywords: *Lavender, sourdough, bakery innovation, antioxidant potential, health benefits*

Acknowledgments. The research was supported by Institutional Project, subprogram 020405 “Optimizing food processing technologies in the context of the circular bioeconomy and climate change”, Bio-OpTehPAS, being implemented at the Technical University of Moldova.

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OLEOGEL AS A FAT ALTERNATIVE IN GLUTEN-FREE MUFFINS: COMPARATIVE EVALUATION OF TEXTURAL PROPERTIES

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Introduction. This study investigated the textural characteristics of gluten-free millet flour muffins formulated with oleogels as alternatives to conventional fats. The development of gluten-free bakery products with improved nutritional and technological properties remains a significant challenge, as the absence of gluten substantially affects crumb structure and texture.

Materials and Methods. Oleogels were prepared using carnauba wax as the structuring agent and three edible oils, namely corn, sunflower, and pumpkin seed oils. For each lipid system, carnauba wax was incorporated at concentrations ranging from 2 to 10% (w/w), resulting in oleogels with different degrees of lipid-phase structuring. The oleogels were incorporated into gluten-free muffin formulations, and their technological performance was compared with that of muffins prepared with conventional vegetable oil and butter. Texture profile analysis (TPA) was performed using a Perten TVT 6700 texture analyzer to determine hardness, springiness, cohesiveness, gumminess, chewiness, and resilience.

Results and Discussion. Particular emphasis was placed on the effects of carnauba wax concentration and oil type on crumb structure and mechanical properties. Increasing carnauba wax concentration modifies the density of the three-dimensional oleogel network, affecting its capacity to immobilize the lipid phase and modulating interactions among lipids, starch, and other structural components of the millet flour matrix. Differences in fatty acid composition and physicochemical properties among corn, sunflower, and pumpkin seed oils also contribute to the formation of oleogel networks with distinct structural characteristics, which influence the organization of the baked matrix and the mechanical and textural properties of the muffin crumb. The findings highlight oleogelation as a promising strategy for modulating the textural properties of millet-based gluten-free bakery products while replacing conventional fats with structured vegetable oils.

Conclusions. This study provides further insight into the relationships among oleogel composition, wax concentration, and crumb texture, supporting the selection of suitable lipid systems for gluten-free muffin formulation. Carnauba wax-based oleogels offer a promising alternative lipid system combining structural functionality with the nutritional benefits of unsaturated vegetable oils.

Keywords: *gluten-free muffins, millet flour, oleogel, carnauba wax, textural properties*

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PROPERTIES OF THE DOUGHS OBTAINED BY PARTIAL REPLACEMENT OF WHEAT FLOUR WITH APPLE POMACE POWDER

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Introduction. The aim of the research was to study the behavior during mixing and fermentation of doughs obtained by partial replacement of wheat flour with apple pomace powder.

Materials and Methods. Dough samples with different dosage of apple pomace powder (5, 10 and 15% of the total mass of the flour-powder mixture) were tested. The dough control sample was prepared without the use of apple pomace powder. The wheat flour "MOPAN 650" (Romania) with ash content 0.5%, wet gluten 24.33% and moisture 11.81% was used as the basis for the mixtures. The flour quality parameters were determined using the NIR Analyzer Perten IM 9500 (Sweden). For the determination of the water absorption capacity, the development time and stability of the dough during mixing and pasting, the Mixolab 2 Chopin Technologies device (France) was used. For the determination of the gas formation and retention capacity in the dough during fermentation, the Rheofermentometer F4 Chopin Technologies device (France) was used.

Results and Discussion. It was found that the partial replacement of wheat flour with apple pomace powder contributes to increasing the water absorption capacity in the dough (by about 4% in the sample with 15% powder compared to the control sample). This effect can be explained by the fact that when using the apple pomace powder for dough preparation, the intake of dietary fiber increases. In samples containing apple pomace powder, an increase in dough development time and a simultaneous decrease in dough stability were observed. It was found that the use of apple pomace powder significantly influences the dough's capacity to form and retain fermentation gases. The total volume of CO2 formed during the fermentation of the dough was 238.5 cm3 higher in the sample with 15% powder. However, the gas retention coefficient in the sample with maximum powder dosage compared to the control sample was 10.95% lower, what can be explained by the fact that when the dosage of powder in the mixture increases, the capacity of the dough to form gluten decreases.

Conclusions. In order to improve the properties of doughs obtained by partial replacing wheat flour with apple pomace powder, it is necessary to use bakery improvers or other ingredients, such as fats or sugar, which influence the rheological properties of the dough.

Keywords: *mixtures, dough behavior, quality parameters*

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ARTISANAL ORGANIC CHEESE RIPENED IN GRAPE POMACE

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Introduction. An important direction in the industrial processing of milk is cheese production, as cheeses are among the most complex and dynamic food products. The geographical area of origin leaves a distinct imprint on these products, imparting specific organoleptic and physicochemical characteristics. Scientific research has demonstrated that animal feeding influences not only the sensory characteristics of cheeses but also their nutritional properties. Cheese produced from the milk of pasture-raised cows has a higher content of conjugated fatty acids and a greater antioxidant capacity than cheese obtained from the milk of cows raised in intensive farming systems. For consumers who appreciate these products, their composition, appearance and, above all, taste represent important quality criteria.

Material and Methods. In the present study, in addition to highlighting the artisanal nature of the process used to produce cheese ripened with grape pomace, as well as the benefits and flavours imparted by the pomace compared with other ripening methods and technologies, the main objective is to present the production technology of cheese ripened with grape pomace through the application of artisanal methods and practices. Both experimental data and information available in the scientific literature were used in conducting the research.

The production of high-quality finished products requires thorough professional training of specialists in the field, whose knowledge should be applied to the continuous improvement of technological processes, the diversification and enhancement of the product range, and the efficient and sustainable use of resources.

Conclusions. Cheese ripening with grape pomace may contribute to the development of a product with specific sensory properties and added value, while also providing an opportunity for the valorisation of a by-product generated by the wine industry.

Keywords: *organic cheese, grape pomace, ripening, sensory characteristics, by-product valorization*

TECHNOLOGICAL AND MECHANICAL PROPERTIES OF TRITICALE PASTA ENRICHED WITH BREWERS' SPENT GRAIN

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Introduction. The valorization of brewing industry by-products, such as brewers' spent grain (BSG), represents a promising approach for developing sustainable food products with improved nutritional value. Incorporating BSG into pasta formulations may modify hydration properties, cooking behavior, and mechanical strength, with these effects depending on the raw material, BSG type, and substitution level.

Materials and Methods. This study aimed to evaluate the influence of fermented light and dark BSG flour incorporation on the technological and mechanical properties of pasta produced from different triticale varieties. Pasta samples were produced from flours obtained from different triticale varieties and supplemented with dark BSG flour at 5 and 10% and light BSG flour at 10 and 17.5%. Technological properties were determined according to AACC Method 66-50.01 by evaluating optimal cooking time (OCT), water absorption (WA), cooking loss (CL), and swelling index (SI). The fracturability of dried pasta was instrumentally determined using a Perten TVT6700 texture analyzer and expressed as the maximum force (N) required to break the sample.

Results and Discussion. BSG incorporation affected the technological parameters depending on BSG type and level, as well as the triticale variety. OCT ranged from 11.25 to 13.35 min and generally decreased slightly with increasing BSG incorporation, suggesting enhanced water penetration and starch gelatinization. WA ranged from 102.28 to 152.38% and generally increased with BSG addition, which may be attributed to the high content of hydrophilic dietary fiber and structural changes within the pasta matrix. CL ranged from 0.15 to 0.25%, with higher values indicating partial weakening of the structural network and increased migration of soluble components into the cooking water. SI ranged from 1.35 to 2.12, demonstrating that swelling behavior was influenced by both triticale variety and BSG type and level. Fracturability ranged from 47 to 94 N. Light BSG generally reduced the mechanical strength of dried pasta, whereas dark BSG frequently increased the force required for breakage; however, the response varied among triticale varieties. BSG type and incorporation level, together with triticale variety, substantially influenced the cooking behavior and mechanical properties of pasta.

Conclusions. The results highlight the potential of BSG as a functional ingredient in triticale-based pasta, although the incorporation level should be optimized according to BSG type and triticale variety to achieve desirable technological and structural properties.

Keywords: *by-product valorization, cooking quality, dietary fiber, fracturability, sustainable food*

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EFFECT OF SEA BUCKTHORN POMACE AND WATER-SOLUBLE EXTRACT ON THE MICROBIOLOGICAL QUALITY OF ICE CREAM

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Introduction. The valorization of agri-food by-products is increasingly recognized as a sustainable strategy for reducing food waste and recovering valuable compounds for food applications. Sea buckthorn (Hippophae rhamnoides L.) pomace is a promising source of bioactive compounds with potential antioxidant and antimicrobial properties. However, their incorporation into perishable foods requires careful assessment of microbiological quality and product stability. Therefore, evaluating the microbiological implications of incorporating sea buckthorn pomace and its extracts into ice cream is of particular relevance.

Materials and Methods. Seven ice cream samples were analyzed: one control sample (CS), three samples supplemented with water-soluble sea buckthorn pomace extract (WSBPE), and three samples with sea buckthorn pomace (SBP) at 0.5%, 1.0%, and 1.5%. Microbiological evaluation included total plate count (TPC), coliform bacteria, Enterobacteriaceae, and Salmonella.

Results and Discussion. The microbiological results differed between ice cream containing SBP and WSBPE. The CS showed a TPC of 1.5×10^3 CFU/g, while SBP-containing samples reached up to 5.4×10^3 CFU/g and WSBPE samples up to 4.0×10^1 CFU/g. Thus, SBP resulted in a more pronounced increase in TPC, whereas WSBPE was associated with substantially lower microbial counts. Nevertheless, all values remained well below the admissible limit of 1×10^5 CFU/g established by Government Decision No. 221/2009. The higher TPC in SBP-containing samples may be related to the microbial load of the raw pomace and the direct incorporation of the solid material, while the lower values observed for WSBPE may reflect the effects of extraction and subsequent processing. Coliform bacteria, Enterobacteriaceae, and Salmonella were not detected in any sample, indicating satisfactory microbiological safety under the tested conditions.

Conclusions. Sea buckthorn pomace and its water-soluble extract produced distinct microbiological profiles in ice cream. SBP-containing samples showed higher TPC values than the control, whereas WSBPE samples exhibited substantially lower counts than those containing solid pomace. However, all samples remained within the established TPC limit, and coliform bacteria, Enterobacteriaceae, and Salmonella were not detected. The findings support the microbiological acceptability of both sea buckthorn-derived ingredients under the tested conditions and emphasize the importance of appropriate sanitation and processing of the raw pomace.

***Keywords**: agri-food by-products, circular bioeconomy, food microbiology, microbial load, functional ingredients*

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WAYS TO ELIMINATE MAJOR QUALITY DEFECTS IN WHOLE-GRAIN FLOUR-BASED BAKERY SEMI-FINISHED PRODUCTS

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Introduction The main advantages of "delayed baking" technologies include: the ability to establish a network of mini-bakeries with minimal equipment; the provision of freshly baked goods to consumers directly at the point of sale; the elimination of waste and unsold inventory; and the long shelf life of semi-finished products. However, manufacturers employing these technologies face certain drawbacks, such as: increased moisture loss at various stages (par-baking, freezing, storage, and final baking); the risk of product collapse and crust separation; the use of food additives (often of inorganic origin); rapid staling after final baking; and reduced finished product yield. A key requirement of this technology is maintaining product quality; it is essential to minimize moisture loss and optimize the recovery of product properties following thawing and final baking.

Materials and Methods. The aim of this study is to justify the feasibility and benefits of using ingredients with high water-absorption and water-retention capacities in the production of semi-finished bakery products and specialty goods using "delayed baking" technology, in order to minimize the aforementioned drawbacks. A bakery product recipe prepared using traditional technology and containing 10% whole-grain flour was selected as the control sample. In the first stage of the study, the effect of adding buckwheat flour, corn flour, and wheat bran (at a level of 10% of the wheat flour mass) on the organoleptic quality characteristics of bread made from par-baked semi-finished products (which already contained 10% whole-grain flour) was evaluated.

Results and Discussion. The incorporation of buckwheat and corn flours, as well as wheat bran, contributed not only to improved functional properties but also to a noticeable enhancement of taste, aroma, and the condition and color of the crust. In the second stage, the study examined the impact of these additives on the physicochemical quality indicators of the bread and the structural-mechanical properties of the crumb, as well as changes in these properties during storage following the final baking. The addition of buckwheat and corn flours and wheat bran improved the structural-mechanical properties of the crumb, specifically increasing its relative plasticity by 3–5%. The higher water-holding capacity of wheat bran and buckwheat and corn flours helped reduce moisture loss during the production process (which, in turn, increased the yield of the finished bread) and slowed moisture loss in the finished products during storage.

Conclusions. It was found that bread freshness was maintained for longer-particularly in samples containing whole-grain flour and wheat bran-likely due to the higher dietary fiber content. These fibers slow down moisture loss during initial baking, freezing, storage of par-baked products, and final baking, and also help reduce the rate of staling during storage.

Keywords: *benefits, feasibility, water absorption, water retention*

PRINCIPAL COMPONENT ANALYSIS OF WHEAT SOURDOUGH-SUPPLEMENTED BREAD BASED ON QUALITY CHARACTERISTICS AND DOUGH RHEOLOGICAL BEHAVIOUR

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Introduction. Wheat sourdough fermentation, driven by the metabolic activity of lactic acid bacteria and yeasts, fundamentally affects dough rheology through biological acidification and enzymatic action. This acidic environment activates endogenous flour proteases and promotes gluten depolymerization, weakening the gluten network. Consequently, these structural and biochemical modifications significantly improve final bread quality enhancing bread color, textural, physical, and sensory characteristics. Principal Component Analysis (PCA) is a powerful multivariate statistical tool that reduces data dimensionality, enabling the identification of dominant variance vectors and co-variations among rheological and quality parameters. Incorporating commercial dried wheat sourdough ingredients offers a promising strategy to modify the physicochemical, rheological, and sensory qualities of bakery products.

Materials and Methods. This study evaluated the effects of incorporating two distinct wheat sourdough formulations from the Sapore range, such as Sapore Rigoletto (SR) and Sapore Medea (SM), at substitution levels ranging from 0% to 4% into wheat flour type 650. The dough was analyzed for pH values (Hach HQ30d pH-meter) and rheological properties using an Alveograph according to ICC Standard Method No. 121 and Rheofermentometer Chopin. The bread quality characteristics were determined for its physical values (porosity, elasticity, loaf volume) according to the SR 91:2007 standard method, color characteristics using a CR-400 colorimeter based on the CIELAB color system, textural values (hardness, springiness, cohesiveness, chewiness) using a TA.HD plus texture analyzer, sensory attributes using a nine-point hedonic scale with a semi-trained panel and sodium concentration by using Flame Atomic Absorption Spectrometry.

Results and Discussion. Principal Component Analysis showed that the first two principal components accounted for 73.27% of the total variance across all measured parameters (PC1: 43.52%, PC2: 29.75%). The control sample (CS) separated strongly along PC1 axes, characterized by higher initial pH values and higher Alveograph extensibility (58 mm) and baking strength values. Increasing sourdough incorporation levels from 1% to 4% in wheat flour induced a clear formulation-dependent shift along PC1 axis, resulting in progressive dough acidification, enhanced crumb yellowness and improved sensory taste, odor, and overall acceptability scores. PC2 differentiated the two sourdough types, with SM formulations displaying higher gas production and retention coefficient, increased springiness, and higher loaf volume compared to samples with SR addition. The samples with higher wheat sourdough addition are strongly correlated, likely due to their positive impact on bread sensory characteristics and a significant decrease in dough pH values.

Keywords: *multivariate analysis, Alveograph, dough fermentation, bread quality*

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BIGELS AS EMERGING STRUCTURING AGENTS IN BAKERY AND CONFECTIONERY PRODUCTION

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Introduction. The imperative to substitute trans-fatty acids and saturated fats in manufactured foods has accelerated research into lipid-structuring technologies. To mitigate cardiometabolic risks, WHO and EFSA recommend limiting saturated fats to below 10% and trans-fats to under 1% of total daily energy intake. However, removing solid fats creates physical and textural challenges in food matrices. Combining oleogels and hydrogels into biphasic bigels offers a viable strategy.

Materials and Methods. Manufactured via high-shear homogenization at controlled temperatures, bigels unify lipid and aqueous phases into a cohesive matrix, delivering benefits such as improved spreadability, enhanced moisture dynamics, and simultaneous encapsulation of hydrophilic and hydrophobic bioactives. Strategic biopolymer selection enables bigels to reduce saturated fat while serving as targeted nutrient delivery systems for gastrointestinal absorption. The potential of biphasic bigels to replace conventional shortenings in bakery and confectionery products without compromising mechanical integrity or sensory quality was systematically evaluated. Synthesized findings demonstrate that bigels reliably exhibit solid-like viscoelastic behavior (G' > G"), maintain high oil-binding capacities up to 100%, and preserve ideal crumb firmness and pore distribution. Specifically, it has been documented that substituting 75% to 100% of conventional shortenings with biphasic systems such as candelilla wax-based oleogel mixtures or 1:1 gelatinized starch-oleogel hybrids achieves up to 50% total fat reduction, 100% oil retention, and enhanced thermal-textural stability, despite elevating rapidly digestible starch from 19.0% to 43.0% [1]. Furthermore, hydrocolloids boost water retention, effectively retarding starch retrogradation and staling in baked goods. In confectionery, bigel incorporation improves heat stability and inhibits fat bloom.

Conclusions. Overall, bigels establish a functional, clean-label approach to reconciling health guidelines with physical quality, while highlighting crucial research gaps in fermented gluten-free baking. Optimizing processing parameters and multi-gelator interactions will pave the way for the large-scale commercial adoption of bigels in healthy food production.

Keywords: *bigel, biphasic systems, fat replacement, hydrocolloids, retrogradation, viscoelasticity*

Acknowledgments. The research was supported by the Institutional Project, subprogram 020405 "Optimization of Food Processing Technologies in the Context of Circular Bioeconomy and Climate Change," Bio-OpTehPAS, implemented at the Technical University of Moldova.

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METHODS AND EQUIPMENT FOR BAKERY PRODUCTS COOLING

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Introduction. The food industry has increasingly focused on optimizing technological processes, reducing energy consumption and production costs, expanding the product range, accelerating production, and shortening the cooling time of finished products, particularly in bakery enterprises.

Modern bakery enterprises employ two main cooling methods: natural (convective) cooling and cooling using conditioned air.

Materials and Methods. An analytical review of existing methods and equipment for cooling bakery products was conducted. Natural (convective) cooling, cooling using conditioned air, and vacuum cooling were considered. The advantages and disadvantages of these methods were analyzed, with particular attention paid to cooling duration, equipment requirements, energy consumption, cooling uniformity, product quality, and the risk of microbiological contamination.

Results and Discussion. Natural cooling is the simplest method but takes a long time, requires large areas, and does not ensure uniform cooling, which can affect product quality. Cooling using conditioned air allows for a reduction in cooling time; however, it requires complex equipment, significant energy consumption, and controlled operating conditions.

Both conventional methods have several disadvantages, including long process duration, large equipment dimensions, difficulties in transporting products, uneven cooling, and the risk of bacterial contamination.

One of the promising directions for intensifying the cooling process of finished bakery products is the implementation of vacuum cooling. This method is based on heat removal through the evaporation of moisture from products with sufficient gas and vapor permeability.

Vacuum cooling significantly reduces cooling time while ensuring uniform temperature distribution inside the product, which positively affects its quality. It also contributes to the improvement of the structural and mechanical properties of baked goods, extends their shelf life, and reduces the risk of microbiological contamination.

Conclusions. Vacuum cooling is a promising alternative to traditional cooling methods for bakery products. Its application can reduce cooling time, ensure more uniform temperature distribution, preserve the structural and mechanical properties of baked goods, extend their shelf life, and reduce the risk of microbiological contamination.

Keywords: *bread, bakery, cooling, vacuum, quality.*

MULTI-CRITERIA OPTIMIZATION OF HYBRID DRYING USING THE HARRINGTON DESIRABILITY FUNCTION

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Introduction. Hybrid convective–microwave drying provides an intensified approach for processing winemaking by-products, for which moisture removal must be balanced against energy consumption and preservation of product quality. The aim of this study was to identify an optimal drying regime by simultaneously considering moisture reduction, energy performance, rehydration capacity and colour preservation.

Material and Methods. Experimental data obtained from 15 drying regimes were subjected to mathematical and statistical processing. The investigated technological factors included drying-air temperature, microwave power, process duration and air velocity. Five response functions were evaluated: final moisture content, specific energy consumption, energy efficiency, rehydration capacity and colour change (ΔE). The first, second and fifth responses were minimized, whereas energy efficiency and rehydration capacity were maximized. Since the responses differed in units and optimization directions, they were transformed into dimensionless individual desirability functions using the Harrington approach. A global desirability coefficient was subsequently calculated as the geometric mean of the individual desirability values.

Results and Discussion. The experimental results demonstrated a clear intensification of moisture removal with increasing drying temperature and microwave power. Final moisture decreased from 18.0% to 7.9%, while specific energy consumption decreased from 5.6 to 2.9 kWh/kg evaporated water. Energy efficiency increased from 63% to 91%, confirming the improved utilization of supplied energy under intensive drying conditions. Rehydration capacity reached a maximum value of 3.7, whereas colour change increased under the most intensive regimes, indicating a compromise between process intensification and colour preservation. The global desirability coefficient ranged from 0.41 to 0.93. The highest value, D = 0.93, was obtained for the regime with a drying-air temperature of 80 °C, microwave power of 900 W, process duration of 18 min and air velocity of 2.4 m/s. Under these conditions, final moisture was 7.9%, specific energy consumption was 2.9 kWh/kg evaporated water, energy efficiency reached 91%, and rehydration capacity was 3.5. The individual desirability values for the five criteria were 0.951, 0.95, 0.95, 0.90 and 0.95, respectively.

Conclusions. The Harrington desirability function proved effective for identifying a balanced drying regime under competing quality and energy criteria. The optimized hybrid convective–microwave process achieved high drying efficiency while maintaining satisfactory functional characteristics of the dried winemaking by-products. The identified regime represents the best compromise among the investigated experimental conditions and demonstrates the potential of microwave-assisted intensification for energy-efficient valorization of winemaking by-products.

Keywords: *drying efficiency, energy consumption, Harrington desirability, microwave-assisted drying, rehydration capacity, winemaking by-product*

Acknowledgments. The results described were obtained through research conducted within the project: 020405 “Optimization of food processing technologies in the context of the circular bioeconomy and climate change”.

DRYCONTROL MONITOR

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DryControl Monitor is a software application developed in C++ using the Visual Component Library, intended for real-time monitoring of drying processes through an intuitive graphical user interface.

Introduction. Industrial dehydration requires strict control over thermodynamic parameters to safeguard product quality and optimize energy profiles. Manual or non-automated oversight frequently leads to processing deviations, batch degradation, and unsafe operating environments. To address these limitations, this research focuses on the development of a dedicated software application designed for real-time visualization, deterministic supervision, and operational hazard mitigation during industrial dehydration cycles.

Material and Methods. The software architecture of DryControl Monitor was engineered in the Object-Oriented Programming paradigm using the C++ language. The graphical user interface and event-driven communication layers were constructed utilizing the Visual Component Library framework. The underlying system logic utilizes programmatic reset modules to establish consistent initial baselines. UI event handlers were implemented to manage multi-threaded user input and real-time interface updates.

Results and Discussion. The application provides a dedicated dialog window that displays process evolution using both a progress bar and a numerical indicator, ensuring clear visualization of the drying stage. Upon initialization, all monitoring parameters are reset to baseline values, ensuring accurate tracking of the drying cycle from its onset. The software efficiently manages user interface events and offers straightforward control over the monitored process. The integrated visual instrumentation allows supervisors to capture immediate variations in the thermal environment. Operational safety is significantly enhanced through a low-latency process interruption routine, enabling operators to deploy a cancel command that halts active operations during critical anomalies. This real-time interface mitigates data loss, minimizes material damage from thermal overexposure, and provides a scalable, reliable terminal for industrial installation control.

Conclusions. DryControl Monitor successfully closes the gap between raw industrial instrumentation and operator oversight. By enabling real-time visualization, process control, and safe interruption, the application improves the supervision and reliability of drying operations within industrial installations. The framework establishes a foundation for integrating automated feedback loops in modern food processing equipment.

Keywords: *C++ programming, graphical user interface, real-time supervision, visual component library*

Acknowledgments. The results described were obtained through research conducted within the project: 020405 “Optimization of food processing technologies in the context of the circular bioeconomy and climate change”.

EFFECT OF COMPRESSION METHOD AND THE MOTION LAW OF PUNCHES ON DENSITY DISTRIBUTION INTO TABLET

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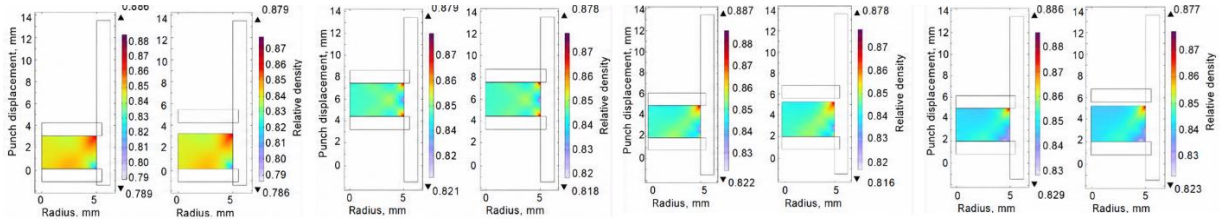
Introduction. Scientific and educational literature suggests that the compression method and the motion law of the punches significantly influence the density distribution into the tablet, which, in turn, prevents the uniformity of its properties.

Materials and Methods. For determination of the density distribution in the tablet it was used the finite element method (FEM), combined with constitutive compression model, in particular, of the density-dependent Drucker-Prager Cap (DPC), which takes into account shear strength with volumetric compression under hydrostatic pressure and permits parameter calibration based on relative density.

Results and Discussion. During one-sided compression, zones of higher and lower stress and density appear near the die surfaces, while the core density does not exceed the average by more than 7%, slightly affecting strength and friability but potentially causing chipping. Double-sided compression produces higher-density zones at the tablet edges, with core density differences also within 4%, lower than in one-sided compressing, showing that the compressing method has minimal effect on density and strength distribution.



a - 1 side compression | b - 2 side a - 1 side compression symetric | c - 2 side compression asymetric | d – nonlinear asymmetric compression

Figure 1. Distribution of tablet density throughout its volume as a function of the punch motion law

It should be noted that this pattern applies only to tablets whose diameter is significantly smaller than their height.

Conclusion. Compression method and the motion law of the punches has a negligible effect on the density distribution into typical tablet.

Keywords: *tablet, compression, kinematics, density, strength friability*

SECTION II:
Sustainability in Nutrition, Leisure and Tourism



NUTRITIONAL THERAPY IN RHEUMATOID ARTHRITIS AND OTHER IMMUNE-MEDIATED INFLAMMATORY DISEASES: EVIDENCE BASED DATA

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Introduction. Nutritional therapy may complement rheumatoid arthritis (RA) management, but biological plausibility does not establish clinical efficacy. Beyond RA, nutritional interventions have also been investigated in psoriasis and inflammatory bowel diseases.

To evaluate dietary interventions in RA and to extend the assessment to psoriasis, spondyloarthritis, Crohn's disease and ulcerative colitis based on published recent randomized controlled trials (RCT) and meta-analyses.

Material and Methods. Building on the published RA-focused narrative review by the authors, a targeted synthesis considered randomized controlled trials (RCTs) and meta-analyses of RCTs evaluating dietary patterns, omega-3 supplementation and probiotics. Observational and preclinical evidence was excluded from efficacy conclusions. No new meta-analysis was performed.1

Results and Discussion. In RA, a meta-analysis of 20 RCTs (1,252 participants) reported improvements in selected clinical and inflammatory outcomes with omega-3 supplementation, although heterogeneity and risk of bias limited certainty.2 Whole-diet findings were less consistent: the ADIRA crossover RCT (n = 50) found no statistically significant primary between-diet difference in the 28-joint Disease Activity Score (DAS28) after 10 weeks.3 Probiotic meta-analysis found reduced C-reactive protein in RA, but no significant DAS28 benefit after trials at high risk of bias were excluded; two spondyloarthritis RCTs found no clinical benefit.4 In psoriasis, the 16-week MEDIPSO RCT (n = 38) demonstrated greater improvement in the Psoriasis Area and Severity Index with a dietitian-guided Mediterranean diet than with standard low-fat advice, alongside stable topical therapy (between-group difference −3.4; 95% confidence interval −4.8 to −2.0).5 In pediatric Crohn's disease, a 78-patient RCT found that an exclusion diet plus partial enteral nutrition improved tolerance and yielded higher reported corticosteroid-free remission at 12 weeks than initial exclusive enteral nutrition followed by unrestricted diet plus partial enteral nutrition (75.6% versus 45.1%; p = 0.01); remission was a secondary endpoint.6 In ulcerative colitis, a Cochrane meta-analysis found low-certainty evidence that probiotics increased remission versus placebo (9 RCTs, 594 participants; risk ratio 1.73; 95% confidence interval 1.19–2.54), without clear superiority over 5-aminosalicylates.7

Conclusions. The evidence supports disease- and intervention-specific effects, not a universal anti-inflammatory diet. Omega-3 supplementation in RA and Mediterranean-style dietary intervention in psoriasis show adjunctive potential, while structured nutritional protocols can support remission induction in selected patients with Crohn's disease. Small samples, heterogeneous interventions and uncertain long-term outcomes warrant individualized integration with medical treatment and adequately powered confirmatory trials.

Keywords: *rheumatoid arthritis, nutritional therapy, inflammatory diseases, randomized controlled trials, meta-analysis*

CONTROL OF MICROBIAL COMMUNITIES IN MEAT PRODUCTS USING BIOPROTECTIVE CULTURES

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Introduction. The microbial ecosystem of meat products is shaped by a variety of intrinsic and extrinsic factors. The targeted use of functional starter cultures makes it possible to regulate the development of the product microbiota and enhance microbiological stability. Of particular interest are bioprotective cultures, whose functionality is associated with competitive interactions with undesirable microorganisms and the production of metabolites with antimicrobial activity.

The aim of this study was to investigate technological approaches to the production of whole-muscle and moulded poultry snacks using bioprotective cultures, and to assess their potential as a tool for the targeted modulation of the product microbiota.

Materials and Methods. The study was conducted using a bioprotective starter culture based on Pediococcus acidilactici. The culture was incorporated into the meat raw material during mixing with the curing ingredients at a dose of 10 g / 100 kg of raw material. Mixing was carried out for 5 – 8 min. The NaCl and sugar concentrations were 1.5 % and 0.01 %, respectively. The meat raw material was then matured for 24 h at 0 – 4 °C and a relative humidity of 70 – 75 %. The microbiological stability of the whole-muscle and moulded poultry snacks was evaluated during storage.

Results and Discussion. The use of the bioprotective culture P. acidilactici in the production of poultry snacks made it possible to establish processing conditions that support the activity of the introduced culture and its role in modulating microbiological processes in the meat matrix. Adding the culture together with the curing ingredients ensured its uniform distribution throughout the raw material and enabled the bioprotective step to be incorporated into the standard production process.

The technological solutions developed for whole-muscle and moulded snacks ensured stable microbiological parameters throughout 90 days of storage under a modified atmosphere containing 30 % CO2 and 70 % N2 at 0 – 22 °C. The results demonstrate the potential of bioprotective cultures as one of the components of a system for controlling the microbiological stability of meat products.

That said, the functional effect of the culture should be considered not in isolation, but in relation to the parameters of the product microenvironment and its indigenous microbiota. This interaction may determine the final microbiological profile of the snacks and the stability of the resulting microbial ecosystem during storage.

Conclusions. The use of a bioprotective culture based on P. acidilactici at a dose of 10 g per 100 kg of raw material in the production of whole-muscle and moulded poultry snacks represents a promising technological approach to the regulation of microbiological processes. Further research should focus on establishing the relationships between the functional activity of the culture, the parameters of the product microenvironment and changes in the indigenous microbiota of the snacks during storage.

Keywords: *microbial stability, moulded meat products, poultry meat*

EFFECT OF VACUUM-FRUIT SOAKING ON THE PHYSICOCHEMICAL AND SENSORY PROPERTIES OF GREEN COFFEE

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Introduction. Coffee is one of the most consumed beverages worldwide, and demand for specialty coffee with distinctive flavor profiles is steadily growing. The processing of the green bean is a key stage that shapes the flavor and aroma potential of the final product. Alongside the traditional natural, washed and honey methods, novel approaches such as controlled and anaerobic fermentation and infusion of the processing medium are emerging. The use of fruit media, rich in sugars and organic acids, combined with vacuum impregnation that intensifies mass transfer, offers a promising route to modify green coffee; however, its effect on the physicochemical and sensory properties of the product remains insufficiently studied.

Material and Methods. Green Coffea arabica beans from Colombia (Tolima region, Caturra variety, grown at 1800 m) were used as the object of study. For the vacuum-fruit soaking treatment, apple, cherry and strawberry purees were applied, while untreated green coffee served as the control. A technological scheme was developed, comprising vacuum infusion, drying, roasting, grinding and beverage preparation by cupping. Physicochemical characterization included pH, total dissolved solids (TDS), total dry matter, colorimetric analysis (CIE L*a*b*) of ground coffee and beverage, and total polyphenol content (Folin–Ciocâlteu). Sensory quality was assessed on a 10-point scale in accordance with SCA principles.

Results and Discussion. The vacuum-fruit soaking method modified the acidity, extractability, color and sensory profile of the beverage. The lowest pH was recorded for the cherry-puree sample (4.60), attributed to organic acids migrating from the fruit, whereas the control, apple and strawberry samples remained close (4.94–4.97). TDS was highest for the apple-puree sample (0.83 %), near the control (0.82 %), and lowest for strawberry (0.72 %), in agreement with the total dry-matter results. Colorimetry revealed lighter ground coffee after treatment (L* up to 41 for strawberry vs. 27 for the control) and shifts in the a* and b* values of both grounds and beverage. Total polyphenol content decreased markedly in the treated samples (130.7–133.7 μg/mL) compared with the control (240.7 μg/mL). In the sensory evaluation, the apple-puree sample obtained the highest overall score (9.00 points), showing a harmonious, well-balanced profile with pronounced body, while the strawberry-puree sample scored lowest.

Conclusions. Vacuum-fruit soaking with fruit purees measurably alters the acidity, extractability, color and polyphenol content of coffee and enables the formation of new organoleptic characteristics. Apple puree provided the most favorable sensory result. The method shows clear potential for developing experimental, higher-value products in the specialty coffee segment and justifies further in-depth study.

Keywords: *Coffea arabica, colorimetry, cupping, fruit puree, polyphenols, sensory evaluation*

Acknowledgments. The research was supported by Institutional Project, subprogram 020405 “Optimizing food processing technologies in the context of the circular bioeconomy and climate change”, Bio-OpTehPAS, being implemented at the Technical University of Moldova.

FOOD SECURITY ASSESSMENT AND SOCIO-ECONOMIC DETERMINANTS OF EATING BEHAVIOR IN THE REPUBLIC OF MOLDOVA

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Introduction. Food security is a fundamental component of public health and sustainable development, directly influencing population health and quality of life. This study aimed to assess the level of food security and to identify the main socio-economic determinants influencing eating behavior among the population of the Republic of Moldova.

Material and Methods. A cross-sectional quantitative study was conducted using a structured sociological questionnaire, applied online via Google Forms to 202 adult respondents (≥18 years) from both urban and rural areas of the Republic of Moldova. The 25-item instrument, organized into five thematic sections, combined closed-ended questions with 5-point Likert-type scales. Data were processed using descriptive statistics in Microsoft Excel, and internal consistency was verified using Cronbach's Alpha.

Results and Discussion. The questionnaire showed acceptable reliability (Cronbach's Alpha = 0.773). The sample was predominantly aged 18–25, urban, employed, and holding higher education degrees. Food insecurity indicators were reported mainly as "never" or "rare," though a smaller share of respondents indicated occasional or frequent occurrence, revealing isolated cases of more severe insecurity. Fruit and vegetable consumption was relatively frequent, whereas whole grains and legumes were consumed less consistently, indicating moderate overall dietary diversity. Among the socio-economic factors influencing food choices, personal taste and access to fresh food outlets showed the strongest influence, while food price exerted a moderate-to-high influence.

Conclusions. The findings confirm a close relationship between socio-economic status and eating behavior in the Republic of Moldova: low income, limited access to resources, and insufficient nutritional education are associated with unbalanced dietary patterns and increased risk of diet-related conditions. These results underscore the need for targeted nutrition education programs and policies aimed at improving sustainable access to healthy food.

Keywords: *food security, eating behavior, socio-economic determinants, Republic of Moldova, questionnaire survey, public health*

Acknowledgments. The research was supported by Institutional Project, subprogram 020405 “Optimizing food processing technologies in the context of the circular bioeconomy and climate change”, Bio-OpTehPAS, being implemented at the Technical University of Moldova.

VALORIZATION OF BIOACTIVE COMPOUNDS FROM ROSEHIP (*ROSA CANINA* L.) THROUGH LIPOSOMAL ENCAPSULATION TECHNOLOGIES

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Introduction. The protection and controlled delivery of bioactive compounds from horticultural sources remain a major challenge in functional food development, as these compounds are highly sensitive to oxidative degradation. This study aimed to valorize the bioactive compounds of rosehip (Rosa canina L.) through liposomal encapsulation and to evaluate the applicability of the resulting liposomal emulsion in a mayonnaise-type food product.

Material and Methods. Hydrosoluble and liposoluble extracts were obtained from rosehip powder and used to prepare a lecithin-based liposomal emulsion through phospholipid dispersion, homogenization, and sonication. The extracts and liposomal systems were characterized by UV-VIS spectrophotometry, total polyphenol content, DPPH antioxidant activity, encapsulation efficiency, retention rate during storage, and microscopic and colorimetric (CIELab) analysis. The liposomal emulsion was subsequently incorporated at 5% and 10% into a mayonnaise-type sauce, replacing part of the oil fraction, and the fortified products were evaluated for physicochemical, colorimetric, and sensory properties compared to a control sample.

Results and Discussion. The rosehip extract showed a high total polyphenol content (≈ 748.6 mg GAE) and moderate-to-high antioxidant activity (58% DPPH inhibition). Encapsulation efficiency was highest for liposoluble compounds, reaching 90.1% for carotenoids, 87% for zeaxanthin, and 86.7% for lycopene, while chlorophyll showed markedly lower efficiency (37.34%). After storage, retention rates remained above 50% for carotenoids (60%) and lycopene/zeaxanthin (54% each), with an average liposome size of approximately 70 μm, within the favorable range for cellular absorption. In the fortified mayonnaise, increasing liposomal emulsion concentration reduced fat content (70% to 66%) and acidity, increased moisture (17.5% to 28.5%), and slightly lowered antioxidant activity (47.78% to 45.4% DPPH inhibition). Sensory evaluation showed good acceptability for the 5% fortified sample (overall score 4.72/5), while the 10% sample scored lower (4.14/5) due to a less creamy texture and a more pronounced rosehip taste.

Conclusions. Liposomal encapsulation proved to be an effective method for protecting rosehip-derived bioactive compounds while preserving their functional properties. Moderate fortification (5%) maintained good sensory and functional quality, supporting the potential of this technology for developing functional foods with enhanced nutritional value.

Keywords: *rosehip (Rosa canina L.), liposomal encapsulation, bioactive compounds, antioxidant activity, functional foods, encapsulation efficiency*

Acknowledgments. The research was supported by the Young Researchers Project No. 25.80012.5107.10TC, entitled “Stabilization of Bioactive Compounds from Horticultural Sources through Liposomal Encapsulation”, implemented at the Technical University of Moldova.

AMARANTH SEED PROTEIN AS A SOURCE OF BIOACTIVE PEPTIDES FOR NEXT-GENERATION FUNCTIONAL FOODS

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Introduction. Bioactive peptides (BPs) are biologically active protein fragments that exhibit various physiological effects after their release from the parent protein. BPs are characterized by a wide range of physiological activities, including antioxidant, antihypertensive, immunomodulatory, anti-inflammatory, and antimicrobial properties. They also demonstrate high bioavailability and biocompatibility and are effective even at low concentrations, which collectively determines their significant potential as components of functional foods.

BPs can be obtained from proteins of plant, animal, marine, and other origins. Amaranth seed meal, a by-product of oil production, is a promising plant source due to its considerable protein content and balanced amino acid composition. The ratio of essential amino acids in amaranth protein is close to that of the "ideal protein" recommended by FAO/WHO.

The aim of this study was to substantiate the conditions for obtaining bioactive peptides from amaranth seed meal protein and to characterize their molecular weight distribution.

Material and Methods. Amaranth protein was obtained by alkaline extraction with sodium hydroxide followed by precipitation at the isoelectric point. BPs were produced by controlled enzymatic hydrolysis using pepsin, trypsin, papain, and pancreatin. The enzymes were applied both separately and sequentially. The yield of water-soluble protein fragments was 19.1% for papain, 42.3% for sequential pepsin and trypsin treatment, and 30% for pancreatin.

Results and Discussion. Gel chromatography showed that the molecular weight distribution depended on the enzyme used. Papain predominantly produced high-molecular-weight peptides, indicating a relatively low degree of hydrolysis. Sequential treatment with pepsin and trypsin resulted in the accumulation of low-molecular-weight peptides and free amino acids. Pancreatin provided a more balanced distribution with a predominance of medium-molecular-weight peptides and was therefore selected for further experiments.

To determine the optimal hydrolysis conditions, the enzyme-to-substrate ratio, hydrolysis duration, and hydromodule were varied at 37 °C. The molecular weight distribution of the resulting peptides was determined by gel chromatography using Sephadex G-25. Taking into account that peptides with molecular weights below 4 kDa are considered particularly promising in terms of physiological activity, the optimal conditions were established. The maximum proportion of peptides in the 0.3–4 kDa range reached 56% at an enzyme-to-substrate ratio of 1:10, a hydrolysis time of 3 h, and a hydromodule of 20.

Conclusion. Thus, amaranth protein can be considered a promising substrate for the production of bioactive peptides. The use of amaranth seed meal as a protein source may increase the efficiency of utilizing this by-product and contribute to the development of functional food ingredients.

Keywords: *bioactive peptides, amaranth, enzymatic hydrolysis, functional food*

BY-PRODUCTS OF MOLDOVAN RED WINEMAKING: VALORIZATION IN THE CIRCULAR ECONOMY

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Introduction. The wine industry generates substantial by-product volumes, and their valorization within the circular economy is a growing priority for the vitivinicultural sector.

Material and Methods. This study evaluates wine lees (WL) and grape skin powder (GSP) from Moldovan red winemaking, using the autochthonous varieties Rara Neagra (RN) and Feteasca Neagra (FN). Residual yeast biomass was characterized physicochemically, and beta-glucans were isolated by ultrasound-assisted acid-alkaline and autolysis-based extraction, then analyzed morphometrically, rheologically, and granulometrically. GSP was extracted with green solvents (glycerol, propylene glycol, ethanol) by maceration and ultrasound-assisted extraction (UAE) and incorporated (2.5%) into oil-in-water cosmetic emulsions, assessed for texture, physicochemical stability, and skin biophysical parameters on one volunteer.

Results and Discussion. (21.91% vs. 20.17% w/w wet lees, $p<0.001$) than RN, while RN was richer in lipids (12.02% vs. 11.07% DM); beta-glucan particles were similarly sized (3.6-4.3 micrometers) in both varieties. GSP extraction yield depended significantly on solvent, method, and variety ($p<0.001$), with ethanol giving the highest yields and ultrasound improving extraction in glycerol and propylene glycol; the propylene glycol series showed the best pH and colour stability (delta E under 1.10). RN extracts increased emulsion firmness (+35.2% in the PG series) via polyphenol-xanthan gum interactions, whereas FN extracts gave high antioxidant potential without affecting texture.

Conclusions. Preliminary biophysical assessment indicated good short-term skin compatibility, with improved hydration, reduced transepidermal water loss, and no visible pigmentation at 2.5% extract incorporation. These findings support the sustainable valorization of Moldovan winery by-products as bioingredients for the food, cosmetic, and pharmaceutical sectors within a circular bioeconomy, pending pilot-scale validation and dedicated safety testing.

Keywords: *antioxidants, beta-glucans, circular economy, cosmetic emulsions, grape skin powder, polyphenols*

Acknowledgments. This research was funded under the ReBrain project – 25.80013.5107.03RE, "Sustainable valorization of residual wine yeasts: exploring multifunctional bioingredients for innovative applications", carried out by the Technical University of Moldova.

ECOTOURISM AND RESPONSIBLE LEISURE: CONSUMER PERCEPTIONS AND BEHAVIORS IN THE REPUBLIC OF MOLDOVA

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Introduction. Ecotourism and responsible leisure have gained increasing attention in the Republic of Moldova, as the country seeks to capitalise on its natural and rural heritage — monasteries, wine routes, protected natural areas and rural guesthouses. Despite growing institutional interest in green tourism development, little is known about how Moldovan consumers perceive ecotourism and whether their leisure behaviour reflects environmentally responsible attitudes. This study aims to analyse Moldovan consumers' perceptions of ecotourism and the extent to which declared environmental attitudes are reflected in actual leisure choices.

Material and Methods. A quantitative research approach was applied, based on an online questionnaire addressed to consumers residing in the Republic of Moldova, primarily in Chișinău and other urban centres, with previous ecotourism or nature-based leisure experience within the country. The instrument covered perceptions of local ecotourism offers, motivations for eco-friendly leisure choices, willingness to pay for certified sustainable services, and self-reported behavioural indicators (waste reduction, resource conservation, support for local communities). Data were processed using descriptive statistics and correlation analysis.

Results and Discussion. The results show that most Moldovan respondents hold a favourable perception of ecotourism, associating it mainly with rural tourism, protected natural areas and agritourism guesthouses, and consider sustainability a relevant criterion when choosing leisure activities. However, a considerably smaller share of respondents consistently translates this favourable perception into concrete responsible behaviour, revealing a noticeable attitude–behaviour gap that mirrors patterns observed in other emerging tourism markets. Age, education level and prior travel experience significantly influence pro-environmental leisure choices among Moldovan consumers, with younger and highly educated respondents from urban areas showing greater willingness to pay a premium for certified eco-friendly services. Limited availability of certified ecotourism offers and low trust in existing sustainability labels were identified as the main barriers preventing responsible behaviour.

Conclusions. The findings confirm a gap between the declared environmental attitudes of Moldovan consumers and their actual leisure behaviour, highlighting the need for clearer sustainability certifications and stronger promotion of local ecotourism offers, useful for tourism operators, guesthouse owners and policymakers in the Republic of Moldova.

Keywords: *attitude–behaviour gap, consumer perceptions, ecotourism, environmental awareness, Republic of Moldova, responsible leisure*

Acknowledgments. This work was carried out within the Institutional Project 020405 "Optimization of food processing technologies in the context of circular bioeconomy and climate change", Bio-OpTehPAS, carried out within the Technical University of Moldova.

EVALUATION OF BREAD QUALITY ENRICHED WITH JERUSALEM ARTICHOKE (HELIANTHUS TUBEROSUS L.) FLOUR

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Introduction. Jerusalem artichoke (Helianthus tuberosus L.) tubers are a valuable raw material for diversifying bakery products due to their high dry matter content and richness in inulin, dietary fibre, minerals and essential amino acids [1]. This study aimed to evaluate the effect of partially replacing wheat flour with Jerusalem artichoke flour on the physicochemical and sensory properties of bread [2].

Material and Methods. Jerusalem artichoke flour was obtained by convective drying of tubers from the Amicul II and Solar varieties and used to replace wheat flour at levels of 2.5%, 5%, 7.5% and 10%. Moisture, ash, titratable acidity, macro- and microelement contents, and amino acid profile were determined, with amino acids analysed by HPLC. Bread was prepared using the indirect method. Dough acidity and volume were monitored during fermentation, while the finished bread was evaluated for crust and crumb colour, crumb porosity and overall sensory quality using a 30-point scoring scale.

Results and Discussion. Jerusalem artichoke flour affected dough fermentation and acidity, with higher substitution levels generally increasing acidity. The optimal fermentation time was 80–100 min, with gas expansion ranging from 125% at 10% substitution to 154% at 5%. Increasing flour addition darkened the crust and changed the crumb colour from yellowish-white to grey, while levels above 7.5% reduced crumb aeration and sensory quality. The 5% substitution level provided the best sensory characteristics, with a total score of 29 points, compared with 18 points at 10%. Amicul II flour was rich in potassium, calcium, magnesium, iron and zinc, while both varieties showed a favourable amino acid profile, contributing to the nutritional value of the enriched bread.

Conclusions. Replacing 5% of wheat flour with Jerusalem artichoke flour resulted in bread with favourable sensory characteristics and enhanced nutritional value, indicating its potential as an ingredient for functional bakery products.

Keywords: dough fermentation, functional food, physicochemical properties, sensory analysis, wheat flour

Acknowledgments. This research was conducted within the framework of the Institutional Project 020405 “Optimization of Food Processing Technologies in the Context of Circular Bioeconomy and Climate Change” (Bio-OpTehPAS), implemented at the Technical University of Moldova.

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DEVELOPMENT OF FUNCTIONAL SNACKS USING FERMENTED PLANT MATRICES

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Introduction. Growing consumer demand for healthy, convenient snacks has driven interest in extruded products with improved nutritional and functional profiles, yet the impact of pre-fermentation on plant-based extrudates remains insufficiently characterized. This study aimed to develop functional extruded snacks from corn flour combined with fermented legumes and to evaluate the influence of lactic fermentation on their nutritional, biochemical, and sensory properties.

Material and Methods. Extruded snacks were formulated from corn flour combined with fermented legume flours (red lentils, peas, chickpeas) in a 70/30 ratio. Fermentation was carried out using Lactiplantibacillus plantarum and Lacticaseibacillus casei at 35°C for 12 hours, until a target pH of 4.5 was reached. pH evolution, phytate content (Wade colorimetric method), tannin content (permanganometric titration), total phenolic content, and DPPH antioxidant activity were determined for both fermented and unfermented flours. Sensory acceptability was assessed using a 9-point hedonic scale, and a consumer ranking test was performed on the final extruded products.

Results and Discussion. Fermentation led to a progressive pH decrease, from initial values of 6.00–6.28 to 4.10–4.20 after 12 hours, confirming active lactic acid fermentation. Phytate content decreased significantly in all samples, by 35.3% in pea flour, 21.9% in chickpea flour, and 10.7% in red lentil flour, while tannin content was also reduced across all legumes, indicating improved mineral bioavailability and protein digestibility. The extruded products showed a higher protein content (11.5–15.3%) and markedly lower fat and salt content compared to a similar commercial snack. The red lentil-based product exhibited the highest antioxidant activity (1.48 mg GAE/g d.w.; 40.9% DPPH inhibition). Sensory evaluation indicated good acceptability, with appearance and color scores between 7 and 9, though taste was affected by a slightly bitter aftertaste linked to finely ground spices. In the consumer ranking test, the red lentil-based product was preferred first, followed by the pea- and chickpea-based products.

Conclusions. Pre-fermentation of plant matrices with lactic acid bacteria effectively reduced antinutritional factors and enhanced the nutritional and functional value of corn-legume extruded snacks, while maintaining good sensory acceptability. The combination of cereal and fermented legume flours represents a viable, reproducible strategy for developing healthier extruded alternatives, with potential for further optimization toward commercial-scale application.

Keywords: *bioactive compounds, fermented plant matrices, phytates, tannins, snacks*

Acknowledgments. The research was supported by the Moldovan Government within the project of Young Researchers 25.80012.5107.11TC BIO-FERM - Valorization of bioactive compounds from alternative plant sources for the development of functional fermented foods, running at the Technical University of Moldova.

LOCAL FOOD ENVIRONMENT AND BARRIERS TO HEALTHY FOOD ACCESS IN THE REPUBLIC OF MOLDOVA: REVIEW

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Introduction. Unhealthy diets remain one of the leading risk factors for noncommunicable diseases worldwide, and the Republic of Moldova presents specific features that heighten this risk. This review aims to identify the main characteristics of the local food environment and to systematize the economic, physical, and informational barriers that limit vulnerable groups' access to nutritionally favorable foods, as a preliminary step toward an empirical study based on questionnaires.

Material and Methods. An analysis of the specialized literature, FAO reports, WFP/World Bank assessments, and relevant national strategies shows that, at the aggregate level, food security in the Republic of Moldova is formally ensured, with average per capita energy intake remaining above the threshold recommended by the WHO. However, the structure of consumption reveals significant imbalances: the population traditionally consumes between 90 and 120 kg of bread per capita annually, compared to approximately 57 kg in the European Union, driven mainly by economic constraints rather than cultural habits alone. Meat consumption (37–53 kg/person/year) and fish consumption (~16 kg/person/year) also remain considerably below European standards.

Results and Discussion. The economic barrier is compounded by price dynamics: between February 2020 and May 2022, food prices rose by more than 50%, with increases of 126% for oils and 69% for cereals, disproportionately affecting low-income households. From a territorial perspective, the poverty rate stands at 32.8% in rural areas compared to 11.9% in urban areas, and the supply system relies heavily on small-scale farming households, which generate over 62% of the country's total agricultural output — a structure indicating a fragmented distribution infrastructure with direct impact on physical access to fresh produce in rural and peripheral areas.

Conclusions. The synthesis of these findings reveals three converging categories of barriers — economic (disproportionate prices relative to income), physical (unequal rural-urban distribution of retail points and fresh produce), and informational (low, insufficiently documented levels of nutritional education) — which disproportionately affect vulnerable groups: the rural population, low-income individuals, and large families. The conclusions highlight the lack of household-level primary data on the food-related perceptions and behaviors of these groups, establishing the rationale for a subsequent questionnaire-based research stage intended to validate the identified barriers and support the design of context-specific preventive interventions.

Keywords: *access to healthy food, food environment, food security, vulnerable groups, Republic of Moldova*

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DEVELOPMENT OF A PRODUCTION TECHNOLOGY FOR GLUTEN-FREE DIETARY BREAD

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Introduction. Gluten-free bread is in growing demand, yet the absence of gluten reduces dough elasticity and gas retention, making satisfactory sensory and technological quality difficult to achieve; hydrocolloids, proteins, starches and psyllium are commonly used to stabilise the structure. This study aimed to develop a production technology for gluten-free dietary bread based on green buckwheat and millet with flaxseed as a natural structure-forming component, and to evaluate its sensory, physicochemical and nutritional characteristics.

Material and Methods. Green buckwheat and millet were used as the main raw materials, with flaxseed, walnut and pumpkin seed kernels, spices and herbs incorporated to improve the structural, nutritional and sensory properties of the bread. Five formulations with different walnut and pumpkin seed kernel ratios were evaluated sensorially to select the optimal sample. Its physicochemical and technological properties (pH, titratable acidity, moisture, porosity, elasticity, baking and cooling losses) and colour parameters (L*, a*, b*) were determined using standard methods. Product quality was assessed against the applicable requirements of Government Decision of the Republic of Moldova No. 741/2025. Nutritional value, including the vitamin and mineral profile, was calculated per 100 g based on the composition and quantities of the raw materials.

Results and Discussion. Sensory evaluation identified sample No. 4 (base formulation with spices/herbs and 25 g each of walnut and pumpkin seed kernels) as the optimal variant, achieving an overall score of 8.33/9. The selected bread exhibited a pH of 6.87 and a titratable acidity of 0.90°. Moisture content (52.76%), porosity (53.24%) and elasticity (80%) demonstrated a sufficiently developed and resilient crumb structure. Baking and cooling losses were 6.11% and 0.99%, respectively, indicating good moisture retention during processing. Colour parameters (L* = 52, a* = +6, b* = +26) indicated a moderately light crumb with pronounced yellow and red components, characteristic of the ingredients used. The bread provided 222.8 kcal per 100 g (11.14% of the reference daily energy intake), while protein, fat and dietary fibre accounted for 13.40%, 13.33% and 11.07% of the respective daily reference values. Based on the chemical composition of the raw materials, the calculated nutritional profile showed appreciable contributions of phosphorus (28.43%), sodium (24.75%), magnesium (22.19%), selenium (18.18%) and iron (15.00%), as well as vitamins B1 (21.67%), E (21.60%), B6 (14.12%), A (13.33%) and β-carotene (13.60%).

Conclusions. The proposed technology yielded gluten-free dietary bread with satisfactory sensory, physicochemical and nutritional characteristics, a stable structure and good moisture retention, confirming its potential for practical implementation.

Keywords: *bread, gluten-free products, physicochemical characteristics, sensory evaluation, nutritional value*

Acknowledgment. This research was supported by the Institutional Project, subprogram 020405 “Optimization of food processing technologies in the context of the circular bioeconomy and climate change,” Bio-OpTehPAS, implemented at the Technical University of Moldova.

VALORIZATION OF GRAIN PROCESSING RESIDUES THROUGH INDUSTRIAL SYMBIOSIS IN UKRAINE

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Introduction. Ukraine is one of the world's leading grain-producing countries, with cereals playing a significant role in its agricultural sector and export economy. Grain processing generates substantial quantities of secondary raw materials, including bran, feed flour, husks, screenings and other residues. Although these streams can provide feed, energy, materials and bio-based products, their valorization in Ukraine remains fragmented. The war since 2022 has further increased the importance of efficient residue management because of damaged and relocated processing facilities, logistical disruptions, energy costs, storage limitations and contamination risks. This study investigates the potential of industrial symbiosis to valorize grain-processing residues in Ukraine.

Material and Methods. The study combines statistical and literature-based analysis using data from the State Statistics Service of Ukraine, FAOSTAT, USDA, Ukrainian grain-sector associations and scientific publications. Grain production and processing data were used to estimate the generation of major processing residues.

Results and Discussion. The analysis demonstrates a substantial resource base for residue valorization. Ukraine produced approximately 59.8 million tonnes of grain and legumes in 2023, including 21.6 million tonnes of wheat, 31.0 million tonnes of maize and 5.5 million tonnes of barley. Flour production generated an estimated 0.68 million tonnes of milling by-products in 2025 when an average flour extraction rate of 70% is assumed. Groat processing also produces considerable residue streams, with by-product shares ranging approximately from 10% to 50%. Wheat bran and feed flour are currently used mainly as animal-feed ingredients. However, valorization must account for safety constraints because contaminants may become concentrated in outer grain fractions. Published studies show that dehulling, debranning, polishing and milling can substantially reduce microbial loads, mycotoxins, pesticide residues and heavy metals in the processed grain, while transferring part of the contaminants the removed fractions. In the Ukrainian context, decentralized valorization near processing facilities could reduce transportation and storage requirements while creating synergies with livestock production, energy generation and other agricultural industries.

Conclusions. Grain-processing residues represent a significant but insufficiently integrated secondary resource in Ukraine. Their systematic quantification, safety assessment and valorization could reduce waste, generate additional value and strengthen the resilience of the agricultural sector. Industrial symbiosis provides a promising framework for connecting grain processors with livestock farms, bioenergy facilities and other industries.

Keywords: *grain by-products, industrial symbiosis, waste management, Ukraine*

Acknowledgments. This work was supported by STSM of the LIAISE COST Action (CA22110), an interdisciplinary European research network focused on Industrial Symbiosis and the transition towards a Circular Economy.

OPPORTUNITIES FOR THE VALORISATION OF BEE POLLEN IN THE DEVELOPMENT OF INNOVATIVE PRODUCTS

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Introduction. Bee pollen is recognised as one of the most valuable natural products of the beehive, being rich in proteins, essential amino acids, vitamins, minerals and bioactive compounds with antioxidant properties. In the Republic of Moldova, beekeeping is a traditional and widespread activity, yet bee pollen remains largely underutilised beyond raw consumption, with limited integration into processed food products. This study aims to evaluate the potential of bee pollen as a functional ingredient and to develop innovative food products enriched with bee pollen, assessing their nutritional, sensory and physicochemical characteristics.

Material and Methods. Bee pollen sourced from local beekeepers was characterised in terms of moisture, protein, total sugar and total phenolic content, following standard analytical methods. Several product formulations were developed by incorporating bee pollen at different concentrations. The physicochemical properties, antioxidant activity and sensory attributes of the enriched products were evaluated and compared with control samples, using descriptive statistics to assess the influence of bee pollen addition on product quality.

Results and Discussion. The results confirmed the high nutritional value of the bee pollen samples, with notable protein and total phenolic content contributing to significant antioxidant activity. The incorporation of bee pollen into the tested formulations improved the nutritional profile of the final products without major negative effects on sensory acceptability up to a certain concentration threshold, beyond which taste and texture attributes were affected. Products enriched with bee pollen showed increased antioxidant capacity compared with the control samples, confirming the functional potential of this beehive product as an innovative ingredient for the food industry.

Conclusions. The findings demonstrate that bee pollen can be successfully valorised as a functional ingredient in the development of innovative food products, enhancing their nutritional and antioxidant profile. The results support the diversification of bee pollen-based products and provide practical insights for the food industry and beekeeping sector in the Republic of Moldova interested in developing value-added, health-oriented food products.

Keywords: *antioxidant activity, bee pollen, functional food, innovative products, nutritional value*

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DEVELOPMENT OF NOODLES WITH ENHANCED NUTRITIONAL VALUE

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Introduction. Pasta products, along with bread, are among the most widely consumed staple foods. Traditional pasta products are manufactured from refined flour obtained from durum and common wheat. The development of the pasta market is increasingly driven by consumer demand for products with enhanced nutritional value.

Pasta products can be enriched with plant- and animal-derived ingredients, food industry by-products and other non-traditional raw materials to increase their content of dietary fibre, protein, antioxidants and other bioactive compounds. Current approaches include the use of wholegrain, gluten-free and protein-rich flours, plant powders, juices and extracts, as well as vitamins, minerals, probiotics and prebiotics. Polysaccharides are also used to compensate for changes in the gluten-starch matrix caused by enrichment.

The aim of this study was to develop noodles with enhanced nutritional value and to determine their quality parameters.

Materials and Methods. The research materials comprised enriched noodles, refined and wholegrain flour obtained from durum wheat, blue cornflower petals. The flour samples were evaluated for organoleptic characteristics and acidity, and their chemical composition was determined. The content and composition of phenolic compounds in the cornflower petal extracts were determined. The control noodle sample was produced using a conventional process involving the mixing of flour with water, noodle forming, pre-drying and drying. Enriched noodle samples were prepared by incorporating into the flour, as the liquid phase, an aqueous extract of blue cornflower petals, an aqueous sodium alginate solution, or a complex system comprising cornflower extract, zinc acetate and sodium alginate. The noodles were evaluated for organoleptic characteristics, moisture content, acidity and cooking properties.

Results and Discussion. Compared with refined durum wheat flour, the wholegrain flour was darker and contained less protein, starch and wet gluten, with weaker gluten, but more bran as a source of dietary fibre; the acidity of both flour types was similar. The blue cornflower petals contained 1.65% total phenolic compounds, including 81.3% flavonoids and 61.4% anthocyanins, while UV absorption spectra confirmed the presence of phenolic acids, flavonoids and anthocyanins. Noodles containing aqueous blue cornflower extract were darker and more acidic, with a lower mass increase coefficient and higher dry matter losses during cooking, whereas sodium alginate improved their structural and organoleptic properties, increased the mass increase coefficient and reduced dry matter losses. The incorporation of cornflower extract containing 41.25 mg of phenolic compounds, 0.8 g of sodium alginate and 15 mg of Zn from zinc acetate per 100 g of noodles resulted in products with the most favourable organoleptic and physicochemical characteristics.

Conclusion. Thus, noodles enriched with phenolic compounds, zinc and sodium alginate were developed. The combination of these bioactive components in wholegrain flour-based noodles may enhance their physiological potential and improve the bioavailability of the active compounds.

Keywords: *flour, noodles, bioactive compounds, nutritional value, quality*

ZERO WASTE BAR: WASTE MINIMIZATION OPPORTUNITIES IN BAR PRODUCTION

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Introduction. The restaurant and bar business is growing alongside increasing attention to sustainable development and responsible consumption. A promising direction for greening hospitality enterprises is the Zero Waste concept, which involves reducing waste generation, reusing raw materials, and managing resources rationally. Studies show that about 20.0 % of the food served in food service establishments may become waste, while in restaurants waste averages 192.0 ± 30.0 g per portion [1]. This study aims to substantiate and experimentally develop ways to minimize waste in bar production through the reuse of plant raw materials.

Materials and Methods. We analyzed waste sources in bar production, systematized reuse methods, and experimentally developed technological solutions based on plant raw materials. Fresh fruits, berries, citrus fruits and herbs were studied, including peels, pulp, seeds and stems traditionally regarded as waste. We assessed their suitability for producing syrups, infusions, purées, cordials, flavored water, and garnishes. The study also analyzed opportunities to reduce inorganic waste through reusable tableware, bar equipment, and less packaging.

Results and Discussion. The analysis showed that much of the potentially usable bar waste is generated during plant raw material preparation. According to a study of hotel food services, the inedible parts removed during preparation accounted for 2.3÷4.7% of the raw material mass [2]. This justifies searching for ways to reuse them technologically. We identified promising uses for individual plant components. Citrus peels can serve as a base for syrups, infusions, and aromatic components; pulp and berry residues – for purées and cordials; herb stems – for syrups and flavored water. Some fruit residues can be used to produce fermented beverages, and dried peels can be used as garnishes. This approach follows the upcycling principle, turning a by-product into a functional ingredient with added consumer value. Reducing inorganic waste involves limiting single-use plastic items, switching to reusable solutions, optimizing purchasing, and choosing suppliers with minimal packaging. The effectiveness of Zero Waste also depends on waste accounting, staff training, and technological tools that ensure full use of raw materials.

Conclusion. The experimental development confirms the potential of reusing plant components in bar production. Key directions include integrated use of fruits, berries, citrus fruits, and herbs; applying upcycling principles; reducing single-use materials; and improving production organization. The proposed solutions help reduce waste generation and increase the resource efficiency of bar production.

Keywords: *food waste, responsible consumption, restaurant and bar business, sustainable development, upcycling*

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ASSESSMENT OF THE CUTTING EDGE CONDITION OF PROFESSIONAL CHEF'S KNIVES

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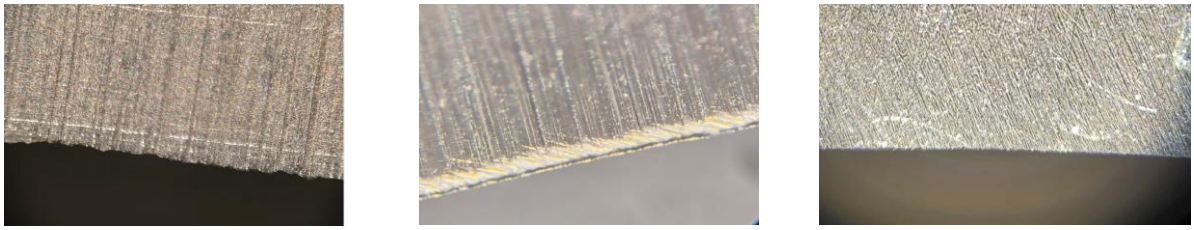
Introduction. Assessing the condition of chef's knife cutting edges is essential for accelerating the processing of raw materials and semi-finished products, minimizing waste, and enhancing the organoleptic properties of culinary products.

Materials and Methods. Optical inspection methods – specifically light microscopy – were employed to assess the condition of the knife cutting edges. A set of key performance indicators was used for an objective evaluation of the sharpening. The methodology is characterized by the assessment of multiple points along the cutting edge and the bevel on both sides.

Results and Discussion. Control parameters such as lighting setup, fixture mounting, and focusing are taken into account.

The following geometric indicators regarding the condition of the cutting edge and bevel are examined: apex condition or light response (presence of a "burr," plastic deformation, rolled edges, or micro-chipping); apex topography (linearity or the presence of micro-fractures and chips); bevel profile (stepped, curved, convex/lenticular, or faceted). Additionally, dynamic and static analyses of the bevel profile are proposed based on its relief parameters.

Based on the obtained results, an integral indicator of the cutting edge and bevel condition is formulated; this allows for conclusions regarding cutting edge symmetry, apex cleanliness, the presence of plastic deformation, chips, and «burrs» (whether folded to one side or symmetrical), as well as symmetrical dulling, angular asymmetry, or wear.



a **b** **c**

Fig. 1. Micrographs of the cutting-edge condition (200x magnification):
a – cutting edge with chipping; **b** – "beard" bent towards the observer (towards the objective);
c – cutting edge without visible defects, with slight chamfer relief.

Conclusions. Parameters for optical inspection, key geometric metrics, and a procedure for assessing the condition of the cutting edge of professional chef's knives have been proposed. This enables a more objective evaluation of sharpening quality and wear, the identification of characteristic defects, and the determination of the degree of wear of the cutting tools.

Keywords: *knife, edge, sharpness, HoReCa*

OPTIMIZATION STRATEGIES FOR COLLAGEN-BASED STRUCTURING AGENTS IN MEAT PROCESSING

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Introduction. The rational use of by-products of meat processing corresponds to the principles of resource conservation and circular bioeconomy. Pig skin is a promising source of collagen for the creation of functional ingredients. Collagen proteins form stable gels and protein matrices that increase the water-holding capacity, emulsion stability and textural properties of meat products. Hydrolyzed collagen has high bioavailability and technological value. The purpose of the research: Development and optimization of a protein structure-forming additive from pig skin for meat products using the methods of multivariate design of experiments and mathematical modeling.

Material and Methods. A three-level quadratic Box plot was used to analyze the effect of enzyme mass fraction and salt concentration on gel density, elasticity, and strength. Rheological indicators were determined on a Lamy Rheology TX-700 rheometer; statistical data processing ensured the construction of adequate regression models.

Results and Discussion. The protein structure-forming additive from pig skin is a concentrated source of collagen (60-65% protein in the dried state), which determines its functional properties. Enzymatic hydrolysis destroys the triple helix of collagen and forms low molecular weight peptides (3–6 kDa), which are characterized by high solubility, low viscosity and good bioavailability. This ensures the formation of a dense and elastic protein matrix, which is critical for the stability of sausage and emulsion products. The optimization of the technological regimes showed that the enzyme mass fraction of 2.5–3.5% and the salt concentration of 0.9–1.0 mol provide the maximum strength, density and elasticity of the gel. The additive increases the viscosity of the minced meat, moisture retention and stability of the fat emulsion, which reduces mass loss during heat treatment and improves the juiciness of the finished products. Thus, mathematical modeling and regression analysis allow predicting the rheological parameters of the system depending on the degree of hydrolysis and protein concentration, ensuring the optimization of technological processes and improving the quality of meat products.

Conclusions. Based on the conducted experiments, adequate mathematical models were built that describe the dependence of the rheological parameters of the protein gel from pig skin on the mass fraction of the enzyme and salt concentration. It was established that the optimal conditions for the formation of a stable protein matrix are achieved with an enzyme of 2.98% and a salt of 0.93 mol, which provides a density of 34.74 g, a gel strength of 21.15 g·cm and an elasticity of 0.61 cm. The elasticity of the gel also depends on the interaction of factors: at a low concentration of salt, the changes are insignificant, while at a high concentration, a significant decrease is observed. Thus, the optimization of technological modes with the use of mathematical modeling allows predicting the properties of the additive and ensures the formation of a stable protein matrix with high functional-technological characteristics.

Keywords: *alternative sources of proteins, rheological characteristics, regression analysis*

INNOVATIVE APPROACHES TO IMPROVING SOYBEAN QUALITY

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Introduction. Soybean is one of the most valuable sources of vegetable protein, but its use in the food industry and animal husbandry is limited by the presence of antinutritional factors, in particular trypsin inhibitors and hemagglutinins. These compounds reduce the digestibility of proteins and the biological value of the product, which necessitates the use of effective methods for their inactivation.

Material and Methods. Investigates the effect of combined microwave and alkaline treatment on the nutritional value of soybeans and the degree of inactivation of trypsin inhibitors. Experimental studies were conducted on soybeans of Ukrainian origin with an initial moisture content of 9%. The buffer capacity of soybeans was determined and it was found that to achieve pH 8, it is necessary to add 1% baking soda by weight of the raw material. Three soybean fractions were studied: whole beans, coarse grinding (2–3 mm) and fine grinding (0.5 mm).

Results and Discussion. It was found that the coarsely ground fraction demonstrates the optimal ratio between moisture retention capacity and alkaline solution permeability. Microwave treatment was carried out at a power of 600 W for 30–150 seconds with a step of 30 seconds. To assess the qualitative parameters, a Bruker TANGO infrared spectrometer was used to determine the activity of trypsin inhibitors and protein solubility in KOH. The results showed that the combined microwave-alkali treatment provided more effective inactivation of trypsin inhibitors compared to pure microwave treatment. At a treatment time of 150 seconds, the activity of trypsin inhibitors decreased from 29.8 mg/g in the control sample to 7.1 mg/g in the microwave treatment and to 4.7 mg/g in the combined microwave-alkaline treatment, which is a decrease of 76.2% and 84.2%, respectively. At the same time, the protein solubility remained at a high level - 87.4% for microwave and 88.2% for microwave-alkaline treatment.

It has been established that a preliminary increase in pH to 8 contributes to the partial destruction of the buffer properties of protein components and increases the efficiency of subsequent heat treatment. The optimal processing parameters were determined as raw material moistening up to 15%, use of coarsely ground fraction, preliminary alkaline treatment to pH 8, and microwave heating for 120–150 seconds at a power of 600 W.

The synergistic effect of combining alkaline and heat treatment is explained by the partial opening of protein structures in an alkaline environment, which makes the disulfide bonds of trypsin inhibitors more accessible for thermal cleavage, while the violation of the buffer properties of protein components reduces the intensity of denaturation under the influence of temperature.

Conclusions. The proposed method allows to significantly increase the nutritional value of soy raw materials while maintaining high protein solubility, which makes it promising for implementation in the food industry and feed production.

Keywords: *soybeans, antinutritional factors, trypsin inhibitors, protein denaturation and solubility*

OPTIMIZATION OF ARTISANAL MEAD PRODUCTION FROM NATURAL HONEY

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Introduction. Natural honey is a sugar-rich raw material with considerable potential for fermented beverage production; however, botanical origin and yeast dosage can markedly influence fermentation performance and product quality. This study aimed to produce mead from natural honey and identify a formulation that provides efficient sugar conversion and a balanced sensory profile.

Material and Methods. Acacia and polyfloral honeys were characterized for simple sugars and protein. Mead primary composition containing 20% honey and 80% water was inoculated with 0.05, 0.08, 0.10, 0.20 or 0.30 g of yeast/100 g and fermented at 28–30 °C for two weeks. The samples were assessed by sensory analysis, direct pH measurement, ferricyanide determination of residual sugars, dichromate-based spectrophotometric determination of ethanol and the Biuret protein assay.

Results and Discussion. Acacia honey contained more simple sugars than polyfloral honey (71.43% versus 66.70%) but less protein (0.24% versus 0.37%). Acacia-based meads had pH values of 3.04–3.38, whereas polyfloral-honey samples ranged from 3.35 to 3.87. Residual sugars in the finished beverages ranged from 4% to 7%, and ethanol content from 5.62% to 7.73% vol. The formulation containing 0.20 g yeast/100 g achieved the lowest residual sugar level (4%), the highest ethanol concentration (7.73% vol.) and the best overall sensory score (8.92 ± 0.05 points). Both lower and higher inoculation levels resulted in less favorable fermentation or sensory performance. The average yield of mead after fermentation and sediment removal was 60 mL from 100 g of starter composition.

Conclusions. Honey botanical origin and yeast dosage significantly affected acidity, sugar utilization, ethanol formation and sensory quality. Among the tested variants, acacia-honey mead inoculated with 0.20 g yeast provided the most effective fermentation and the most harmonious sensory profile.

Keywords: *mead preparation, fermentation efficiency, ethanol yield, residual sugars*

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IMPACT OF HEMP PROTEIN CONCENTRATE ON THE STRUCTURE AND CONSUMER PERCEPTION OF PLANT-BASED ÉCLAIRS

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Introduction. Valorising agro-industrial by-products in bakery and confectionery products supports the nutritional upgrading of conventional formulations, aligned with circular bioeconomy principles. Hemp (Cannabis sativa L.) seed cake, a by-product of oil pressing, is a valuable protein source suitable for concentration and incorporation into plant-based food matrices. This study evaluated the impact of hemp protein concentrate (HPC) on the structural, physicochemical, amino acid and sensory characteristics of choux pastry éclairs, and on consumer perception.

Material and Methods. Éclairs were formulated with 1–20% HPC (flour basis), obtained from hemp seed cake (74.15 ± 0.14% protein, d.b.). External/internal volumes were measured by rapeseed displacement (AACC 10-05.01); baking loss, water activity and proximate composition were determined by standard methods. Amino acids were quantified by acid hydrolysis/ion-exchange chromatography (AAA 339 analyser) and sensory perception by CATA–PCA. Pearson correlations linked HPC level to technological parameters.

Results and Discussion. HPC incorporation increased external volume from 42.15 ± 0.24 to 51.50 ± 0.16 cm³ and internal volume from 18.34 ± 0.15 to 38.47 ± 0.08 cm³, while baking loss decreased from 26.85 ± 0.20% to 24.67 ± 0.17% (10% HPC) and water activity from 0.62 ± 0.01 to 0.56 ± 0.01. Protein rose from 8.23 ± 0.08% to 11.32 ± 0.11%, carbohydrates fell from 54.89 ± 0.15% to 49.39 ± 0.12%, with stable lipid content (5.12–5.29%). HPC level correlated strongly with external volume (r = 1.00), internal volume (r = 0.98), protein (r = 1.00) and moisture (r = 0.96). Amino acid content increased markedly: threonine +60%, isoleucine +59%, leucine +48%, lysine +29%, glutamic acid +90%, arginine +90%; GABA was detected at ⩾10% HPC. CATA – PCA identified 10% HPC as optimal, associated with “aerated interior”, “light and fluffy” and “satisfying”, while 20% HPC showed “nutty aroma”, “crispy crust”, “glossy surface” and “well-risen”, indicating a premium sensory profile. Crust lightness decreased from 89.62 ± 0.24 to 82.38 ± 0.21 and crumb lightness from 93.78 ± 0.15 to 88.41 ± 0.16, with ΔE reaching 9.17 (crust) and 5.54 (crumb).

Conclusions. HPC incorporation at 10–20% optimised expansion, internal aeration, water retention, protein density and sensory complexity, with 10% HPC recommended for balanced technological–sensory performance and 20% HPC for differentiated, intensely flavoured products. These results confirm hemp seed cake as a viable functional protein source for plant-based confectionery, consistent with circular bioeconomy principles.

Keywords: *hemp protein concentrate, choux pastry, éclairs, plant-based protein, sensory evaluation, circular bioeconomy*

Acknowledgments. The research was supported by the Moldovan Government within the project of Young Researchers 25.80012.5107.11TC BIO-FERM - Valorization of bioactive compounds from alternative plant sources for the development of functional fermented foods, running at the Technical University of Moldova.

AUTHENTIC TRADITIONAL RECIPES – A RESOURCE FOR THE DEVELOPMENT AND PROMOTION OF NATIONAL TOURISM

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Introduction. Gastronomic heritage constitutes a significant component of intangible cultural heritage and a resource with considerable economic and tourism potential, capable of contributing to the differentiation and competitiveness of tourist destinations. In this context, authentic traditional recipes represent expressions of cultural identity, collective memory, and food practices transmitted across generations. The Republic of Moldova possesses a diverse gastronomic heritage, shaped by the historical, cultural, and socioeconomic characteristics of its various regions.

Material and Methods. The research methodology is based on the analysis and synthesis of specialized literature, a systemic approach to gastronomic heritage, and an analysis of the ways in which traditional culinary products can be valorized for tourism purposes. The research takes into consideration criteria such as the authenticity of recipes, the origin and specific characteristics of ingredients, traditional preparation techniques, continuity of intergenerational transmission, and the degree of integration into tourism activities. Furthermore, the study examines opportunities for the valorization of gastronomic heritage through agrotourism guesthouses, food service establishments, gastronomic events and festivals, as well as thematic tourism routes and products.

Results and Discussion. The research findings indicate that authentic traditional recipes can be regarded as a multifunctional resource for tourism development, possessing cultural and identity-related value, as well as economic and promotional value. Their integration into the tourism offer can contribute to the diversification of tourism products, stimulate the consumption of local agri-food products, support local producers and rural entrepreneurship, and increase the added value generated within local communities. At the same time, the incorporation of traditional gastronomy into tourism activities can facilitate the transmission and preservation of traditional culinary knowledge, techniques, and practices.

Conclusions. The research concludes that an integrated approach to the preservation and valorization of gastronomic heritage is necessary, whereby the cultural dimension is correlated with tourism and economic development objectives. The systematic documentation of traditional recipes, preservation of traditional preparation techniques, promotion of local products, and integration of these elements into tourism structures and products can contribute to strengthening the gastronomic identity of the Republic of Moldova and enhancing its attractiveness as a tourist destination.

Keywords: *gastronomic heritage, traditional gastronomy, authentic recipes, intangible cultural heritage, gastronomic tourism, rural tourism*

Acknowledgment: This research was supported by the Institutional Project, subprogram 020405 “Optimization of food processing technologies in the context of the circular bioeconomy and climate change,” Bio-OpTehPAS, implemented at the Technical University of Moldova.

ENERGY EFFICIENCY CHARACTERISTICS OF TOURIST GUESTHOUSES IN THE REPUBLIC OF MOLDOVA

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Introduction. Tourist guesthouses exhibit specific characteristics in terms of energy use, determined by building characteristics, the seasonality of tourism activities, occupancy rates, the type of heating and domestic hot water systems, as well as the equipment used to ensure tourists' comfort. In the Republic of Moldova, assessing the energy efficiency of tourist guesthouses is relevant not only for reducing operational costs but also for enhancing the competitiveness and sustainability of tourism accommodation facilities.

Material and Methods. The research methodology is based on the analysis of the energy characteristics of tourist guesthouses and the assessment of energy consumption in relation to building area, accommodation capacity, and occupancy rate. Energy efficiency can be assessed using indicators such as specific energy consumption, energy consumption per accommodation unit, and energy consumption per overnight stay. The analysis considers factors such as the level of thermal insulation of buildings, the age of the construction, the efficiency of heating systems, the type of energy sources used, equipment efficiency, and user behavior.

Results and Discussion. The research findings highlight that the energy efficiency level of tourist guesthouses is influenced by the interaction between the technical characteristics of buildings, the energy systems employed, and the way energy consumption is managed. Significant potential for reducing energy consumption can be achieved through improved thermal insulation, modernization of heating and lighting systems, the use of energy-efficient equipment, optimization of domestic hot water production, and implementation of energy consumption monitoring and control systems. Furthermore, the use of renewable energy sources can contribute to reducing dependence on conventional energy sources and lowering energy costs in the long term.

Conclusions. In conclusion, the energy efficiency of tourist guesthouses in the Republic of Moldova represents an important component of the sustainable management of tourism activities. The implementation of integrated energy efficiency measures can contribute to reducing energy consumption and operational costs, improving tourists comfort, and increasing the competitiveness of guesthouses. A systematic approach to energy consumption and the identification of the most effective technical and managerial solutions can create favorable conditions for the development of a more competitive, resilient, and sustainable tourism sector.

Keywords: *energy efficiency, energy consumption, tourist guesthouses, energy performance, sustainable tourism, energy management*

Acknowledgment. This research was supported by the Institutional Project, subprogram 020405 "Optimization of food processing technologies in the context of the circular bioeconomy and climate change," Bio-OpTehPAS, implemented at the Technical University of Moldova.

USE OF WHEY IN LOW-LACTOSE DAIRY PRODUCT TECHNOLOGY

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Introduction. Intensive research is being conducted worldwide to develop methods and technologies for the more efficient use of dairy by-products from the food industry. Whey – which accounts for 80% to 90% of the volume of milk – can serve as an effective base for creating new types of products or as a viable alternative to traditional ingredients, thanks to its composition. The main component of whey is lactose, which accounts for about 70% of dry matter and is a limiting factor for the consumption of products by people with lactase deficiency [1]. In this regard, there is a need to develop technologies for reducing or removing lactose in order to expand the range of low-lactose products and solve the problem of effective processing of whey. Due to its composition, whey can be an effective basis for creating new types of products or a full-fledged alternative to traditional ingredients.

Material and Methods. An analysis of modern research on the modification of the composition and functional and technological properties of whey for its effective use in the food and biotechnological industries was carried out. Modern processing methods were analyzed, in particular membrane and biotechnological technologies, as well as directions for creating functional and low-lactose products. The results of research on the production of lactose-free and low-lactose dairy products and complex processing of whey were summarized [2].

Results and Discussion. Research aimed at modifying the composition and functional-technological properties of whey is actively being conducted worldwide. The goal is to adjust the properties of the raw material for use across various industries, particularly for the development of new, high-quality food products. Whey presents both an environmental challenge and a promising raw material for product manufacturing, primarily due to its high lactose content. Given its composition, whey can serve as an effective base for developing new types of products or as a viable alternative to traditional ingredients. An analysis of research indicates that modern technological approaches should be directed not only toward the utilization of whey as a waste product but also toward the production of functional food ingredients and low-lactose products that meet modern food safety requirements and consumer demand.

Conclusions. The development of optimal technologies for the use of secondary dairy resources in the production of food products with a simultaneous reduction in food waste is one of the priority areas of rational environmental management. Therefore, the data obtained create scientific prerequisites for the development of food technology using secondary dairy resources.

Keywords: *whey, low-lactose products, ecologization, lactose*

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PHYSICOCHEMICAL CHARACTERIZATION AND FORMULATION OF PLANT-BASED NUTRACEUTICAL TABLETS

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Introduction. The increasing interest in natural functional products encourages the valorization of plant-based ingredients with complementary nutritional and technological properties. This study aimed to characterize different rice (Oryza sativa) flours [1] and pumpkin (Cucurbita spp.) powder [2] and to assess their suitability for the formulation of solid nutraceutical supplements.

Material and Methods. Four rice types (white Oryza sativa L. ssp. Indica, brown Oryza sativa L. ssp. Indica, basmati Oryza sativa L. ssp. Circum-Basmati and black rice Oryza sativa L. ssp. Indica) and pumpkin (Cucurbita spp.) were investigated. The physicochemical analyses included pH, titratable acidity, soluble solids, moisture and starch content. Rice protein content was determined using the Biuret spectrophotometric method, while carotenoids in pumpkin powder were evaluated spectrophotometrically. A composite formulation containing 1.5 g pumpkin powder, 1.0 g rice flour and 1.0 g pectin gel was subsequently compressed into solid units [1, 2].

Results and Discussion. Fresh pumpkin showed a slightly acidic pH (≈5.8), whereas rice samples ranged from neutral to slightly alkaline (pH 6.9 – 7.6). Titratable acidity was 0.058 g malic acid/100 g in fresh pumpkin and 0.045 g lactic acid/100 g in rice flour; after recalculation for dehydration, pumpkin powder reached 0.61 g/100 g. Soluble solids in rice extracts increased from 10.0% in white rice to 20.0% in black rice. Brown rice showed the highest experimentally determined protein content (715 mg/100 g), followed by black (375 mg/100 g), white (220 mg/100 g) and basmati rice (135 mg/100 g). Starch content varied between 73 and 77%, while moisture ranged from 10.8 to 12.9% in rice flours and was 7.6% in pumpkin powder. Pumpkin powder contained carotenoids at 3.66–4.43 mg/100 g, with the highest value recorded for lycopene. The proposed formulation yielded ten compact units with an average mass of 0.35 g.

Conclusions. The results demonstrate the technological compatibility of rice flour and pumpkin powder for obtaining solid plant-based supplements. Rice provides a starch-rich structural matrix, while pumpkin powder contributes carotenoids and other bioactive compounds. Pectin gel ensured adequate cohesion during compression. Further studies should address carotenoid stability, bioavailability, sensory acceptability and product safety.

Keywords: *bioactive compounds, carotenoids, functional foods, pectin, rice, pumpkin*

Acknowledgments. The research was supported by Institutional Project, subprogram 020405 "Optimizing food processing technologies in the context of the circular bioeconomy and climate change", Bio-OpTehPAS, being implemented at the Technical University of Moldova.

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SUSTAINABLE PRACTICES IN RESTAURANT BUSINESS: SEAFOOD, FOOD WASTE AND RESPONSIBLE CONSUMPTION

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Introduction. The growing demand for healthy, high-quality and gastronomically attractive food increases the role of fish and seafood in contemporary restaurant menus. At the same time, seafood products are characterized by relatively high cost, specific storage requirements and limited shelf life, which makes their rational use particularly important for sustainable restaurant management. The aim of this study was to identify visible elements of sustainable practices in restaurant business, with particular attention to seafood, food waste reduction and responsible consumption.

Material and Methods. The study was based on a comparative analysis of publicly available menus and restaurant websites of 10 restaurants in Odesa. The establishments were selected to represent different restaurant concepts while maintaining a significant presence of fish and seafood in their menus. Five groups of indicators were assessed: representation of fish and seafood dishes; indication of local or Black Sea origin; seasonal positioning; visible signs of rational use of food raw materials; and communication related to responsible consumption and sustainability. Each indicator was evaluated as clearly present, partially present or not identified in publicly available information.

Fish and seafood dishes were identified in all 10 analysed restaurants (100%), confirming their significant role in the gastronomic offer of Odesa. Local or Black Sea origin of seafood was explicitly indicated in 4 establishments (40%), while seasonal positioning was clearly identified in 3 restaurants (30%). In 5 cases (50%), menu characteristics indicated opportunities for more rational utilization of food raw materials, although these observations cannot be interpreted as evidence of formal food-waste management systems. Explicit communication concerning responsible consumption or sustainability was identified in only 2 establishments (20%).

Results and Discussion. The results therefore demonstrate a substantial gap between the widespread use of seafood as a gastronomically valuable product and the explicit integration of sustainability principles into restaurant communication and menu management. Fish and seafood provide particular opportunities for implementing sustainable practices because their relatively high economic value makes losses especially significant. Demand forecasting, optimized purchasing, appropriate storage, portion management and the rational utilization of edible components can contribute to reducing food losses. A whole-product approach may also increase resource efficiency through the use of suitable fish and seafood components in stocks, sauces, appetizers and other menu items. At the same time, highlighting local and seasonal seafood can strengthen the gastronomic identity of restaurants and support more responsible consumption patterns.

Conclusions. The study demonstrates that sustainable restaurant development requires a transition from isolated environmental initiatives to an integrated approach combining resource efficiency, menu management, gastronomic value and consumer communication. For seafood-oriented and mixed-concept restaurants, the systematic implementation of such practices can reduce food losses, improve the efficiency of high-value raw materials and create additional value for consumers.

Keywords: *conscious consumption, food waste, hospitality industry, menu management, resource efficiency, seafood*

THE USE OF QUINCE BY-PRODUCTS FOR THE IMPROVEMENT OF FUNCTIONAL PROPERTIES OF BAKERY PRODUCTS

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Introduction. Quince is the bright golden-yellow pomaceous fruit of Cydonia oblonga Miller (Rosaceae). It has an intense and pleasant aroma, but as most varieties are too hard, sour, and astringent to be eaten raw, it is cooked and mostly processed into food products [1].

Material and Methods. The aim of this research was to develop a novel proposal for incorporating quince by-products powder (QPP) into bakery products and to evaluate their physical, antioxidant and sensory attributes. Four different formulations of brioche-style buns were prepared within the study. First two samples were prepared without QPP. First formulation was processed with baking yeast (BYBSB-0) and second one with sourdough (SBSB-0). QPP was used to prepare sourdough brioche-style buns with 2.5% (QBSB-2.5) and with 5.0% (QBSB-5).

Results and Discussion. Results showed that baking loss was varying insignificantly between 9.91% and 9.95% for all evaluated formulations. Phenolic profile of QBSB-2.5 and QBSB-5 attested TPC of 198.34 and 353.21 mg GA/100g and TFC of 117.31 and 234 mg QE/100g. Total carotenoid content achieved the highest value of 31.01 mg/100g in QBSB-5. Incorporation of QPP increased DPPH value till 81.57% and 77.68 % in QBSB-2.5 and QBSB-5 samples, in comparison with BYBSB-0 sample of 4.34% and QBSB-0 of 7.33%. ABTS antioxidant activity had the same correlation as DPPH scavenging activity, and ABTS maximum value was achieved in QBSB-5 (67.04 %). Although QPP had an effect on color characteristics of brioche-style buns. Formulation containing 5% of QPP recorded the lowest L* index and the highest a* and b* indexes at 50.34, 4.18 and 39.57, respectively. BYBSB-0 sample exhibited the highest L* index and the lowest a* and b* indexes, measuring 73.02, -1.21 and 25.23, respectively. QBSB-2.5 had high scores on all sensory attributes (≥8.43). Notably, QBSB-5 demonstrated a hardness value of 881.12 g similar to BYBSB-0 (901.74 g) and QBSB-0 (904.02 g) samples.

Conclusions. Implications of these results are significant for advancing sustainable recovery of natural bioactive compounds from QPP within the bakery industry.

Keywords: *quince by-products, waste valorization, brioche-style buns, antioxidant potential*

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MULTIVARIATE STATISTICAL ANALYSIS AS A TOOL FOR CHARACTERIZING FUNCTIONAL FOOD FORMULATIONS

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Introduction. The incorporation of plant-derived bioactive compounds into food matrices represents a promising approach for the development of functional foods; however, their stability and effective integration may be limited by their physicochemical properties and interactions with food components. Liposomal encapsulation offers a suitable strategy for protecting bioactive compounds and facilitating their incorporation into complex food matrices.

Material and Methods. This study aimed to evaluate food formulations enriched with liposome-encapsulated bioactive compounds derived from sea buckthorn and rosehip and to apply statistical tools for the integrated interpretation of their quality characteristics. Five experimental formulations, including a control and samples containing different levels of liposomal preparations, were investigated. Selected physicochemical, antioxidant, colorimetric, and sensory parameters were evaluated and subjected to analysis of variance and multivariate statistical analysis.

Results and Discussion. Significant differences ($p < 0.05$) were observed among formulations for selected quality attributes, indicating that the incorporation of liposomal preparations influenced the overall characteristics of the investigated food system. Principal component analysis (PCA) provided an integrated representation of the multidimensional dataset, with the first two principal components explaining 97.35% of the total variance (PC1 = 90.63% and PC2 = 6.72%). The multivariate approach highlighted relationships among physicochemical, antioxidant, colorimetric, and sensory characteristics and enabled the overall differentiation of the investigated formulations without relying on individual parameters alone.

Conclusions. The results demonstrate the usefulness of combining liposomal delivery systems with integrated statistical approaches for the evaluation of functional food formulations. This approach may support the characterization and further optimization of foods enriched with encapsulated plant-derived bioactive compounds.

Keywords: *functional foods, sea buckthorn, rosehip, nutrition, multivariate analysis, bioactive compounds, food quality*

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ANALYSIS OF THE LOCAL NUTRITIONAL CONTEXT AND FACTORS INFLUENCING THE CONSUMPTION OF ECOLOGICAL FOOD PRODUCTS

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Introduction. The growing global interest in sustainable and healthy nutrition has increased consumer demand for ecological (organic) food products. However, such products still represent a relatively limited segment of the food market in the Republic of Moldova. This study aimed to analyse the local food context, factors influencing the consumption of ecological products, and consumer awareness of their benefits, accessibility, and role in a healthy diet.

Materials and Methods. An integrated methodological approach was applied, combining a structured online questionnaire (distributed via Google Forms), market analysis, and statistical processing of the collected data using IBM SPSS Statistics. The questionnaire was organised into five thematic blocks covering respondent profile, awareness, attitudes and trust, purchasing behaviour and barriers, and information sources/market development perspectives.

Results and Discussion. The respondent sample was predominantly young, female, urban, and characterised by a medium self-reported income level. Consumer awareness was divided, with approximately half of respondents reporting limited knowledge of ecological products and a similar proportion expressing confidence in their understanding. The absence of pesticides and synthetic chemicals was the most frequently perceived attribute (74.5%), while respondents relied more on "Bio/Eco/Organic" claims than on official certification logos. Supermarkets were the main purchasing channel, and health protection was the leading purchase motivation (85.5%), although consumption remained predominantly occasional. High prices and scepticism about certification authenticity emerged as the main barriers, and respondents were willing to accept only marginal price increases. Social media and personal recommendations were the dominant information sources, while QR-code verification was preferred for confirming product authenticity.

The market analysis indicated that the ecological food sector in the Republic of Moldova remains limited, with certified products predominantly imported and local producers concentrated in specialised shops and farmers' markets.

Conclusions. The findings indicate a gap between positive attitudes toward ecological food and its regular consumption, alongside the relatively limited development of the local market. In the surveyed sample, health was the main purchase motivation, while high prices, limited knowledge of certification standards, and concerns about product authenticity were major barriers. Improved consumer education, transparent product verification tools (e.g., QR-code labelling), and greater market accessibility could strengthen consumer confidence and support the development of the ecological food sector in the Republic of Moldova.

Keywords: *awareness, certification, consumer behaviour, market barriers, organic food products, questionnaire survey*

Acknowledgments. The research was supported by the Institutional Project, subprogram 020405 "Optimizing food processing technologies in the context of the circular bioeconomy and climate change", Bio-OpTehPAS, being implemented at the Technical University of Moldova.

EFFECT OF LACTIC ACID FERMENTATION ON THE TECHNOLOGICAL AND BIOACTIVE PROPERTIES OF AMARANTH (*AMARANTHUS SPP.*)

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Introduction. Lactic acid fermentation is a promising biotechnological approach for improving the technological and bioactive properties of pseudocereals. Amaranth (*Amaranthus spp*.) is a promising fermentation substrate due to its high-quality protein content and favourable protein digestibility. This study evaluated the technological and bioactive effects of controlled lactic acid fermentation on amaranth.

Materials and Methods. Amaranth flour was hydrated at a 1:1 ratio using glucose solutions at two concentrations (0.5 and 1.0%). Six experimental variants were obtained using Lacticaseibacillus casei, Lactiplantibacillus plantarum, or Streptococcus thermophilus as starter cultures, with an initial microbial concentration of approximately 10^7 CFU/g. Fermentation was performed at 37 ± 1 °C until pH ⩽ 4.5, followed by pasteurisation at 85 ± 1 °C for 30 min. Fermentation kinetics, titratable acidity, moisture content, total polyphenol content, and DPPH radical-scavenging activity were evaluated.

Results and Discussion. All starter cultures induced progressive acidification with distinct fermentation kinetics. L. casei achieved the target pH most efficiently, reaching pH 4.4 within 21 h at both glucose concentrations. L. plantarum reached pH 4.5 after 21 h with 1.0% glucose and after 24 h with 0.5% glucose, while S. thermophilus showed the fastest initial acidification but required 24 h to reach pH 4.4. Increasing glucose from 0.5 to 1.0% did not substantially accelerate fermentation. Titratable acidity varied among the variants, while moisture remained stable.

Fermentation affected the bioactive profile depending on the starter culture and glucose concentration. L. plantarum with 0.5% glucose showed the highest total polyphenol content (386.85 ± 2.63 μg/mL), an increase of about 12% compared with the unfermented sample. S. thermophilus with 1.0% glucose showed the highest DPPH radical-scavenging activity among the fermented variants, retaining approximately 88-89% of the initial activity.

Conclusions. The results demonstrate that the technological and bioactive characteristics of fermented amaranth can be selectively modulated through the choice of fermentation conditions. Under the studied conditions, L. casei with 0.5% glucose was advantageous for rapid acidification, L. plantarum with 0.5% glucose promoted the highest polyphenol content, whereas S. thermophilus with 1.0% glucose provided the highest DPPH radical-scavenging activity among the fermented variants. Overall, L. casei with 0.5% glucose showed the most balanced technological potential, combining efficient acidification with low glucose supplementation and preservation of amaranth's bioactive characteristics.

Keywords: *acidification, antioxidant activity, bioactive compounds, lactic acid bacteria, polyphenols, pseudocereals*

Acknowledgments. The research was supported by the Moldovan Government within the project of Young Researchers 25.80012.5107.11TC BIO-FERM – "Valorization of bioactive compounds from alternative plant sources for the development of functional fermented foods", running at the Technical University of Moldova.

THE EFFECT OF GRAPE SKIN POWDER ON THE NUTRITIONAL AND TECHNOLOGICAL QUALITY OF LOW-SUGAR SPONGE CAKE

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Introduction. Sugar is an essential ingredient in sponge cake, influencing the texture, volume, colour and stability of the batter through its role in stabilising the egg foam, forming porosity and developing colour through caramelisation. In the current climate, with a focus on healthier bakery products, reducing sugar has become a technological and nutritional necessity. This study investigates how reducing the sugar content, combined with the addition of grape skin powder as a functional ingredient, influences the physico-chemical properties and quality of sponge cake. The central objective is to optimise the production process for a sponge cake with reduced sugar content and high biological value.

Material and Methods. The basic sponge cake recipe was adapted to allow for the addition of grape skin powder (GSP) of Feteasca alba variety. The grape skin powder obtained through convective drying retained a high level of bioactive compounds, confirming its potential for use as a functional food ingredient (antioxidant activity of 87.91% and a total polyphenol content of 274 mg GAE/g). Three variants were prepared by incorporating different amounts of GSP: 0 % (control), 5.0 %, 7.5 % and 10.0 %, and by reducing the sugar content by 5 % and 10 %. The physicochemical indices, sensory properties, total polyphenol content and antioxidant activity were determined using standard analytical methods.

Results and Discussion. The results obtained demonstrated the direct influence of reduced sugar content on the physico-chemical characteristics of the finished product. Consequently, the product's density increased with the concentration of the powder, whilst porosity decreased from 82.2 % in the control sample to 78.5 % and 75.34 % for the samples with 5 % and 10% sugar reduction respectively, resulting in a texture appropriate for sponge cake and well-balanced. At the same time, the polyphenol content increased in proportion to the amount of powder added: from 0.129 mg GAE/g in the control sample to 0.178 and 0.198 mg GAE/g, for the samples with reduced sugar content and the incorporation of GSP, marking an increase in the antioxidant value from 7.86 % in the control sample to 14.62 % and 49.37 %, respectively, for the samples with reduced sugar content and the incorporation of GSP.

Conclusions. The results of the research support the recommendation that sponge cakes with reduced sugar content and added grape skin powder are functional products, suitable for daily consumption and for promoting a healthy diet.

Keywords: *sponge cake, low-carbohydrate, grape skin, polyphenols, antioxidant activity*

Acknowledgment. This research was supported by the Institutional Project, subprogram 020405 "Optimization of food processing technologies in the context of the circular bioeconomy and climate change," Bio-OpTehPAS, implemented at the Technical University of Moldova.

DEVELOPMENT OF A PRODUCTION TECHNOLOGY FOR HIGH-PROTEIN BURGER BUNS FOR PERSONALIZED NUTRITION

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Introduction. Research was conducted at the laboratories of Odesa Bread Plant No. 4 and Odesa National University of Technology to develop a bakery product for personalized nutrition-specifically, a burger bun enriched with high-protein sunflower flour. This additive contains 60 g of plant-based protein and 7 g of fiber per 100 g of product, making it a promising ingredient for enhancing the nutritional value of the buns.

Material and Methods. The study determined the optimal inclusion level for the additive. Samples were tested with high-protein sunflower flour content ranging from 20% to 40% of the total flour mass. The additive's impact on gas formation processes was analyzed.

Results and Discussion. Gas formation dynamics indicate that increasing the additive content in the dough reduces the volume of carbon dioxide released during fermentation. Regarding the intensity of gas formation, increasing the high-protein sunflower flour content triggers a significant initial surge; however, the process rate subsequently drops sharply (after 1.5 hours of fermentation), and the readings remain unstable compared to the control sample. Based on the results, it was concluded that when using this additive in burger bun formulations (at levels of 20–40%), it is advisable to prepare the dough using the sponge-and-dough method, incorporating the additive during the final mixing stage to obtain a product enriched with plant-based protein. The characteristics of the dough-kneading process (specifically with the addition of high-protein sunflower flour at levels ranging from 20% to 40% of the total flour mass) were determined using a farinograph and a consistograph. The results indicate that incorporating this additive into the bun formulation extends dough development time while simultaneously reducing dough elasticity and stability. In particular, increasing the proportion of the additive lowers the water absorption capacity of the wheat-sunflower flour blend and results in dough with insufficient strength; this necessitates determining the optimal inclusion level, adjusting the formulation, and selecting an appropriate dough preparation method.

Analysis of the impact of the additive's mass fraction on the kneading process and gas production intensity during fermentation revealed that inclusion levels exceeding 20% negatively affect the dough's structural-mechanical properties, water absorption capacity, and gas production processes.

Conclusions. The developed technology will help expand the range of bakery products designed for personalized nutrition. Due to their reduced carbohydrate content and increased protein content, these buns will be particularly beneficial for specific population groups, such as athletes and individuals with diabetes.

Keywords: *enrichment, high-protein flour, personalized nutrition*

INNOVATIVE PAR-BAKED BAKERY PRODUCTS IN MODERN RESTAURANT PRACTICE

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Introduction. The modern development of the restaurant business is accompanied by growing consumer demand for freshly baked products, a wide range of bakery items and fast service. Under conventional production practices, the need to determine baking volumes in advance may result in unsold products and increased food losses when actual demand differs from forecasted demand. Par-baked technology represents an innovative solution that allows the final stage of bakery product preparation to be transferred directly to the restaurant and carried out according to current demand.

Material and Methods. The aim of the study was to substantiate the prospects of using par-baked bakery products as an innovative component of modern restaurant practice, considering their influence on assortment management, product freshness and rational use of food resources. The study was based on an analytical assessment of the technological and organizational advantages of using par-baked bakery products in food service establishments. The main criteria considered were production flexibility according to demand, product storage and preparation requirements, opportunities for assortment diversification, freshness of finished products, reduction of unsold products and potential reduction of food losses. Particular attention was paid to the possibility of separating the initial production stage from final baking and transferring the latter directly to the food service establishment.

Results and Discussion. The analysis demonstrated that par-baked technology provides food service establishments with greater flexibility in managing bakery production. Baking in small batches at different times of the working day makes it possible to adapt production volumes to actual consumer demand and reduce the need to prepare the entire daily volume of products in advance. This, in turn, may reduce the risk of unsold products and associated food losses. The use of par-baked products also makes it possible to offer freshly baked products during different service periods without organizing a complete production cycle directly at the establishment. From the perspective of restaurant menu management, this technology creates opportunities to expand the assortment of bread, buns and other small bakery products while maintaining operational flexibility. Demand-controlled baking contributes to more rational use of raw materials and production resources, while standardization of par-baked products can ensure consistent quality of finished products. At the same time, the effectiveness of the technology depends on compliance with storage conditions, logistics organization, availability of appropriate equipment, staff training and the accuracy of demand forecasting.

Conclusions. The use of innovative par-baked bakery products can contribute to the modernization of food service operations by combining product freshness, assortment flexibility and rational production planning. Their implementation creates conditions for reducing the risk of overproduction and food losses, optimizing resource use and increasing the consumer value of bakery products. Further research should focus on quantitative assessment of the economic efficiency of the technology, the influence of storage duration of par-baked products on the quality of finished products, and consumer perception of freshly baked products.

Keywords: *bakery products, food losses, hospitality industry, innovative technologies, menu management, par-baked products*

THE EFFECT OF SPROUTED GRAIN FLOUR ON THE BREAD PRODUCTION PROCESS

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Introduction. Vitamin fortification and healthy eating consistently rank among leading global trends. Bakery products are a staple food for all segments of the population. Different countries address the challenge of ensuring adequate intake of vitamins and trace elements in various ways, often enacting legislation that mandates the fortification of raw materials and finished products specifically flour and baked goods.

Results and Discussion. It is well established that products made from finely milled flour fail to provide the human body with sufficient amounts of vitamins, minerals, dietary fiber, essential amino acids, and other vital nutrients. Most beneficial compounds are lost during the milling process along with the grain's germ, bran and aleurone layer.

The modern baking industry is constantly seeking new, more advanced technologies. Research into the potential use of flour made from sprouted wheat grain represents a promising avenue for innovation.

There is a pressing need to study and analyze the key benefits of using sprouted wheat flour in the production of bakery products. Sprouted wheat grain is distinguished by its high content of B-group vitamins and vitamin C, as well as minerals such as iron, magnesium, and phosphorus. The sprouting process significantly enhances the bioavailability of essential vitamins, minerals, and other beneficial compounds, including antioxidants, dietary fiber, and enzymes. These substances play a crucial role in maintaining health and supplying the body with essential nutrients. There are several ways to incorporate sprouted grain into bakery products; however, using sprouted grain flour eliminates the need for additional equipment to dose or add whole grains to the dough. Specialized grain processing methods and technologies including soaking, sprouting, and subsequent drying have been developed to produce such flour. Although implementing this technology entails higher costs (particularly for installing additional equipment), it enables the production of bakery products with enhanced biological and nutritional value.

Conclusions. Research findings are expected to serve as a basis for improving technological processes and formulations, as well as for promoting healthy eating among consumers. It is necessary to define the specific technological aspects of producing bakery products using sprouted wheat flour. Studying the effect of varying proportions of sprouted grain flour on key production stages—dough mixing, fermentation, and baking—will help determine optimal formulations and processing parameters to improve the quality of the finished products.

Keywords: *fortification, global trends, sprouted grain*

CHARACTERIZATION OF THE NUTRITIONAL QUALITY OF ZIZIPHUS JUJUBA PULP BASED ON PHYSICO-CHEMICAL INDICATORS AND MINERAL COMPOSITION

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Introduction. Ziziphus jujuba Mill is a fruit species of considerable nutritional value due to its high content of nutrients and bioactive compounds. The fruits are rich in easily digestible carbohydrates, fiber, vitamins (particularly vitamin C and B vitamins), minerals, and antioxidants (polyphenols, flavonoids), and are associated with health benefits as well as the prevention of certain metabolic and cardiovascular disorders. Thanks to its composition, this species allows for various forms of utilization in the food industry, such as dried fruits, juices, or functional powders. It is also distinguished by its drought resistance and adaptability to varied soil and climate conditions, making it promising for cultivation in the Republic of Moldova and for the diversification of the fruit assortment. For this study, the Kitaiski-107 variety was selected due to the large size of its fruits. The fruits analyzed weigh 10 to 15 g, and the pulp accounts for approximately 90 to 93% of the total fruit mass.

Material and Methods. The pulp of the Ziziphus variety Kitaiski-107, harvested in 2025 and grown in the Central region of the Republic of Moldova, was evaluated in terms of its chemical composition, mineral content, and bioactive compounds.

Results and Discussion. The pulp is characterized by moisture content (77.5 g/100 g), titratable acidity (0.60 degree acidity), fiber content (2.8 g/100 g), sugar content (26.8 g/100 g), and ash content (0.8 g/100 g). Minerals, including potassium (3.56 g/kg), phosphorus (525.0 mg/kg), calcium (198.8 mg/kg), magnesium (160.8 mg/kg), iron (6.30 mg/kg), and zinc (0.095 mg/kg), were present in significant concentrations. The results showed that the pulp of native Ziziphus is an important source of bioactive compounds: ascorbic acid (68.6 mg/100 g), polyphenols (1.88–1.95 mg GAE/g), and antioxidant activity (94.9–95.7%).

Conclusions. The results highlighted that Ziziphus pulp is an important source of nutrients and bioactive compounds with functional properties, characterized by high nutritional value.

Keywords: *Ziziphus pulp, physicochemical parameters, minerals, bioactive compounds*

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TOURISTS BETWEEN EXPECTATIONS AND REALITY: PERCEPTIONS OF AUTHENTICITY AND SUSTAINABILITY IN GUESTHOUSES FROM THE REPUBLIC OF MOLDOVA

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Introduction. Rural tourism based on guesthouses is developing significantly in the Republic of Moldova, closely linked to sustainability and the authenticity of the tourist experience. Tourists increasingly seek contact with nature, local traditions and rural communities, preferring personalized experiences over mass tourism. This study analyzes tourists' perception of sustainability and authentic experiences offered by guesthouses in the Republic of Moldova, aiming to identify directions for improving services and increasing tourist satisfaction.

Material and Methods. The research combined theoretical and empirical methods: analysis and synthesis of specialized literature on sustainable tourism and authentic experience, complemented by the comparative and descriptive methods. The empirical foundation of the research was the sociological survey method, through the application of two distinct questionnaires: one addressed to tourists, the other to guesthouse administrators. The tourists' questionnaire was applied to a sample of 135 respondents, accommodated in six tourist guesthouses selected based on location, size and the type of services provided. The instrument assessed the importance given to authenticity, the sustainability of services, the motives for the stay, and the degree of satisfaction.

Results and Discussion. The results show that 45% of tourists consider the authenticity of the experience very important when choosing a guesthouse, confirming demand's orientation toward authentic tourism, based on traditions, local gastronomy and contact with the rural environment. Likewise, 46% regard sustainability as an essential factor in the accommodation decision, a sign of growing awareness of tourism's impact on the environment and local communities. Regarding the motivation for the stay, 75% indicate relaxation as the main purpose, suggesting that guesthouses are perceived mainly as places of retreat from urban hustle. Notably, 53% of respondents expressed dissatisfaction with the services provided, highlighting a gap between expectations and the actual offer, related to the limited diversity of activities and the insufficient authentic valorization of local resources. The results suggest that administrators should invest in diversifying services, staff training and visible sustainable practices, so that the positive perception of authenticity is backed up by a higher-quality accommodation experience.

Conclusions. Tourists' perception of guesthouse sustainability and authenticity in the Republic of Moldova is generally favorable, though gaps remain between expectations and services provided. Sustainable development of the sector requires diversifying the offer and valorizing local resources authentically, in order to increase tourist satisfaction.

Keywords: *tourist perception, sustainable tourism, authentic experience, guesthouses*

Acknowledgment. This research was supported by the Institutional Project, subprogram 020405 "Optimization of food processing technologies in the context of the circular bioeconomy and climate change," Bio-OpTehPAS, implemented at the Technical University of Moldova.

CULINARY HERITAGE AND ITS SUSTAINABILITY: A QUALITATIVE STUDY IN ARDAHAN, TÜRKIYE

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Introduction. Culinary practice occupies a central place within cultural heritage, yet its transmission is uneven and its erosion often proceeds unnoticed. Ardahan, a province in north-eastern Türkiye, hosts Terekeme, Ahiska, Türkmen, Lezgi, Poşa, Georgian, Circassian and Tat communities whose interaction has produced a distinctive cuisine, and holds four registered geographical indications.

Material and Methods. This study asks how local residents understand and sustain that heritage, and what is being lost. Semi-structured face-to-face interviews comprising nine open-ended questions were conducted between July and October 2024 with thirteen residents of the central district, drawn from local residents and tradespeople. Interviews were recorded and transcribed, and identities were anonymised. The semi-structured format allowed follow-up questions to be introduced during the exchange [1].

Results and Discussion. The data were subjected to descriptive, content and word-frequency analysis. Participants associated heritage most strongly with culinary culture, and the assets they named were predominantly gastronomic: Ardahan kaşar cheese and Ardahan goose were named by all thirteen, ahead of every built or material asset. Whole-animal use emerged as ordinary practice: the meat, rendered fat, offal and feathers of the goose are all put to use, and wild plants such as evelik and nettle remain in the everyday repertoire. Against this, a substantial repertoire is no longer prepared, including zülbiyet, furuç, haşıl, dövmeç, ovmaç and evelik sarma, the loss was attributed to the death of knowledge holders, out-migration, and the erosion of ingredients and skills. Ten of the thirteen considered that local foods are not adequately treated as a cultural asset, and eleven held no view when asked about intangible gastronomic heritage within sustainable gastronomy. The pattern is consistent with earlier Turkish evidence of gastronomic assets approaching disappearance [2]. Awareness of culinary heritage as a sustainability resource is lowest where that heritage is richest, and the practices now disappearing are those that historically kept local food systems circular.

Conclusions. Safeguarding requires coordinated action among local government, civil society and food-service enterprises: documenting inherited recipes, supporting the region's honey and cheese festivals, and placing regional dishes on local menus.

Keywords: *gastronomy tourism, geographical indication, intangible cultural heritage, local cuisine, whole-animal use*

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DEVELOPMENT OF CIRCULAR TECHNOLOGICAL CHAINS "GRAIN – FOOD PRODUCTS – COMPOUND FEED"

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Introduction. Grain processing connects food and feed production through numerous material streams. In conventional linear systems, fractions not included in the main food product may be treated as low-value residues, although many retain nutritional and technological potential. A circular approach considers these fractions as resources for subsequent processing and can increase the overall utilization of grain components. The aim was to substantiate the formation of an integrated technological chain "grain - food products - compound feed" based on cascading use of raw materials.

Material and Methods. The chain from grain processing to food manufacture and subsequent use of suitable side streams in compound feeds was analysed. Attention was focused on milling and cereal fractions, bakery and pasta residues, brewing and starch-processing streams, together with requirements for stabilization, quality control, traceability and adaptation to feed-manufacturing operations.

Results and Discussion. A circular chain can be organized according to the sequence: origin of the material, characterization, technological preparation, quality and safety control, and final use in feed production. Bran, feed flour and other cereal fractions may be incorporated after appropriate conditioning, whereas high-moisture streams require rapid processing or drying. Grinding, thermal treatment, extrusion and pelleting can modify particle size, stability and handling properties and create standardized feed ingredients from variable side streams. The efficiency of the system depends not only on nutritional value but also on logistics, energy demand and proximity of food and feed enterprises; territorial integration is particularly advantageous for unstable high-moisture materials. Traceability is essential because contaminants may be redistributed during grain processing, and the suitability of a side stream must be confirmed before its use in feed. Cascading use gives priority to food applications and directs suitable remaining fractions to feed or other uses, thereby increasing the degree of utilization of the original grain. Such integration also requires coordinated information on material origin, composition, moisture, storage history and process behaviour so that feed formulations and processing modes can be adjusted to batch variability. Digital monitoring and batch traceability can improve this coordination and support faster technological decisions.

Conclusions. The "grain - food products - compound feed" concept provides a practical basis for circular integration of grain processing, food and feed industries. Its implementation requires standardized secondary streams, reliable safety control, traceability, differentiated preparation and optimization of processing, logistics and energy use across the entire chain.

Keywords: *by-products, feed production, grain processing*

HEMP (CANNABIS SATIVA L.) SEED CAKE AND INFLORESCENCE AS EMERGING RESOURCES FOR FUNCTIONAL FOOD INGREDIENTS IN THE REPUBLIC OF MOLDOVA — A REVIEW

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Introduction. Following the legal relaunch of industrial hemp (Cannabis sativa L.) cultivation in the Republic of Moldova in November 2024, increasing volumes of seed cake and inflorescence biomass are generated as by-products of the oil-pressing and harvesting chain, without an established national food-valorisation circuit. This review aims to synthesise current evidence on the composition and functional food valorisation of hemp seed cake and inflorescence, and to outline their economic and circular-economy potential for Moldova's agri-food sector.

Material and Methods. A narrative literature review was conducted using the Web of Science, Scopus and Google Scholar databases, covering studies on the physicochemical and phytochemical composition of hemp seed cake and inflorescence, extraction and bioprocessing techniques, and their incorporation into bakery, confectionery and pasta food matrices.

Results and Discussion. Hemp seed cake, the residual by-product of cold-pressing hemp seeds, retains a high protein content (up to 31.6% d.b.) and dietary fibre (up to 43.8% d.b.), together with a total polyphenol content of up to 535 mg/kg — exceeding whole seeds (319 mg/kg) — predominantly Cannabisin F. Recent Moldovan research showed that protein concentrates obtained from hemp seed cake can reach protein contents above 74% (d.b.), with several essential amino acids exceeding FAO/WHO reference values. Hemp inflorescence, a fraction generated after seed harvesting and currently valorised mainly as low-value residue, is recognised as rich in phenolic compounds, flavonoids and terpenes, with growing interest for incorporation into functional bakery and pasta matrices, although a consolidated valorisation pathway is still lacking nationally. Economically, converting these residual flows into functional ingredients could reduce reliance on imported protein sources, add value to biomass currently used mainly as animal feed or discarded, and support farmers in the newly relaunched hemp sector, contributing to circular-economy objectives relevant to Moldova's EU accession process.

Conclusions. Hemp seed cake and inflorescence represent an emerging, currently underutilised biomass resource with significant potential to generate economic value while reducing agro-industrial waste. These findings support an integrated research approach to valorising hemp by-products into functional food ingredients, in line with circular economy principles.

Keywords: *hemp seed cake, hemp inflorescence, functional food ingredients, circular economy, bioactive compounds, Republic of Moldova*

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ACRYLAMIDE FORMATION AND MITIGATION IN EXTRUDED PRODUCTS FROM CEREALS AND FOOD INDUSTRY BY-PRODUCTS

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Introduction. Acrylamide is a potentially hazardous food contaminant formed during high-temperature processing through the Maillard reaction between asparagine and reducing sugars. Due to its potential carcinogenic, mutagenic, and neurotoxic effects, its formation in thermally processed foods is subject to continuous monitoring.

Material and Methods. This study investigated acrylamide formation in extruded cereal- and food by-product-based products, focusing on the effects of raw material composition, protein content, and extrusion temperature, as well as strategies for reducing its formation. Three groups of extrudates were examined: (1) corn variety 394 supplemented with 5–20% apple, tomato, or grape pomace powders (Sauvignon and Codrinsky varieties); (2) mixtures of wheat bran with corn or buckwheat, and corn bran; and (3) gluten-free products based on soriz groats supplemented with dried fruits, buckwheat flour, or chickpeas.

Results and Discussion. Protein content, extrusion temperature, and acrylamide concentration were determined for each sample. Results are expressed as mean ± standard deviation for control and samples treated with 3% citric acid. Citric acid treatment consistently reduced acrylamide levels by 15.9–21.1%, mainly due to pH reduction, which limits acrylamide-forming reactions, in agreement with literature data [1]. Acrylamide formation was significantly affected by raw material composition and extrusion conditions. The higher levels observed in wheat-bran-based products compared with corn-flour products are likely related to their greater content of asparagine and reducing sugars, the main precursors of acrylamide [2].

Conclusions. Increasing the proportion of plant by-product powders and extrusion temperature increased acrylamide formation, confirming the importance of raw material composition and processing conditions. An integrated approach combining formulation and extrusion optimization with citric acid treatment may therefore provide an effective strategy for reducing acrylamide and improving the safety of extruded products.

Keywords: *acrylamide, citric acid, extruded products, food safety, Maillard reaction*

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DESIGN SOLUTIONS FOR INDUSTRIAL KITCHENS BASED ON INDUSTRY 5.0 PRINCIPLES

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Introduction. The aim of this work is to identify design solutions for industrial kitchens that ensure human-centricity, sustainability, and resilience, thereby creating a safe, adaptive, and comfortable work environment without compromising food safety requirements.

Materials and Methods. The recommendations were developed based on the core principles of Industry 5.0.

Results and Discussion. The proposed design solutions include:

- Incorporating adaptive transformation capabilities into workstations, allowing for the rapid adjustment of configurations, work surface heights, and equipment placement in accordance with the production process and the physical needs of the staff;
- Reducing unnecessary movement by optimizing workstation setups with additional holders, shelves, and dispensers;
- Automating inventory management processes, as well as demand analysis and forecasting, through AI integration;
- Managing the microclimate, lighting, and noise levels. Creating a digital twin with augmented reality elements to facilitate staff training, alongside the installation of sensors and cameras to monitor the indoor microclimate and other operational parameters in real time;
- Ensuring sustainability by reducing water and electricity consumption, as well as by closely monitoring product expiration dates to prevent waste. Ensuring resilience through the modularity of all equipment and adaptability to fluctuations in demand, staffing levels, and equipment failures. Throughout this process, compliance with food safety standards remains the primary design requirement;
- Efficiency is evaluated based on staff movement paths, the number of workflow intersections, operation durations, ergonomic indicators, electricity and water consumption, waste volume, and kitchen reconfiguration time.

Conclusion. The proposed approach enables the modeling of changes using a digital twin and the adaptation of workstations without requiring a major kitchen redesign. This reduces staff travel distances and resource consumption, lowers ergonomic risks, and maintains food safety.

Keywords: *kitchen, planning, sustainability, food safety, Industry 5.0*

SECTION III
Food Chemistry, Oenology and Biotechnology in the Food Industry



CULTIVAR-DEPENDENT CAROTENOID PROFILES OF SEA BUCKTHORN (HIPPOPHAE RHAMNOIDES L.) BERRIES

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Introduction. Sea buckthorn berries are a valuable source of carotenoids. Zeaxanthin esters, particularly zeaxanthin dipalmitate (ZDP), are frequently reported as predominant components; however, considerable differences in carotenoid composition may occur among cultivars. The aim of this study was to evaluate the cultivar-dependent variability of carotenoid profiles in ripe sea buckthorn berries and to identify a limited set of parameters suitable for cultivar differentiation.

Materials and Methods. Ripe berries of 17 sea buckthorn cultivars were investigated. All extraction procedures were performed under reduced-light conditions to minimize carotenoid degradation and isomerization. Seeds were manually removed and the berry pulp was extracted repeatedly with methanol/ethyl acetate/petroleum ether (1/1/1, v/v/v) until discoloration of the matrix. The combined extracts were filtered through anhydrous sodium sulphate and evaporated under reduced pressure at 40 °C. Carotenoids were analysed by HPLC-PDA using a C30 stationary phase. Chromatographic profiles were recorded at 450 nm, while PDA spectra within the 200 800 nm range were used. ZDP and β-carotene were selected as the principal compositional markers. Their relative contributions to the total integrated carotenoid profile were expressed as percentages, while total carotenoid content was used as an independent quantitative parameter.

Results and Discussion. Considerable differences in both the qualitative chromatographic fingerprints and the abundance of the major carotenoids were observed among the cultivars. ZDP was the predominant carotenoid in most cultivars, whereas the relative contribution of β-carotene showed pronounced cultivar-dependent variation. Three parameters – ZDP (%), β-carotene (%), and total carotenoid content – were therefore selected to provide a simplified description of the carotenoid profile of each cultivar. Plotting the cultivars in two-dimensional coordinates based on the relative contents of ZDP and β-carotene revealed distinct compositional patterns. According to the relative predominance of these two compounds, the investigated cultivars could be provisionally differentiated into ZDP-dominant, β-carotene-dominant, and balanced carotenoid profiles. Total carotenoid content provided an additional quantitative dimension for differentiation. The cultivars “Seirola” and “R1” exhibited exceptionally low relative ZDP contents, accounting for 6-7%. Moreover, some cultivars exhibited minor peaks with atypical spectral characteristics, indicating that cultivar-dependent variability is not restricted to the relative proportions of the predominant carotenoids but may also involve differences in minor carotenoid composition.

Conclusions. The carotenoid composition of ripe sea buckthorn berries exhibits pronounced cultivar-dependent variability. A three-parameter approach combining the relative contents of ZDP and β-carotene with total carotenoid content provides a simple and informative means of describing this variability. The proposed approach may serve as a basis for further development of HPLC carotenoid fingerprinting for the differentiation of sea buckthorn cultivars.

Keywords: *β carotene, cultivar differentiation, HPLC-PDA, zeaxanthin dipalmitate ZDP*

Acknowledgments. This research was conducted within the framework of Subprogram 020405.

MICROALGAE AND CYANOBACTERIA AS BIOINTERFACE MODELS FOR NANOSTRUCTURED ANTIMICROBIAL MATERIALS: FROM BIOMEDICAL TO FOOD INDUSTRY APPLICATIONS

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Introduction. The development of nanostructured antimicrobial materials requires a comprehensive understanding of nanoparticle–cell interactions and the biological factors influencing their activity and safety. These considerations are relevant to biomedical coatings and other functional surfaces, including those used in food processing and packaging. This study explored photosynthetic microorganisms as biological models for investigating responses to metallic nanoparticles and identifying factors relevant to the development of bioactive nanostructured materials.

Materials and Methods. Cyanobacteria and microalgae, including Arthrospira platensis, Nostoc linckia, Dunaliella salina, Porphyridium purpureum, and Haematococcus lacustris, were exposed to metallic nanoparticles with controlled physicochemical properties. Species with distinct cellular architectures and extracellular polymeric substance (EPS) profiles were selected to represent diverse biological interfaces. Concentration-dependent responses were evaluated through changes in growth and selected biochemical and protective markers, including carotenoids, phenolic compounds, antioxidant enzymes, and EPS production.

Results and Discussion. Nanoparticle exposure induced concentration-dependent biological responses that varied among the investigated microorganisms. Sub-toxic concentrations stimulated adaptive mechanisms, including the accumulation of protective metabolites and EPS, whereas higher concentrations produced inhibitory effects. Interactions between nanoparticles and extracellular polymeric substances influenced nanoparticle aggregation, surface accessibility, and effective bioavailability. Species-specific differences highlighted the importance of cellular organization and extracellular structures in determining biological responses to nanomaterials. These findings provide insights into the biological factors that should be considered when developing nanostructured materials with antimicrobial functionality.

Conclusions. Photosynthetic microorganisms provide complementary biological models for investigating nanoparticle–cell interactions and identifying concentration-dependent transitions between adaptive and inhibitory responses. The findings contribute to the biological evaluation of nanomaterials intended for functional coatings, particularly those developed for biomedical applications. The underlying principles may also inform future research on antimicrobial surfaces and nanostructured materials for food processing and packaging, where biological activity must be balanced with material safety.

Keywords: *microalgae, cyanobacteria, metallic nanoparticles, biointerfaces, nanostructured coatings, antimicrobial materials*

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MODERN MACERATION–FERMENTATION TECHNOLOGY FOR QUALITY ENHANCEMENT OF AUTOCHTHONOUS RED WINES

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Introduction. The quality and composition of red wine are strongly influenced by the conditions under which grape solids remain in contact with the fermenting must. The efficiency of this stage determines the release of phenolic substances and pigments, while also affecting the development of the wine's aromatic and sensory characteristics. The Soft System® technology provides an alternative approach by combining automated fermentation management, controlled must homogenization, and regulated oxygen exposure.

Material and Methods. Wines from the autochthonous cultivars Băbeasca Neagră and Feteasca Neagră were produced using conventional and Soft System® maceration–fermentation procedures. For both grape varieties, the technological parameters were maintained under controlled conditions to allow comparison of the two approaches. The obtained wines were characterized according to physicochemical parameters, phenolic composition, color-related characteristics, aromatic profile, and sensory properties.

Results and Discussion. The application of Soft System® improved fermentation performance, with the experimental wines reaching lower final density and residual sugar values. Fermentation proceeded approximately 12–15% faster than under conventional conditions. A slight decrease in pH was observed, whereas total acidity remained comparatively unchanged, indicating a favorable effect on wine stability. The technological treatment also promoted the transfer of phenolic constituents from grape material into the wine. Total polyphenol levels were higher by 30–40 mg/L, while anthocyanin concentrations reached values of up to 145 mg/L. These changes were associated with increased color intensity and greater chromatic stability. Shortening the post-fermentation maceration period from seven to five days did not impair the structural characteristics of the wines. Efficient cap homogenization and regulated oxygen exposure compensated for the shorter contact period and contributed to limiting excessive tannin extraction. Sensory assessment further indicated a more pronounced expression of red-fruit, spicy, and vanilla aromas, accompanied by greater aromatic persistence, balance, and structural integration.

Conclusions. Under the conditions investigated, Soft System® proved capable of improving several technological and quality attributes of wines from Băbeasca Neagră and Feteasca Neagră. The technology enhanced fermentation efficiency and phenolic extraction while allowing a shorter post-fermentation maceration period. The resulting wines showed favorable chromatic and sensory characteristics, demonstrating the potential of this approach for obtaining stable and well-structured red wines.

Keywords: *anthocyanins, autochthonous grapes, fermentation, phenolic composition, sensory evaluation, wine quality*

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VARIETAL RESPONSES OF FETEASCA NEAGRĂ AND RARA NEAGRĂ WINES TO DIFFERENT MACERATION TECHNIQUES

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Introduction. Phenolic compounds and color attributes are key quality parameters of red wines and are strongly influenced by the maceration process. The present study aimed to compare the effects of conventional maceration–fermentation (MF), cryomaceration (CM), and thermomaceration (TM) on the extraction of phenolic compounds and the chromatic characteristics of wines produced from the indigenous Moldovan grape cultivars Feteasca Neagră and Rara Neagră.

Material and Methods. Microvinification experiments were performed using grapes harvested in the 2023 and 2024 vintages. The three maceration techniques were applied ĂUunder controlled conditions. Total phenolic content (TPC), anthocyanins, proanthocyanidins, color intensity (CI), and hue (H) were assessed by spectrophotometric analysis, whereas individual flavan-3-ols and procyanidins were identified and quantified by high-performance liquid chromatography coupled with mass spectrometry (HPLC–MS).

Results and Discussion. Among the evaluated treatments, thermomaceration at 70 °C proved to be the most effective for extracting phenolic compounds, reaching total phenolic contents of 1410.7 mg GAE/L in Rara Neagră and 1685.9 mg GAE/L in Feteasca Neagră. The same treatment also produced the highest concentrations of proanthocyanidins (384.4 and 518.8 mg/L, respectively). In contrast, cryomaceration favored the preservation of color in Feteasca Neagră, resulting in the greatest color intensity (CI = 10.58) and the lowest hue value (H = 0.66), while thermomaceration generated the highest color intensity in Rara Neagră (CI = 6.65). Regardless of the maceration technique employed, Feteasca Neagră consistently showed a higher capacity for phenolic accumulation than Rara Neagră, indicating distinct varietal responses to extraction conditions.

Conclusions. The findings confirm that maceration temperature is a decisive factor governing the extraction of phenolic constituents during vinification. Although thermomaceration maximized the recovery of phenolic compounds, cryomaceration provided superior color preservation in Feteasca Neagră. These cultivar-specific responses highlight the importance of selecting appropriate maceration strategies to improve the quality of wines produced from native Moldovan grape cultivars.

Keywords: *anthocyanins, cryomaceration, HPLC–MS, polyphenols, thermomaceration*

Acknowledgments. This research was supported by Institutional Project, subprogram 02.04.05 Optimizing food processing technologies in the context of the circular bioeconomy and climate change, Bio-OpTehPAS, being implemented at the Technical University of Moldova.

MULTI-PARAMETRIC CHARACTERIZATION OF PHENOLIC COMPOSITION IN SELECTED MOLDOVAN DRY WINES

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Introduction. The phenolic composition of wine is determined by grape variety and is further influenced by technological and environmental factors, resulting in considerable variability even among wines produced from the same cultivar. Chromatographic fingerprinting at different detection wavelengths provides complementary information on individual classes of phenolic compounds and may therefore be useful for the comparative characterization of wines. The aim of this study was to evaluate the phenolic profiles of wines produced from three Moldovan grape cultivars and to assess the variability observed among wines of the same varietal origin.

Materials and Methods. Nine dry Moldovan wines produced from three autochthonous grape cultivars were investigated: white wines from Fetească Albă (2025 vintage), rosé wines from Rară Neagră (2024 vintage), and red wines from Fetească Neagră (2025 vintage), with three wines from different producers included for each cultivar. Phenolic compounds were analysed by reversed-phase HPLC-DAD using an "Agilent 1290 Infinity III" system equipped with a C18 column and gradient elution in a water-acetonitrile-acetic acid mobile-phase system. Chromatographic profiles were evaluated at 250/270 nm for phenolic acids, 325 nm for hydroxycinnamic acid derivatives, 360 nm for flavonols, and 520 nm for anthocyanin-type compounds. Identification and characterization of the principal chromatographic components were supported by their retention behaviour and UV-Vis spectral characteristics. Analyses were performed in duplicate.

Results and Discussion. Multi-wavelength HPLC-DAD analysis revealed pronounced differences in phenolic composition both between wine types and among wines produced from the same cultivar. Particularly illustrative differences were observed for the three Fetească Neagră wines. The sum of hydroxycinnamic acid derivatives was relatively similar in wines from Mircești, Gogu, and Equinox, reaching 71.55 ± 0.42, 64.9 ± 1.8, and 66 ± 14 mg/L, respectively. In contrast, substantially greater variability was observed for flavonols (24.22 ± 0.77, 29.86 ± 0.15, and 47 ± 11 mg/L) and especially for anthocyanins (502 ± 39, 527.0 ± 4.0, and 257 ± 38 mg/L, respectively). A pronounced producer-dependent variation was also evident in Rară Neagră rosé wines, where hydroxycinnamic derivatives ranged from 15.7 ± 2.1 to 24.5 ± 3.2 mg/L and flavonols from 0.340 ± 0.048 to 10.3 ± 1.0 mg/L. Thus, the different phenolic fractions did not vary proportionally, producing individual multi-wavelength chromatographic patterns.

Conclusions. Multi-wavelength HPLC-DAD analysis provides a comprehensive yet relatively simple approach for the comparative characterization of the phenolic composition of Moldovan wines. The considerable differences observed among wines produced from the same cultivar demonstrate that varietal origin alone does not determine their phenolic fingerprint. The combined evaluation of hydroxycinnamic derivatives, flavonols, and anthocyanins provides complementary compositional information and may constitute a useful basis for further differentiation and characterization of wines from autochthonous Moldovan grape cultivars.

Keywords: *"Fetească" wines, phenolic fingerprinting, "Rară Neagră", reversed-phase HPLC*

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EFFECT OF STARCH SOURCE ON WATER-HOLDING CAPACITY DURING STORAGE OF FERMENTED COCONUT BEVERAGES

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Introduction. Modified starches can be used as thickeners and stabilizers to improve the quality of fermented plant-based beverages [1]. Previous studies have shown that acetylated distarch adipate (E1422) from different botanical sources can produce different structural and rheological properties in fermented coconut beverages [2]. However, their ability to maintain water-holding capacity during prolonged refrigerated storage remains insufficiently characterized. This study aimed to compare the water-holding capacity of fermented coconut beverages containing waxy corn- and tapioca-derived E1422 during 28 days of refrigerated storage.

Materials and Methods. Coconut extract was prepared from coconut flour by hot-water extraction. Fermented coconut beverages were prepared with 4% E1422 derived from waxy corn or tapioca. The mixtures were pasteurized at 95 °C for 10 min, cooled to 40 °C, and fermented with a vegan starter culture to pH 4.5. The samples were stored at 4 ± 2 °C for 28 days. Water-holding capacity was measured on days 1, 7, 14, 21, and 28 of storage by centrifugation at 3700 × g for 15 min.

Results and Discussion. The samples with waxy corn starch had a higher water-holding capacity at the beginning of storage than the tapioca-containing samples. In the waxy corn starch samples, water-holding capacity remained nearly constant over 28 days. By contrast, a gradual reduction was observed in the samples with tapioca starch, particularly toward the end of storage.

Conclusions. Fermented coconut beverages containing waxy corn-derived E1422 showed greater stability of water-holding capacity during 28 days of refrigerated storage, whereas those containing tapioca-derived E1422 showed a gradual decline in this parameter. These results indicate that E1422 starches from different botanical sources may differ in their ability to maintain water-holding capacity in fermented coconut beverages during storage.

Keywords: *coconut, corn, fermented beverage, modified starch, tapioca*

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THERMAL STABILITY OF PHENOLIC COMPOUNDS IN RARA NEAGRA GRAPE MARC EXTRACTS

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Introduction. Sweet grape pomace is considered a promising source of bioactive substances, including anthocyanins, polyphenols, and flavonoids, which are widely associated with anti-oxidant activity. These compounds may play a role in limiting processes associated with oxidative stress and the development of chronic disorders. Antioxidant-rich diets and functional foods have received increasing attention in recent years because of their potential contribution to reducing the risk of cancer and other chronic diseases that represent major causes of mortality worldwide. Since thermal processing can promote the degradation of thermolabile compounds, the optimization of temperature and time conditions are essential for preserving the functional properties and quality of food products containing such substances.

Material and Methods. Extracts were prepared from unfermented sweet red grape pomace of the Rara Neagra variety, harvested 2025. Extraction was performed using 60% ethanol citric acid acidified. The resulting hydroalcoholic extracts were subsequently subjected to thermal treatment at 80, 100, 120, and 140 ± 5°C for 7, 14, 21, and 30 min.

Results and Discussion. The applied thermal conditions produced a pronounced temperature-dependent effect on the phenolic composition of the extracts, range of 80–140°C and 7–30 min, the total phenolic content decreased from 50.67 to 17.98 mg GAE/g DW. In comparison, the total anthocyanin concentration showed relatively little variation. However, a reduction in monomeric anthocyanins was observed following thermal exposure, indicating the occurrence of structural transformations and/or degradation of individual anthocyanin forms. The UV–VIS spectra indicated comparatively high stability of the extracts at 80–100°C, whereas substantially greater changes occurred at 120–140°C. Despite the reduction in monomeric anthocyanins at elevated temperatures, thermal treatment under acidic conditions was associated with improved color-related characteristics of the extracts: 520 nm increased absorbance and higher color intensity.

Conclusions. The sweet red grape pomace can serve as a valuable raw material for obtaining extracts rich in naturally occurring bioactive compounds. The relative stability of anthocyanins under acidic conditions and moderate thermal exposure supports the potential application of these extracts as natural food colorants. Their stability at 80–100°C may remain suitable under moderate thermal processing conditions, such as pasteurization or short-duration heating. Conversely, the 120–140°C resulted in more pronounced degradation, indicating that severe or prolonged thermal treatments may compromise both the functional properties and coloring capacity of the extracts.

Keywords: *anthocyanins, antioxidant compounds, grape pomace, polyphenols, Rara Neagra, thermal treatment*

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VALORIZATION OF APPLE AND PEAR BY-PRODUCTS AS SOURCES OF BIOACTIVE COMPOUNDS FOR FUNCTIONAL FOOD APPLICATIONS

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Introduction. The valorization of fruit-processing by-products represents an important approach to reducing food waste and obtaining sustainable sources of functional ingredients. Apple and pear pomaces contain valuable phenolic compounds and other bioactive constituents with potential applications in functional foods. The present study aimed to characterize apple and pear pomaces and investigate processing and extraction strategies for the recovery of bioactive compounds.

Materials and Methods. Apple and pear pomaces were processed into stable powders by controlled drying and grinding. Apple pomace from Starkrimson, Idared and Jonagold cultivars was dried under forced convection at 57, 63 and 68 °C, followed by milling and sieving. The powders were characterized for physicochemical properties, total phenolic content (TPC) and antioxidant activity, while individual phenolic and organic acids were determined by HPLC. For pear pomace, ultrasound-assisted extraction with aqueous ethanol was optimized using a Box–Behnken design, considering ethanol concentration, extraction time and ultrasonic power. TPC was determined by the Folin–Ciocalteu method, antioxidant activity by the DPPH assay, and individual phenolic compounds by HPLC. Statistical evaluation included response surface methodology and ANOVA ($p < 0.05$).

Results and Discussions. Apple pomace showed significant differences among cultivars in TPC and antioxidant activity, with Starkrimson presenting the highest values, followed by Jonagold and Idared. For pear pomace powders, TPC ranged from 200.64 to 301.09 mg GAE/100 g dry sample, while antioxidant activity ranged from 0.56 to 0.97 mmol Trolox/100 g, with Abate showing approximately 1.5-fold higher values than Santa Maria. Optimized ultrasound-assisted extraction achieved a TPC of approximately 280 mg GAE/L, with chlorogenic acid, rutin and epicatechin among the predominant phenolic compounds.

Conclusions. The obtained results demonstrate that apple and pear pomaces can be effectively transformed into bioactive-rich powders and phenolic extracts. Controlled drying and assisted extraction represent promising strategies for their valorization as functional ingredients, supporting circular-economy approaches in the food industry.

Keywords: *apple and pear by-products, bioactive compounds, polyphenols, antioxidant activity*

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LAYERED DOUBLE HYDROXIDES FOR ENVIRONMENTAL REMEDIATION

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Introduction. The presence of these xenobiotic compounds in wastewater frameworks poses severe ecological risks due to their complex synthetic structures, recalcitrance to natural degradation, and resistance to standard, conventional treatment methodologies. Furthermore, because these pollutants exhibit high stability under thermal and photolytic conditions, they significantly inhibit photosynthetic activity within aquatic ecosystems and display documented cytotoxicity toward microecology.

Materials and Methods. To address these challenges, various remediation techniques have been evaluated, including coagulation/flocculation, advanced oxidation processes (AOPs), nanofiltration, and adsorption using diverse solid matrices—such as agricultural waste, activated carbons, and surfactant-modified clays. Among these methodologies, adsorption is widely considered superior due to its high separation efficiency and the superior quality of the treated effluent, particularly within optimized sorption operations. Within the classification of advanced nano-adsorbents, layered double hydroxides (LDHs) have emerged as highly efficient waste scavengers for organic and inorganic pollutants. The utilization of LDHs for dye immobilization represents a facile, cost-effective, and scalable approach for effluent decontamination prior to environmental release. This endothermic or exothermic mass transfer process is governed by operating parameters such as contact time, initial adsorbate concentration, solution pH, and system temperature. Recent investigations indicate that LDHs are highly effective for the reticulation of organic anions. This performance is attributed to their tunable layered structure and key physicochemical properties, including high specific surface area, controlled pore size distribution, and thermal and mechanical stability—all of which can be enhanced via structurally engineered processing to function as specialized nanofilters. The primary objective of this research is to evaluate the thermodynamic adsorption capacity of synthesized LDHs toward targeted pollutants and to elucidate the underlying mass transfer mechanisms. This includes assessing the coupled effects of contact time, initial dye concentration, adsorbent dosage, temperature, and competitive inorganic anion interactions. Known alternatively as synthetic anionic clays, LDHs present a unique lamellar topology characterized by a hydrophilic nature, high anion-exchange capacity (AEC), and significant specific surface area. This pristine matrix facilitates the intercalation of bulky organic or inorganic counter-ions (e.g., dyes, pharmaceuticals, pesticides, and polymers) within the brucite-like interlayer spaces, generating advanced organic-inorganic hybrid nanocomposites.

Conclusions. Based on these favorable properties, this study investigates the application of laboratory-synthesized LDHs for the targeted immobilization and retention of persistent organic pollutants (POPs), highlighting the utility of structurally modified LDHs as alternative functional materials for carbon capture and environmental remediation.

Keywords: *layered double hydroxides, anionic clays, adsorption, environmental protection, wastewater treatment*

INFLUENCE OF GRAPE-DERIVED ORGANIC AMENDMENTS ON THE PHYSICOCHEMICAL AND SENSORY CHARACTERISTICS OF RKATSITELI WINE

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Introduction. The recycling of winery residues as organic soil amendments represents a potential approach to improving resource efficiency within a circular bioeconomy. However, information on the effects of grape-derived amendments on Rkatsiteli grape and wine quality under Moldovan vineyard conditions remains limited. This study therefore evaluated the physicochemical and sensory characteristics of Rkatsiteli wine obtained from vines subjected to different organic residue treatments.

Material and Methods. The experiment was conducted in a Rkatsiteli vineyard in the Codru region of the Republic of Moldova during the 2025 growing season. Three treatments were compared: an unamended control (C), direct incorporation of grape seeds (V1), and incorporation of a grape pomace–bovine manure mixture (V2). Five vines from each treatment were individually evaluated for harvested grape mass and berry-juice soluble solids, after which grapes were used to produce one wine batch per treatment. Physico-chemical analyses were performed in triplicate. Wine composition was monitored through apparent refractometric readings, titratable acidity, pH, alcohol content, total extract, and volatile acidity. Sensory quality was assessed by 15 trained professional assessors using eleven criteria, and principal component analysis was applied to the sensory dataset.

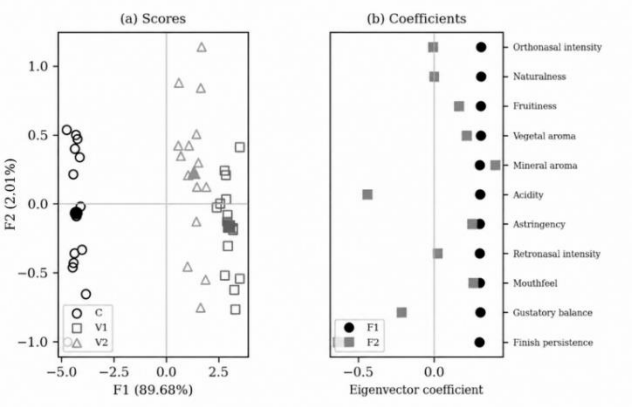

Figure 1. Mean quality scores of sensory analyses PCA interpretation

Results and Discussion. Composite sensory quality indices were 76.01, 91.01, and 87.60 for C, V1, and V2, respectively. PCA showed a clear differentiation of the three sensory profiles, with the first component explaining 89.68% of the standardized variance.

Conclusions. Under the conditions of this single-season exploratory study, grape-seed and grape pomace–bovine manure amendments were associated with differences in the physicochemical and sensory characteristics of Rkatsiteli wine.

Keywords: *circular bioeconomy, organic amendments, grape pomace, wine quality*

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ANTIOXIDANT ACTIVITY IN PLANT AND FOOD MATRICES: THE ROLE OF PHENOLIC COMPOUNDS, PROCESSING AND STORAGE

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Introduction. Antioxidant activity is an important indicator of the functional potential of plant raw materials and food products and is mainly associated with the presence of phenolic compounds and other bioactive substances.

Material and Methods. The aim of this study was to comparatively analyze and integrate the results obtained from several investigations on the antioxidant activity (AA) of different plant and food matrices using the DPPH and ABTS assays, as well as to assess the influence of pretreatment, extraction, fortification, and storage conditions on the stability of bioactive compounds. The studies included hydrophilic and lipophilic extracts obtained from plant by-products, including apple, quince, and grape pomace, jostaberry fruits, pectins, vegetable oils, and food products fortified with polyphenol-rich extracts. The ability of the extracts and products to scavenge DPPH radicals and ABTS radical cations was evaluated, and the results were correlated with total phenolic content (TPC), processing conditions, and storage duration.

Results and Discussion. In jostaberry fruits, AA was significantly influenced by the pretreatment method. For extracts obtained from frozen fruits, DPPH and ABTS antioxidant activity values ranged from 17.60 to 35.26 and from 35.64 to 109.17 mg Trolox equivalents/g dry weight (TE/g DW), respectively. For freeze-dried fruits, the corresponding ranges were 7.50–7.96 and 45.73–82.22 mg TE/g DW, whereas for dried fruits they were 6.31–7.40 and 34.04–52.20 mg TE/g DW, respectively. Extracts obtained by ultrasound-assisted method generally exhibited higher antioxidant activity than those obtained by microwave-assisted extraction. For pectin obtained from apple pomace using non-conventional extraction methods, DPPH scavenging capacity ranged from 4.32 to 18.86 μmol TE/g DW and was influenced by the extraction parameters. The variation in AA was associated with changes in TPC, which ranged from 2.16 to 13.05 mg gallic acid equivalents/g DW (GAE/g DW). Pectin extracted via the ultrasound-assisted method exhibited slightly higher DPPH antioxidant activity compared to that extracted using microwaves. Fortification of grape seed oil with polyphenolic extracts increased DPPH scavenging capacity from 0.003 to 0.580 mmol TE/kg, concomitantly with an increase in TPC up to 141.34 mg GAE/kg. However, after 12 months of storage, AA decreased approximately tenfold, suggesting reduced stability of hydrophilic bioactive compounds in the lipophilic oil matrix during storage. Comparative analysis of the results highlighted the complementary nature of the DPPH and ABTS assays for antioxidant activity assessment, with their responses depending on the nature of the bioactive compounds and the analyzed matrix, as well as on pretreatment and extraction methods, fortification, and storage duration.

Conclusions. The findings demonstrate that processing and storage conditions can substantially affect the antioxidant properties of plant-derived materials and food products.

Keywords: *antioxidant activity, DPPH, ABTS, plant extracts, phenolic compounds, food matrices, bioactive compounds*

Acknowledgments. The research was supported by Institutional Project, subprogram 020405 “Optimizing food processing technologies in the context of the circular bioeconomy and climate change”, Bio-OpTehPAS, being implemented at the Technical University of Moldova.

MODERN STRATEGIES FOR FOOD FRAUD DETECTION: A RISK-BASED APPROACH AND PERSPECTIVES FOR THE REPUBLIC OF MOLDOVA

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Introduction. Food fraud represents a major challenge to food safety, consumer protection, and market integrity and includes adulteration, substitution, falsification of origin, dilution, and misleading labelling. Increasingly complex food supply chains and diversified fraudulent practices require a transition from predominantly reactive controls to proactive, integrated, and risk-based strategies. This paper analyses modern approaches to food fraud detection and prevention and considers their implementation in the Republic of Moldova in comparison with the European Union.

A key component of modern control systems is the Risk-Based Approach (RBA), which prioritises official controls according to the probability of fraud, product vulnerability, operator compliance history, and potential impact on consumers. By directing analytical and inspection resources towards high-risk products and supply chains, RBA improves control efficiency and facilitates earlier detection of non-compliance. In the European Union, this principle is incorporated into the official control framework, particularly through Regulation (EU) 2017/625, and is complemented by cooperation and rapid information-exchange mechanisms.

Modern analytical control combines screening and confirmatory methods. Rapid screening techniques, including sensors, rapid tests, NIR and Raman spectroscopy, allow large numbers of samples to be evaluated efficiently. Suspected samples are subsequently examined using confirmatory methods such as GC-MS, LC-MS, NMR, PCR, DNA sequencing, and isotope analysis. This creates an integrated analytical sequence of "screening – suspicion – confirmation" and supports evidence-based official decisions.

Food fraud prevention also depends on authenticity, integrity, and traceability. Authenticity verifies correspondence between declared and actual product characteristics, integrity reflects the absence of intentional manipulation, while traceability enables products and ingredients to be followed throughout the supply chain. Food profiling or fingerprinting further strengthens authentication by comparing chemical, isotopic, spectroscopic, genetic, or chemometric characteristics with reference profiles of authentic products. This approach is particularly relevant to fraud-prone commodities such as wine, honey, vegetable oils, dairy products, and meat.

Conclusions. The European Union has developed an integrated and preventive system supported by advanced analytical infrastructure, databases, digital traceability, and cross-border cooperation. The Republic of Moldova is progressing towards harmonisation with these principles, but further development is needed in risk-based control, digital traceability, food profiling, and access to advanced confirmatory techniques. Strengthening laboratory capacities, creating national authenticity databases, introducing systematic fraud vulnerability assessments, and expanding digital tools could support the transition towards a preventive and predictive control model, enhance consumer protection, and improve the competitiveness of Moldovan food products.

Keywords: *food fraud, authenticity, food integrity, traceability, risk-based approach, screening*

Acknowledgments. The research was conducted within the institutional project, subprogramme 020405, "Optimisation of Food Processing Technologies in the Context of the Circular Bioeconomy and Climate Change", Bio-OpTehPAS, implemented at the Technical University of Moldova.

ADSORPTION AND CATALYTIC OZONATION OF METHYLPREDNISOLONE ON STARCH-MODIFIED MONTMORILLONITE KSF

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Introduction. Methylprednisolone (MP), a synthetic glucocorticoid widely used in clinical practice, may reach aquatic environments through incomplete removal in conventional wastewater-treatment systems.

Material and Methods. This study investigates a starch-modified montmorillonite KSF (MMT-KSF) composite as a renewable hybrid adsorbent and catalytic support for MP removal from aqueous solutions. The effects of contact time, solution pH, initial concentration, composite dosage, temperature and agitation rate were examined. Adsorption kinetics were interpreted using pseudo-first-order, pseudo-second-order and intraparticle-diffusion models, while equilibrium data were assessed through the Langmuir, Freundlich and Temkin isotherms. Thermodynamic parameters were estimated from temperature-dependent distribution data, and catalytic ozonation was compared with adsorption and ozonation alone.

Results and Discussion. MP uptake increased from 0.25 mg g^{-1} after 2 min to 12.3 mg g^{-1} at 120 min and remained close to this value at 180 min (12.1 mg g^{-1}), indicating that operational equilibrium was reached after approximately 120 min. Alkaline conditions favored retention, with an optimum near pH 9.5 corresponding to 10.8 mg g^{-1}, while increasing agitation improved external mass transfer, with 300 rpm yielding 11.4 mg g^{-1}.

By contrast, ozonation alone removed only 9 to 11 % of MP over 5 to 180 min, which shows the limited effectiveness of the uncatalyzed oxidation stage and supports the use of the composite-assisted process.

Conclusions. The starch-modified MMT-KSF composite therefore offers a promising low-cost platform for coupling adsorption with catalytic oxidation. Further work should quantify mineralization and transformation products and assess catalyst reuse and performance in real water matrices.

Keywords: *methylprednisolone, montmorillonite KSF, starch composite, adsorption, catalytic ozonation, water treatment.*

USING ULTRASONIC TECHNOLOGY TO ACCELERATE THE EXTRACTION OF 7-DEHYDROCHOLESTEROL FROM SALMON SKIN

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Introduction. Secondary raw materials from Atlantic salmon (Salmo salar) processing, particularly skin, are a valuable source of endogenous provitamin D_3, 7-dehydrocholesterol (7-DHC) [1]. Increasing the yield of 7-DHC in the solvent before photochemical isomerization can increase the final concentration of synthesized cholecalciferol (vitamin D_3) [2]. The aim of this study was to investigate the effect of ultrasonic treatment duration on the dynamics and efficiency of 7-DHC extraction from raw salmon skin into ethanol and determine the optimal process conditions.

Material and Methods. Raw Atlantic salmon (Salmo salar) skin was used as the study object. Provitamin D_3 was extracted with 95% ethanol. To intensify extraction, an ultrasonic bath (80 W, 30°C) was used for 5, 10, 20, 30, and 40 min. Extract without ultrasonic treatment served as the control. The yield and dynamics of 7-DHC extraction were assessed spectrophotometrically using characteristic absorption maxima in the UV range (270–295 nm).

Results and Discussion. Traditional 60-min extraction without ultrasonic treatment yielded 740 μg of 7-DHC per 100 g of raw material. Ultrasonic cavitation increased extraction efficiency due to mechanical disruption of the lipid-protein matrix and accelerated mass transfer. After 5 min, the yield was 480 μg/100 g (−35% vs. control), increasing to 715 μg/100 g (−3%) after 10 min and 970 μg/100 g (+31%) after 20 min. The maximum yield, 1230 μg/100 g (+66%), was obtained after 30 min. Increasing treatment to 40 min decreased the yield to 1080 μg/100 g and distorted the characteristic UV absorption profile. Prolonged cavitation may intensify sonochemical processes, including free-radical formation and localized microthermal effects, promoting oxidative degradation and secondary isomerization of the chemically unstable conjugated diene system of 7-DHC.

Conclusions. Ultrasonic treatment (80 W, 30°C) significantly intensifies 7-DHC extraction from salmon skin and has a defined time optimum. A 30-min treatment provides the maximum yield (1230 μg/100 g) and is the optimal duration for obtaining an extract suitable for subsequent photochemical vitamin D_3 synthesis. Further treatment is not advisable due to possible sonolytic and oxidative degradation of the provitamin.

Keywords: *bioactive compounds, fish processing by-products, physical processing methods, ultrasound treatment, ultraviolet treatment, vitamin D_3*

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EFFECT OF QUINCE POMACE PRETREATMENT ON THE PROPERTIES OF EXTRACTED PECTIN

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Introduction. Cydonia oblonga Mill. remains relatively underexplored despite the high nutritional and bioactive potential of quince fruits and their by-products. Compared with apples, quince fruits contain higher levels of dietary fiber, protein, phenolic acids, carbohydrates, vitamins, and minerals, while having a lower water content. Quince pomace, in particular, represents an excellent source of dietary fiber and valuable polysaccharides.

Material and Methods. The aim of this study was to evaluate the effect of hydroethanolic–aqueous pretreatment of quince pomace on the equivalent weight (EW), anhydrogalacturonic acid (AUA) content, degree of esterification (DE), total phenolic content (TPC), and antioxidant activity (AA) of pectin extracted under conventional conditions. Pectin was extracted from native quince pomace (cv. Bereczki) and from pomace subjected to hydroethanolic–aqueous pretreatment. The pretreatment consisted of maceration in 75% (v/v) ethanol for 24 h, followed by heating at 70 °C for 3 h. The mixture was then centrifuged, and the sediment was suspended in distilled water for 24 h, filtered, and dried. Pectin extraction was performed using citric acid at pH 1.5, 80 °C, for 3 h. The structural characteristics of the extracted pectin samples were determined by titrimetric methods, while TPC was assessed using the Folin–Ciocalteu method and AA by the DPPH radical-scavenging assay.

Results and Discussion. Statistical analysis revealed significant differences ($p < 0.05$) between pectin obtained from native and pretreated quince pomace. Pretreatment significantly decreased pectin yield (12.2 vs. 8.1%), EW (461.2 vs. 388.7 g/mol), DE (53.98 vs. 38.74%), TPC (6.30 vs. 4.25 mg GAE/g DW), and DPPH radical-scavenging capacity (7.95 vs. 6.12 μmol TE/g DW). In contrast, the AUA content increased from 73.89 to 82.98%, indicating a higher degree of pectin purity after pretreatment. A strong correlation between AA and TPC was observed for pectin extracted from native pomace ($R^2 = 0.9699$), whereas a weaker, although still substantial, correlation was found for pectin obtained from pretreated pomace ($R^2 = 0.7916$). In conclusion, hydroethanolic–aqueous pretreatment modified the quince pomace matrix, increasing the accessibility of cell-wall components to the acidic extraction medium and suggesting enhanced depolymerization and de-esterification of pectin, as reflected by the increased AUA content and reduced EW and DE. Although pretreatment enhanced the apparent purity of the extracted pectin, it significantly reduced extraction yield, phenolic content, and, consequently, antioxidant activity.

Conclusions. These findings demonstrate that pretreatment conditions strongly influence both the structural characteristics and bioactive properties of quince pomace-derived pectin.

Keywords: *anhydrogalacturonic acid content, antioxidant activity, degree of esterification, equivalent weight, yield*

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YEAST-MEDIATED BIOSYNTHESIS OF COPPER NANOPARTICLES AS A PROMISING APPROACH FOR APPLICATION IN FOOD TECHNOLOGIES

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Introduction. Nanotechnology is one of the promising areas in the development of the modern food industry, particularly for the development of materials with antimicrobial and antioxidant properties. In this context, copper nanoparticles (CuNPs) have the potential to be incorporated into functional food packaging materials and coatings for food-contact surfaces, as well as into systems aimed at enhancing the microbiological safety of food products. At the same time, the development of environmentally friendly methods for the synthesis of CuNPs remains an important research challenge.

Material and Methods. The biomass of Saccharomyces cerevisiae M437 was produced by batch cultivation in yeast extract-peptone-dextrose medium and subsequently used for the preparation of a cell-free aqueous yeast extract employed in the biosynthesis of CuNPs. Copper sulfate anhydrous was used as a source of copper ions. The biosynthesis of CuNPs was carried out at temperatures of 30, 35, 40, 45, and 50 °C.

Results and Discussion. The formation of CuNPs was confirmed under all conditions investigated. The UV spectra of the synthesized samples have shown characteristic absorption in the range of 230-300 nm, with a maximum at approximately 260 nm. Variation in the copper sulfate concentration within the range of 1-3 mM did not result in significant changes in absorption intensity, indicating that the studied biosynthetic approach can be applied over this range of precursor concentrations.

Temperature was found to be one of the key parameters affecting the size of the resulting CuNPs. After 24 h of biosynthesis, the average hydrodynamic diameter of the nanoparticles ranged from 129,6 to 200,3 nm. Increasing the temperature from 30 to 50 °C resulted in an approximately 54.6% increase in their average size, indicating a substantial effect of this parameter on the processes of CuNPs formation and growth.

Further extension of the biosynthesis process to 72 h was accompanied by an increase in nanoparticle size. At the same time, the polydispersity index values remained within the range of 0,17-0,26, characterizing the resulting systems as relatively homogeneous in terms of particle size distribution. The zeta potential of the synthesized CuNPs was negative, ranging from −9,25 to −12,4 mV, and was not significantly affected by the process temperature.

Conclusions. Thus, controlling the temperature of biosynthesis makes it possible to regulate the size of CuNPs and, consequently, provides opportunities for further optimization of their characteristics depending on the intended application. A promising direction for further research is investigation of the antimicrobial activity of the obtained CuNPs against microorganisms contaminating food, raw materials and products, as well as assessment of their potential application in nanocomposite packaging materials and functional coatings.

Keywords: *copper nanoparticles, biosynthesis, yeast, Saccharomyces cerevisiae*

DEVELOPMENT OF A WET DOG FOOD FORMULA

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Introduction. The modern dog food market is characterized by increasing requirements for nutritional value, safety, and technological quality. The production of wet food in the form of sausage-type products is a promising direction, combining convenience of use, attractive organoleptic properties, and the possibility of utilizing various meat raw materials. The aim of this study is to substantiate formulation and technological solutions for producing a balanced, safe, and stable wet dog food in the form of sausage-type products.

Material and Methods. The study was conducted considering the possibility of using meat raw materials, by-products, and returned meat products generated at HAVRYLIVKA LLC. The material balance of raw materials and finished products, as well as the monthly volumes of waste and returned products from retail outlets, were analyzed. During formulation development, the nutritional value of protein and fat components, the technological properties of raw materials, and the need to ensure the homogeneity, water-holding capacity, and fat-holding capacity of the meat batter were taken into account. The quality of the finished feed was assessed based on moisture, protein, fat, and ash content, water activity, acidity, consistency, structural stability, microbiological parameters, and safety.

Results and Discussion. Based on an analysis of the enterprise's raw material resources, the use of returned meat products and secondary meat raw materials was proposed to expand the product range and implement resource-efficient production principles. The developed wet dog food formulation in sausage form includes pork skin, by-products, poultry and pork meat, starch, corn grits, nitrite salt, and a spice-aromatic mixture. Unpackaged pork skin 15.0–17.0, By-products 40.0–42.0, Poultry and pork meat (returned products) 22.0–25.0, Nitrite salt 0.3–0.4, Starch 5.5–6.3, Corn grits 8.0–8.5, Spice-aromatic mixture "Ham Flavor" 1.0–1.6. When developing the formulation, it is important to ensure not only an appropriate level of protein and energy but also a balanced amino acid profile, lipid-phase stability, and technological compatibility of the ingredients. Starch and corn grits contribute to the formation of the product's consistency and moisture retention, while meat components provide the main share of animal protein. Preliminary laboratory studies indicate that the developed sausage-type products may be classified within the economy and mid-range segments of the dog food market. Important quality indicators include the content of major nutrients, water activity, acidity, consistency, and water- and fat-holding capacity. These characteristics determine product stability during storage and help prevent the separation of broth or fat. Particular attention should also be paid to the microbiological safety of the finished feed.

Conclusions. The development of wet dog food in the form of sausage-type products is a promising approach to expanding the product range and rationally utilizing meat raw materials and returned products. The proposed formulation, based on by-products, meat raw materials, and structuring components, creates the prerequisites for producing an affordable feed with appropriate technological properties. Further research should focus on optimizing formulations for different age groups and physiological categories of dogs, improving nutritional quality, incorporating functional ingredients and natural antioxidants, and implementing quality and safety control systems at all stages of production.

Keywords: *formula, nutritional value, quality, wet food, dogs*

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UTILIZATION OF THE FETEASCĂ NEAGRĂ GRAPE VARIETY IN RED WINE PRODUCTION

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Introduction. Fetească Neagră is an indigenous grape variety used to produce red wines and has been known since medieval times. The quality of the wine produced from this variety depends on several factors, such as terroir, climatic conditions, viticultural practices, and production technology. While some factors cannot be controlled, modifying the production process offers a valuable opportunity to leverage and enhance the variety's potential to achieve remarkable results.

Material and Methods. Several red wine production methods exist, each with its own advantages and disadvantages. A novel technology for producing premium red wines–incorporating both established and innovative elements–was developed at the Department of Oenology and Chemistry at UTM. This technology was employed during the 2025 winemaking season at the Javgur winery to produce red wines from the Fetească Neagră grape variety. The young wine is produced from grapes harvested at technological maturity according to the established method.

Fresh, un-destemmed crushed grapes–harvested at phenolic maturity and containing a sugar content that ensures an alcohol level of 13–15.5% vol. in the finished wine–are obtained and mixed with young wine. The resulting mixture (young wine and fresh crushed grapes) undergoes maceration during alcoholic fermentation and is then held for at least 10 days–concurrently with malolactic fermentation–before being drained and pressed.

Results and Discussion. The wine produced using this proposed method features a balanced physicochemical composition, with an alcohol concentration of 13–15.5% vol., an extract content exceeding 30 g/dm³ (including phenolic substances in the range of 1.7–3.3 g/dm³), a titratable acidity of 4–6 g/dm³, and an anthocyanin concentration of 360–430 mg/dm³.

Elevated concentrations of protective phenolic substances (antioxidants) were detected in the experimental wines. These include flavanols (quercetin: 1.8–4.5 g/dm³), non-flavanols (gallic acid: 7.5–8.5 mg/dm³), and resveratrol (4.5–6.2 mg/dm³), thereby confirming the enhanced therapeutic properties of the produced wines.

Keywords: *utilization, crushing, fermentation, anthocyanins, flavanols*

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GREEN SYNTHESIS OF HIGH-AMYLOSE STARCH NANOPARTICLES VIA CONTROLLED ENZYMATIC HYDROLYSIS AND ACOUSTIC CAVITATION

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Introduction. Starch nanoparticles (SNPs) have emerged as a premium, 100 % bio-based alternative to synthetic nanomaterials in high-growth industries. However, traditional top-down chemical synthesis relies on hazardous, highly concentrated inorganic acids, generating environmental risks and toxic waste. This technology offers a sustainable, zero-acid alternative. By combining precise enzymatic endo-hydrolysis with high-intensity acoustic cavitation, we successfully deconstruct rigid high-amylose maize starch granules and reassemble them into highly uniform nanoparticles. The resulting material serves as a superior reinforcing filler for biodegradable food packaging, a biocompatible carrier for drug delivery, and an eco-friendly stabilizer for Pickering emulsions.

Materials and Methods. Raw Materials: high-amylose maize starch (amylose content ⩾ 50 %), bacterial α-amylase (endo-1,4-α)-D-glucan glucanohydrolase), 0.1 M phosphate buffer (suspension in buffer is autoclaved at 120 ° C for 20 – 30 min to completely dismantle the rigid native crystalline structure. Enzymatic hydrolysis: the paste is incubated with α-amylase (2–5 U/g of starch pH 6.0–6.5), and absolute ethanol (99.8 %). For hydrothermal gelatinization: a 2 % (w/v) starch) at 60°C. Ultrasound-Assisted Precipitation: the warm hydrolysate is fed dropwise into ice-cold absolute ethanol (1:3 ratio) under continuous 300 W pulse ultrasonication (80 % amplitude) to force self-assembly and suppress macro-aggregation. The suspension is centrifuged at 10,000 RPM for 15 min, washed with water and ethanol, shock-frozen at -80°C, and vacuum-dried via lyophilization for 24 hours.

Results and Discussion. In-process hydrolysis control was monitored by colorimetric iodine testing acts as a critical gatekeeper. A stable violet/red-purple hue marks the ideal stop point. A shift to brown/yellow indicates over-hydrolysis into low-molecular dextrins, triggering batch rejection. Particle size and distribution measured Dynamic Light Scattering (DLS) confirms an average hydrodynamic diameter (Dh) of 20–60 nm with a narrow Polydispersity Index (PDI 0.3), proving high size uniformity. Colloidal Stability & Morphology were studied by the Zeta Potential ranges between -10 mV and -25 mV, ensuring robust electrostatic repulsion. Electron microscopy (TEM/AFM) reveals distinct, isolated spherical nanoparticles. Crystalline polymorphism were installing by X-ray Diffraction (XRD) shows a complete transition from the native A-type to a highly functional V-type crystalline lattice which guarantees superior barrier and encapsulation properties.

Conclusion. The bioprocess is Efficient. Scaling the protocol to 100 g of raw starch input yields 45.0 – 65.0 g of premium dry SNP powder. The calculated 35 – 55 % mass reduction represents the necessary removal of water-soluble sugars to eliminate product stickiness.

Green Chemistry Compliance: the process uses non-toxic biological catalysts instead of harsh acids, and the absolute ethanol anti-solvent can be efficiently recovered up to 92 – 95 % via closed-loop distillation for industrial reuse. This validated laboratory SOP provides excellent batch-to-batch reproducibility and serves as a solid technological foundation for pilot-scale scale-up.

Keywords: *high-amylose maize starch, starch nanoparticles (SNPs), bacterial alpha-amylase, ultrasonic cavitation, anti-solvent precipitation, V-type crystallinity, green chemistry.*

BIOLOGICAL ACTIVITY OF EXTRACTS FROM THE INNER MEMBRANE OF PEACH STONES

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Introduction. The term ‘extract’ is generally used to refer to the extraction of medicinal substances from plants using solvents (alcohol, water, ether, glycerine and mixtures thereof). Most often, an extract has a high concentration of active ingredients and is free from sediment. Depending on the type of solvent used, extracts can be aqueous, alcoholic, aqueous-alcoholic or ether-based.

Material and Methods. Preparation of an aqueous extract from the kernels of Cardinal peaches, harvested in 2021.

Results and Discussion. The process consists of the following stages: the prepared water from the tank and the crushed material from the hopper are fed into a mixer, where they are mixed for 20 minutes. The mixed mass is then pumped into a tank, where the aqueous extract is left to infuse for 24 hours at a temperature of 20 °C. After infusion, the aqueous extract is pumped through a filter. The filtered aqueous extract is transferred to a tank for the finished extract.

The aqueous extract is subsequently used in the manufacture of cosmetic products or is filled, packaged, labelled and sent to the warehouse for storage.

Using the technology developed under laboratory conditions at the Department of Milk, Oil and Fat Products and the Beauty Industry, an aqueous extract was obtained from the pulp of peach stone kernels. Alcoholic and hydroalcoholic extracts were prepared using a similar method (the volume fraction of alcohol in the hydroalcoholic extract was 50 per cent).

The next stage involved determining the physiological effect of the extracts obtained based on their biological activity. This indicator is widely used to analyse food products that possess health-promoting, therapeutic or preventative properties. The aim of this study was to demonstrate that the developed aqueous, alcoholic and aqueous-alcoholic extracts based on the pulp of peach stones possess high biological activity due to their high antioxidant content.

All extracts obtained in the laboratory from peach kernels and stones exhibit high biological activity, ranging between 10,000 units of activity per sample, as the rate of electron transfer in the $NAD \cdot H_2$–$K_3Fe(CN)_6$ system increases significantly in their presence, indicating the presence of antioxidant activity. The aqueous extract exhibits the highest biological activity – 125,000 units of activity – which exceeds the corresponding values for the alcoholic and aqueous-alcoholic extracts by 23.8 per cent and 8.3 per cent, respectively.

Conclusions. Based on biochemical analysis and data from the literature, it has been established that the extracts obtained using the proposed method exhibit a fairly high level of antioxidant activity.

Keywords: *extracts: aqueous, alcoholic, aqueous-alcoholic, technology.*

ALTERNATIVE MEDIA FOR UREASE-PRODUCING BACTERIA IN BIOCEMENTATION

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Introduction. Microbially induced calcium carbonate precipitation (MICP) is a promising approach to biocementation; however, its application is limited by the high cost of cultivating urease-producing bacteria, particularly due to nutrient media components. Therefore, readily available plant-based and industrial by-products may help reduce biomass production costs while maintaining functional activity.

Materials and Methods. A comparative analysis was performed using the results of our previous study on the cultivation of Bacillus sp. VUK5 in soybean meal acid hydrolysate, TSB, and yeast extract-based medium [1], together with data from recent studies investigating the replacement of conventional nitrogen sources in media for Sporosarcina pasteurii [2, 3].

Results and Discussion. In our study, soybean meal acid hydrolysate supported the accumulation of more than 5 g/L dry biomass by Bacillus sp. VUK5 and a urease activity of 423.44 μM urea/min after 72 h of cultivation, whereas tryptic soy broth resulted in approximately 4.5 g/L biomass and 200 μM urea/min, respectively. The yeast extract-based medium provided only approximately 2.2 g/L biomass and lower urease activity [1]. For S. pasteurii ATCC11859, partial replacement of soybean peptone with the less expensive corn steep liquor reduced the medium cost by 50.5% while increasing urease activity by 24.2% [2]. In a study of industrial nitrogen sources, S. pasteurii ATCC 11859 BNCC 337394 showed a urease activity of 27.75 U in the control medium containing 20 g/L pure yeast extract, while partial replacement with 5 g/L yeast extract and 10 g/L industrial yeast extract resulted in 22.2 U, corresponding to approximately 80% of the control activity [3].

Conclusions. The use of plant-derived raw materials and industrial alternative nitrogen sources is a promising approach for the production of urease-producing biomass. The analyzed studies demonstrate that replacing conventional medium components does not necessarily reduce functional efficiency and may simultaneously decrease cultivation costs while maintaining MICP performance.

Keywords: *biocementation, CaCO3, Sporosarcina pasteurii, urease activity, nitrogen sources*

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VALORIZATION OF BREWING INDUSTRY WASTE WITHIN THE CIRCULAR ECONOMY FRAMEWORK

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Introduction. The global brewing industry produces approximately 1.86 billion hectoliters of beer annually, generating substantial quantities of organic waste that present severe environmental challenges and economic burdens. Traditional disposal routes, such as direct land application or low-value animal feed, fail to capitalize on the rich chemical potential of these byproducts. Transitioning toward advanced valorization strategies is critical to support circular economy principles, reduce industrial carbon footprints, and convert low-cost waste streams into high-value bioproducts.

Material and Methods. This study evaluates the chemical profile and processing methodologies for the primary waste streams of beer production: Brewers' Spent Grain (BSG), Brewers' Spent Yeast (BSY), spent hops, and pot ale. Characterization methods focused on analyzing structural polysaccharides (cellulose, hemicellulose), functional proteins, beta-glucans, and bioactive polyphenols. Methodological transformation approaches were categorized into four main pathways: biotechnological bioconversion using microbial fermentations, thermochemical and anaerobic digestion energy recovery, bio-extraction of pharmaceutical-grade compounds, and industrial carbon capture technologies for fermentation-derived CO_2.

Results and Discussion. Biotechnological conversion demonstrated that BSG and BSY serve as viable low-cost substrates for producing high-value enzymes, organic acids (lactic and citric), and functional food ingredients such as xylitol and pullulan. Energy recovery investigations confirmed that processing spent grain via thermochemical routes yields effective solid biofuels, while anaerobic digestion of liquid pot ale generates high-yield biogas suitable for on-site thermal energy. Furthermore, bioactive extraction isolated xanthohumol from spent hops, exhibiting potent antimicrobial properties, while modified BSG proved effective as a low-cost bio-adsorbent for heavy metal removal in wastewater treatment. Finally, integrated CO_2 capture and purification systems successfully recovered fermentation gas for beverage carbonation, significantly lowering overall facility emissions.

Conclusions. Valorizing brewery byproducts through an integrated biorefinery approach transforms environmental liabilities into sustainable economic opportunities. Combining bioconversion, energy recovery, bioactive extraction, and carbon reuse provides a comprehensive framework to enhance resource efficiency and minimize the ecological footprint of global beer manufacturing.

Keywords: *brewers' spent grain, valorization, biotechnology, sustainability, waste management*

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NATURAL AND MODIFIED CLAY MATERIALS FOR FOOD INDUSTRY WASTEWATER TREATMENT

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Introduction. Food industry wastewater commonly contains complex mixtures of organic matter, fats and oils, dyes, phenolic compounds, nutrients and, in some cases, heavy metals. The treatment of these effluents requires efficient and adaptable technologies able to operate under variable wastewater composition.

Material and Methods. This study reviews the potential of natural clay minerals and clay-derived materials for the removal of pollutants characteristic of food industry wastewater [1,2]. Particular attention is given to smectites and montmorillonite-based materials, including acid-activated clays, organoclays, aluminium-intercalated or pillared clays, and layered double hydroxides.

Results and Discussion. The analysis highlights that the adsorption performance of clay-based materials is governed by mineral structure, specific surface area, porosity, ion-exchange capacity, surface charge and the nature of the pollutant. Natural montmorillonite-type clays are particularly relevant for the retention of metal cations, cationic dyes and selected phenolic compounds through ion exchange, surface complexation, pore diffusion and non-specific intermolecular interactions [1,2]. Chemical modification by acid activation, organophilization, intercalation or pillaring can tailor the textural and surface properties of clays, increase the accessibility of adsorption sites and extend their applicability towards a broader range of organic and inorganic contaminants. Layered double hydroxides provide complementary performance for anionic pollutants, such as phosphates, nitrates and anionic dyes, due to their positively charged layers and anion-exchange ability.

Operational conditions, especially pH, sorbent dose, contact time, ionic strength and competing species, remain critical for adsorption efficiency.

Conclusions. Overall, clay-based materials represent promising low-cost and modifiable adsorbents for food industry wastewater treatment. Further investigations should focus on regeneration, long-term stability, performance in real multicomponent effluents and techno-economic assessment at pilot and industrial scale.

Keywords: *adsorption, aluminium-intercalated clays, food processing effluents, layered double hydroxides, montmorillonite, sustainable remediation*

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PESTICIDE RESIDUES IN PLANT-BASED FOODS: SOURCES AND CONTROL

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Introduction. Modern agricultural production relies heavily on chemical plant protection products to secure crop yields and prevent post-harvest losses. However, the pervasive occurrence of pesticide residues in food commodities presents a critical challenge for public health and environmental integrity. Agrochemicals enter edible crops through direct foliar application, root uptake from soil, and environmental cross-contamination via spray drift, runoff, and contaminated irrigation water. The accumulation and persistence of these xenobiotics in food crops are governed by high chemical stability, systemic plant translocation, and repeated applications, as well as the long-term persistence of legacy organochlorine contaminants whose soil dissipation half-lives span from 980 to 6200 days [1].

Results and Discussion. Through the systematic synthesis of empirical monitoring data across European agricultural systems, substantial disparities in residue prevalence have been established between conventional and organic farming frameworks. Conventional crop samples show higher detection frequencies (41.0%–85.7%) with complex mixtures of up to 18 compounds, whereas organic commodities exhibit lower detection rates (13.7%–40.0%) restricted to 1–5 substances. Total residue burdens in conventional crops exceed those of organic produce by over an order of magnitude, with median total concentrations spanning 2.7–46.4 μg/kg and peak levels reaching 228–951 μg/kg [1]. Regulatory evaluations across European markets indicate overall Maximum Residue Level exceedance rates ranging from 3.7% to 3.9% in general monitoring programs, rising up to 10.3% for imported commodities, whereas harvest-level field surveys report localized exceedance intervals of 5.3%–12.2% [1].

Conclusions. The primary health risks linked to chronic dietary ingestion involve pesticide-induced oxidative stress, cholinesterase inhibition, cellular cytotoxicity, and endocrine disruption, contributing to neurodevelopmental disorders, hepatotoxicity, and carcinogenesis. Resolving this global issue requires transitioning toward Integrated Pest Management, precision agriculture with smart sprayers, biopesticides, green post-harvest treatments, and mandatory professional certification for agrochemical application. Continuous monitoring and standardized regulation remain essential for global food security.

Keywords: *bioaccumulation, dietary exposure, health risk assessment, integrated pest management, organic agriculture*

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PHYSICOCHEMICAL PROPERTIES OF PLANT PROTEINS ISOLATED BY WET, DRY, AND FERMENTATIVE METHODS

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Introduction. Pea (Pisum sativum L.) is a high-protein legume crop in Moldova with a well-balanced amino acid profile, relevant as a model for plant protein valorisation from oilseed meals. Protein purity, yield, color, and odor are critically dependent on extraction strategy and govern suitability for functional food applications.

Materials and Methods. Yellow pea flour (21.8% protein, 3.1% fat, 1.87% ash, 7.5% moisture; 180-190 μm) served as a unified raw material. The wet alkaline extraction (WE), involved alkaline extraction (pH 9.0, 35-40°C, 1:10 w/v), isoelectric precipitation (pH 4.5, lactic acid), and freeze-drying. The dry fractionation (DE) was performed by solvent-free air-classification milling. The microorganism-assisted fermentation (MF) comprised lactic-acid fermentation (Lactobacillus spp., 10^6–10^8 CFU/mL, 30-37°C, 10-20 h, pH 4.0-5.0) before alkaline extraction under identical WE conditions. Proximate composition (Kjeldahl N×6.25; Soxhlet; AOAC) was determined in triplicate. Color (CIE L*, a*, b*, C*, YI) was assessed by colorimetry.

Results and Discussion. The three methods yielded preparations with markedly different compositional and color profiles. WE produced the highest-purity isolate (97.8% protein; fat 0.45%; ash 0.51%) with virtually no off-odor, positioning it as a premium functional ingredient, albeit at the lowest protein recovery (30.1%). DE delivered a 79.7% protein concentrate at the highest yield (∼40.4%; fat 1.15%; ash 1.44%), offering a favorable industrial mass balance without aqueous processing. MF yielded the lowest-purity concentrate (55.9%; recovery ∼12%) due to partial protein hydrolysis during fermentation, yet holds promise as a platform for targeted biomodification. Regarding color, WE and DE showed comparable lightness (L* ≈ 47.8), whereas MF was markedly darker (L* = 37.3), attributable to Maillard-type reactions. YI was highest for MF (117.6) and lowest for WE (97.7; C* = 32.9), consistent with partial pigment degradation under alkaline conditions – making WE the most color-neutral product, critical for light-colored food matrices.

Conclusions. The extraction method decisively shaped the pea protein physicochemical profile. WE delivered superior purity (97.8%), favorable color, and minimal odor – a premium isolate for emulsified and white-matrix food applications. DE offered the highest yield (40.4%) with industrial scalability. MF warrants further optimisation to exploit its biomodification potential. These findings provide a comparative framework for extraction method selection in plant protein valorisation from pea.

Keywords: *color parameters, extraction, pea protein isolate, proximate composition, yield*

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RESISTANT STARCH AS A PROTECTIVE MATRIX FOR UNSTABLE BIOACTIVE COMPOUNDS

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Introduction. The use of bioactive compounds (BAC) in food products is limited by their low stability during storage and processing, lability in the gastrointestinal tract, etc. A promising method is the immobilization of BAC in polysaccharide matrices capable of protecting them and regulating their release. Resistant starch (RS) may be promising for such systems due to its resistance to enzymatic hydrolysis.

The aim of the study is to analyze the potential use of RS for the stabilization and controlled delivery of BAC and to determine the key mechanisms of their interaction with the starch matrix.

Results and Discussion. The effectiveness of resistant starch (RS) as a carrier for bioactive compounds (BAC) has been confirmed by a number of studies. Noor et al. demonstrated that RS nanoparticles derived from lotus stems stabilize pickering emulsions containing ferulic acid. Encapsulation efficiency was 30.09%, 63.98%, and 52.23% at ferulic acid concentrations of 2%, 10%, and 20%, respectively, with the use of 20% ferulic acid ensuring the sustained release of BAC [1]. Patel et al. established that RS, in a combined matrix with maltodextrin and whey protein isolate, ensures effective microencapsulation of curcumin (82.42%), enhances its thermal stability, and helps preserve its antioxidant activity [2]. Shang et al. demonstrated that high-amylose starch forms V-type complexes with flavonoids, in which BAC are incorporated into the hydrophobic cavity of amylose, which provides protection against thermal degradation [3]. Therefore, the protective effect of RS is realized through the physical retention of biologically active substances in the matrix or molecular complexation with amylose, which contributes to increased stability and controlled release of BAC.

Conclusion. RS is a promising component of stabilization and delivery systems for BAC. Experimental data confirm its ability to physically retain BAC, enhance their stability, and facilitate controlled release.

Keywords: *bioactive compounds, resistant starch, stabilization, immobilization*

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EFFICIENCY OF MICROORGANISM CELL DISRUPTION IN BEAD MILLS

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Introduction. Extracting valuable components from unicellular organisms sometimes requires cell disruption using bead mills. The productivity of cell processing can depend on the parameters of the milling medium, specifically the concentrations of the cell suspension and the beads.

Materials and Methods. Pressed yeast Saccharomyces cerevisiae was used as the model microorganism. Yeast cell disruption was performed in a vertical bead mill equipped with disk-type grinding elements. The degree of cell disruption was assessed via microscopic analysis.

Results and Discussion. The study investigated the influence of the volumetric ratio of yeast suspension to beads and the concentration of yeast cells in the suspension on the productivity of the disruption process in the bead mill. A non-linear relationship was established between both factors and cell disruption productivity. As the yeast cell concentration in the suspension increased from 20% to 35–45%, disruption productivity rose from 0.05 to 0.28 g/s. A further increase in yeast cell concentration to 55% resulted in a decrease in disruption productivity. Increasing the volumetric ratio of yeast suspension to beads from 0.2 to 0.3 led to a slight increase in cell disruption productivity. Peak disruption productivity values – from 0.18 to 0.28 g/s were observed at a ratio of approximately 0.3. A further increase in the volumetric ratio of suspension to beads to 0.92 reduced the cell disruption rate to 0.05–0.15 g/s, with higher rates observed at higher yeast cell concentrations in the suspension. The maximum cell disruption rate was 0.28 g/s, achieved at a suspension-to-bead volumetric ratio of 0.32 and a yeast cell concentration of 44%. These observed dependencies can be explained by a decrease in the frequency of bead-cell contacts at high volumetric ratios of yeast suspension to beads, as well as an increase in suspension viscosity at high yeast cell concentrations, which affects bead movement dynamics.

Conclusion. The results obtained are significant for selecting operating parameters for bead mills and enhancing the productivity of the microorganism cell disruption process.

Keywords: *bead mill, beads, cell, disruption, yeast.*

SEA BUCKTHORN POMACE AS A SOURCE OF POLYSACCHARIDES

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Introduction. Hippophae rhamnoides L. (sea buckthorn), is originally from China and is used by humans for medicinal and edible properties; its fruits and by-products from juice pressing are very rich in different bioactive compounds such as flavonoids, phenolic acids, vitamins (especially vitamin C and E), unsaturated fatty acids, polysaccharides. Polysaccharides are gaining attention due to their positive activity on the human body, such as antioxidant, hepatoprotective, hypolipidemic, anti-obesity, antitumor, prebiotic and antibacterial activities; and therefore, they are used for functional foods and food supplements formula.

Results and Discussion. The activity of polysaccharide is influenced by different parameters (e.g. molecular weight, glycosidic linkages, monosaccharide composition, spatial conformation or branching degree). The extraction procedure used for polysaccharides are conventional techniques or emerging techniques (hot-water extraction, ultrasound assisted extraction, microwave assisted extraction, enzyme assisted extraction); each of these techniques influencing differently the polysaccharides activities. The extraction procedure may influence polysaccharide yield, composition and functionality. The extraction procedure based on ultrasound assisted extraction or hot water extraction presented lower bile-acid-binding activity and radical-scavenging activity then pressure assisted extraction, moreover the type of solvent influences the composition and prebiotic activity of polysaccharide. Extraction pH plays an important role in polysaccharide structure–activity relationships. Acidic conditions may promote glycosidic-bond hydrolysis and reduce molecular weight, while alkaline conditions facilitate the release of cell-wall-bound polysaccharides and alter their conformation. Neutral extraction generally preserves structural integrity. However, systematic comparisons of sea buckthorn polysaccharides obtained under different pH conditions remain limited. Sea buckthorn pomace, a major juice-processing by-product, retains valuable polysaccharides and represents a low-cost resource for valorization.

Conclusions. Therefore, this study evaluates the effects of extraction pH combined with gradient ethanol fractionation on the structural and functional properties of pomace polysaccharides, focusing on hypoglycemic potential and pH-dependent structure–activity relationships. The results may support the targeted recovery of bioactive polysaccharides and the high-value utilization of sea buckthorn by-products.

Keywords: *sea buckthorn, pomace, valorization, polysaccharides*

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ENHANCING THE STABILITY OF ROSEHIP CAROTENOIDS THROUGH LIPOSOMAL ENCAPSULATION

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Introduction. Rosehip berries (Rosa canina L.) is a valuable natural source of carotenoids with antioxidant and health-promoting properties; however, their low water solubility and susceptibility to degradation may limit their stability and application in functional foods. Liposomal encapsulation represents a promising strategy for protecting these bioactive compounds and improving their functionality in food systems.

Material and Methods. This study aimed to evaluate the encapsulation efficiency, storage stability, and in vitro digestive behavior of liposomal systems containing carotenoids extracted from rosehip berries. Carotenoid-rich rosehip extracts were incorporated into liposomal delivery systems, which were subsequently characterized in terms of particle size, encapsulation efficiency, retention of bioactive compounds, and stability during four weeks of storage. The behavior of free and liposome-encapsulated carotenoids under simulated gastric and intestinal digestion was also evaluated based on changes in antioxidant activity. The developed liposomal systems exhibited nanoscale particle sizes ranging from 194.87 to 285.68 nm, supporting their suitability for incorporation into food matrices. High encapsulation efficiency (92.4 ± 1.2%) and retention rate (87.4 ± 2.4%) demonstrated the effective incorporation and retention of rosehip carotenoids within the liposomal systems.

Results and Discussion. During four weeks of storage, the content of encapsulated bioactive compounds decreased from 85.56 ± 2.12 μg to 66.56 ± 2.45 μg, indicating moderate losses and suggesting a protective effect of liposomal encapsulation against degradation. During in vitro digestion, encapsulated carotenoids exhibited higher antioxidant activity than the free extract, reaching 89.32 ± 1.45% during the gastric phase and 24.35 ± 1.49% during the intestinal phase, indicating improved stability of the bioactive compounds under simulated digestive conditions. Overall, liposomal encapsulation proved to be an effective approach for protecting rosehip carotenoids, combining high encapsulation efficiency and retention capacity with enhanced stability during storage and in vitro digestion.

Conclusions. These findings support the potential application of rosehip carotenoid-loaded liposomes as delivery systems for the development of functional and fortified food products.

Keywords: *rosehip, encapsulation efficiency, nutrition, storage stability, antioxidant activity, functional foods*

Acknowledgments. The research was supported by Institutional Project, subprogram 020405 “Optimizing food processing technologies in the context of the circular bioeconomy and climate change”, Bio-OpTehPAS, being implemented at the Technical University of Moldova.

MICROBIOLOGICAL AND TECHNOLOGICAL ASPECTS OF DEVELOPING A RANGE OF SAFE FOOD PRODUCTS UNDER MARTIAL LAW IN UKRAINE

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Introduction. Technologically advanced, microbiologically safe and fortified food products determine the state of biological health of a person and ensure the preservation of the population's gene pool. Under martial law in Ukraine, stricter requirements are imposed on the organization of nutrition for all segments of the population, especially the military contingent, temporarily displaced persons, etc. Constant anxiety and destruction lead to the absence or insufficiency of the necessary sanitary and hygienic conditions, and a limited assortment of food products. The short storage periods of the vast majority of traditional types of raw materials and many types of products worsen food security. That is why it is necessary to urgently develop a special assortment of products for the organization of nutrition for participants in military operations, temporarily displaced children and the adult population, not only taking into account the achievements of nutrition, but also observing the microbiological safety of products during long-term storage. It is also necessary to provide for a nutrient composition of products that has increased rehabilitation capabilities.

Material and Methods. The purpose of the work is to develop new fortified types of products with increased biological activity and nutritional value in a convenient container for consumers to use, ensuring compliance of products with microbiological regulations and sanitary standards of quality and safety during long-term storage. To determine the possibility of using traditional and introduced types of food raw materials, an analytical review was carried out and an analysis of many types of raw materials was conducted according to a set of indicators of nutritional value with the determination of their calorie nutritional density, which was partially reflected in the above publications.

Results and Discussion. Assortment and packaging: An expanded range of first and second canned dishes has been developed, packaged in convenient retort packages for single use (with a volume of 350–500 cm^3). Technological parameters: Sterilization modes have been substantiated on modern equipment and industrial sterility and microbiological stability of products have been confirmed. Safety and bioactivity: Chemical-technological analyses and biotesting on two types of test organisms have proven the high quality and safety of the products at the organismal and cellular levels. Practical value: The new product is characterized by a balanced nutrient composition, increased rehabilitation potential and meets the nutritional requirements under martial law.

Keywords: *fortified canned foods, microbiological safety, long-term storage, nutrition under martial law*

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STUDIES AND RESEARCH ON POSSIBILITIES OF ENVIRONMENTAL DEPOLLUTION WITH CLAY-BASED MATERIALS

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Introduction. This study analyzes the structural and thermal changes resulting from pillaring a natural clay (K10/montmorillonite, sample denoted P6), yielding a hybrid material (K10_PILC, sample denoted P10) with high potential for environmental depollution.

Material and Methods. This study highlights the differences between the raw material (K10/P6) and the pillared clay (K10_PILC/P10), which is essential for evaluating adsorption capacities [1]. We characterized samples P6 and P10 comparatively by thermogravimetric analysis and differential scanning calorimetry (TGA/DSC) up to 204 °C to determine the dehydration profile. Fourier-transform infrared spectroscopy (FTIR) was used to identify functional groups, and X-ray diffraction (XRD) evaluated the interlayer spacing and phase crystallinity.

Results and Discussion. TGA analysis showed similar overall mass loss (8.84% for P6 and 8.75% for P10), but the derivative variation of mass and heat flow (DSC) showed a different water desorption energy for sample P10, specific to the modification of the pore network. FTIR spectroscopy confirmed the presence of O–H groups and Si–O bonds. The broadening and intensification of bands in sample P10 indicate an altered interlayer chemical environment due to pillar anchoring. XRD data provided final confirmation of intercalation by displacement and evaluation of the basal reflection d (001).

Conclusions. Corroboration from TGA/DSC, FTIR, and XRD analyses demonstrates modification of the porous network and chemical environment in sample P10. These modifications confirm the success of the pillaring process and the feasibility of using this modified material as a high-performance adsorbent in water purification technologies [1].

Keywords: *adsorption, depollution, porosity, thermal stability, interlamellar structure*

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BIOACTIVE POTENTIAL OF ELDERBERRY ANTHOCYANINS: STABILITY AND TECHNOLOGICAL PERSPECTIVES

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Introduction. Sambucus nigra L. berries are a valuable source of anthocyanins with antioxidant and colorimetric properties and therefore represent a promising raw material for the development of naturally derived ingredients for food systems. Their anthocyanin profile is distinctive, while the growing demand for clean-label products increases interest in their use as natural colorants and functional ingredients. However, technological application remains limited by the sensitivity of these pigments to processing and storage conditions.

Material and Methods. A literature review was conducted using PubMed, ScienceDirect, Web of Science and Google Scholar. Peer-reviewed studies published between 2010 and 2025 addressing elderberry anthocyanins, their composition, stability, antioxidant properties and food-related applications were considered. The search included terms related to anthocyanin stability, copigmentation, microencapsulation, CIELab color parameters and antioxidant activity. Following duplicate removal, screening and eligibility assessment, 34 scientific articles were included in the final analysis.

Results and Discussion. The anthocyanin profile of elderberries is predominantly characterized by cyanidin-3-sambubioside and cyanidin-3-glucoside. Anthocyanin content varies according to genotype, climatic conditions, maturity stage and post-harvest storage, with fully ripe fruits generally showing higher anthocyanin concentrations and antioxidant activity. Stability is strongly affected by pH, temperature, light, oxygen, ascorbic acid and metal ions, which can promote pigment degradation, color loss and reduced antioxidant capacity. Copigmentation and microencapsulation were identified among the most promising stabilization approaches. Encapsulation systems based on maltodextrin, gum arabic and whey proteins may protect anthocyanins against environmental and processing factors. CIELab parameters, together with DPPH, ABTS, FRAP and ORAC assays, are useful tools for monitoring chromatic characteristics and antioxidant activity.

Conclusions. Elderberry anthocyanins show considerable potential for use as natural colorants and bioactive ingredients in food matrices. Their technological value depends on controlling the factors responsible for degradation and selecting suitable stabilization strategies. Further studies should optimize protective systems in complex food matrices and investigate the bioavailability of stabilized anthocyanins to support their effective application in functional and clean-label food products.

Keywords: *bioavailability, clean label, copigmentation, microencapsulation, natural pigments.*

THE TECHNOLOGICAL VALUE OF ITALIAN GRAPES VARIETIES IN THE CONTEXT OF CLIMATE CHANGE IN THE REPUBLIC OF MOLDOVA

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Introduction. It is well known that soil and climate conditions significantly influence the dynamics of sugar accumulation, pH levels, and titratable acid content in the berries, as well as the final balance between these parameters in the production of quality wines. The quality of dry wines depends largely on harvesting conditions and the degree of grape ripeness. Given that grape varieties have different ripening periods, determining the optimal harvest time is essential for ensuring the quality and character of the wine. In this context, the dynamics of grape ripening indices for cultivated varieties were studied during the 2025 ripening season. In the Republic of Moldova, the summer of 2025 was marked by persistent heat waves and below-average rainfall. The average monthly air temperature in August ranged from +23 to +26 °C, exceeding the long-term climatological norm by approximately 3.5–4.5 °C, which highlights the exceptional thermal conditions of the period.

Material and Methods. This study investigated the climatic conditions of 2024 and 2025 in relation to vine growth, as well as soil and topographical characteristics, with a view to producing dry wines in the context of climate change. The research focused on agrobiological, oenological, and technological analyses of the composition of Italian grape varieties harvested in the northern part of the Republic of Moldova, specifically the Albariño, Glera, Nebbiolo, and Sangiovese varieties.

Results and Discussion. In the process of producing the base wines, grapes from the studied vineyard were examined; these were characterized by a compact structure and a large number of uniformly developed berries. At the same time, the evolution of the grape ripening process was analyzed, as well as the dynamics of alcoholic fermentation. Modern technological schemes for producing base wines were also developed, along with the sensory profiles of these wines. The results obtained in the first years demonstrated that the territory of Vărăncău is particularly valuable: the grapes presented a superior quality, determined by excellent accumulations of sugars, between 190-239 g/L-1 and titratable acidity, between 7.56-10.9 g/L-1 specific to the clay soils of this region. The alcohol content by volume in the wines produced ranged from 11.16–12.6 % vol.

Conclusions. The soil and climate conditions in the Republic of Moldova, characterized by abundant solar and thermal resources, are very favourable for growing this grape variety, which produces high-quality dry wines.

Keywords: *climatic conditions, grapevine, Italian grapes: Albariño, Glera, Nebbiolo, Sangiovese plantation, planting material, vegetation*

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CRITICAL STUDY OF METHODS FOR ASSESSING THE PROTEIN STABILITY OF WINES

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Introduction. Protein instability of wines, especially white wines, constitutes a major problem in ensuring their stability and is associated with (relevant expenses) to combat it. The large number of proteins present in wines and their chemical diversity make it difficult to adequately assess instability and, therefore, to make decisions for the correct, precise treatment focused on unstable proteins. The arsenal of recommended methods is impressive, differing in application conditions and mechanism of action - thermal, chemical, electrostatic.

Material and Methods. The object of the study was white wines, not protein-stabilized, from different varieties, wine-growing areas of the Republic of Moldova, from different years, produced according to different technologies - Savignon Blanc (microvinification 2023 and 2024-SB MV 2023, SB MV 2024, industrial 2024-SB 2024), Chardonnay (microvinification 2024-Ch MV 2024, and industrial Chardonnay 2024-Ch 2024), Pinot Gris (industrial 2024-PG 2024) and Viorica (industrial, 2024-V 2024), which were subjected to testing by various methods. These were thermal, with heating the samples to 80°C (30, 60, 120 minutes) followed by spontaneous cooling to 20oC or for 60, 120 and 180 minutes and measuring turbidity before and after cooling (ΔNTU), electrostatic (Protocheck) and chemical (with Bentotest and with Trichloroacetic Acid, TCA). At the same time, the total protein content was determined by different methods (Bradford, SDS, SDS+KCl, SF), glycoproteins, polysaccharides, polyphenols-factors that influence the protein stability of wines.

Results and Discussion. It was shown that with increasing heating and cooling time of wine samples, regardless of cooling time, ΔNTU tends to increase, although unevenly - from 1.9 times for Ch MV 2024 to 5.9 times for SB MV 2024 (60+180 minutes compared to 30 minutes). For some wines, the increase in ΔNTU with heating time is gradual, rapid (SB MV 2023, tg α=0.445) or slow (PG 2024, tg α=0.006), while for others this increase is irregular (SB MV 2024).

According to thermal tests, all wines were classified as protein unstable, the closest to the stability criteria being Ch 2024 and PG 2024 in the 30 and 60 minute tests. For all wines, a good correlation for ΔNTU was attested only for heating for 30 and 60 minutes (R2=0.9968), while for other combinations the correlations are worse or absent. The protein stability of PG 2024 is also confirmed by the Protocheck, Bentotest and TCA tests. In other cases, comparative results of different tests are contradictory. There are also no correlations between the test results and the total content of proteins, glycoproteins, polysaccharides and phenolic compounds, which confirms the complexity of the mechanisms of protein haze formation and the decisive role of certain groups of proteins with a structure sensitive to thermal shocks and other types (from the TLP group and chitinases, with molecular masses of approximately 20-30 kDa).

Conclusions. This fact requires a careful interpretation of protein stability tests in order to intervene appropriately with stabilizing treatments, as selectively as possible, without affecting other wine quality criteria.

Keywords: *white wines, protein stability, heat tests, chemical tests, Protocheck, Bentotest*

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POLYPHENOLIC POTENTIAL OF WINES MADE FROM THE FETEASCA NEAGRĂ, RARA NEAGRĂ, AND RIZOGEN AMETIST GRAPE VARIETIES

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Introduction. Phenolic compounds represent one of the most important classes of bioactive compounds in grapes and wine, playing a decisive role in the physicochemical, organoleptic, and chromatic characteristics of wines. These compounds are responsible for the wine's color and astringency, its antioxidant and free-radical-scavenging properties, and its structure and stability.

Material and Methods. The study focused on wines produced from the indigenous grape varieties Fetească Neagră (FN, vintages 2019, 2021, 2023), Rară Neagră (RN, vintages 2020, 2022, 2023), and the clonal variety Ametist (A, vintages 2023–2024, using different production techniques). The main quantitative indices of phenolic composition were determined: Total Polyphenol Index, total phenolic substance content (TPS, gallic acid equivalent, mg/L-1), total anthocyanin content (AT, malvidin-3-glucoside, mg/L-1), monomeric anthocyanins, polymerized anthocyanins, and pigments bound to tannins and polysaccharides.

Results and Discussion. The SFT content varies in single-varietal wines depending on the vintage for all wines (869–992 mg/L-1 for FN, 713–1,132 mg/L-1 for RN, and 512–852 mg/L-1 for A), and depending on the winemaking technique (A, 2024: 782–852 mg/L-1). There is a satisfactory correlation between the SFT and IPT parameters. Based on both the intensity and hue of the FN and A wines (2023), it can be assumed that the level of oxidation in these wines is more advanced than in the other cases. The total anthocyanin content does not correlate with the SFT content; it is minimal in FN wine (2021), with maximum values observed in Ametist wines (2024, 431–623 mg/L-1). The rhizogenic A variety demonstrates good pigment potential and good extractability of these pigments. The Polymerized Pigment Index (PPI) ranges from 33.7% (FN, 2023) to 81.0% (FN, 2021), with the other samples showing intermediate values.

Conclusions. The proportion of anthocyanins bound to polysaccharides and salts was also estimated, ranging from 3.6% (RN, 2023) to 31.2% (A, 2024). This information is useful for assessing the quality and stability of wines and their biological potential.

Keywords: *rizogen variety, phenolic compounds, monomeric anthocyanins, polymeric anthocyanins, proanthocyanidins, polysaccharides*

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POLYPHENOLS IN WINES FROM WILD FOREST GRAPEVINES, SUBSPECIES VITIS SYLVESTRIS GMEL

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Introduction. Wild (forest) grapevine, subspecies Vitis Sylvestris Gmel, has been known on the current territory of the Republic of Moldova for thousands of years, currently being found in intact forests on the banks of the Prut and Dniester rivers. Its integration into the vital cycle of people is associated with the ancient Cucuteni-Tripolie culture, a fact demonstrated by various archaeological artifacts collected over the years. In the distribution area of V. Sylvestris Gmel - countries on the entire Mediterranean coast, on the southern Black Sea coast, in Southern and Central Europe, complex physicochemical research is being carried out on both grapes and wines obtained from them. Our research comes to complement the current information about V. Sylvestris Gmel and was carried out on grape wine samples, harvested from the same location (Zberoaia village, Nisporeni district, 46° 58′ 07″ N and 28° 06′ 25″ E) in 2023, 2024 and 2025. The wines were produced at the Department of Oenology and Chemistry in the Microvinification Laboratory, under various alcoholic fermentation conditions.

Material and Methods. The content of total phenolic substances (TPS) was determined by the Folin-Ciocalteu method (expressed in Gallic Acid equivalent, mg/l) and by the Total Polyphenol Index (TPI). The amount of anthocyanins, in malvidin-3-O-glucoside eqv, was assessed by the pH-differential method. The Polymerized Pigment Index (PPI, %) was determined by the action of K2S2O5 in a buffer solution with pH 3.2. Polymerized tannins with high and low molecular weights were evaluated by the HCl Index, and tannins combined with polysaccharides by the Ethanol Index. The monomeric and polymeric forms of polyphenols, flavonoid and non-flavonoid forms, non-tannins, polymeric pigments with low molecular weights, chromatic characteristics, the effect of copigmentation, etc. were determined spectrophotometrically.

Results and Discussion. Depending on the year and technology, the SFT content varies between 2913 and 5727 mg/l and IPT-between 153 and 279. They are well above the values for red wines and the amounts of anthocyanins, with a maximum value of 7656 mg/l eq Malvidin-3-O-glucoside. IPP demonstrated maximum levels in 2024-between 89 and 95%, while after 8 months from production in the 2025 harvest it varied between 46-66%. The high content of phenolic compounds, anthocyanins and other substances determined an important role of copigmentation, which can reach 40%.

Conclusions. Thus, Vitis Sylvestris Gmel grapes are very rich in phenolic substances, differing in many parameters from red wines from traditional varieties.

Keywords: *Vitis Sylvestris, polyphenols, anthocyanins, monomers, polymers, proanthocyanidins, tannins, copigmentation*

Acknowledgment. The research was funded by Institutional Project 020405 Bio-OpTehPAS "Optimizing food processing technologies in the context of the circular bioeconomy and climate change", running at Technical University of Moldova.

ANALYTICAL ASSESSMENT OF PHTHALATE MIGRATION FROM PLASTIC FOOD PACKAGING

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Introduction. The present study investigated the migration of potentially hazardous compounds from plastic food packaging into edible oils, bottled water, and soft drinks commercially available in the Republic of Moldova and developed analytical approaches for the assessment of phthalate contamination.

Materials and Methods. Migration experiments were performed using model solutions simulating food-contact conditions, while GC–MS screening was employed to identify plastic additives and non-intentionally added substances.

Results and Discussion. Several packaging-related contaminants were detected. Organophosphorus compounds, including phosphoric acid tris(2-ethylhexyl) ester, together with 1,1,3-trimethyl-3-phenylindane, were identified in sunflower oil packaging. PET packaging used for bottled water and soft drinks contained several phthalate plasticizers, with dibutyl phthalate and bis(2-ethylhexyl) phthalate among the most frequently detected compounds. Their measured concentrations, however, remained below established regulatory migration limits. Trace amounts of other polymer-related substances, including styrene trimer and erucylamide, were also detected, confirming the potential contribution of plastic packaging to the chemical contamination of food and beverages. For quantitative phthalate determination, key extraction parameters, including solvent type, extraction time, pH, alcohol content, and sugar concentration, were systematically investigated and optimized. Extraction was characterized by rapid initial mass transfer, with 68–87% of extractable phthalates recovered within the first minute. A solvent-to-sample ratio of 1:10 provided an appropriate balance between extraction efficiency and solvent consumption. Phthalate recovery remained relatively stable over the investigated pH range, while increasing alcohol concentration slightly improved recovery. Higher sugar concentrations caused a moderate decrease, probably due to increased matrix viscosity and reduced mass transfer. Overall, these matrix effects were limited, demonstrating the robustness of the extraction procedure for different beverage compositions. The optimized GC–MS procedure showed satisfactory analytical performance, with recoveries of 81–96%, repeatability below 5%, and detection limits of 0.006–0.01 mg/L. For a more comprehensive assessment of total phthalate contamination, a complementary approach based on phthalate ester hydrolysis followed by o-phthalic acid determination using capillary electrophoresis with spectrophotometric detection was proposed.

Conclusions. Overall, the combined GC–MS and hydrolysis–capillary electrophoresis strategy provides a reliable and complementary tool for identifying packaging-related contaminants and assessing phthalate residues, with potential application in routine food quality and safety control.

Keywords: *capillary electrophoresis, food safety, GC–MS, migration, phthalates, plastic contaminants*

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SUSTAINABLE APPLE WASTE BIOCHAR FOR DIBUTYL PHTHALATE REMOVAL FROM COMPLEX WATER MATRICES

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Introduction. This study evaluated activated biochars derived from apple processing waste and functionalized with metal oxides for the removal of dibutyl phthalate (DBP) from water matrices with different chemical compositions. Particular attention was given to the effects of salinity and temperature, adsorption stability during repeated cycles, and environmental safety. Salinity exerted a material-dependent effect on DBP adsorption.

Results and Discussion. The NiO-functionalized biochar (A-ac-NiO-ext-1:1) showed a progressive decrease in adsorption capacity with increasing ionic strength, likely due to competition between inorganic ions and DBP for active sites and partial pore blockage. In contrast, Fe_3O_4-modified biochar (A-ac-Fe_3O_4-1:2) exhibited a strong positive relationship between salinity and adsorption capacity ($r = +0.989$), attributed to the salting-out effect and enhanced hydrophobic interactions. The magnetic Fe_3O_4-NiO composite showed stable adsorption performance across the investigated salinity conditions. Temperature significantly enhanced DBP adsorption by all metal oxide-modified biochars, indicating an endothermic process. Adsorption capacity increased from 298 to 318 K and was maintained or further improved at 338 K. The overall adsorption affinity followed the order A-ac-Fe_3O_4-1:2 ≫ A-ac-NiO-ext-1:1 > A-ac-Fe_3O_4-NiO-ext-1:1 > A-ac-Alg. Increasingly negative Gibbs free energy values (approximately −2 to −9 kJ/mol) indicated that adsorption became more thermodynamically favorable at higher temperatures. Reusability tests over three adsorption cycles demonstrated that A-ac-Fe_3O_4-1:2 maintained the highest adsorption capacities and showed superior performance under high-salinity conditions. The NiO-functionalized material exhibited gradual capacity loss, whereas the alginate-based biochar showed poor durability, particularly in low-to-moderate salinity waters. Among the tested materials, A-ac-Fe_3O_4-1:2 displayed the most promising characteristics, combining adsorption capacities of up to 6.25 mg/g with salinity tolerance, thermal stability, regeneration potential, and magnetic properties facilitating adsorbent recovery. These findings are particularly relevant to groundwater treatment in Moldova and Romania, where substantial variations in sulfate, chloride, calcium, and magnesium concentrations require adsorbents capable of maintaining predictable performance across salinity gradients. Furthermore, leaching tests showed that Fe and Ni concentrations remained below 0.05 mg/L after three regeneration cycles, indicating strong immobilization of the metal oxides and low environmental risk under the tested conditions.

Conclusions. Overall, Fe_3O_4-functionalized apple-waste biochar represents a promising sustainable adsorbent for DBP removal from freshwater and moderately saline water matrices.

Keywords: *adsorption, environmental safety, magnetic adsorbent, regeneration, salting-out effect, thermodynamics*

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SUSTAINABILITY EDUCATION IN VITIVINICULTURE: STUDENTS' PERCEPTIONS AND PROFESSIONAL RELEVANCE

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Introduction. Sustainability competencies are becoming increasingly important in wine technology education as the vitivinicultural sector responds to climate change, resource constraints, and environmental pressures. However, the effectiveness of sustainability-oriented university courses depends on their ability to develop knowledge that students perceive as relevant to professional practice.

Material and Methods. This study evaluated undergraduate students' perceptions of the course "Sustainable Development of the Vitivinicultural Sector", with particular attention to perceived knowledge development, professional relevance, useful topics, and priorities for improving the learning process.

A structured questionnaire was administered to 18 undergraduate students enrolled in the Wine Technology and Fermented Products study programme. The instrument included five-point Likert-scale items, multiple-response questions, and open-ended questions. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to analyse students' responses. Self-assessed knowledge of sustainability increased from 2.40 ± 0.63 before the course to 4.47 ± 0.52 after course completion. Students assigned a high importance to sustainability in the vitivinicultural sector (4.87 ± 0.35) and evaluated the course as professionally relevant (4.47 ± 0.92). The overall course assessment was 4.73 ± 0.46. Carbon footprint, water resource management, and waste management were identified as particularly useful topics. Waste valorisation and greenhouse gas emission reduction were among the most frequently identified priorities for the sector, indicating strong student interest in resource efficiency and environmental impact reduction.

Results and Discussion. The results indicate a substantial increase in students' perceived sustainability knowledge following course participation and a high perceived relevance of sustainability to professional activity. The findings also identify specific content areas that can strengthen sustainability education in wine technology. Further development of the course should integrate experiential and data-based learning, including winery case studies, carbon and water footprint calculations, energy-efficiency assessment, life-cycle assessment, and valorisation of grape-processing by-products.

Conclusions. Linking these activities to real technological decisions could strengthen students' capacity to assess resource use and environmental impacts and to select more sustainable winemaking solutions.

Keywords: *circular economy, curriculum development, vitivinicultural industry, sustainability competencies, undergraduate higher education*

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STARCH AND NON-STARCH HYDROCOLLOID BLENDS FOR STABILIZATION OF FRUIT FILLINGS

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Introduction. Fruit fillings are complex multicomponent food systems whose stability is determined by the content of water, sugars, organic acids, pectic substances, and structuring agents. The main technological challenges include free moisture release, syneresis, changes in consistency, and structural disruption during production, freezing, storage, and thermal processing. The use of starch and non-starch hydrocolloid blends is a promising approach to stabilizing such systems [1].

Material and Methods. The aim of the study was to investigate the effect of starch and non-starch hydrocolloid blends on the properties of fruit fillings.

Results and Discussion. Starch is widely used as a thickener and structuring agent in the food industry. Its functional properties are determined by the ratio of amylose to amylopectin and the structure of starch granules, which affect swelling, gelatinization, viscosity, and retrogradation [1]. Acidic conditions, thermal treatment, and mechanical stress may reduce the stability of starch-based systems, which is particularly relevant for fruit fillings.

Combining starch with non-starch hydrocolloids, including guar gum, xanthan gum, gellan gum, and pectin, makes it possible to regulate the structural and rheological properties of the system. Hydrocolloids compete with starch for water and affect granule swelling, viscosity, and water-holding capacity [1].

A study of waxy corn starch with guar gum and xanthan gum showed increased viscosity and gelatinization temperature with increasing hydrocolloid concentration [2]. These changes indicate that hydrocolloids modify the flow and structural characteristics of starch-based systems.

Starch–pectin blends are of particular interest for fruit fillings. A model fruit filling based on tapioca starch and low-methoxyl pectin demonstrated stability during freeze–thawing and baking without syneresis [3]. This finding indicates the potential of starch–pectin combinations for products subjected to both freezing and subsequent thermal processing.

Conclusions. Starch and non-starch hydrocolloid blends are a promising approach to stabilizing fruit fillings. Their application makes it possible to regulate viscosity, water-holding capacity, structural stability, and resistance to syneresis. Further research should focus on determining the optimal component ratio considering acidity, total solids content, and processing conditions.

Keywords: *fruit fillings, starch, hydrocolloids, rheological properties, syneresis, stabilization*

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MODERN POLYMERIC CONTAINERS AND PACKAGING FOR FOOD PRODUCTS

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Introduction. Containers and packaging play a strategic role in protecting food products from mechanical influences, chemical degradation and microbiological spoilage. Purpose of the work: review of modern types, properties of polymer materials, progressive food packaging systems; study of the legislative framework for controlling the safety of polymer containers and their labeling; study of the technological parameter of sealing strength for various types of polymer containers, polyethylene films for their sealing; development of scientifically based sterilization modes for long-term storage food products.

Material and Methods. To measure the sealing strength parameter, a standard membrane compensation method was used; the development of sterilization modes was carried out in accordance with the methodology for developing sterilization and pasteurization modes for canned food and canned semi-finished products. Scientific novelty - for the first time, certain types of polymer containers were used for sterilization of canned food products, the parameter of sealing strength of containers was studied and scientifically based sterilization modes were developed.

Results and Discussion. Progressive active and intelligent packaging systems are used for packaging food products, which allows to prolong the freshness of products, optimize production cycles and minimize the content of preservatives in the food composition. The work determines the sealing strength parameter for polymer containers of the C-PET type, which is 0.05 MPa; for combined metal and polymer semi-rigid containers, this technological parameter is 0.09 MPa, which ensures the absence of depressurization during high-temperature heat treatment. Experimental values of the sealing strength parameters were used in the development of scientifically based sterilization modes for fish and meat canned products in the studied types of polymer containers, this will allow enterprises to produce high-quality food products that are safe to use and have a long shelf life.

Conclusions. Food polymer packaging must guarantee the safety and quality of food products, be chemically neutral, act as a barrier to the penetration of harmful substances, microorganisms from the outside, and be environmentally friendly; these requirements are provided by regulatory documents. The “smart” packaging system is an advanced technology in which active components are introduced into the material of the polymer container, the packaging informs the consumer about the condition of the product during storage, controls its physicochemical parameters and the environment in the container. The integration of polymer packaging into the food industry requires its adaptation to technological processes and requires the mandatory determination of the parameter of the container sealing strength for its further use in heat treatment and sterilization processes to ensure the quality of food products and its long shelf life.

Keywords: *special food products, technology, heat treatment, shelf life, stress-protective ingredients*

LOW-INTERVENTION WINEMAKING: TECHNOLOGICAL APPROACHES FOR WINE QUALITY AND SUSTAINABILITY

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Introduction. Low-intervention winemaking is based on the controlled reduction of oenological inputs and processing operations while maintaining fermentation performance, wine stability and sensory quality. Key practices include spontaneous or partially spontaneous fermentation, the use of indigenous Saccharomyces and non-Saccharomyces yeasts, reduced sulphur dioxide (SO_2) addition, limited clarification and filtration, and controlled oxygen exposure. The technological effects of these practices are strongly dependent on grape variety and fermentation conditions [1].

SO_2 remains an important technological agent in red winemaking because of its antioxidant and antimicrobial properties and its effects on phenolic extraction, oxidation control and colour stabilization [2]. Its effectiveness depends on pH, temperature, microbial status and the phenolic potential of the cultivar. This was demonstrated for Rară Neagră and Fetească Neagră, two cultivars with distinct phenolic profiles.

Material and Methods. Experimental wines were produced under spontaneous and controlled fermentation conditions. Spectrophotometric measurements were used to determine colour intensity and hue. SO_2 addition increased colour intensity in both cultivars, although the effect depended on cultivar and fermentation conditions. SO_2 addition increased absorbance at 420 nm by 6–18% in both cultivars, indicating an effect on the yellow-brown colour fraction and oxidation-related processes. Changes at 620 nm were less consistent, suggesting a limited effect on the blue colour fraction during the early stages of wine development.

Results and Discussion. The findings demonstrate that low-intervention winemaking requires a balance between reduced technological inputs and effective process control. Spontaneous fermentation and SO_2 management can modify wine colour and phenolic stability, with the magnitude and direction of these effects depending on cultivar and fermentation temperature. From a sustainability perspective, reducing additives and processing operations may decrease material consumption and waste, but these benefits depend on maintaining wine stability and minimizing product losses.

Conclusions. Low-intervention winemaking can therefore contribute to sustainable wine production when reduced inputs are combined with cultivar-specific process management, analytical monitoring and preventive control.

Keywords: *food technology, sulphur dioxide, sustainable winemaking, wine quality, wine stability*

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FEATURES OF FORMULATING HIGH-PERFORMANCE COMPOUND FEEDS

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Introduction. Modern compound feed production in feed formulation requires a transition from assessing crude protein level and minimizing feed cost to a comprehensive evaluation of the biological, technological, and economic efficiency of the formula. A high-performance compound feed should meet the physiological requirements of a specific animal group, provide the required level of available nutrients, have stable technological properties, and contribute to the planned economic outcome. The quality of a formula is largely determined by the accuracy of feed ingredient characterization and the appropriateness of the constraints established during optimization.

Materials and Methods. The study summarizes current approaches to the formulation of compound feeds for monogastric animals, taking into account their nutritional requirements, the nutritive value of feed raw materials, amino acid profiles, the ideal protein concept, and the ratio of metabolizable energy to protein. The economic feasibility of feed ingredients was assessed based on the cost per unit of available nutrient. Feed formulation was considered as a mathematical optimization problem aimed at minimizing feed cost while meeting established constraints on ingredient composition, nutritional value, safety, and technological properties of the feed.

Results and Discussion. It was established that the quality of a modern feed formula is determined by the interaction of four components: biological, technological, economic, and quality-related factors. Formulation should begin with determining animal requirements rather than with the list of feed ingredients available in stock. As age and productivity change, requirements for energy, amino acids, minerals, and the permissible level of fiber also change; therefore, the use of a single formula throughout the entire production cycle may represent a compromise solution.

It was demonstrated that the same crude protein level does not guarantee the same biological value of compound feeds. It is important to meet the animal's requirements for individual essential amino acids, taking into account their availability and their ratios to lysine in accordance with the ideal protein concept. Equally important is the alignment of protein level with the energy value of the feed, since insufficient energy supply limits the efficient utilization of protein.

It was established that a less expensive feed ingredient does not necessarily result in a lower production cost. When selecting ingredients, their energy value, digestibility, amino acid availability, fiber level, and antinutritional factors should be taken into account. Micro-ingredients should also be used functionally to address specific biological or technological challenges rather than merely increasing the number of additives in the formula.

Conclusions. The formulation of high-performance compound feeds is a multi-criteria task in which minimum feed cost cannot be the sole target criterion. An optimal formula should simultaneously meet animal requirements, ensure efficient utilization of nutrients, provide technological suitability and safety, and achieve the desired economic outcome. The application of mathematical optimization with justified constraints makes it possible to develop a formula that is not simply the least expensive per tonne of compound feed, but economically efficient when animal productivity and the cost per unit of production are taken into account.

Keywords: *economic efficiency, feed ingredients, optimization, nutritional value*

SOIL TO WINE PROFILES OF RKATSITELI AMENDED WITH DRIED GRAPE SEEDS AND POMACE BOVINE MANURE COMPOST

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Introduction. Millions of tons of winery by-products are produced annually by the world's wine production, creating a significant waste management challenge. Valuing by-products as organic fertilizers is becoming more widely acknowledged as a successful way to enhance soil fertility and promote sustainable viticulture within a circular economy framework. It has been demonstrated that soil management techniques affect berry quality (sugar content, titratable acidity, polyphenol content) as well as vine physiology (photosynthetic rate, water-use efficiency), ultimately influ-encing the physico-chemical and sensory qualities of the resulting wine.

Material and Methods. This pilot study characterized soil-to-wine response profiles of Rkatsiteli to dried grape seeds (V1) and grape pomace co-composted with bovine manure (V2), relative to an untreated control (C), in a Cricova vineyard (Codru PGI region). The trial comprised 15 vines (five per treatment); amendments were incorporated at 25–30 cm depth in late spring 2025. Vine performance was monitored during 2025–2026, and grapes harvested in 2025 were pooled by treatment and microvinified separately under the same protocol. Evaluations covered yield components, berry composition, one post-application soil sample from the 30–60 cm layer per treatment, final wine chemistry, and sensory scores from 15 tasters.

Results and Discussion. The inflorescence primordia underlying the 2025 crop had formed before amendment application, the first inventory was treated as a biological baseline rather than as a treatment response: V2 retained the highest mean inflorescence number in both inventories (21.6 and 19.2 vine^{-1} in 2025 and 2026, respectively), whereas the lower pre-treatment live-bud proportion in V1 (21.1% versus 55.4–56.5% in C and V2) contextualized its lower crop. At harvest, V2 had the greatest mean cluster mass (274 g) and a yield close to C (4.08 versus 4.33 kg vine^{-1}). V1 yielded 3.43 kg vine^{-1} but had the highest mean soluble solids (21.1 °Brix). Among the single soil samples, V1 had the highest total N (0.104%), whereas V2 had the highest mobile K_2O (168.7 mg kg^{-1}). The V1 treatment wine had the highest alcohol content (12.33% vol.), dry extract (23.8 g L^{-1}), and mean sensory score (91 of 100).

Conclusions. The descriptive pilot results identified contrasting amendment-associated profiles: V1 combined lower yield with the highest soluble solids, alcohol content, dry extract, and mean sensory score, whereas V2 showed the greatest cluster mass and a yield close to the control. The findings demonstrate the value of integrated soil-to-wine assessment for comparing winery-derived amendments and support further replicated, multi-vintage field and vinification trials.

Keywords: *circular viticulture, organic fertilization, sensory evaluation, winery by-products*

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COMPARATIVE EVALUATION OF PRIMER EFFICIENCY FOR THE DETECTION AND QUANTIFICATION OF BRETTANOMYCES BRUXELLENSIS YEASTS

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Introduction. Brettanomyces bruxellensis is a primary wild yeast causing wine spoilage through volatile phenol production, leading to severe economic and quality losses. Developing rapid, specific, and reliable real-time PCR (qPCR) assays is essential for early detection, especially for preventative monitoring in micro-wineries [1]. This study comparatively evaluated the amplification kinetics and efficiency of two new primer pairs, p33-34 and p35-36, targeting informative ribosomal DNA regions to optimize diagnostic performance.

Material and Methods. Real-time PCR assays utilized SYBR Green chemistry. Analytical performance was determined using a 10-fold serial dilution of B. bruxellensis template DNA. Standard curves were constructed by plotting cycle quantification (Cq) values against log DNA quantities. Linear regression analysis determined amplification efficiency (E), coefficient of determination (R^2), slope, and y-intercept values.

Results and Discussion. Both primer systems demonstrated robust, tightly replicated, and evenly spaced sigmoid amplification profiles across all dilutions, reaching high fluorescence plateaus. This confirms strong technical reproducibility and a reliable dynamic range. Linear regression revealed strong linearity for both systems. The p33-34 pair exhibited an efficiency (E) of 106.0%, an R^2 of 0.992, a slope of -3.187, and a y-intercept of 33.770. Conversely, the p35-36 pair showed a more optimized efficiency (E) of 103.4% (nearer the 100% ideal) and superior linearity with an R^2 of 0.998, a slope of -3.244, and a y-intercept of 33.978, indicating fewer late-cycle kinetic deviations.

Conclusions. While both primer pairs provide reliable diagnostic profiles, p35-36 demonstrated superior kinetic attributes, outstanding linearity, and tighter amplification efficiency. Thus, while both tools confirm presence, the p35-36 pair offers higher technical robustness for exact quantitative monitoring. Implementing this optimized system improves routine wine microbiological control, offering micro-wineries an accessible, precise tool to prevent economic spoilage.

Keywords: *wild yeasts, micro-winery, primers, SYBR Green, real-time PCR*

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TECHNOLOGY FOR INTEGRATING A QUALITY AND SAFETY ASSURANCE SUBSYSTEM INTO FOOD PRODUCTION

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Introduction. The modern food industry combines heterogeneous production environments with a wide range of products. Universal quality and safety assurance models remain largely declarative, since reproducible tools for their transfer into the conditions of a particular enterprise are lacking. The aim of the work was to develop a technology for integrating the base model of the production quality and safety assurance subsystem into food production conditions and to verify its applicability at operating enterprises.

Material and Methods. The input data comprised the architecture of the base model, which covers ten components, 102 structural-functional elements and 113 typed links of 6 types [1]. An open adaptive loop was formalised, comprising a sensor, a separator, a database, a comparator, a regulator and an effector. The integration is presented as a five-stage procedure with a defined completion criterion for every stage. The implementation of structural-functional elements was assessed against five criteria on a three-point scale. Actual channel weights were obtained by adjusting the reference weights with a combined coefficient. Network characteristics were computed in Python. Field testing was carried out under the production conditions of the molecular-genetic and microbiological laboratory of FE “SGS UKRAINE”, which evaluates the quality of food products and grain raw materials, and at the grain terminal of LLC “M.V. CARGO”.

Results and Discussion. Both actual subsystems reproduced the topology of the reference model, while the discrepancies were concentrated in the channel weights. The laboratory retained 94.4 % of the total reference weight with 18 defective routes, the terminal 79.8 % with 33 routes. The discrepancy profile proved common to both objects, with deviations concentrated in the metrological, risk-oriented, managerial and methodological loops. Material and coordination routes were preserved in full. The load entropy remained at 99.7–99.8 % of the reference value. The component “Personnel” retained the status of the only transit node. The network profile of the base model served as a reference architecture for measuring the deficit of the actual subsystem. Following the comparison, targeted integration plans were drawn up and implemented, and their results were recorded in implementation acts and test protocols.

Conclusions. The developed technology provides a food industry enterprise with a reproducible risk-oriented procedure for the diagnostics and purposeful strengthening of the quality and safety assurance subsystem.

Keywords: *adaptive loop, base model, network analysis, process modelling, risk assessment*

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S.C. DINA COCIUG SRL
http://www.dina.md

• **1993–1999:** The company began operations by servicing refrigeration equipment. It later expanded its partnerships with European and Italian manufacturers, launched the “Complete Offer” program, and opened a branch in Bălți.

• **2001–2009:** The company established its own production department under the DINOX brand and entered the air conditioning market. It received international recognition and innovation awards, while also implementing the ISO 9001 quality management and OHSAS 18001 occupational health and safety standards.

• **2013–2020:** The company received the Moldova Eco-Energetică Award and developed refrigeration systems with heat pumps. It restructured its sales department, celebrated 25 years in business, and transitioned to the ISO 9001:2015 standard.

• **2021–2025:** The company completed a full rebranding in 2021, became an EcoSave partner, celebrated its 30th anniversary in 2023, opened a branch in Comrat, and moved its headquarters to 9/D Meșterul Manole Street in Chișinău. Recent developments include adding the HISAR cutlery brand and launching the DINA Culinary Laboratory in 2025.

Î.M. EFES VITANTA MOLDOVA BREWERY S.A.
http://www.efesmoldova.md

The history of local beer dates back to 1873, when Chișinău's first brewery was built. The drink soon became so popular that it was even delivered to people's homes. For those who preferred to spend time with friends, dozens of venues opened, featuring billiard tables and even bowling lanes.

By 1919, the brewery was producing four types of beer, with a monthly output of more than 600 decalitres. It was also one of the most technologically advanced facilities of its time, equipped with enormous brewing tanks and bottling lines.

The EFES team, work continuously to give beer lovers the opportunity to enjoy the distinctive taste of high-quality beer, made with care and passion using state-of-the-art equipment. We also expect consumers to treat our products responsibly. We firmly believe that beer must always be consumed in moderation and with the utmost responsibility.

Furthermore, we do not condone excessive consumption of our products, driving after drinking, or drinking during working hours or while participating in sports. Individual responsibility is fundamental to us. It motivates us to create distinctive products that can be fully enjoyed only in appropriate, safe and lawful circumstances.

S.R.L. "CARMEZ PROCESSING"
https://carmez.md/

The company's history dates back to 1904, when the city authorities approved the construction of the first privately owned slaughterhouse in the southwestern part of Chișinău. It covered an area of just 2,576 m². Over the next three decades, the business operated and steadily expanded: production capacity grew, and the company built its own artesian well.

Construction of the modern enterprise began in 1947. By the beginning of the following decade, two new cold-storage facilities had been built, covering 1,000 m² and 2,000 m². A plan was also approved to build a new sausage production department.

Over the next three decades, the company continued to improve its production capacity, modernize its existing departments, and strengthen its personnel management.

After the dissolution of the Soviet Union, Carmez JSC was established and produced meat products until 2013. That year, following its merger with Carmez International, the company underwent a complete structural reorganization. Its product range was reviewed, and its production and finished-product packaging processes were modernized.

In 2019, a new production facility and logistics center were commissioned, with a total area of 10,000 m². They comply with approved sanitary regulations and European food quality and safety standards. The company's certification to ISO 22000:2018 confirms its compliance with these requirements.

Today, Carmez Processing is the largest and most modern enterprise in Moldova's meat processing industry. Built with the assistance of specially invited foreign experts, it has a production capacity of 80 tonnes of finished products per day. Its own logistics network, consisting of more than 60 refrigerated trucks, enables the company to deliver products throughout Moldova every day.

LA MAMUCA STROPȘA ALEXANDRA SRL SC
https://www.facebook.com/LaMamuca.md/

"La Mămuca" is a street-food bakery and pretzel shop offering fresh, tasty products to passers-by.

The bakery and pretzel shop began operating in 2014. Its main activity is the production and sale of baked goods. The company currently employs around 85 people and has eight locations in Chișinău, one of which is also a production facility. It quickly became one of the city's favorite places to grab a bite. Its selection includes croissants, pretzels with various toppings and fillings such as sesame, poppy seeds, cinnamon and cheese, as well as doughnuts, puff-pastry buns and more.

"La Mămuca" serves passers-by delicious, golden-brown baked goods, coffee and a cheerful mood!



FRANZELUȚA S.A.
https://franzeluta.md/

Franzeluța S.A. is Moldova's largest and most trusted bakery producer, with more than 75 years of experience and a strong heritage of traditions, values and purpose. A reliable partner in the community, the company is committed to sustainable development and the highest standards of service. It strives to surprise customers with excellence and provide safe products throughout the country.

We do our utmost to preserve the familiar taste of the past while meeting society's needs. We pay close attention to the quality of our raw ingredients and to every stage of production, so that our products are both delicious and wholesome.

We offer affordable prices, but above all, we offer quality. This is supported by a state-of-the-art laboratory accredited by the national accreditation body MOLDAC, as well as by the highly qualified specialists and dedicated employees who put care into their daily work.

Franzeluța S.A. meets the most demanding national and international requirements. The company holds prestigious certifications, including ISO 22000 for food safety management systems, Kosher certification, and ISO/IEC 17025, which sets out the general requirements for the competence of testing and calibration laboratories. These certifications attest to the quality and safety of the products made by the company.

SRL MARCU BAKERY
https://www.facebook.com/marcubakery

A good day starts with a good breakfast. To make any journey more enjoyable, stop by Marcu Bakery for a morning meal. The bakery is located in the village of Peresecina, along the Chișinău–Orhei route.

There, you'll find delicious pies fresh from the oven, great coffee, and a friendly, smiling team. Pan-fried pies, oven-baked pies, bread and pastries—it's all fresh and incredibly tasty.



G.T. MORARU ION VASILE

The team at G.T. “Moraru Ion Vasile,” are based in the village of Sipoteni, Călărași District, where we produce natural juices and apple vinegar.

Under the “De Sipoteni” brand, we offer apple and strawberry juice, cold-pressed and made by direct extraction. As stated on the label, the product contains no preservatives, sugar or additives and is made in the Republic of Moldova.

We showcase local fruit and production, offering products made in Sipoteni with care for their natural flavor.



I.M. VINARIA PURCARI S.R.L.
https://purcariwineries.com/

Château Purcari's long history began in 1827, with a special decree establishing Bessarabia's first specialized wine estate. The winemakers' efforts were later rewarded with a gold medal in 1878 at the Paris World's Fair, where the iconic Negru de Purcari was recognized.

Despite historical hardships and the socio-economic challenges facing Bessarabia, Château Purcari continued to operate, bringing iconic wines to the public—wines that became a fixture on the tables of European royal families. After weathering the tests of maturity imposed by political and economic transition, Château Purcari experienced a true revival in 2003, when it became part of the Purcari Wineries Group, led by Victor Bostan.

Thanks to changes and improvements in winemaking, winery infrastructure and sustainability, Château Purcari quickly became a new destination on Moldova's wine map, representing the Ștefan Vodă PGI region.

Over 20 years of transformation and investment, the Group has grown into one of the leading wine producers and the largest exporter of bottled wine in Moldova.



MILKMARK S.A. "FABRICA DE UNT DIN FLORESTI"
https://milkmark.md/

The MilkMark team operate in the dairy processing sector, producing butter and other dairy products. Our main goal is to provide products that are safe, consistent and made responsibly. Our factory follows simple principles: respect for the raw ingredients, sound production practices and the consumers who choose MilkMark products.

Food safety is a priority in everything we do. We comply with hygiene and control requirements at every stage of production, from milk reception to the finished product.

We use simple, suitable ingredients to make our dairy products, paying close attention to the quality and traceability of our raw materials.

We organize our production and delivery processes to ensure that MilkMark products reach consumers in proper condition while retaining the characteristics of each product.

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