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Conference Report

Abstracts of the 6th International Electronic Conference on Foods †

Arun K. Bhunia [1,2]

[1] Department of Food Science, Purdue University, West Lafayette, IN 47907, USA; bhunia@purdue.edu
[2] Department of Comparative Pathobiology, Purdue Institute of Inflammation Immunology and Infectious Diseases, Purdue University, West Lafayette, IN 47907, USA

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Abstract

The 6th International Online Conference on Foods—Future Horizons in Foods and Sustainability (Foods 2025) was hosted by the MDPI Journal *Foods* (ISSN 2304-8158, Impact Factor 5.1) from 28–30 October 2025, bringing together global experts, researchers, and practitioners to discuss the latest advancements and explore the challenges and opportunities shaping the future of food science and sustainability. As the demand for innovative and sustainable food solutions continues to grow, the role of food science in addressing global challenges has never been more vital. Foods 2025 aimed to foster collaboration and inspire breakthroughs to enhance food quality, safety, security, and sustainability. Furthermore, Personalized Foods or Foods as Medicine will drive future innovations.

Keywords: food quality; food safety; foods as medicine; sustainability; phytochemicals; biotechnology

1. Introduction

Foods 2025 featured a wide range of sessions covering critical topics in food science, including, but not limited to, the following:

A. Food Technology and Engineering;
B. Nutritional and Functional Foods;
C. Food Quality and Safety;
D. Food Microbiology;
E. Chemistry and Physicochemical Properties;
F. Sustainable Food Security and Food Systems;
G. Food Biotechnology;
H. Foods as Medicine.

2. Session A: Food Technology and Engineering

2.1. Production and Thermal Stability Analysis of Broken Rice Flour: Potential Applications in the Food and Packaging Industries

Gabryelle Araújo Coutinho, Nayana Hayss Araújo Da Silva, Mariana Lopes Geraldo and Camila Argenta Fante

Department of Food, Faculty of Pharmacy, Federal University of Minas Gerais, Belo Horizonte 31270-901, Brazil

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Rice production (*Oryza sativa* L.) generates a large amount of by-products, such as broken rice, which represents 8–14% of the grain's weight. Broken rice, composed of approximately 90% starch, consists of cracked or defective grains that are functionally similar to whole rice but are undesirable for human consumption due to their lack of visual appeal. Therefore, this study aims to produce broken rice flour (BRF) and characterize its thermogravimetric properties. The broken rice was purchased in Belo Horizonte, Minas Gerais, Brazil. It was washed, sanitized with sodium hypochlorite at a concentration of 200 mg·L^{-1} for 15 min, dehydrated in an oven at 70 °C ± 2 °C for 36 h, ground using a knife mill, sieved through an 80-mesh screen, and stored in polyethylene bags at 25 °C ± 2 °C. For the thermogravimetric analysis (TGA), 20 mg of BRF was placed in an aluminum crucible under a nitrogen atmosphere with a flow rate of 50 mL·min^{-1} and a heating rate of 15 °C·min^{-1} up to a final temperature of 600 °C. The TGA of BRF showed a thermal degradation process in three stages within the temperature range of 40 to 600 °C. The first stage, from 40 to 260 °C, corresponds to the dehydration process, characterized by water loss through evaporation. The second stage, from 260 to 340 °C, occurred due to the breakdown of C–H, C–O, and C–C bonds, attributed to the decomposition of starch, cellulose, and lignin. The third stage, from 340 to 600 °C, was caused by the carbonization of the materials. BRF exhibited thermal stability up to approximately 280 °C, highlighting its potential as a versatile raw material for both the food industry and materials science. Thus, BRF becomes a viable alternative for the development of new products and biopolymers, adding value and meeting the growing demand for sustainable products.

2.2. Data Analysis and Machine Learning on Eye-Tracking Data to Interpret Consumer Behavior for Yogurt Products with a Novel Edible Bio-Film

Georgios Anthimopoulos [1], Danai Ioanna Koukoumaki [2], Konstantinos Gkatzionis [3], Dimitris Sarris [2] and Efstathios Kaloudis [1]

1 Computer Simulation, Genomics and Data Analysis Laboratory, Department of Food Science and Nutrition, University of the Aegean, Metropolite Ioakeim 2, 81400 Myrina, Lemnos, Greece
2 Laboratory of Physico—Chemical and Biotechnological Valorization of Food By-Products, Department of Food Science & Nutrition, School of Environment, University of the Aegean, Leoforos Dimokratias 66, 81400 Myrina, Lemnos, Greece
3 Laboratory of Consumer and Sensory Perception of Food & Drinks, Department of Food Science and Nutrition, University of the Aegean, Metropolite Ioakeim 2, 81400 Myrina, Lemnos, Greece

This study presents a data-driven framework that integrates eye-tracking technology with algorithmic analysis to uncover patterns in consumer attention and preference. Using yogurt packaging as a case study, we recorded the gaze behavior of 100 participants as they viewed paired images, one featuring conventional plastic film and the other a novel, brown edible film derived from microorganisms. A key methodological innovation lies in the unsupervised identification of Areas of Interest (AOIs): Instead of relying on pre-defined regions, we employed clustering algorithms (e.g., k-means with silhouette score optimization) to detect natural groupings in gaze data, enabling more objective and personalized AOI boundaries. Multiple eye-tracking metrics were analyzed, including fixation duration, saccade duration and velocity, and pupil diameter. These features were processed and modeled using a suite of machine learning classifiers, including Decision Tree, Random Forest, Gaussian Process, Multilayer Perceptron, and AdaBoost. The results demonstrated classification accuracies of up to 83% in predicting participants' product preference based solely on visual behavior, highlighting a strong correlation between gaze dynamics and consumer decisions. Statistical comparisons also revealed significantly longer

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gaze durations toward the edible film, suggesting increased attention or a novelty effect. Future work should validate these findings by combining eye-tracking results with sensory evaluation methods, such as external preference mapping, and physicochemical analyses of the products to better understand how visual attention relates to sensory perception and product characteristics. The proposed approach showcases how advanced computational methods can enhance the interpretation of eye-tracking data in consumer research. Given the focus on yogurt, this methodology holds significant potential for informing sustainable packaging development, consumer segmentation, and product positioning in dairy and related food sectors. While the stimulus involved sustainable packaging, the broader contribution lies in demonstrating how machine learning and algorithmic analysis can uncover latent drivers of consumer choice from complex biometric signals.

2.3. Development and Characterisation of Texture-Modified Foods for Individuals with Swallowing Difficulties

Obafemi Kunle Akinwotu [1], Ayten Aylin Tas [2], Kevin David Anthony Taylor [1] and Bukola Adenike Onarinde [1]

[1] School of Agri-Food Technology & Manufacturing, University of Lincoln, PE12 7PT Holbeach, UK

[2] Department of Health Professions, Faculty of Health and Education, M15 6GX Manchester, UK

This study developed and evaluated three (3) selected texture-modified foods designed for people with swallowing difficulties, with the aim of meeting IDDSI Level 4 requirements. The three samples included a mechanically whipped pea-based foam (MWPF) made with green peas, pea protein, xanthan gum, and Chlorella algae; a carrot purée with xanthan and guar gum (CPXG), which was puréed, frozen, and reheated using microwave treatment; and a carrot purée with xanthan gum only (CPX). All samples were evaluated using IDDSI testing methods and instrumental tools to measure hardness, adhesiveness, viscosity, and particle size. MWPF showed the softest and smoothest texture, with 800 N/m^2 hardness, 20 J/m^3 adhesiveness, 300 cP viscosity, and 201 μm particle size. In comparison, CPX had a firmer and stickier texture (2300 N/m^2, 1100 J/m^3, 1500 cP, 490 μm), and CPXG became very thick after cooling, reaching a viscosity of 3600 cP and particle size of 629 μm. MWPF maintained its texture for at least 30 min and passed the IDDSI spoon tilt test at 21 °C, while CPXG failed the test after cooling from 95 °C to 35 °C. While all the samples met IDDSI Level 4 standards using either mechanical whipping or hydrocolloid thickening, mechanical whipping produced better textural and rheological properties in MWPF compared to the hydrocolloids used in CPX and CPXG. However, whipping introduced air, which reduced the nutrient density per volume. In conclusion, mechanical aeration is a useful method for producing safer textures for dysphagia diets, but future investigations are required to ensure that improvements in texture do not come at the cost of nutritional adequacy.

2.4. Effect of Addition of Amaranth (Amaranthus cruentus L.), Quinoa (Chenopodium quinoa W.) and Maca (Lepidium meyenii W.) Flour on Physicochemical and Rheological Properties of Dough

Beatriz Valcarcel Yamani and Suzana Caetano Da Silva Lannes

Biochemical Pharmaceutical Technology Department, School of Pharmaceutical Sciences, University of Sao Paulo, Sao Paulo-SP 05508000, CEP, Brazil

The effects of the addition of amaranth (*Amaranthus cruentus* L.), quinoa (*Chenopodium quinoa* W.) and maca (*Lepidiun meyenii* W.) flours on the physicochemical and rheological properties of wheat doughs were evaluated. Composite flours were prepared with 10%, 20%, 30% and 40% additions of amaranth, quinoa or maca flours, and their physicochemical (moisture, protein content, ash content, color, particle size and falling number) and

rheological (farinograph and extensograph) properties were evaluated. The addition of maca flour significantly increased the protein and ash content and reduced the brightness of the flour. With a 40% addition of maca, the composite flour also presented a higher percentage of particles with sizes $\leq$0.088 mm (up to 38.92%). An increase in the percentage of particles with sizes $\geq$0.177 mm (up to 33.39%) was observed in amaranth composite flours. Together with the control (wheat flour), quinoa and amaranth composite flours showed higher falling number values, indicating low enzymatic activity, while with an increasing maca flour addition, a significant increase in the enzymatic activity was observed (low falling number) ($p < 0.001$). The results of farinograph and extensograph analyses showed a significant decrease in the stability, development time, resistance, maximum resistance and extensibility of the dough and an increased tolerance index in the mixture. Also, with increased flour addition, all the doughs showed an increase in their percentage of water absorption. In conclusion, with the addition of amaranth and quinoa flours, doughs tended to be more plastic and short (low resistance to extension and extensibility), while they tended to be more rigid and short (high resistance to extension) with the addition of maca flour.

2.5. Electronic Nose with Modulated Temperature Sensor Array for Classification of Tomato Paste Fermentation

Víctor González, Alejandro Bernal, Félix Meléndez, José Ignacio Suárez and Jesús Lozano

Industrial Engineering School, University of Extremadura. Av. Elvas s/n., 06006 Badajoz, Spain

Introduction: Tomato paste is a key ingredient in the food industry, widely used in sauces, soups, and ready-to-eat meals. Its high concentration of sugars, acids, and moisture makes it particularly susceptible to microbial contamination and fermentation if not properly stored. Undesired fermentation alters the paste's chemical composition, generating off-odors, gas production, and color changes—leading to product rejection and economic losses. Traditional quality control methods can be time-consuming or require destructive sampling. Electronic noses with temperature-modulated sensors provide a fast, non-invasive approach to detect changes in volatile organic compounds (VOCs), offering a practical solution for monitoring spoilage in tomato paste.

Methods: A digital electronic nose was assembled using commercial MOX gas sensors: BME688, ENS160, SGP40 and ZMOD4410. A colour sensor (AS7341) was also included. BME688 and ENS160 allowed the software to control the hotplate temperature, while SGP40 and ZMOD4410 were modulated by adjusting the heater voltage. Sensors were exposed to a triangular temperature/voltage waveform from 200 °C to 400 °C and 3.3 V to 0.5 V, respectively.

Four sealed 2.4 kg industrial tomato paste bags were obtained from local producers. Half of each bag served as a control, while the other half was mixed with 50 mL of water and stored at 25 °C to induce fermentation.

Results: The electronic nose showed distinct response curves when sweeping the sensor temperature. Fermented samples produced different VOC profiles compared to non-fermented ones, which was evident in the curve shapes for each sensor. These differences were consistent and repeatable across all sensor types.

Conclusions: This study confirms that an electronic nose with temperature-modulated MOX sensors can effectively distinguish between fresh and fermented tomato paste. The thermal response curves provide a unique fingerprint for each condition, supporting the use of this system for quality control and spoilage detection in tomato-based products.

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2.6. Enhanced Enzymatic Deacidification of Squid Oil: Process Optimization and Comparison with Traditional Alkali Refining

Nan Pan [1], Huyishan Ma [2], Xiaoting Chen [1], Jingna Wu [3], Fang Zhang [2] and Zhiyu Liu [1]

1 Key Laboratory of Cultivation and High-Value Utilization of Marine Organisms in Fujian Province, National Research and Development Center for Marine Fish Processing (Xiamen), Fisheries Research Institute of Fujian, Xiamen 361013, China
2 College of Biological Science and Engineering, Fuzhou University, Fuzhou 350116, China
3 Xiamen Key Laboratory of Marine Medicinal Natural Products Resources, Fujian Universities and Colleges Engineering Research Center of Marine Biopharmaceutical Resources, Xiamen Medical College, Xiamen 361023, China

Squid oil is a rich source of ω-3 fatty acids (including EPA and DHA), which are highly beneficial to human health. However, the refining of squid oil is challenging due to its dark color, high acid value, and strong fishy odor. This study investigates enzyme-catalyzed deacidification as an alternative to conventional alkali refining. The aim is to reduce the acid value and optimize the deacidification process. Comparative experiments were carried out using four commercial lipases (Lipozyme 435, Lipozyme TL IM C, Lipozyme RM IM C, and DF Amano IM) and a self-prepared immobilized enzyme (GS "Amano" 250 G). Lipozyme 435 showed the highest deacidification efficiency. Subsequently, single-factor experiments and a Box–Behnken design combined with response surface methodology were applied to optimize the enzymatic deacidification process. The optimal conditions were determined to be a reaction time of 6 h, an ethanol concentration of 19%, and an enzyme loading of 83 PLU/g. Under these conditions, the acid value of the squid oil was reduced from 60.17 mg KOH/g to 2.27 mg KOH/g, corresponding to a deacidification rate of 94.58% and a yield of 73.22%. Notably, this yield represents a significant 51.28% improvement compared to traditional alkali refining. The enzymatic deacidification method offers several advantages over traditional processes, such as simplicity, higher yield, lower energy consumption, and reduced pollution. Additionally, the use of molecular sieves and high-speed homogenization to enhance substrate solubility proved effective in improving deacidification efficiency. Overall, these findings provide valuable technical insights and support for the enzymatic deacidification of high-acid squid oil.

2.7. Identifying Distinct Markers in Non-Volatile Compounds for Baijiu Based on Non-Targeted Metabolomics Analysis and Machine Learning

Jiawen Duan [1,2,3], Fei He [2,3], Dan Qin [1], Hehe Li [2,3], Baoguo Sun [2,3] and Fazheng Ren [1]

1 Department of Nutrition and Health, China Agricultural University, Beijing 100193, China
2 Key Laboratory of Geriatric Nutrition and Health, Beijing Technology and Business University, Ministry of Education, Beijing 100048, China
3 Beijing Key Laboratory for Food Quality and Safety, Beijing Technology and Business University, Beijing 100048, China

Baijiu is globally recognized as one of the most prestigious distilled spirits. The traditional blending of baijiu plays a pivotal role in developing its unique flavor profile and overall quality. The complex flavor matrix of baijiu comprises both volatile compounds and non-volatile compounds. Volatile compounds primarily define aromatic perception, and non-volatile compounds significantly contribute to palate structure and overall body integration. Researchers have studied more on volatile compounds in baijiu and lack of studies on non-volatile compounds. Notably, systematic comparative analyses of non-

volatile compounds dynamics across baijiu have remained conspicuously absent. To address this knowledge gap, non-targeted metabolomics were employed to analyze the non-volatile compounds in various baijiu samples using ultra-high performance liquid chromatography combined with electrospray ionization–triple quadrupole linear ion trap–MS/MS (UPLC–ESI–Q TRAP–MS/MS), and a total of 861 non-volatile compounds were identified. Based on differential metabolite analysis, Kyoto Encyclopedia of Genes and Genomes pathway enrichment analysis, and machine learning, the differences between the base samples and the commercial baijiu were explored, in addition to 7 pathways and 23 metabolic pathway markers that were found to be relevant to the formation of baijiu metabolites. By bridging traditional artistry with systems metabolomics, this study not only advances our understanding of the traditional blending process but also offers novel molecular targets for optimizing quality control in modern baijiu production.

2.8. Innovative Lab-on-Chip for the Rapid Detection of Polyphenolic Compounds in Olives and Their Derivatives

Alessandro Bianchi [1], Giorgia Tori [2], Neetu Malik [2], Isabella Taglieri [1], Mariacristina Gagliardi [2], Marco Cecchini [2], Antonella Battisti [2], Francesca Venturi [1] and Chiara Sanmartin [1]

[1] Department of Agriculture, Food and Environment, University of Pisa, via del Borghetto 80, 56124 Pisa, Italy

[2] NEST, Nanoscience Institute—CNR and Scuola Normale Superiore, p.zza S. Silvestro 12, 56127 Pisa, Italy

Polyphenols are key quality markers in olives and extra virgin olive oil (EVOO), influencing antioxidant potential, sensory traits, and shelf-life. Measuring polyphenol levels in fruits provides insight into the physiological condition of the plant, environmental interactions, and the overall quality of the harvest. This study aimed to develop a portable Lab-On-Chip platform integrating Quartz Crystal Microbalance with Dissipation monitoring (QCM-D) for the rapid assessment of olive phenolic content at various ripening stages, minimizing the need for expensive and time-consuming laboratory procedures. Sixty olive samples were collected at different ripening stages (green to fully ripe) across three cultivars, and thirty corresponding oil samples were analyzed. Olive phenolics were quantified using both aQCM-D device and the Folin–Ciocalteu (FC) method, allowing for direct comparison. Sensor surfaces were functionalized with bio-derived polymers (thiolated chitosan and carboxymethylcellulose), enabling selective binding of polyphenols. Standard solutions of hydroxytyrosol and tyrosol were used for calibration. QCM-D responses (Δf and ΔD) showed a strong correlation ($R^2 = 0.91$) with total polyphenol content measured using the FC method (range: 250–1300 mg GAE/kg). The repeatability of the QCM-D method showed an RSD 5%, with the analysis time under 10 min per sample. Compared to FC, the QCM-D method required only a non-toxic hydroalcoholic solvent (20% ethanol), offering faster turnaround and potential in situ application. The system successfully differentiated samples according to ripening stage, with early-harvest olives exhibiting the highest polyphenolic load and QCM-D signal. A multivariate predictive model (PLS regression) is being developed to correlate QCM-D fingerprints with the phenolic profiles and sensory parameters of the resulting oils. This integrated platform represents a valuable tool for quick and accurate phenolic analysis, enabling improved decision-making regarding harvest timing. Ultimately, it supports quality control practices that align with market trends and consumer preferences.

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2.9. Pampas Grass-Derived Nanocellulose for Mechanical and Hydrophobicity Enhancement of Starch-Based Packaging Films

Elsa Marisa Vieira [1], Lara Carvalho [1], Tomás Amaral [2] and Cristina Delerue-Matos [1]

[1] REQUIMTE/LAQV, Instituto Superior de Engenharia do Porto, Instituto Politécnico do Porto, Rua Dr. António Bernardino de Almeida 431, 4249-015 Porto, Portugal

[2] Ciências Químicas e das Biomoléculas, Escola Superior de Saúde, Instituto Politécnico do Porto (ESS/IPP), 4249-015 Porto, Portugal

Recent advancements have increasingly focused on utilizing renewable natural resources to produce nanocellulose for polymer reinforcement. Cortaderia selloana (pampas grass), a robust and widely distributed grass species known for its resilience in extreme environments, represents an abundant yet underutilized source of lignocellulosic biomass [1].

This study presents a novel method combining mechanical treatment with subcritical water processing to extract cellulose nanofibers (CNFs) from pampas grass. The resulting CNFs were characterized in terms of morphology, chemical composition, rheological behavior, and physical properties. These nanofibers were then incorporated into a starch-based film reinforced with chestnut shell fibers (CSFs) using a solvent casting technique as described in [2]. The film formulation was optimized using response surface methodology, evaluating the effects of the glycerol content (X1), CNFs/CSF ratio (X2), and zinc oxide (ZnO) nanoparticle content (X3) on the film's mechanical, optical, and physicochemical properties.

The extracted CNFs measured 1–12 μm in length and 35–120 nm in diameter and demonstrated superior thermal stability (320–700 °C) compared to commercial cellulose. FTIR analysis confirmed a high purity level, with negligible presence of lignin and hemicellulose. Incorporating just ~2% CNFs significantly enhanced the film's thermal stability and overall performance. Scanning electron microscopy (SEM) revealed a uniform microstructure with no visible phase separation between components.

In conclusion, a starch-based nanocomposite film reinforced with CNFs and CSF was successfully developed, exhibiting improved mechanical strength and water resistance. This environmentally friendly approach offers promising potential for sustainable food packaging applications.

2.10. PLS-DA-Based Classification of Red Wine Vintages via Digital Imaging and Chemical Properties

Emirhan Atlayan, Berkay Berk and Sevcan Ünlütürk

Department of Food Engineering, İzmir Institute of Technology, İzmir 35430, Türkiye

Classification of wine vintages plays a key role in verifying authenticity and product quality. Although advanced tools like FTIR spectroscopy combined with chemometrics are widely used, they require high-cost equipment and technical expertise. Digital image analysis offers a rapid, low-cost, and non-destructive alternative.

A total of 13 red wine samples from two vintages were analyzed. Total monomeric anthocyanin (TMA) content was determined using UV–Vis spectrophotometry, and total soluble solid (TSS) and alcohol levels were measured using a digital refractometer. Controlled lighting conditions were achieved using a custom-designed imaging cabinet, and CIE Lab color features were extracted from images using Python OpenCV. Orthogonal Partial Least Squares Discriminant Analysis (OPLS-DA) models were constructed in R with a nested cross-validation design (LOO outer loop with inner 5-fold hyperparameter tuning) to mitigate overfitting. Model significance was confirmed by permutation testing, and key variables were analyzed with Variable Importance in Projection (VIP) scores across folds.

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The final model achieved 92% classification accuracy and a Q^2 of 0.56. The classification error corresponded to a single misclassified sample. Given the small sample size, this single error had a disproportionate impact on overall accuracy. Expanding the dataset would stabilize accuracy metrics significantly. The significance of the model was confirmed through permutation testing (100 iterations), yielding $p < 0.05$, indicating that the observed class discrimination is unlikely due to random chance. Two clusters were observed on the S-plot: one being a strong negative correlation with L_{avg} (older) and other being a strong positive correlation with TMA (younger). Hyperparameter optimization selected zero orthogonal components across all CV loops, resulting in a pure PLS-DA structure. Key variables contributing to class separation included L_{avg} and TMA (VIP > 1).

These findings demonstrate that digital imaging combined with chemometric modeling can effectively discriminate vintages, which offers a practical, non-invasive tool for rapid vintage authentication and quality monitoring.

2.11. The Influence of Storage Conditions on Selected Physical Properties of Freeze-Dried Carrot Snacks Covered with Edible Films Based on Pork Gelatin

Agnieszka Ciurzyńska, Monika Janowicz, Magdalena Karwacka, Sabina Galus, Eryk Jezierski and Jakub Zwierzchowski

Department of Food Engineering and Process Management, Institute of Food Sciences, Warsaw University of Life Sciences-SGGW, Nowoursynowska Str., 159c, 02-776 Warsaw, Poland

The food packaging market is experiencing dynamic growth, driven by the emphasis on sustainable development and emerging technological innovations. Packaging must not only be ecological but also modern and attractive to consumers. Edible, soluble films are made from natural materials such as animal or plant proteins, polysaccharides and lipids. Freeze-dried products are characterized by high hygroscopicity and a delicate structure. The use of edible films for packaging freeze-dried bars can be an interesting alternative to plastic packaging.

The aim of this study was to investigate the changes in selected physical properties of freeze-dried carrot snacks packed in edible films based on pork gelatin at concentrations of 8% during storage at temperatures of 4 °C and 20 °C. For freeze-dried snacks after storage for 3 and 6 months at different temperatures, selected physical properties based on microscopic analysis, porosity, mechanical properties, and water activity were investigated.

The obtained results allowed us to state that the use of food films does not protect the product from adverse changes in physical properties and that the temperature and storage time affect the quality of freeze-dried carrot snacks. With the extension of storage time, water activity increased, porosity decreased, and the structure and mechanical properties weakened. The storage temperature of 20 °C and the time of 3 months are the most beneficial for samples covered with film with a concentration of 8% gelatin.

2.12. The Potential of Gamma-Decalactone in Active Edible Packaging for Strawberry Preservation

Gabriela Kozakiewicz [1], Jolanta Małajowicz [2], Magdalena Karwacka [1], Agnieszka Ciurzyńska [1], Karolina Szulc [1], Anna Żelazko [1] and Sabina Galus [1]

[1] Faculty of Food Technology, Warsaw University of Life Sciences—SGGW, 159c Nowoursynowska St., 02-776 Warsaw, Poland

[2] Faculty of Chemistry, Warsaw University of Life Sciences—SGGW, 159c Nowoursynowska St., 02-776 Warsaw, Poland

This study presents the development and evaluation of active edible films and coatings based on apple pectin enriched with γ-decalactone (GDL), a natural aroma compound with

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antimicrobial properties. Formulations were prepared using a 5% pectin solution with 30% glycerol as a plasticizer and GDL at concentrations of 2.5%, 5%, and 10%. The films were characterized in terms of microstructure, optical properties (increase in opacity from 1.10 to 8.64 a.u./mm), mechanical strength (decrease from 13.84 to 5.68 MPa), gas and water vapor permeability (decrease in sorption from 1.45 to 0.80 g/g dry matter), UV-visible light barrier properties, and antimicrobial activity. FTIR analysis confirmed interactions between GDL and the polymer matrix. GDL addition significantly increased film porosity and enhanced bioactivity—5% GDL completely inhibited the growth of *Bacillus subtilis* and *Yarrowia lipolytica*, and reduced *Monilinia fructicola* development by 70%.

In the application part, the effect of the coatings on the quality of strawberries stored for 9 days under refrigerated conditions was assessed. The coatings reduced weight loss and firmness degradation, and slowed spoilage—only 14.29% of fruit showed decay compared to 57.14% in control samples. Despite accelerated softening, the coatings stabilized pH, color, and soluble solids content. PCA analysis confirmed the impact of coatings on the quality variability of strawberries during storage. These results indicate the potential of GDL as a component of active edible coatings and justify further research on the optimization of its controlled release in biodegradable packaging systems for perishable products.

2.13. The Role of Granule Surface-Associated Lipids in Modulating Starch Functionality and Digestibility

Abdela Befa Kinki, Bilatu Agza Gebre, Mengting Ma and Zhongquan Sui

Department of Food Science & Technology, School of Agriculture and Biology, Shanghai Jiao Tong University, Shanghai 200240, China

Granule Surface-Associated Lipids (GSALs) play a pivotal role in modulating the physical, functional, and nutritional properties of starch, despite their low abundance. Studies reveal notable differences in lipid content and interaction patterns among starch granules from various sources. Cereal starches, such as wheat and maize, possess higher levels of GSALs, whereas tuber starches like potato and cassava contain lower but functionally significant amounts. The study reveals that these lipids consist mainly of neutral lipids, glycolipids, and phospholipids, with palmitic, stearic, and oleic acids as the predominant components. These lipids influence starch behavior through helical complex formation with amylose, interfacial modification of granule surfaces, and stabilization of crystalline domains. Their removal markedly alters swelling power, water absorption capacity, and enzymatic hydrolysis rates, indicating that even small lipid fractions significantly affect functional performance. Studies show that GSALs enhance peak viscosity and accelerate retrogradation kinetics. The literature further confirms that GSAL removal significantly modifies starch thermal properties, notably lowering the onset of gelatinization temperature and increasing peak viscosity. In vitro digestion studies reveal that GSALs inhibit enzymatic hydrolysis, as evidenced by elevated hydrolysis index post-extraction. GSALs also promote resistant starch formation, which is more pronounced in cereals than in tubers, and enhance extrudate expansion and mechanical strength in thermoplastic starch, particularly from cereals. These findings establish GSALs as essential design elements for tailored applications: cereal starches suit thermally stable foods and robust bioplastics, while tuber starches are ideal for rapid viscosity development. Future research should prioritize in operando characterization, lipidomics profiling, and crop engineering to fully harness GSAL functionality. This review redefines GSALs as indispensable starch modifiers with broad implications for food and material science innovation.

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2.14. A Biochar-Integrated Hydroponic Platform for Enhanced Microgreen Food Cultivation Under Water-Limited Conditions

Ruogu Tang and Juzhong Tan

Department of Animal and Food Sciences, University of Delaware, Newark, DE 19713, USA

This study presents a novel biochar-fortified hydrogel cultivation system designed to enhance lettuce microgreen growth under moisture-limited conditions—an escalating challenge in controlled-environment agriculture and urban food production. Biochars derived from various biomass sources were incorporated at different concentrations (1–10% *w*/*w*) into a phytagel-based hydrogel matrix to tailor the physicochemical properties of the growing substrate for optimal plant performance.

Lettuce microgreens were cultivated under progressively reduced relative humidity (from 70% to 30%) to simulate drought stress. Experimental results demonstrated that both biochar type and dosage significantly influenced the water retention, aeration, and nutrient availability of the hydrogel substrate. These improvements translated into higher biomass yield, enhanced shoot and root elongation, and elevated chlorophyll content compared to untreated controls. Substrate characterization confirmed that biochar amendments substantially increased surface area and porosity, resulting in superior moisture-buffering and sorptive functions critical for sustaining plant growth under limited water conditions.

This work advances food technology and engineering by offering a scalable, cost-effective strategy for functional substrate engineering in soilless cultivation systems. The integration of diverse biochar types into hydrogel media represents a sustainable and circular innovation that supports water-efficient, high-density crop production—particularly relevant for vertical farming, urban agriculture, and precision farming technologies. By addressing critical resource constraints, this engineered platform has significant potential to drive resilient and sustainable food production technologies in the face of climate variability and global food security challenges.

2.15. A Comparative Life Cycle Assessment of Drying Strategies for the Valorization of Pea Byproducts

Nelly Bafumi [1], Alessandro Dal Pozzo [1], Stella Plazzotta [2] and Alessandro Zambon [1]

[1] Dipartimento di Ingegneria Civile, Chimica, Ambientale e dei Materiali, Università di Bologna, via Terracini n.28, 40131 Bologna, Italy

[2] Department of Agricultural, Food, Environmental and Animal Sciences, University of Udine, via Sondrio 2/A, 33100 Udine, Italy

The valorization of food industry byproducts is crucial for reducing the agri-food supply chain's environmental impact and ensuring food security. Substandard peas alone generate 0.135 million tons/year of waste in the EU. Innovative technologies like Supercritical CO_2 Drying (SCD) offer a promising approach to valorizing food waste with a zero-waste strategy. This study aims to apply Life Cycle Assessment (LCA) methodology to compare the environmental impact of Solvent Exchange + Supercritical Drying (SE + SCD) with traditional Air-Drying (AD) and Freeze-Drying (FD). This work focused on the carbon footprint derived from the pea drying process using the climate change (CC) indicator.

The preliminary study was conducted based on preliminary results achieved at the pilot scale [3], projecting the results at a bigger scale. For the LCA study, the functional unit was set to1 kg of substandard peas. The system boundaries were set from suboptimal pea discharge to the obtainment of dried peas. Primary data were derived from literature [3] and company interviews, while secondary data were obtained from the Italian energy mix and the Ecoinvent 3.10 database.

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Among the technologies, AD showed the lowest environmental impact at both scales (0.037 and 0.429 kg CO_2 eq, respectively). At the pilot scale, SCD and FD had comparable emissions; however, at the industrial scale, SCD showed the highest emissions. A total of 35% of the impact at the industrial scale from SE + SCD was derived from solvent consumption.

These findings highlight the potential of SE + SCD as an innovative drying technology; however, future improvements in the solvent and CO_2 recovery systems could be crucial for minimizing the environmental impact and leveraging this technology for food waste valorization. This work was part of the project "Upcycling pea waste side streams for developing future food ingredients-UPea", by the Italian Ministry of University and Research (MUR) through the Next Generation EU, PNRR M4C2-I1.1, for the funded Project PRIN 2022 [Grant No. 20222P5C3E – CUP C53D23004980006].

2.16. A Novel Maillard Intermediate as a Flavor Precursor and Color Modulator: Thermal Behavior and Processing Adaptability of an Alanine–Xylose Amadori Rearrangement Product in Model and Meat Systems

Junhe Yu [1], Heping Cui [2], Imre Blank [3], Frank Oliver [4] and Xiaoming Zhang [2]

1 Laboratory for Functional Foods and Human Health, Center for Excellence in Post-Harvest Technologies, North Carolina Agricultural and Technical State University, North Carolina Research Campus, 500 Laureate Way, Kannapolis, NC 28081, USA
2 State Key Laboratory of Food Science and Technology, School of Food Science and Technology, Jiangnan University, 1800 Lihu Road, Wuxi 214122, Jiangsu, China
3 Zhejiang Yiming Food Co., Ltd., Jiuting Center Huting North Street No. 199, Shanghai 201600, China
4 Chair of Food Chemistry and Molecular Sensory Science, Technical University of Munich, Lise-Meitner-Strasse 34, D-85354 Freising-Weihenstephan, Germany

Amadori rearrangement products (ARPs), as stable intermediates of the Maillard reaction, offer potential for controlled flavor generation and color modulation in thermally processed foods. This study investigated the flavor–color formation and thermal processing adaptability of an alanine–xylose ARP (AX-ARP) under varying temperatures (100–160 °C), pH values (4.5–10.5), and precursor ratios using aqueous model systems and a meat matrix. Volatile compounds were analyzed via headspace solid-phase microextraction coupled with gas chromatography–mass spectrometry (HS–SPME–GC–MS), and flavor profiles were characterized by means of an electronic nose and principal component analysis (PCA). In model systems, AX-ARP produced 1.8–5.4 times more total volatile compounds (TVCs) than its precursor mixture (AX) at 100–140 °C, with furfural and pyrroles being dominant. Pyrazines were only generated above 120 °C or under alkaline pH. Alanine addition (ARP–alanine molar ratio = 1:3) significantly increased pyrazine content (from 0.52 to 5.54 μg/L), while excess xylose suppressed overall TVC production. Color measurements showed that browning intensity (A_{420}) and a^* values increased significantly under acidic conditions and precursor supplementation. In the meat matrix (chicken sausage), the roasting, microwave, and frying treatments enhanced ARP-derived flavor release, with frying yielding the highest TVCs (274.6 μg/L). Across all cooking methods, AX-ARP addition significantly suppressed lipid oxidation markers in meat, reducing levels of hexanal by 88–99% and those of nonanal by 72–97% compared to controls. Since lipid oxidation contributes to rancidity, off-flavors, and reduced shelf life, this suppression highlights the potential of AX-ARP to enhance both the sensory quality and storage stability of meat products. PCA showed that pH, precursor ratio, and cooking method significantly influenced the flavor profile of AX-ARP, with alkaline conditions shifting it closer to that of its AX precursor.

These findings highlight the potential of alanine–xylose ARP as a novel flavor precursor and color modulator for thermally processed meat products.

2.17. Advances in Plant Protein Extraction and Purification from Traditional Methods to Modern Technologies

Thomas Wilbur Davis

Doctor of Plant Health, University of Nebraska-Lincoln, Lincoln, NE 68583, USA

The global shift toward plant-based proteins is driven by the need for sustainable food systems, improved public health, and enhanced food security. However, traditional extraction methods, such as alkaline extraction–isoelectric precipitation (AE–IEP), often result in protein denaturation, limited functionality, and increased environmental impact. These limitations have prompted efforts to develop more efficient and sustainable technologies.

This study systematically examines peer-reviewed studies comparing conventional techniques (AE–IEP and salt and solvent extraction) with innovative approaches such as ultrasound-assisted extraction (UAE), pulsed electric field (PEF), microwave-assisted extraction (MAE), ionic liquid extraction, and membrane-based purification. Articles were searched in Web of Science and Scopus using the keywords "Plant Protein Extraction" and "Purification." From 3761 initial records, duplicates, non-English texts, and studies without methodological detail were excluded. After screening and eligibility checks, 124 full-text articles were assessed, and 72 studies were finally included in the synthesis.

The synthesis of the current literature shows that modern approaches are being applied across a wide range of crops and biological sources, from cereals and legumes to oilseeds, algae, and underutilized plants. Emerging methods consistently improve extraction efficiency, enhance solubility and emulsification properties, and reduce contaminants such as phenolics, anti-nutritional compounds, and toxins. Research also highlights the integration of nanotechnology, enzymatic modification, and microbial or biopolymer-based approaches, which expand functional and therapeutic applications. Studies on protein–polyphenol complexes, bioactive peptides, extracellular vesicles, and enzyme-assisted detoxification further demonstrate how extraction and purification are increasingly linked to health-related benefits, not just yield and purity.

Overall, modern technologies provide substantial improvements in the quality and functionality of plant protein isolates. Yet, challenges remain in balancing yield, purity, and cost, as well as scaling laboratory advances into industrial processes. These advances, when adapted to different plant sources and market needs, hold strong potential for building resilient protein systems that meet both nutritional demands and sustainability goals.

2.18. Advancing Cold Brew Coffee Through Probiotic Integration

Patimakorn Klaiprasitti

Department of Food Technology, Faculty of Technology, Khon Kaen University, Khon Kaen 40000, Thailand

The global coffee industry, a cornerstone of economic and cultural life, faces evolving consumer demands for a holistic experience integrating taste, health benefits, and convenience. This shift necessitates innovative product development, ensuring consumer satisfaction and stringent food safety standards. This study introduces instant cold brew coffee in powder form as a significant technological advancement. This format preserves fresh coffee's sensory quality while substantially improving product stability and shelf life, directly addressing food quality. It also inherently mitigates microbial risk, simplifies logistics, and reduces supply chain costs—all critical for enhancing food safety and efficiency. Driven by increasing gut health awareness, we explored integrating lactic acid

bacteria (LAB) into this innovative coffee. Research meticulously investigated the stress adaptation of five LAB strains under various sublethal conditions; notably, *Lactobacillus casei* showed superior resilience to heat and cold stress, while *Lactobacillus acidophilus* demonstrated stronger tolerance to acidic environments and bile salts. To simulate industrial drying, probiotic strains underwent thermal challenges, revealing that acid adaptation significantly enhanced *L. acidophilus TISTR 1338*'s heat tolerance. A novel encapsulation method, utilizing rice bran-derived prebiotics, pectin, and resistant starch via crosslinking and freeze-drying, was developed to enhance probiotic viability under harsh processing and storage. This innovation achieved the highest encapsulation efficiency, ensuring encapsulated probiotics retained a viable count of 5 log CFU/g after in vitro digestion, meeting functional food thresholds. Ultimately, this innovation enables synbiotic cold brew coffee that delivers tangible health benefits, setting new benchmarks for modern food safety and quality. By transforming a perishable beverage into a stable, safe, and functional powdered product, this research marks a significant advancement in functional beverage technology and probiotic delivery systems, benefiting producers and consumers alike through innovation and a strong commitment to quality.

2.19. Analyzing the Health Perceptions and Consumption Patterns of Pre-Cooked Noodles

Njomza Gashi [1,2], Besjana Elezaj [3], Dejsi Qorri [4] and Salih Salihu [2]

1 Center for Complex Systems and Microbiome Innovations, Faculty of Agricultural and Food Sciences and Environmental Management, University of Debrecen, H-4032 Debrecen, Hungary
2 Department of Food Technology with Biotechnology, Faculty of Agriculture and Veterinary, University of Prishtina, 10 000 Prishtina, Kosovo
3 Department of Urban Agriculture, Faculty of Agriculture and Veterinary, University of Prishtina, 10 000 Prishtina, Kosovo
4 Institute of Economics, Faculty of Economics and Business, University of Debrecen, H-4032 Debrecen, Hungary

This study explores consumer attitudes towards pre-cooked noodle consumption and its perceived health implications. A comprehensive survey was conducted with 400 participants, representing a diverse range of age groups, educational backgrounds, and family sizes across different regions of Kosovo. The primary aim of the research was to assess the relationship between noodle consumption habits and various health concerns, with a particular focus on issues such as the high sodium content, the presence of preservatives, and the potential for weight gain associated with frequent consumption. By analyzing demographic variables alongside consumption patterns, this study sought to gain a deeper understanding of how health perceptions influence consumer choices in the context of pre-cooked noodle consumption.

A total of 400 questionnaires were distributed, gathering data on demographic characteristics, consumption frequency, and health-related perceptions. The results indicate that convenience plays a major role in pre-cooked noodle consumption, with 56.8% of respondents citing time constraints as the primary reason for their choice. Despite the convenience, health concerns were prevalent, with a significant number of respondents expressing worries about high sodium content and additives. Furthermore, a majority of participants reported no existing health issues, though many were aware of potential risks, especially in relation to weight gain and high sodium intake.

These findings suggest that while pre-cooked noodles are popular due to their convenience, health concerns remain a significant factor influencing consumer behavior. This study highlights a need for healthier alternatives in the market to address these concerns.

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2.20. Antioxidant Properties of Olasiman (Portulaca oleracea) Against Oxidative Rancidity of Roasted Peanuts

Kristan Diane Canta, Kylene Michele Balbuena, Chynna Mae Marie Bautista, Amie Lawrenz Castillo, Louise Claire Rivera and Ashlyn Reign Sarce

College of Science, Bulacan State University, Malolos, Bulacan 3000, Philippines

Peanuts, a widely cultivated crop in the Philippines, are susceptible to oxidative rancidity due to their high fat content. Antioxidants are commonly applied to inhibit oxidation in peanuts. This study assessed the effectiveness of adding *Portulaca oleracea* extract to roasted peanuts to control oxidative rancidity. The *Portulaca olerecea* extract, known for its antioxidant and omega-3 content, was evaluated for its pH (4.6), total soluble solids (56 °Bx), and color (yellow brown). Different concentrations of the extract (10%, 15%, and 20%) were incorporated into roasted peanuts. For a two-week storage period, rancidity indices such as moisture content, peroxide value, and free fatty acid were measured. Roasted peanuts with 10% *P. olerecea* extract exhibited the lowest moisture content of 1.49–1.53%, while the control group had the highest moisture content of 2.42–3.89% for 2-week storage. In contrast, in terms of peroxide value, the control group had the lowest peroxide value (0.19–0.45 meq/kg), followed by roasted peanuts with 20% *P. olerecea* extract (0.19–0.54 meq/kg). The same was observed for free fatty acid, with the control group exhibiting the lowest %FFA of 1.08–1.35% oleic acid, followed by the sample with 20% *P. olerecea* extract (1.09–1.35%), all exceeding the CODEX standards of 1.0%. All samples of roasted peanuts with *P. oleracea* showed a result of 10 cfu/g for the total plate count, less than 10 cfu/g for *E.coli*, a total coliform count less than 10 cfu/g, and a yeast count and mold count less than 10 cfu/g, and *S. aureus* showed less than 10 cfu/g, which passed FDA standards. Furthermore, a sensory evaluation with 96 panelists was conducted after thirty-eight days of storage, favoring the roasted peanuts with 10% *P. oleracea* extract, where an off flavor was not detected. Further research is recommended to explore the potential of *Portulaca oleracea* as a food antioxidant comprehensively in longer storage periods.

2.21. Artificial Intelligence-Driven Analysis of Enzymatically Modified Lysozyme: Predicting Bioactivity and Allergenicity of Functional Peptide Fractions

Łukasz Tomczyk [1], Aneta Tomczak [2], Agata Biadała [1] and Renata Cegielska-Radziejewska [1]

[1] Department of Food Quality and Safety Management, Poznan University of Life Sciences, Poznan, Poland

[2] Department of Food Biochemistry and Analysis, Faculty of Food Science and Nutrition, Poznan University of Life Sciences, Poznan, Poland

Introduction: Lysozyme is a well-established antimicrobial protein, commonly used in food preservation due to its efficacy against Gram-positive bacteria. However, its limited activity against Gram-negative strains and allergenic potential present challenges for broader food-related applications. In our previous research, we demonstrated that the enzymatic hydrolysis of lysozyme under specific conditions leads to the formation of bioactive peptide fractions with improved surface properties, expanded antimicrobial spectrum, and reduced immunogenicity. Building on these findings, the present study aims to provide a detailed characterization of the generated lysozyme preparations using advanced multivariate statistical analyses. By evaluating the relationships between hydrolysis conditions and functional outcomes—such as peptide content, surface hydrophobicity, antioxidant capacity, and immunoreactivity—this work supports the rational development of novel, sustainable biofunctional ingredients for the food and health sectors.

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Methods: Sixteen lysozyme variants were generated under varying enzyme concentrations, pH, and reaction times. Each preparation was characterized for hydrolytic and antioxidant activity, surface hydrophobicity, peptide/oligomer content, and immunoreactivity using electrophoresis, ELISA, and Western blot. Multivariate data were analyzed using machine learning models, including multilayer perceptrons (MLP), random forests, and principal component analysis (PCA), to identify patterns and predictive relationships.

Results: MLP and random forest models successfully classified lysozyme preparations based on functional outcomes such as antibacterial efficacy and immunogenic potential. PCA revealed strong correlations between peptide fraction content, hydrophobicity increase, and allergenic signal reduction. The most effective preparations, characterized by >80% peptide content and >40% hydrophobicity increase, were obtained at high pepsin ratios (1:125 to 1:100) and low pH. AI-driven modeling predicted optimal reaction conditions for target functionalities with over 90% accuracy.

Conclusions: This study integrates enzymatic protein engineering with AI-based data analysis to enable rational design of lysozyme-derived antimicrobial peptides. Our findings highlight how predictive models can guide the development of functional food or pharmaceutical ingredients with reduced allergenicity and enhanced bioactivity, demonstrating a novel interdisciplinary approach for protein optimization.

2.22. Assessment of the Iron–Rice Premix Production and Shelf-Life from Different Local Manufacturers Through Statistical Process Control Tools

Abbie L. Padrones [1], Gyle D. Tampil [1], Richard L. Alcaraz [2], Bianca Drew Marie E. Espeño [3], Maricar D. Albao [1] and Junimer B. Lala [1]

[1] Department of Science and Technology, Food and Nutrition Research Institute, Bicutan, Taguig City 1630, Philippines
[2] Department of Science and Technology, Regional Office V, Legazpi City 4500, Philippines
[3] Department of Health, Research Institute for Tropical Medicine, Muntinlupa City 1781, Philippines

The iron–rice premix (IRP), created by the Department of Science and Technology–Food and Nutrition Research Institute (DOST-FNRI) and distributed through licensed manufacturers, was designed to combat iron deficiency anemia in the Philippines. This study evaluated IRP production from various licensees using statistical process control (SPC) methods. The research team examined key product aspects such as kernel composition, size, bulk density, moisture, color, iron content, taste, and microbiological quality from collected samples submitted by four production facilities. SPC was implemented in two stages: Phase I established control charts to measure production consistency, while Phase II monitored for subtle variations using data from an established control. Additionally, IRP stability was tested after six months of storage, focusing on iron retention, sensory attributes, and safety.

Our findings revealed that IRP from three out of four manufacturers met the Department of Health–Food and Drug Administration (DOH-FDA) standards. Of these, only two manufacturers consistently produced IRP within statistical control, supported by high capability indices (Cp-KD > 1.33, Cp-KC > 1.25). The study results also demonstrated that IRP remained physically and chemically stable—including iron content—when kept at room temperature, maintaining quality and safety throughout the storage period. To further enhance quality assurance, it is recommended that advanced quality control measures be integrated into future technology transfer trainings.

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2.23. Automation-Assisted Recovery and Dispensing of Micro-Particle Salt in Industrial Food Production Lines: System Development and Experimental Analysis

Furkan Tığ [1] and Fatih Kırmızıgöl [2]

[1] Afyon Kocatepe University, Afyonkarahisar 03200, Turkey
[2] Mechanical Engineering Department, İzmir Kâtip Çelebi University, Izmir 35620, Turkey

In industrial food production, dispensing systems for ingredients such as salt and spices play a significant role in enhancing flavor, preserving products, and ensuring consistency. The literature emphasizes that excessive salt consumption in processed foods poses serious challenges not only for public health but also for sustainability. While macro-scale recovery systems for biscuit crumbs or dough are present in limited studies, there is a notable experimental research gap regarding closed-loop automation systems capable of real-time recovery of micro-particle food materials.

In this study, a salt dispensing machine operating with micro-particle salt was designed and developed with an integrated feedback recovery system. The developed system enables the real-time return of salt particles that have been dispensed but did not adhere to the dough back onto the production line via a conveyor belt. Experimental tests were conducted to analyze the amount of salt dispensed per minute and the distribution uniformity across the belt surface at different conveyor speeds.

Preliminary findings indicate that the real-time recovery system significantly reduces waste and enhances hygiene compared to manual systems. The transition to an automated system reduces dependence on human labor, eliminating time losses caused by manual intervention. Since manual systems require human involvement, it is difficult to determine comparative percentage-based data. Although academic sources lack numerical data on salt recovery, industry reports mention cheese salting systems with up to 271 kg/min dosing capacity, but without real-time recovery features. The system proposed in this study achieves a dispensing capacity of 50 kg/min, making it the highest throughput micro-particle dispensing system with recovery reported in the food-grade category. This study presents a scalable, hygienic, and Industry 4.0-compatible automation solution that contributes to environmental sustainability, production efficiency, and food safety, while demonstrating the feasibility of adapting recovery systems to micro-particle food applications such as salt, spices, and flour.

2.24. Biosensors for the Analysis of Bioactive Compounds in Functional Drinks: Evolving Technologies and Long-Term Potential

P. Barciela [1], A. Perez-Vazquez [1], E. Yuksek [1], A. Silva [1,2], A. G. Pereira [1,3], M. F. Barroso [2] and M.A. Prieto [1]

[1] Instituto de Agroecoloxía e Alimentación (IAA), Universidade de Vigo, Nutrition and Food Group (NuFoG), Campus Auga, 32004 Ourense, Spain
[2] REQUIMTE/LAQV, Instituto Superior de Engenharia do Porto, Instituto Politécnico do Porto, Rua Dr António Bernardino de Almeida 431, 4200-072 Porto, Portugal
[3] Investigaciones Agroalimentarias Research Group, Galicia Sur Health Research Institute (IIS Galicia Sur). SERGAS-UVIGO, 36213 Vigo Spain

The growing consumer focus on well-being and sustainability, coupled with the widespread adoption of plant-based diets, has fueled a significant surge in the global functional drink market, which is expected to expand by USD 13.7 billion from 2024 to 2028. These types of beverages have emerged as a leading segment due to their ease of use, sensorial desirability, and capacity to deliver bioactive compounds in relevant physiological concentrations. Today, R&D lines are being focused on formulations fortified with antioxidants, vitamins, essential amino acids, omega-3 fatty acids, prebiotics, and probiotics, with

synergistic benefits in the modulation of the immune system, inflammation, or cognitive health. Quantification of these compounds is a critical stage in the design, control of quality, and compliance of functional drinks. Yet, their screening involves technical hurdles given the complexity and variability of food matrices, ranging from simple aqueous mixtures to colloidal systems or stabilized emulsions, as in the case of dairy-type beverages of vegetable origin. Moreover, it is often required to simultaneously detect multiple analytes with diverse physicochemical properties, which increases analytical difficulty. Against this backdrop, biosensors are emerging as encouraging analytical platforms that deliver high sensitivity and specificity, real-time response, and miniaturization potential for in situ solutions. In particular, electrochemical and optical biosensors have proven to be effective in targeting key bioactive compounds in complex matrices. The latest progress in transducers based on nanotechnology and biological recognition elements like aptamers has significantly improved detection limits and operational stability. Therefore, this systematic review, conducted in accordance with PRISMA guidelines, will give an up-to-date overview of the state of the art in biosensing technologies applied to functional drinks by critically evaluating parameters and long-term potential for more scalable, intelligent, and affordable food analysis systems.

2.25. Characterization and Quantification of Dietary Fiber Extracted via Sonication from Oat Cultivar SGD81

Muhammad Suhail Ibrahim [1], Ghulam Abbass [2], Humaira Rafique [2], Wajahat Azeem [3] and Ahmed Mujtaba [4]

[1] Institute of Food and Nutritional Sciences, PMAS-Arid Agriculture University, Rawalpindi 46000, Pakistan
[2] i3N/CENIMAT, Department of Materials Science, NOVA School of Science and Technology and CEMOP/UNINOVA, Campus de Caparica, 2829-516 Caparica, Portugal
[3] Department of Plant Pathology PMAS Arid Agriculture University, Rawalpindi 46000, Pakistan
[4] Food Sciences and Technology, Kohsar University Murree, Rawalpindi 75660, Pakistan

Polysaccharides have gained attention from researchers due to their various therapeutic and biological advantages; hence, various sources are being explored. Oats were chosen in this study to be an efficacious and economical source of dietary fiber (DF). Oats are mostly used for livestock and poultry feed and thus have a low utilization rate and low added value. In this study, dietary fiber was extracted by sonication with extraction conditions optimized using the response surface methodology (RSM). Three factors, including time, temperature, and amplitude, were taken at three levels. The optimal extraction conditions were found to be 14.65 min for time, 24.23 °C for temperature, and 76.51% for amplitude. Under these optimal conditions, the observed values for yield, TDF, SDF, and IDF were 34.267 g, 14.6882 g, 4.0731 g, and 10.6241 g, respectively. X-ray diffraction analysis indicated maximum crystallinity due to the acoustic effect of the sonication process. Scanning electron microscopy showed a loose porous network structure. Fourier-transform infrared spectroscopy of DF showed characteristic absorption peaks at 3620.39 cm^{-1}, 3450.65 cm^{-1}, 2914.44 cm^{-1}, 1720.5 cm^{-1}, 1519.91 cm^{-1}, 1438.9 cm^{-1}, 1249.87 cm^{-1} and 1022.27 cm^{-1}, while the infrared spectrum showed characteristic absorption peaks at 3450.65 cm^{-1}, 3450.65 cm^{-1}, 2914.44 cm^{-1}, 1720.5 cm^{-1}, 1519.91 cm^{-1}, 1438.9 cm^{-1}, 1249.87 cm^{-1} and 1022.27 cm^{-1}, which is consistent with the structure of cellulose polysaccharide. Differential scanning calorimetry analysis showed that there were three exothermic peaks at 240–310 °C, 320–350 °C, and 440–460 °C, which may represent the pyrolysis peaks of hemicellulose, cellulose, and lignin, respectively, indicating that

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DF had good thermal stability. The results indicate that the oat DF can be used for the production of dietary fiber products and health-care products.

2.26. Characterization of By-Products from the Production of Blackberry Juice and Liqueur

Inmaculada Gómez, Hayat Makroudi, Beatriz Melero and Miriam Ortega-Heras

Department of Biotechnology and Food Science, Faculty of Sciences, University of Burgos, 09001 Burgos, Spain

The growing preference for natural additives is driving the recovery of bioactive compounds from the food industry by-products. The objective of this study was to characterize the powered products obtained from by-products from the blackberry juice and liqueur production industry and evaluate their antioxidant effects. The residues obtained from two types of by-product (blackberry juice or liqueur) were studied in two ways: as a whole (seeds plus skin, S + S) and considering only the seeds (S). Thus, four samples were analyzed based on the type of by-product and the fraction studied: juice-S + S (JSS), juice-S (JS), liqueur-S + S (LSS), and liqueur-S (LS). The proximate composition, water activity (aw), pH, acidity, and polyphenols were determined. The capacity to inhibit fat oxidation (Rancimat method) was studied at three concentrations: 4%, 6%, and 8%. All the analyses were carried out in duplicate. ANOVA and Tukey's test were performed. The residues containing only seeds (JS and LS) were characterized by a higher fiber (81.6–83.5%) and fat content (11.7–12.5%) and lower levels of sugars (10.6–1.50%) and acidity (0.474–0.205 g citric acid/100 g), respectively, compared to the residues containing seeds plus skin (JSS and LSS, respectively), which showed the following contents of fiber (28.3–53.4%), fat (4.3–8.4%), sugars (42.2–24.4%), and acidity (1.59–1.43 g citric acid/100 g). The content of polyphenols (27.7–28.4 mg GAE/g) and anthocyanins (6.12–2.21 mg cyanidin-3-glucoside/g) was higher in the seeds plus skin fraction (JSS and LSS) than in the seeds (polyphenol content: JS 27.2, LS 16.4 mg GAE/g; anthocyanin content: JS 0.752, LS no detected mg cyanidin-3-glucoside/g). The antioxidant activity and fat oxidation inhibition capacity were also higher in the JSS and LSS products. Therefore, the studied by-products could be used as functional ingredients in the development of healthier foods due to their high content of polyphenols with proven antioxidant activity.

2.27. Chitosan-Based Active Films Enriched with Moroccan Essential Oils for Antimicrobial Packaging Applications

Hajar El Aidos [1], Ahmed Elidrissi [1], Abir El-Araby [1], Rachid Mamouni [2] and Fouad Achemchem [1]

[1] Bioprocess and Environment Team, LASIME Laboratory, Agadir Superior School of Technology, University Ibn Zohr, BP 33/S, Agadir 80150, Morocco

[2] Biotechnology, Materials & Environment Team, Agadir Faculty of Sciences, University Ibnou Zohr, Agadir 80150, Morocco

Ensuring the microbiological safety and extended shelf-life of food products remains a global priority. In this context, the development of biodegradable and bioactive packaging films represents a promising eco-innovative solution. This study aimed to develop and evaluate active packaging films based on chitosan extracted from shrimp shells and enriched with essential oils. Chitosan was selected for its intrinsic film-forming and antimicrobial properties, while essential oils from *Thymus satureioides* and *Rosmarinus officinalis* were incorporated for their bioactivity. The extracted chitosan (EXT) showed a yield of 12%, with a degree of deacetylation sufficient for effective film formation. SEM (Scanning Electron Microscopy) analysis revealed distinct morphological differences between extracted and commercial chitosan (COM). EXT displayed a rough, highly porous surface with thin,

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irregularly shaped flakes and layered structures, suggesting high surface area and potential reactivity. In contrast, COM exhibited smoother, denser, and more compact platelet-like structures with fewer visible pores, indicative of higher purity and crystallinity. Antimicrobial testing of the resulting films using agar diffusion against *Listeria monocytogenes*, *Staphylococcus aureus*, *Salmonella enteritidis*, and *Escherichia coli* demonstrated significantly greater inhibition zones ($p < 0.05$) for films enriched with essential oils compared to control films. Notably, antimicrobial efficacy increased with oil concentration, and Gram-positive bacteria were more susceptible, especially in films enriched with *Thymus satureioides* oil at 7.5% v/v. Overall, the study supports the potential of extracted chitosan-based films as sustainable, bioactive materials for food and pharmaceutical packaging, combining structural integrity with enhanced antimicrobial performance.

2.28. Classification of Bottled Mineral Waters Using an Electronic Tongue and Machine Learning Techniques

Victor Gonzalez Blanco [1], Juan Alvaro Fernandez [1], Patricia Arroyo Muñoz [1], Eduardo Pinilla Gil [2] and Jesús Lozano Rogado [1]

[1] Industrial Engineering School, University of Extremadura, 06006 Badajoz, Spain
[2] Department of Analytical Chemistry, University of Extremadura, 06006 Badajoz, Spain

Introduction: Bottled mineral water is widely consumed globally, exceeding 400 billion liters annually. Its popularity stems from dietary preferences, health concerns, and limited access to potable tap water in some regions. Ensuring the quality and proper classification of bottled waters is crucial to meet regulatory standards and consumer expectations. In this context, electronic tongues offer a cost-effective solution for monitoring and classifying mineral waters based on their electrochemical signatures.

Methods: A portable electronic tongue system, developed by the Perception and Intelligent Systems Research Group at the University of Extremadura, was used. Cyclic voltammetry was performed with a potential sweep from −1000 mV to 1000 mV at 1 V/s using gold screen-printed electrodes. Five commercial mineral water brands were analyzed. For each brand, three bottles were selected, and five replicates were recorded per bottle to obtain representative voltammograms.

The resulting data matrix was evaluated using mean squared error (MSE) to assess repeatability across bottles. Principal Component Analysis (PCA) was applied for dimensionality reduction, and a multilayer perceptron neural network was used for classification.

Results: Low MSE values indicated high repeatability across bottles from the same brand. PCA showed clear clustering by brand, with PC1 strongly correlating with mineralization levels. A single-layer perceptron with eight neurons, trained using the first 20 principal components, achieved 100% classification accuracy across the five brands.

Conclusions: The electronic tongue designed based on a single, non-selective electrode type demonstrated reliable discrimination between bottled mineral water brands. PCA confirmed a strong relationship between electrochemical response and mineralization level. This approach simplifies the traditional multi-electrode setup and presents a low-cost, robust solution and an alternative to commercial electronic tongues/potentiostats for quality control and regulatory compliance in the bottled water industry.

2.29. Color from Waste: Sustainable Pigment Extraction from Coffee Residues

Motolani Adepeju Bamidele [1], Mónica L. Chávez x González [1], Leonardo Sepulveda Torre [1], Juan Alberto Ascacio Valdés [1], Orlando Daniel De La Rosa Flores [2], Cristobal Noe Aguilar [1] and José Sandoval Cortés [1]

[1] Department of Food Research, Faculty of Chemical Sciences, Autonomous University of Coahuila, 25280 Saltillo Coahuila, Mexico

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[2] School of Engineering and Sciences, Tecnologico de Monterrey, 64849 Monterrey, Nuevo León, Mexico

The exploration of environmentally sustainable pigment sources has become a focal point in contemporary research as industries endeavor to discover alternatives that reduce ecological impact. Among the promising alternatives being examined is the use of coffee residues, which are abundant in bioactive compounds, including pigments [4,5]. This study focused on the extraction of pigments from coffee pulp using innovative techniques such as microwave- and ultrasound-assisted extraction. The polyphenolic content and antioxidant potential of the extracted pigments were assessed. Extraction was conducted at various pH levels (2, 5, 7, 9, and 12) and ethanol concentrations (100:0, 25:75, 50:50, 60:40, 75:25, and 0:100). The process was performed at different temperatures (30–50 °C) and durations (30, 40, 50, 60, and 70 min). The polyphenolic content of the extracted pigments was characterized using Folin and HCl butanol assays, respectively. The antioxidant potential of the pigments was evaluated using DPPH and FRAP assays. The pigments were characterized using HPLC-MS. The highest concentration of hydrolyzable tannins, at 4.75 mg GAE/g, was achieved with the 60:40 ethanol/water mixture of UAE at 50 °C for 60 min, whereas the aqueous extract with pH 12 at 40 °C for 70 min yielded the highest concentration of condensed tannins, at 12.4 mg CE/g. The condensed tannin content increased with pH. The HPLC-MS analyses revealed the presence of Caffeic acid 4-*O*-glucoside, 1-Caffeoylquinic acid, 3-Feruloylquinic acid, HHDP-hexoside, 1,3-dicaffeoylquinic acid, 5-heptadecylresorcinol, and cyanidin 3-*O*-xylosyl-rutinoside. The polyphenolic composition increased with time and temperature. The antioxidant activity of the extracts increased with increasing polyphenolic content. This study highlights the potential of coffee residue-derived pigments as natural colorants. These pigments not only serve as sustainable additives, but may also enhance the shelf life of treated products through their bioactive properties.

2.30. Comparative Analysis of Drying Techniques for Custard Apple Pulp: Hot Air, Vacuum, and Microwave-Assisted Methods

Shalini Singh [1,2] and Ashish Kumar Sharma [3]

[1] Department of Dairy Science and Food Technology, Institute of Agricultural Sciences, Banaras Hindu University, Banaras, Uttar Pradesh 221005, India
[2] Food Engineering Department, College of Food Processing Technology and Bio-Energy, Anand Agricultural University, Anand, Gujarat-388110, India
[3] Agricultural Engineering Department, College of Agriculture, Anand Agricultural University, Jabugam, Gujarat-391155, India

The drying characteristics of custard apple pulp were investigated using three different drying techniques: hot-air tray drying, vacuum tray drying, and tray combined with microwave drying. The effects of drying temperature (45, 50, and 55 °C) and maltodextrin addition (0, 15, 20, and 25%) on the drying kinetics, solubility index, dried product recovery percentage, and color values (L*, a*, and b*) were evaluated. Non-linear regression analysis was performed to fit the experimental data to seven thin-layer drying models. The Hii model best described the drying behavior of custard apple pulp, which was dried using a hot-air tray dryer and a tray combined with a microwave dryer, whereas the Midilli et al. model was most suitable for the vacuum tray dryer. The drying time was significantly reduced by increasing the temperature and using a vacuum dryer (240 to 420 min) followed by a tray combined with a microwave dryer (394 to 420 min). The addition of maltodextrin improved the solubility index and recovery percentage of the dried pulp. The L* value, solubility index, and product recovery ranged from 54.56 to 69.59%, 49.23 to 69.72%, and 20.83 to 50.25%, respectively. The vacuum dryer and tray combined with the microwave

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dryer showed potential for industrial applications because of their shorter processing times. This study provides valuable insights into optimizing the drying process of custard apple pulp and selecting appropriate drying techniques for commercial preservation while maintaining the quality attributes of the product.

2.31. Comparative Study of Dehydration Techniques on the Nutritional and Sensory Quality of Dates, Tomatoes, and Zucchini

Olfa Rebai, Malek Ben Temessek and Sami Fattouch

National Institute of Applied Sciences and Technology (INSAT), LR21ES02, Laboratory of EcoChemistry, University of Carthage, Tunis 1080, Tunisia

This study presents a comparative evaluation of two drying methods, conventional convective drying (hot air) and freeze-drying (lyophilization), applied to selected Mediterranean fruits, namely dates (*Phoenix dactylifera*), tomatoes (*Solanum lycopersicum*), and zucchini (*Cucurbita pepo*). The objective was to assess the impact of these methods on key quality parameters, including moisture reduction efficiency, total phenolic content, antioxidant activity (DPPH assay), vitamin C content (HPLC), color stability (L*, a*, b*), and texture characteristics (hardness and chewiness). Freeze-drying demonstrated superior performance in preserving sensitive bioactive compounds, with vitamin C retention exceeding 85% $\pm$ 1.5%, total phenolic content reaching 93.4 $\pm$ 2.1 mg GAE/100 g dry weight, and antioxidant activity reaching 79.2 $\pm$ 1.8% inhibition. In contrast, hot-air drying, while more energy-efficient (approximately 0.8 kWh/kg), led to greater nutrient degradation, with vitamin C retention around 55% and antioxidant activity at 58.6%. Sensory evaluation by a trained panel revealed that freeze-dried products received the highest overall acceptability scores (8.2/9), particularly in terms of appearance, aroma, and texture, whereas hot-air-dried samples showed noticeable declines in visual appeal and mouthfeel. This study highlights the trade-offs between nutritional preservation, sensory quality, and energy efficiency. These findings provide valuable guidance for selecting appropriate drying technologies in the context of sustainable food processing and the valorization of Mediterranean plant-based resources. Overall, freeze-drying remains the preferred technique when product quality is the priority, while hot-air drying offers a viable option where cost and energy are the priority.

2.32. Convergence or Divergence: A Comparative Analysis of Scientific and Traditional Cassava Processing Practices and Their Implications for the Uptake of Agro-Processing Technologies

Jenifer Apil [1], Bernard Obaa [1], Peter Atekyereza [2] and Lucy Mulugo [1]

[1] Department of Extension and Innovation Studies, College of Agricultural and Environmental Sciences, Makerere University, Kampala P.O. Box 7062, Uganda

[2] Department of Sociology and Anthropology, College of Humanities and Social Sciences, Makerere University, Kampala P.O. Box 7062, Uganda

The Government of Uganda and research institutions have promoted improved cassava processing technologies to enhance the quality of processed products. However, its uptake is still low. There is growing recognition of the value of integrating traditional and scientific processing practices to enhance the sustainable uptake of agricultural interventions. However, studies that combine traditional and scientific processing practices in a complementary way while acknowledging convergences and divergences are limited. We contrast traditional and scientifically recommended cassava processing practices across eight operation units of harvest, peeling, washing, chipping, fermenting, drying, milling, and storage. Data were collected using participant observations, focus group discussions, in-depth individual interviews, key informant interviews, and 420 household surveys, which were subjected to thematic and descriptive statistics. Our results indicate conver-

gences in the operation units of drying, milling, and storage. Divergence is highlighted at harvest, peeling, washing, chipping, and fermenting, driven by injunctive and descriptive norms, perceptions, and interwoven relations. In this sense, some improved cassava processing technologies do not align with cultural norms and beliefs, and the values of traditional processors. Future efforts in promoting cassava processing interventions would benefit from more location-specific and holistic approaches that integrate cultural norms, perceptions, and interwoven operation units alongside improved technologies.

2.33. Correlation Between Visual Appearance and Physicochemical Attributes of a Chinicuil-Based Condiment Using Computer Vision for Quality Monitoring

Aurea Bernardino-Nicanor [1], Leopoldo González-Cruz [1], Laura García-Curiel [2], Andrea Janitzitzi García-Ortega [1] and Jesús Guadalupe Pérez-Flores [3]

[1] Laboratory of Food Chemistry and Biochemistry, National Technological Institute of Mexico, Celaya Campus, Celaya 38010, Mexico
[2] Academic Area of Nursing, Health Sciences Institute, Autonomous University of the State of Hidalgo, San Agustín Tlaxiaca 42060, Mexico
[3] Academic Area of Chemistry, Basic Sciences and Engineering Institute, Autonomous University of the State of Hidalgo, Mineral de la Reforma 42184, Mexico

The prediction of physicochemical attributes in foods using visual indicators represents a valuable strategy for non-invasive quality monitoring. In this study, a model was developed to estimate the pH and total titratable acidity (TTA) of a powdered condiment made with *Comadia redtenbacheri* (chinicuil), based on visual information obtained through computer vision. Images were captured under controlled conditions using a high-resolution 48 MP camera positioned 40 cm above the sample at a fixed 90° angle, inside a standardized lighting chamber equipped with daylight-balanced neutral white LED illumination (5600 K) to prevent shadows and reflections. Subsequently, the color components L*, a*, and b* were extracted using OpenCV. This visual data was integrated with experimental measurements of pH and TTA obtained during storage at different temperatures and times, forming a single structured dataset. Multiple linear regression models (OLS) were fitted to evaluate the relationship between visual descriptors and physicochemical properties. The model for pH showed a moderate fit (adjusted $R^2 = 0.403$), with temperature being the only statistically significant predictor. In contrast, the model for TTA achieved a stronger fit (adjusted $R^2 = 0.779$), with both time and temperature identified as relevant predictors. None of the color components (L*, a*, b*) had significant individual effects, although they contributed to the overall model structure. These results suggest that the product's acidity is more sensitive to storage conditions than pH. In conclusion, the study demonstrates the feasibility of using computer vision as a complementary tool to estimate physicochemical properties throughout the product's shelf life, with potential for integration into automated monitoring systems for dehydrated foods.

2.34. Deep Learning-Based Hyperspectral Image Reconstruction from RGB Data for Gluten Detection and Quantification in Food Products

Adewale Abiola Oloyede and Akinbode Adedeji

Department of Biosystems and Agricultural Engineering, University of Kentucky, Lexington, KY, USA

Detecting and quantifying gluten in food products is crucial for safeguarding individuals with gluten-related disorders, such as celiac disease and gluten intolerance. Effective detection technology will safeguard against harm to consumers (food safety) and reduce the potential losses of the industry. Hyperspectral imaging (HSI) has emerged as a powerful tool for gluten detection, owing to its ability to capture both spatial and spectral

data. However, the high cost, complexity, and need for expert operation have limited its accessibility, particularly for consumer-level applications. This study addresses these challenges by investigating the deep learning techniques used to reconstruct hyperspectral images from standard RGB images, making gluten detection and quantification feasible for handheld devices. In this study, corn flour (CF) samples were contaminated with varying concentrations of wheat flour (WF), ranging from 0 to 10% at 0.1% (0–0.24%) and 0.5% (2.5–10%) increments. HSI data were captured with a camera covering the 400–1000 nm range, while RGB images were obtained using the built-in camera of a Samsung Galaxy smartphone. To identify the most relevant spectral regions for gluten detection, ground-truth hyperspectral cubes were constructed using key wavelengths selected by feature selection algorithms. The study compared different hyperspectral reconstruction algorithms, including Hyperspectral Convolutional Neural Network-Dense (HSCNN-D) and High-Resolution Network (HRNET), for gluten detection and quantification. Performance was evaluated using metrics such as the mean relative absolute error, root mean square error, and peak signal-to-noise ratio. K-nearest neighbors (KNN) and Random Forest (RF) classifiers were applied to detect gluten sources, and RF regression was used to quantify gluten sources. KNN and RF achieved testing accuracies of 85.7% and 90.8%, respectively, for the HRNET model and above 80% in the HSCNN-D and other models. RF regression showed an R^2p of 0.6 for HRNET and values above 0.5 for the other models.

2.35. Design and Evaluation of the Process to Obtain Mixed Puree of Pumpkin (Cucurbita moschata) and Carrot (Daucus carota) to Be Preserved by Sous Vide Technology

Silvana Cecilia Ruiz [1], Diego Gutierrez [2,3] and Silvia del Carmen Rodriguez [2,3]

[1] Estación Experimental Agropecuaria Santiago del Estero, Instituto Nacional de Tecnología Agropecuaria, Santiago del Estero 4200, Argentina
[2] Instituto de Ciencia y Tecnología de los Alimentos, Facultad de Agronomía y Agroindustrias, Universidad Nacional de Santiago del Estero (UNSE), Santiago del Estero 4200, Argentina
[3] CIBAAL CONICET-UNSE, Villa El Zanjón, Santiago del Estero, Santiago del Estero 4206, Argentina

The objective of this study was to design and evaluate a process for preparing a mixed puree with pumpkin (P) and carrot (C), which would then be preserved using sous vide technology (vacuum cooking), which is not yet commercially available. The design included an evaluation of the stages to include in the preparation of each vegetable, as well as the different mixing ratios. The following were evaluated: cooking methods and times for both vegetables (conventional with water at 100 °C, 5 and 10 min, and steam at 105 °C, 5, 10, 15, and 20 min); mixing ratios (100:0, 75:25, 50:50, 25:75, 0:100 *w*/*w* C:P), puree homogenization times (0.5–2 min), and ascorbic acid (AA) addition (0.0–1.0%). The process and blend selection were carried out through sensory testing (with 10 trained judges, evaluating overall appearance, color, consistency and flavor), color determination (using a colorimeter to determine L*, a* and b*) and pH. Finally, a general acceptability test of the designed product was conducted with 80 untrained individuals. The proposed process for preparing the vegetables (obtained from producers in Santiago del Estero, Argentina) was as follows: washing with potable water, disinfection with NaClO solution (200 ppm-5 min), draining, peeling, cutting into 1 mm thick slices, steaming (C for 20 min and P for 5 min), mixing (75:25 *w*/*w* P:C), adding AA (0.75%), homogenization for 1.5 min, vacuum packing and cooking under vacuum (90 °C for 9 min). The product designed without added AA obtained an acceptability of 90% and a pH of 6.1 ± 0.2, while with the addition of 0.75% AA, the pH dropped to 4.3 ± 0.1. This is important in foods treated with sous vide, where

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the pH must be lower than 4.5 to prevent the development of anaerobic pathogens. This designed food presented a pleasant flavor and high sensory acceptance (82%).

2.36. Development of a Rapid and Affordable Machine Learning-Based Screening Technique for Honey Adulteration Using UV–Visible Absorption Spectra

Ethan Josiah Sabacan and Benelyn D. Dumelod

Department of Food Science and Nutrition, College of Home Economics, University of the Philippines Diliman, Quezon City 1101, Philippines

Honey, a high-value product, is a frequent target of food fraud through adulteration with low-cost sweeteners. Up to 87% of local honey products sold in the Philippines are adulterated, with some containing as much as 100% substitution. Beyond health risks to consumers, adulterated honey undermines consumer trust, compromises nutritional and therapeutic qualities, and distorts market competition, putting authentic producers at a disadvantage. This study assessed the feasibility of ultraviolet–visible (UV-Vis) spectrometry at 220–450 nm, coupled with machine learning (ML), as a rapid and affordable screening technique for honey adulteration. Fifty-nine authentic Philippine honey samples from three bee species were analyzed in their unadulterated and adulterated forms with C3 and C4 syrups at a 10% concentration. C3 and C4 sugars are derived from plants using the C3 (Calvin cycle) or C4 (Hatch–Slack pathway) photosynthetic processes, respectively. In honey, C3 sugars originate from the nectar of fruit tree flowers and wildflowers; C4 sugars used as adulterants are usually sourced from sugarcane or maize. However, C3 sugars are now commercially available and could be used as adulterants, challenging the reliability of established methods based on the isotope ratio. In this study, data analysis indicated possible discrimination of samples by bee species rather than adulteration status. A supervised ML model trained to discriminate between adulterated and unadulterated samples initially showed 98% accuracy with 100% sensitivity, but once a grouping function was applied to address temporal data leakage, model performance dropped to 34% accuracy and sensitivity. This finding highlights the need to carefully examine ML implementation issues in honey authentication research, particularly regarding sampling balance, data splitting, and model validation, since reported accuracies in published studies frequently exceed 90%. While the present model does not yet achieve reliable discrimination between pure and adulterated samples, protocol refinements and enhanced chemometric approaches can improve robustness for honey authenticity screening.

2.37. Digitalization of Food Materials: A Key Step for Industry 4.0

Manoj K Patel [1] and Geoffrey Robert Mitchell [2]

[1] Central Scientific Instruments Organisation, Council of Scientific and Industrial Research, Chandigarh 160030, India

[2] Centre for Rapid and Sustainable Product Development, Polytechnic of Leiria, 2430-080 Marinha Grande, Portugal

The Food Processing 4.0 concept takes food processing into the digital era by leveraging Industry 4.0 technologies to improve the quality and safety of food and reduce waste [6]. Despite the severe environmental challenges facing the food industry (such as accounting for a significant portion of global anthropogenic GHG emissions and biodiversity loss [7]), Food Processing 4.0 offers novel pathways towards sustainable production through digital technologies (e.g., digital mixing, personalised food)—for instance, by optimising processes to reduce resource waste or by utilising precision formulations to lower carbon footprints. One of the major advantages of the digitalisation of manufacturing is the ability to optimise the workflow in terms of any objective function. Such objective

functions could include greenhouse gas emissions, nutritional value, reversing obesity and of course, more medically formulated objective functions such as the prevention of diabetes. Another advantage of digital manufacturing is the ability to vary the properties during the fabrication process [8], thereby opening up pathways to personalisation and to graded structures in the final product. A key and necessary step in digital optimisation is to define the digital coordinate space for food materials and the method of describing properties and composition. We are looking forward to a scenario of 3D printing of food materials. This is akin to 4D printing of more technical products, in which the part printed is not the final product, but is transformed via an optical, thermal or similar method to the final product, which in general will exhibit a different shape. In the case of food 3D printing, a major part of the fourth stage will be a thermal transformation to largely the same shape but with different properties and composition. This presentation introduces these concepts and lays out a roadmap of possibilities and actions.

2.38. Drying Kinetics and Quality of Grapes (Vitis vinifera L. cv. Alphonse Lavallée): Needle Micro-Perforation vs. Alkaline Treatment

Ebru Köroğlu, Berkay Berk and Sevcan Ünlütürk

Department of Food Engineering, İzmir Institute of Technology (İzmir Yüksek Teknoloji Enstitüsü), İzmir 35430, Türkiye

Grapes are among the most widely cultivated and exported fruits in Turkey. However, their high moisture and sugar contents make them highly perishable, limiting their shelf life and requiring drying as a preservation method. Hot air drying is generally preferred due to its controllable conditions and shorter processing time. To reduce quality losses during drying, chemical or physical pretreatments are commonly applied.

This study investigates needle micro-perforation as a physical alternative to the widely used alkaline dipping pretreatment in grape drying. For this purpose, Kavacık grapes (*Vitis vinifera* L. *cv. Alphonse Lavallée*) were pretreated by means of alkaline dipping and needle micro-perforation using needle lengths of 0.5, 1.0, and 1.5 mm, followed by convective drying at 60, 70 and 80 °C. Micro-perforation was applied to the entire surface of the grapes, with an average pore diameter of 0.46 mm. Drying behavior was modeled using Fickian and Non-Fickian diffusion models, and physico-chemical properties such as water activity, rehydration ratio, pH, titratable acidity, and color were analyzed.

Drying kinetics showed that the Non-Fickian model better fitted the data, indicated by higher R^2 and lower RMSE and χ^2 values. The results also revealed super-diffusion in alkaline-dipped and sub-diffusion in micro-perforated grapes. Micro-perforated grapes exhibited a water activity of 0.44 $\pm$ 0.05, a rehydration ratio of 2.00 $\pm$ 0.07, a pH of 4.34 $\pm$ 0.07, a titratable acidity of 0.94 $\pm$ 0.16 g tartaric acid/100 g, and a ΔE of 4.33 $\pm$ 1.41. At 60 °C, both pretreatments resulted in statistically similar physico-chemical characteristics ($p > 0.05$). Since similar drying behavior and physico-chemical properties were obtained, needle micro-perforation can be considered a potential alternative to alkaline dipping.

2.39. Effect of Bioinputs on the Crop Performance and Overall Quality of Watermelon (Citrullus lanatus) Produced in Santiago del Estero, Argentina

Silvana Cecilia Ruiz [1], Yesica Gramajo Dominguez [1], Sofía A. Villarreal [2], Abel Emilio Azar [1], Gabriela S. Corbalan [2], Veronica A. Medina [2] and Elisa Mariana García [2,3]

[1] Instituto Nacional de Tecnología Agropecuaria, Estación Experimental Agropecuaria Santiago del Estero, Santiago del Estero G4200, Argentina

[2] Instituto de Ciencias Químicas. Facultad de Agronomía y Agroindustrias, Universidad Nacional de Santiago del Estero, Santiago del Estero G4200, Argentina

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[3] Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Ciudad Autónoma, Buenos Aires C1033AAJ, Argentina

The objective of this study was to evaluate the effect of bioinputs on the productive performance and quality of two watermelon varieties—Delicia and Hollar—produced in Santiago del Estero, Argentina. A 2 × 2 factorial arrangement was used in a completely randomized block design, with two watermelon varieties and two treatments (with and without bioinputs), totaling 20 experimental units. Treatments were randomly assigned within each block. Fruits were harvested at commercial maturity, halved, and triplicate samples were taken from each. Data from duplicate measurements of each half were used for statistical analysis, yielding four analytical replicates per treatment–variety. Yield (kg ha^{-1}) was used to evaluate crop productivity. Physical quality parameters included soluble solids (% SS), titratable acidity (% TA), SS/TA ratio, and rind thickness (mm). The functional quality of peel and pulp was determined using spectrophotometric methods: total phenolic compounds (TPC, Folin–Ciocalteu), antioxidant capacity (AC, $DPPH^{\bullet}$), and citrulline. TPC and AC were expressed as mg gallic acid per 100 g, and citrulline was expressed as mg per 100 g. Statistical comparisons were made using the LSD test ($p < 0.05$). Bioinputs increased yield by 23% compared to conventional treatments. No significant differences ($p > 0.05$) were observed in physical parameters, with values around 11% SS, 0.2% TA, an SS/TA ratio of 52, and 18 mm rind thickness. Although not significant, bioinputs tended to enhance functional quality, particularly in the Hollar variety. This variety showed higher TPC in pulp (132 ± 12 mg GAE/100 g) and higher AC and citrulline content in peel (23 ± 2 mg GAE/100 g) and pulp (249 ± 19 mg/100 g). These results highlight the potential of bioinputs to improve production without compromising fruit quality. Although fruit quality was not affected, a trend toward improved functional quality was observed in one variety. This is important, as producers seek alternatives to costly fertilizers, and consumers increasingly look for safer, healthier foods.

2.40. Effect of Carqueixa (Pterospartum tridentatum) Antioxidant Extract on the Quality and Sensorial Characteristics of Pork Burger

Carmen María Botella-Martínez, Raquel Lucas-González, José Ángel Pérez-Álvarez, Juana Fernández-López and Manuel Viuda-Martos

Higher Polytechnic School of Orihuela (EPSO), Miguel Hernández University, Institute on Agri-Food and Agri-Environmental Research and Innovation (CIAGRO-UMH), Crta. Beniel km 3.2, 03312 Orihuela, Spain

Carqueixa (*Pterospartum tridentatum L. Willk.*) is a Mediterranean leguminous plant rich in bioactive compounds, particularly phenolics, which are associated with notable antioxidant properties and traditional medicinal uses. Due to increasing consumer demand for natural additives and industry interest in replacing synthetic antioxidants, carqueixa has emerged as a promising functional ingredient in food products. This study investigates the impact of carqueixa extracts on the physicochemical, technological, and sensory attributes of pork burgers. Three independent replicates of each batch were prepared. The first batch followed a traditional formulation composed of 100% meat (50:50:18:1.5:0.2 of lean meat, backfat, water, sodium chloride, and white pepper, respectively). This mixture was divided into three equal portions and supplemented with carqueixa at concentrations of 0%, 1%, and 2%. The determinations carried out on the three burger batches were the chemical composition, physico-chemical properties, cooking characteristics, lipid oxidation, and sensory attributes. The main result showed that the incorporation of 1% and 2% carqueixa altered the color, texture, and cooking properties of pork burgers without compromising nutritional composition. In particular, burgers with 1% carqueixa showed reduced lipid oxidation (TBARS) in both raw (28% of decreased) and cooked states (8% of decreased),

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improved dimensional stability during cooking, and favorable textural modifications, including increased hardness and chewiness. Sensory evaluation revealed that burgers enriched with 1% carqueixa received the highest overall acceptability scores, while higher concentrations slightly decreased juiciness and flavor perception. These results suggest that carqueixa extract, especially at 1% concentration, is a promising natural additive for meat product formulations, as it improves oxidative stability and sensory quality, while responding to consumer demand for clean-label ingredients.

2.41. Effects of Different Emulsion Gels and Extrusion Temperature on Structural Properties of Meat Substitutes Processed by High-Moisture Extrusion of Soybean Protein

BO LIU [1], Yutaka Kitamura [2] and Mito Kokawa [2]

[1] Graduate School of Science and Technology, University of Tsukuba, Tsukuba 305-8572, Ibaraki, Japan

[2] Institute of Life and Environmental Sciences, University of Tsukuba, Tsukuba 305-8572, Ibaraki, Japan

In order to develop a new type of plant-based meat substitute and investigate the effects of different emulsion gels on improving the structural characteristics and quality of plant-based meat substitutes, this study investigates the structural properties of meat substitutes produced via high-moisture extrusion using soybean protein (SP) and three types of emulsion gels: polysaccharide-based (PB), protein–polysaccharide composite-based (PPCB), and gelled double emulsion-based (GDEB) gels. The effects of processing temperature (130–170 °C) and soybean protein/emulsion gel (50%:50%, 45%:55%, 40%:60%) on protein aggregation were evaluated. Confocal laser scanning microscopy (CLSM) and scanning electron microscopy (SEM) revealed that SP:GDEB formulations exhibited the most compact and stable protein networks, particularly at a 45%:55% ratio, whereas SP:PB showed network fragmentation at high temperatures. Fourier transform infrared spectroscopy (FTIR) analysis indicated that SP:GDEB provided the highest thermal stability under different processing temperatures and emulsion gel concentrations; the integral intensity of the amide I band did not change significantly. Fluorescence spectroscopy demonstrated that SP:GDEB maintained stable tertiary protein structures across all temperatures, with little fluctuation in fluorescence intensity, whereas SP:PB and SP:PPCB were more susceptible to temperature fluctuations. Protein solubility analysis showed that SP:PB had the highest solubility, while SP:GDEB exhibited the lowest due to extensive hydrophobic interactions. Disulfide bond formation increased with temperature in SP:PB and SP:PPCB. However, SP:GDEB retained a higher sulfhydryl content, indicating superior thermal resistance. Degree of texturization studies revealed that SP:PB achieved optimal texturization at 140–150 °C, whereas SP:GDEB maintained stable texturization across a broader temperature range.

2.42. Effects of Osmotic Dehydration with Ternary Solutions on Water Loss and Quality Attributes of Poultry Meat

Dominika Opat, Krzysztof Dasiewicz and Iwona Szymańska

Department of Food Technology and Assessment, Institute of Food Science, Warsaw University of Life Sciences, Nowoursynowska St. 159c, 02-776 Warsaw, Poland

Introduction: Osmotic dehydration is a mild, energy-efficient method for partial water removal, used to extend shelf life and preserve the quality of food. While traditionally performed with binary solutions (e.g., NaCl alone), recent studies suggest that ternary solutions—combining NaCl with maltose syrup—can improve mass transfer and product quality. However, this approach has not been extensively explored in poultry meat.

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The aim of the study was to investigate the effect of osmotic dehydration using ternary solutions on selected quality attributes of poultry meat.

Methods: The research material consisted of chicken breast meat. Samples were subjected to osmotic dehydration using five different solutions: a binary solution of 20% NaCl and four ternary solutions combining 5% or 10% NaCl with either 40% or 60% maltose syrup. Beakers with the prepared solutions were placed in a refrigerated cabinet at 3 °C. Their contents were continuously mixed using magnetic stirrers, ensuring uniform distribution of both salt and maltose syrup throughout the solutions. Samples were collected before dehydration (0 h) and after 2, 4, 6, and 8 h of immersion. At each time point, pH, moisture content, water activity (aw), and salt content were measured using standard physicochemical methods to evaluate mass transfer dynamics and quality changes.

Results and Conclusions: Ternary solutions significantly enhanced dehydration efficiency. Moisture content dropped from 75.22% to as low as 54.37%, with a concurrent decrease in water activity from 0.971 to 0.920, favoring microbial stability and extended shelf life. Notably, higher maltose concentrations led to better moisture removal and reduced NaCl uptake, preserving desirable quality traits.

The results highlight the potential of ternary osmotic solutions in poultry processing to achieve effective dehydration while limiting salt absorption, offering a balanced and efficient method for meat quality enhancement.

2.43. Enhancing the Foaming Properties of Pea Protein Through Enzymatic Treatment and High-Pressure Homogenization

Florencia Sabena, Javier Aponte Elera, Fernando A. Bellesi and Ana M.R. Pilosof

ITAPROQ—Instituto de Tecnología de Alimentos y Procesos Químicos (CONICET/UBA), Ciudad Autónoma de Buenos Aires 1428, Argentina

Commercial pea protein isolate (PPI) is widely recognized as a sustainable alternative to animal proteins. However, like most plant proteins, it has limited *techno-functional* properties due to its denaturation and aggregation during industrial processing. This study investigates the combined use of high-pressure homogenization (HPH) and enzymatic hydrolysis to improve the foaming properties of commercial PPI. A 5% (*w*/*w*) PPI solution was treated at 1000 bar using a high-pressure homogenizer (PandaPLUS, GEA, Germany) at room temperature and adjusted to pH 5. This condition (1000 bar pH 5) was selected due to its high foam stability, despite its limited foaming capacity (overrun 140%). To enhance overrun, samples were hydrolyzed with HT200 protease (40 °C, enzyme/substrate ratio 1:10). Particle size (Mastersizer 3000, Malvern) and soluble fraction were evaluated, along with foam properties after whipping for 3 min at 200 rpm (Griffin & George stirrer, room temperature). Interfacial properties of the hydrolysates were analyzed using a Tracker tensiometer (Teclis, Germany). Hydrolysis time was inversely correlated with interfacial tension, improving surface activity. Particle size showed no significant changes after enzymatic treatment. Overrun increased with hydrolysis time, reaching 350%, but foam stability decreased due to the elasticity reduction in the interfacial film. To obtain a sample with both high foaming capacity and stability, mixtures of the 15 min hydrolysate with the original sample were prepared at 50:50 and 25:75 (hydrolyzed/non-hydrolyzed) ratios. The mixtures achieved an overrun of 250%, maintaining a high foam stability. These results highlight the potential of combining green processing strategies (HPH and enzymatic hydrolysis) to enhance the foaming performance of commercial PPI, supporting its application in plant-based products.

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2.44. Evaluation of the Incorporation of Red Currant Pomace and Extract in Meatballs Using Conventional Quality Assessment

Laura Jūrienė, Jovita Jovaišaitė and Petras Rimantas Venskutonis

Department of Food Science and Technology, Kaunas University of Technology, Radvilėnų pl. 19, LT-50254 Kaunas, Lithuania

Meat is a vital protein source in human diets, but its production is costly and environmentally impactful. Consequently, there is a discernible trend towards the development of meat-based products that incorporate plant-derived and unconventional ingredients such as antioxidant phytochemicals to inhibit oxidation processes and the formation of potentially carcinogenic compounds during meat processing. There is growing interest in biorefining agri-food by-products to extract nutrient-rich substances for various applications, including use in meat products. Ensuring safety and stability in meat products, given their susceptibility to microbiological contamination and oxidation, is crucial. This study aimed to determine the impact of additives on the quality and lipid oxidation of meat products. Red currant pomace was analyzed for its proximate composition, dietary fiber content and antioxidant capacity. For meat products containing additives, we quantified the color, pH, myoglobin form changes, texture profile and lipid oxidation during storage and performed a sensory evaluation. Red currants had 25% dietary fiber, 16% protein and a lower antioxidant capacity and total phenolic content compared to the extract. The addition of red currant pomace and extract to meat products reduced their pH values. The addition of 1.5 and 3% pomace reduced their lightness (L*), yellowness (b*) and redness (a*) compared with those of the control sample. The firmness increased with the addition of the pomace, while the extract did not have any effect. Plant-based additives (pomace or extract) strongly inhibited lipid oxidation (by more than three times compared to the control) during the storage of meat products. Sensory evaluation of meat products showed that the control sample and the sample with the extract were the most acceptable for the panelists. Taken together, red currant pomace and extract may be considered promising antioxidant-containing and fibre-rich materials for use in pork meat products and may increase their nutritional quality due to red currants' health benefits.

2.45. Evaluation of Olive Seed Powder in the Development of Bio-Based Packaging Materials

Selin Arda, Aylin İleri and Pınar Terzioğlu

Polymer Materials Engineering Department, Engineering and Natural Sciences Faculty, Bursa Technical University, Bursa 16330, Türkiye

The European Union has established several sustainability goals related to packaging as part of its broader environmental and climate policies. There is increasing interest in the evaluation of food waste and reduction in petroleum-based plastic usage. Olive seeds, a by-product of olive oil production, are emerging as sustainable biofiller for packaging materials. Olive seed powder is used in biocomposites as an organic filler due to its advantages such as its easy accessibility, biodegradability, low density, and low cost. In the studies conducted to date, olive seed powder incorporated various polymer matrices. However, olive seed powder incorporating PVA/Gelatine films has yet to be investigated. Therefore, the present study focuses on the properties of PVA/Gelatine/Olive seed powder composite films.

In this context, biodegradable composite films were developed using solvent casting by incorporating varying amounts of olive seed powder (0.5–2.0%) into a PVA/Gelatine matrix. This study examined the effect of olive seed powder incorporation on the colour, microstructure, mechanical, and structural characteristics of the films. FTIR analysis confirmed interactions between the olive seed powder and the polymer matrix. The

addition of olive seed powder had little effect on the mechanical properties of the films. The elongation at break value of the control film was 138.58 ± 24.31%. It decreased to 108.91 ± 11.65 with 2% filler incorporation.

Furthermore, SEM analysis revealed that the olive seed powder enhanced the structural compatibility between PVA and gelatin. As the concentration of olive seed powder increased, the yellowness index of the films changed from 8.81 to 16.92. These findings suggest that PVA/Gelatin-based biodegradable composite films containing olive seed powder have potential applications as environmentally friendly packaging materials. This study will provide insights into minimizing plastic pollution and will also create new economic opportunities for the olive industry. The commercialization of the developed films will be a good choice to meet the consumer demand for sustainable products.

2.46. Fermented Plant-Based Milks: Effects of pH Value and Storage Conditions on Protein Stability

Idil Tekin

Science and Technology Application and Research Center, Dokuz Eylül University, İzmir 35390, Türkiye

Introduction: The growing demand for plant-based dairy alternatives has accelerated the development of fermented plant-based milks. Protein stability is one of the most important quality factors that affects texture, shelf life, and consumer acceptability. Although soy and oat milks are frequently used in various formulations, their protein systems are sensitive to changes in temperature and pH value. This study aims to investigate how pH adjustments and storage temperatures affect protein stability in fermented soy and oat milks.

Methods: Commercial soy and oat milks were inoculated with a starter culture containing Lactobacillus spp. and incubated at 37 C for 12–24 h to initiate fermentation. Before inoculation, selected samples were adjusted to specific pH levels ranging from 4.5 to 6.5 to evaluate the impact of initial acidity. Following fermentation, all samples were kept for a maximum of 10 days at 25 C and 4 C. Protein stability was assessed by sedimentation analysis, and total protein content was measured using the Kjeldahl method.

Results: Preliminary results indicate that samples adjusted to lower pH values (around 4.5–5.0) and stored at 4 C exhibited significantly improved protein stability, with reduced sedimentation and better protein retention. In contrast, storage at 25 C led to increased sediment formation and protein destabilization, especially in samples with higher initial pH values.

Conclusions: The results highlight the importance of both pH value adjustment and cold storage in preserving protein stability in fermented plant-based milks. These findings provide useful insights for optimizing formulation and storage strategies, ultimately supporting the development of higher-quality plant-based dairy alternatives.

2.47. Green Food Wrap—An Innovative Packaging Material for Confectionery Products

Adithya Unni, Aswathy P A, Lavanya M, Arjunan Somanathan and Abhija C G

Verghese Kurien Institute of Dairy and Food Technology, Kerala Veterinary and Animal Sciences University, Mannuthy, Thrissur 680651, Kerala, India

We have only been using petroleum-based products in our day-to-day lives for a short time. Among these products are petroleum-based packaging materials. The environmental impact of synthetic plastics and the growing demand for sustainable alternatives have prompted research into biodegradable packaging materials. This study explored the development of an innovative green food wrap using bioactive compounds extracted

from pumpkin peel, a common agricultural by-product. The primary objectives were to formulate a biodegradable film and evaluate its physicochemical and antimicrobial properties for potential application in confectionery packaging. Another objective was to utilise by-products from the agricultural industry effectively, as agricultural waste is now becoming a major problem. The films were characterized in terms of their thickness, colorimetry, moisture content, solubility, water vapor transmission rate (WVTR), tensile strength, elongation at break, and antioxidant and antimicrobial activity.

The study was carried out on a film whose base composition included pectin, sodium alginate, and microcrystalline cellulose, into which varying concentrations of pumpkin peel extract (5 mL, 10 mL, and 15 mL) were added. The thickness of all the films was comparable at around 3.153 mm. The antioxidant activity of the films was determined using a DPPH assay, and it was found to be around 95% for the film containing 10 mL of the extract. Regarding antimicrobial activity, the activity against *Staphylococcus aureus* was determined using the disc diffusion method to identify the zone of inhibition. The film containing 10 mL of the extract also performed the best in this test, with a zone of inhibition of around 1 cm, which was larger than that of the other films.

These findings suggest that pumpkin peel-based wraps could serve as a sustainable alternative to conventional plastic packaging, contributing to waste reduction and environmental conservation. In the search for an alternative to plastics or a solution for the increasing damage they cause to the environment, this biodegradable film has great significance. Moving towards a more sustainable environment will have a great impact on human and environmental health.

2.48. Heterologous Expression and Enzymatic Characterization of Human α-Glucosidase in Picha Poastoris

Yuting Xu [1], Harold Corke [2] and Zhongquan Sui [1]

[1] Department of Food Science & Technology, School of Agriculture and Biology, Shanghai Jiao Tong University, Shanghai 200240, China

[2] Department of Biotechnology and Food Engineering, Guangdong Technion-Israel Institute of Technology, Shantou 515063, China

α-Glucosidase enzymes play a crucial role in digesting starch into glucose, making it a prominent target for diabetes management and the formulation of low-glycemic-index (GI) products. The objective of this research was to develop a *Pichia pastoris* expression system for the production of three recombinant human α-glucosidases, MGAM-C, MGAM-N, and SI-N, with subsequent screening of high-expression strains, protein purification, and enzymatic analysis. The coding sequences for human MGAM-C, MGAM-N, and SI-N were codon-optimized according to the codon preference of *P. pastoris*. The constructed plasmids, pPIC9k-MGAM-C, pPIC9k-MGAM-N, and pPIC9k-SI-N, were linearized and transformed into the G115 by electrotransform. After screening using MD and G418, the yeast strains were cultured and induced with methanol. Expression of the target proteins was confirmed by SDS-PAGE and Western blotting. On 10% SDS-PAGE, each of the expressed proteins appeared as a distinct band of approximately 100 kDa, indicating successful translation of the *MGAM* and *SI* genes and production of the corresponding recombinant proteins in *P. pastoris*. Optimization of fermentation conditions revealed that the maximum expression levels were achieved at 72 h, 120 h and 168 h for GS115-MGAM-C, GS115-MGAM-N and GS115-SI-N, respectively. The enzymatic activities of MGAM-C, MGAM-N and SI-N were subsequently measured at 36.56 U/L, 21.15 U/L and 7.51 U/L following purification. This work provides a reliable *P. pastoris* expression system for human α-glucosidases, with MGAM-C, MGAM-N, and SI-N successfully expressed and purified, thereby supporting applications in functional foods, glycemic management, and food technology.

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2.49. High-Pressure Homogenization Enhances the Colloidal Stability and Emulsifying Capacity of Commercial Pea Protein

Demetrio Javier Aponte Elera, Florencia Sabena, Fernando Bellesi and Ana M.R. Pilosof

Instituto de Tecnología de Alimentos y Procesos Químicos (ITAPROQ), Universidad de Buenos Aires, Buenos Aires C.P.1428, Argentina

The rising demand for plant-based protein beverages, driven by ethical, health, and sustainability concerns, underscores the need to enhance the functionality of ingredients such as commercial pea protein isolate. Although nutritionally valuable and low in allergens, commercial pea protein's limited solubility and emulsifying capacity restrict its application in protein beverages. This study aimed to evaluate the effect of high-pressure homogenization (HPH) on the solubility, colloidal stability, and emulsifying properties of a commercial pea protein isolate.

Solutions of commercial pea protein isolate (80%) at 3% *w*/*w* were treated at pressures ranging from 0 to 2000 bar (PandaPLUS, GEA, Germany). Solubility, particle size (Mastersizer, Malvern), and colloidal stability were analyzed via the Turbiscan Stability Index (TSI). Oil-in-water emulsions were formulated using 10% olive oil and 90% protein solution, and their droplet size and stability were evaluated after processing with an Ultra-Turrax and ultrasonic treatment.

HPH significantly improved solubility from 17.6% to 94% at 2000 bar, attributed to aggregate disruption. Particle size decreased notably from 48.1 µm to 0.5 µm, while TSI values dropped from 50 (0 bar) to 5 (2000 bar), indicating enhanced colloidal stability. Emulsions prepared with HPH-treated protein showed reduced droplet size, reaching 0.14 µm at 1500 bar compared to 0.59 µm at 0 bar. The most stable emulsions were obtained using protein treated at 1000 bar, exhibiting the lowest TSI values.

At acidic pH (3 and 5), droplet size slightly increased, yet emulsion stability improved significantly, with TSI reductions of up to 85% at pH 3—likely due to enhanced viscoelastic properties.

Overall, HPH effectively modified the structure of the commercial pea protein isolate, improving its solubility, colloidal stability, and emulsifying functionality, thereby supporting its application in protein-rich beverages.

2.50. Impact of Innovative Aging Techniques on the Profile of Romanian Pear Brandy

Petruț-Cristian Balaș [1], Elena Mudura [1], Carmen Rodica Pop [2], Alina Maria Truța [3], Corina Maria Șutea [1], Ioana Macea [1], Mariana Mărginean [1] and Teodora Emilia Coldea [1]

[1] Department of Food Engineering, Faculty of Food Science and Technology, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, 400372 Cluj-Napoca, Romania
[2] Department of Food Science, Faculty of Food Science and Technology, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, 400372 Cluj-Napoca, Romania
[3] Department of Forestry, University of Agricultural Sciences and Veterinary Medicine, 400372 Cluj-Napoca, Romania

The aging of natural distillates using wood fragments combined with physical methods aims to accelerate the development of desired sensory characteristics while increasing economic value and ensuring product standardization. This study explores an innovative rapid aging approach for Romanian pear brandy by applying electric field treatment to samples in contact with wood fragments (American oak, common oak, and mulberry). The

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goal was to reduce the traditional aging duration of 12–24 months to 20–60 min, while maintaining or enhancing the sensory and chemical qualities of the final product.

Samples were exposed to electric fields at 20 V, 35 V and 50 V for 20, 45 and 60 min. After treatment, the chromatic characteristics were measured and compared to two control groups: raw (untreated) distillates and distillates matured for 3 days with the same wood types but without electric treatment. The most intense color was achieved with mulberry wood at 20 V, showing nearly double the value compared to the 3-day untreated sample. Hue values obtained with Quercus robur (common oak) under specific treatments (V20T45, V35T45, and V50T45) were similar to those reported for barrel-aged grape marc distillates in previous studies.

Volatile and phenolic compound analyses confirmed the technique's effectiveness. Ethyl acetate content increased significantly in the mulberry-treated sample at V20T20 (85.5 mg/L), compared to 49.27 mg/L in the 3-day sample. The highest phenolic concentration was observed in American oak samples treated for 60 min at 20 V (15.148 µg/mL), while untreated samples showed no phenolic presence.

Our results demonstrate that electric field-assisted aging in the presence of wood fragments can replicate or surpass traditional maturation effects in a fraction of the time. This method allows for precise control of extraction, reduces production and storage costs, limits alcohol evaporation, and supports sustainable industrial application. Faster product turnover can lower excise costs and improve economic efficiency without compromising quality.

2.51. Impact of Pre- and Post-Annealing Treatments on Crosslinked and Octenyl Succinic Anhydride-Modified Potato Starch

Fatima Asmat, Tahira Mohsin Ali and Marium Shaikh

Department of Food Science and Technology, University of Karachi, Karachi, Pakistan

Background and objectives: The sequence in which modifications are applied is known to impact the characteristics of starch. The objective of this study was to determine which sequence of annealing (prior or post) could lead to improved properties of diesterified crosslinked and substituted OSA-modified potato starch extracted from the Lady rosetta variety. **Methods:** The impact of prior and post annealing on crosslinked and OSA-modified potato starch was investigated in terms of dynamic rheology, percent crystallinity and in vitro digestibility. **Results:** Irrespective of the sequence of modifications employed, all potato starches were observed to have B-type crystallites. However, the amount of crystallinity differed with respect to the sequence of modifications as well as the type of modification. The crystallinity was observed to be the lowest for native starch (19.18%), but prior annealing of OSA-modified starch resulted in higher crystallinity, at 34.52%. For crosslinked potato starch, post-annealing resulted in the highest crystallinity, at 35.10%. The RS content was closely related to crystallinity. Post-annealed crosslinked starch, which exhibited the highest crystallinity, also showed the highest RS content at 54.30%, while native starch, which had the lowest crystallinity, was observed to have the lowest RS content at 18.28%. Annealing increased the phase angle of crosslinked and OSA-modified starches. However, the extent of the increase in phase angle was greater in the case of pre-annealing of OSA-modified and post-annealing of crosslinked starches. **Conclusions:** The high-RS potato starches developed in this study can be used to prepare low-glycemic products as the FDA has declared RS as a synthetic fiber. Significance and novelty: The impact of prior and post annealing on crosslinked and OSA-modified potato starch has never been studied before. The sequence of annealing had very different results for crosslinked and OSA-modified potato starch. In the case of crosslinking, post-annealing resulted in

more significant changes in techno-functional properties, while in the case of OSA, it was prior annealing.

2.52. Impact of Ultrasound Treatment on the Quality and Microstructure of Semitendinosus Muscle from Old Philippine Carabaos (Bubalus bubalis)

Francene P. Go [1], Oliver D. Abanto [2] and Benelyn D. Dumelod [1]

[1] Department of Food Science and Nutrition, University of the Philippines Diliman, Quezon City 1101, Philippines

[2] Institute of Animal Science, University of the Philippines Los Baños, Los Baños 4031, Laguna, Philippines

Commercially available carabeef (CB) is often tough as it is usually sourced from old carabaos retired from farm work. This study explored the feasibility of ultrasound (US) technology in improving CB tenderness, with the possibility of benefiting both the carabeef industry and consumers seeking nutritious, high-quality, and affordable meat. Semitendinosus muscles from Philippine carabaos (*Bubalus bubalis*) were treated using a water bath-type sonicator and analyzed for changes in meat quality. The effects of treatment duration (TD: 20, 30, 40 min) and water bath temperature (WBT: 5, 12, 25 °C) on tenderness, pH, moisture content (MC), water-holding capacity (WHC), and color were assessed. Significant effects were detected in selected treatment combinations. Warner–Bratzler shear press results showed general improvement in tenderness across treatment durations. Color analysis revealed increased lightness (L*) and yellowness (b*) ($p < 0.05$), with no change in redness (a*). TD had no significant effects on pH, MC, or WHC ($p > 0.05$). Scanning electron microscopy revealed US-induced damage to connective tissue layers, including disrupted structure, cavities, and loss of integrity—observations that were associated with enhanced meat tenderness. This study demonstrates the potential of US technology in improving CB texture with minimal impact on other quality parameters. Our results support further optimization studies addressing industrial applications, process conditions, and animal traits.

2.53. In Vitro Gastrointestinal Digestion of Dehulled Full-Fat and Fat-Reduced Hemp Seed Milks: A Comparative Study of Protein Bioaccessibility, Physical Stability, and Digestive Behavior

Nour M.H. Awad and Mustafa Mortas

Department Food Engineering, Faculty of Engineering, Ondokuz Mayıs University, Samsun 55139, Turkey

Hemp seed milk is an emerging plant-based dairy alternative with high nutritional value; however, its digestibility and nutrient bioaccessibility remain underexplored, particularly in relation to compositional factors such as fat content. This study provides a novel comparative analysis of the in vitro digestion behavior of dehulled full-fat and fat-reduced hemp seed milks, marking one of the first investigations to link fat reduction with protein digestibility, coagulation dynamics, and nutrient bioaccessibility. Milk samples were developed using optimized processing parameters: a 5.23% seed-to-water ratio at pH 8.26 for full-fat and 11.1% at pH 8.5 for fat-reduced variants combined with ultrasound homogenization and thermal pasteurization. Simulated oral, gastric, and intestinal digestion phases were performed using a modified static in vitro protocol. Analytical parameters included gastric pH trends, coagulation behavior, SDS-PAGE protein profiling, and the protein bioaccessibility index (BI). The fat-reduced formulation showed superior protein bioaccessibility (72.76%) compared to the full-fat formulation (66.41%), likely due to reduced lipid interference and improved intestinal diffusivity. Notably, it exhibited delayed but firmer coagulation and a slower gastric pH decline, indicating better physical and buffering stability—a desirable trait in functional beverage design. In contrast, full-fat milk

showed rapid curd formation and earlier phase separation. While protein digestibility increased with time in both samples, the full-fat milk reached higher final digestibility (84%) due to faster enzymatic hydrolysis, whereas the fat-reduced milk demonstrated slower but more sustained degradation, consistent with its higher protein content. This work aligns with the "Food Technology and Engineering" theme by integrating formulation optimization, process engineering (ultrasound and pasteurization), and in vitro digestion modeling to evaluate the structural and functional performance of novel plant-based milks. The findings offer technological insights into tailoring fat content to enhance bioaccessibility and stability, supporting the development of clean-label, nutritionally functional beverages.

2.54. Influence of Modified-Atmosphere Packaging, Antioxidants and Mild Heat Treatment on the Shelf Life of Fresh-Cut Eggplant (Solanum melongena)

María Laura Lemos, Diego Ricardo Gutierrez and Silvia del Carmen Rodriguez

[1] Instituto de Ciencia y Tecnología de los Alimentos, Facultad de Agronomía y Agroindustrias (ICyTA), Universidad Nacional de Santiago del Estero (UNSE), Córdoba X5000HUA, Argentina

[2] Centro de Investigaciones en Biofisica Aplicada y Alimentos (CIBAAL-CONICET-UNSE), Villa El Zanjón, Santiago del Estero, Villa El Zanjón, Santiago del Estero 4206, Argentina

In order to be processed as freshly cut vegetables, eggplants must be subjected to some treatment to delay enzymatic browning, which occurs rapidly after cutting, reducing their sensory acceptability. In this work, the influence of passive and active modified-atmosphere packaging (MAP), antioxidants (A1: Ascorbic acid 1%; A2: Citric acid 1%) and their combinations with a mild thermal process on the shelf life of cut eggplants was evaluated. Eggplant slices (Black nite variety, obtained in Santiago del Estero, Argentina) 1 cm thick were subjected to different treatments: a—MAP (packaged in air with 35 µm polypropylene); b—MAP1: packaged with 3% O_2 + 15% CO_2; c—MAP2: packaged with 5% O_2 + 15% CO_2; d—A1 + MAP; e—A2 + MAP; f—A2 + MAP1; g—TT (heat treatment with water at 50 °C for 1 min) + A2 + MAP; h—TT + A2 + MAP1; i—Control (no treatment). Fifteen trays of each treatment were stored for 12 days at 5 °C. The evolution of sensory characteristics (with a trained panel), color (with a colorimeter) and browning index, ascorbic acid (AA), total phenols (TP), antioxidant capacity (AC), microorganism count (mesophilic and psychrophilic aerobes, enterobacteria, molds and yeasts) and browning-related enzymes (polyphenol oxidase (PPO)) were periodically evaluated. The main factors limiting shelf life were overall appearance, color, browning index and ascorbic acid evolution. In all treatments, the microbial count was always below 10^7 CFU/g (acceptable limit) during storage, except in the control. Treatment h was the most effective in prolonging the shelf life of eggplants, maintaining their optimal sensory characteristics for up to 10 days, with greater retention of AA and AC (approximately 64% and 70%, from the start of storage, respectively) and without significantly varying the initial level of TP and the enzymatic activity of PPO (1.5 ± 0.1 Eq chlorogenic acid.kg^{-1} and 2.8 ± 0.4 UEA.mg^{-1} protein, respectively).

2.55. Influence of Packaging Materials on the Quality Evolution of Extra Virgin Olive Oil Under Simulated Household Storage and Use Conditions

Beatrice Sordini, Stefania Urbani, Agnese Taticchi, Maurizio Servili, Roberto Selvaggini, Gianluca Veneziani, Luigi Daidone, Franco Famiani, Arianna Bonucci, Ilenia Dottori, Davide Nucciarelli and Sonia Esposto

Department of Agriculture, Food and Environmental Sciences, University of Perugia, 06126 Perugia, Italy

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Oxidative degradation compromises the sensory, healthy, and commercial value of extra virgin olive oil (EVOO) by depleting antioxidants and producing undesirable off-flavour compounds. Therefore, selecting appropriate primary packaging materials is crucial for preserving the shelf life and overall quality of EVOO. This comparative study evaluated the influence of three packaging materials on the physicochemical and sensory properties of EVOO under conditions simulating typical household storage and use. The same EVOO was stored in polyethylene terephthalate (PET), bag-in-box (BB), and chrome-plated tin (CPT) containers (3 L) and exposed to 25 °C under a 12 h light/dark cycle. To mimic household consumption, 75 mL of EVOO was withdrawn daily and collected over 40 days. Every 10 days, legal quality parameters (free acidity, peroxide value (PV), K_{232}, and K_{270}), phenolic and volatile compounds, as well as sensory attributes of EVOOs, were monitored. The type of packaging material significantly affected the oxidative stability and overall quality of the EVOO during household consumption. Free acidity, K_{232}, and K_{270} slightly increased across all containers, while PET exhibited a significant rise in peroxide value, exceeding regulatory limits. In addition, EVOO stored in the PET container experienced losses of 44% in α-tocopherol and 26% in total hydrophilic phenols. In contrast, there were only 1% and 11% reductions for EVOOs stored in BB and CPT containers, respectively. A significant decline in C_5-C_6 aldehydes and C_6 esters, associated with the "green" attributes of EVOOs, occurred for PET-packaged EVOOs compared to BB and CPT, with a higher accumulation of C_7-C_9 aldehydes and 3-methyl-1-butanol, which are responsible for rancid and winey–vinegary defects, respectively. Among the three packaging materials tested, PET offered lower protection against oxidation than BB or CPT. The EVOOs stored in BB and CPT retained more antioxidants, developed fewer off-flavour compounds, and maintained the oil's compliance with extra virgin standards.

2.56. Influence of the Application of Tea Tree Essential Oil (Melaleuca alternifolia) on the Sensory, Microbiological, and Antioxidant Quality of Minimally Processed Anco Squash

Julio Federico Benites [1], Diego R. Gutierrez [2], Silvana Cecilia Ruiz [3] and Silvia del Carmen Rodriguez [2]

1 Food Science and Technology Institute, Faculty of Agronomy and Agroindustries, National University of Santiago del Estero (UNSE), Santiago del Estero CP4200, Argentina
2 Instituto de Ciencia y Tecnología de los Alimentos, Facultad de Agronomía y Agroindustrias, Universidad Nacional de Santiago del Estero (UNSE), CIBAAL CONICET-UNSE, Villa El Zanjón, Santiago del Estero 4206, Argentina
3 Instituto Nacional de Tecnología Agropecuaria, Estación Experimental Agropecuaria Santiago del Estero (INTA-EEASE), Santiago del Estero 4200, Argentina

The influence of tea tree essential oil (TTEO) and modified-atmosphere packaging (MAP) on the quality of grated anco squash (AS) (*Cucurbita moschata*) was studied. AS (obtained in Santiago del Estero-Argentina) were washed, sanitized, cut, peeled, grated, washed, and centrifuged. The product was then subjected to TTEO treatments at two concentrations (4 and 8 µL/mL) and applied in three ways: spraying (TA), immersion (TI), and strips soaked in EO adhered to the storage container (TV). A NaClO immersion treatment (TH) and a control (immersion in water) (TC) were also included. All samples were conditioned in trays coated with 35 mm polypropylene to generate MAP and stored for 8 days at 5 °C. Samples from each treatment were analyzed in triplicate at 24 h and 8 days, assessing sensory quality, antioxidant, and microbial growth (mesophiles, psychrophiles, and enterobacteria). The sensory evaluation was carried out by 11 trained individuals, who assessed six attributes on a scale of 1 to 9, with aroma and flavor being critical parameters from the judges' acceptability point of view. The results showed that applying TTEO at a

higher concentration (8 µL/mL) in all forms was an appropriate strategy for maintaining microbiological quality for 8 days, although this concentration significantly affected aroma, decreasing its acceptability. TA had the highest values ($p < 0.05$) and was the most accepted until the fourth day. No changes were observed in phenolic compounds and an increase in antioxidant capacity and carotenoids was recorded at the end of storage. According to the parameters studied, the use of TTEO (8 µL/mL) with MAP was effective in maintaining the overall quality of AS for 4 days. For this reason, the use of TTEO could be considered to improve the nutraceutical profile of AS and also in conjunction with other technologies to prolong its shelf life.

2.57. Influence of the Combined Application of Lemon Essential Oil and UV-C Radiation on the Sensory Quality of Minimally Processed Rocket

Diego Ricardo Gutiérrez [1,2], Federico Benitez [1], Silvana Cecilia Ruiz [3] and Silvia Del Carmen Rodriguez [1,2]

1 Instituto de Ciencia y Tecnología de los Alimentos, Facultad de Agronomía y Agroindustrias, Universidad Nacional de Santiago del Estero (UNSE), Santiago del Estero G4200, Argentina
2 Applied Biophysics and Food Research Center, National Council for Scientific and Technical Research, National University of Santiago del Estero (CIBAAL—CONICET-UNSE), Villa El Zanjón, Santiago del Estero CP4209, Argentina
3 Instituto Nacional de Tecnología Agropecuaria, Estación Experimental Agropecuaria Santiago del Estero (INTA-EEASE), Santiago del Estero G4200, Argentina

The consumption of minimally processed vegetables has grown rapidly due to increased consumption of healthy, additive-free products and the time savings involved in their preparation. However, the processing operations necessary for their preparation limit their shelf life. Rocket is a vegetable consumed as a salad and its main post-harvest problem is the yellowing and dehydration of its leaves. The combined application of essential oils (EOs) with other treatments such as UV-C radiation can be an alternative to reduce the effective concentration of EOs and the dose of UV-C radiation, and prolong the shelf life of this vegetable processed as a minimally processed vegetable. In this work, the effect of the individual application of different concentrations of lemon EO (4 and 8 µL/mL), UV-C radiation dose (10 kJ/m^2), and the combination of both treatments on the sensory quality of rocket (*Eruca Sativa* Mill.) leaves cut for 7 days at 5 °C was studied. A disinfection treatment with NaClO (150 ppm-2 min) and a control (no treatment, washed only with water) were included. Sensory attributes (general appearance, color, aroma, uncharacteristic odors, taste, and dehydration) were evaluated periodically bytrained judges, and color determination using L*, a*, and b* parameters. The results showed that the combination of AE (8 µL/mL) + UV-C allowed for better preservation of the sensory quality of rocket during storage, registering significantly higher scores than the rest of the treatments in all the descriptors evaluated. Likewise, no significant changes in color parameters were recorded in the combined treatment, with L* values close to 70. Therefore, these results are promising for continuing studies with these technologies in the conservation of this vegetable.

2.58. Isolation of Novacetimonas Hansenii, a Cellulose-Producing Bacterium, and Its Polysaccharide Characterisation

Lucía Pucciarelli, Micaela Medrano and Judith Piermaria

Department of Biological Sciences, Faculty of Exact Sciences, Centre for Research and Development in Food Science and Technology (CIC-CONICET-UNLP), National University of La Plata, La Plata 1900, Argentina

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The development of biomaterials using eco-friendly methodologies is an important goal for researchers. Among these materials, bacterial cellulose is produced by a non-pathogenic microorganism; it has the advantages of having a three-dimensional nanofibrous structure, higher purity and crystallinity than plant cellulose; is biocompatible and biodegradable; and can be combined with other biopolymers for the development of new materials. The aim of this work was to isolate cellulose-producing bacteria from kombucha, the symbiotic culture of bacteria and yeast (SCOBY); to study the production of the biopolymer in isolated culture; and to characterize it. It was possible to isolate eight strains of acetic acid bacteria, of which two were cellulose-producing, in isolated culture. The strain with the highest polymer production was identified as *Novacetimonas hansenii*, which was found to be capable of producing 206 mg/L of cellulose in Y3 medium after 10 days of culture at 30 °C. The isolated polymer was lyophilized and characterized by FTIR, X-ray, and SEM microscopy. The crystallinity index corresponded to 81 ± 3%, the evaluation of the infrared spectra was performed in the mid IR range from 500 cm–1 to 4000 cm^{-1} and showed peak profile characteristics corresponding to the -OH group, -CH_2 and C-O-C group at wavelengths of 3375 cm^{-1}, 2875 cm^{-1} and 1100 cm^{-1}, respectively. The microscopic evaluation allowed us to observe the nanofibrillar character of its structure and calculate the diameter of nanofibers, which was around 40-120 nm. Hydrolysis using sulfuric acid and subsequent washing and sonication resulted in obtaining nanoparticles that were combined with the prebiotic polysaccharide kefiran in a 1:10 ratio to obtain cryogels. The viscoelastic characteristics were evaluated and it was observed that the loss tangent was 0,05 at 1 Hz. These cryogels have potential for the development of functional foods.

2.59. Microfluidized Hydrogels and Emulgels Structured with Insoluble Dietary Fiber: Influence of Processing on Physical Properties

Domenico Mammolenti [1], Elisabetta Bruno [1], Francesca Romana Lupi [1], Noemi Baldino [1], Maria del Carmen García [2], José Muñoz [2] and Domenico Gabriele [1]

[1] Department of Information, Modeling, Electronics and Systems (D.I.M.E.S.), University of Calabria, Via P. Bucci, Cubo 39C, 87036 Rende, Italy

[2] Department of Chemical Engineering, University of Seville, EPS, C/Virgen de Africa, 7, 41011 Seville, Spain

The utilization of insoluble dietary fibers (IDFs), like citrus fiber, in food formulations is receiving a lot of attention from both industry and academia. The interest in using IDFs is due to their physiological benefits and technological performance. Different homogenization techniques can be used to prepare both hydrogels and O/W emulgels containing IDFs. In the present research, hydrogels and emulgels containing citrus fiber as a structuring agent were produced by means of microfluidization. This study focuses on the effect of microfluidization cycles and channel geometry on the rheological and physical properties of hydrogels (with 0.01 w/w of citrus fiber) and emulgels (with 0.01 w/w of citrus fiber in water, 0.2 w/w of oil solution made of extra virgin olive oil, and 0.15 w/w of organic soy lecithin). After a pre-homogenization step, samples were homogenized by means of microfluidization at 172 MPa using two types of interaction chambers. In particular, samples were microfluidized using (a) two Z-type interaction chambers in series and (b) one Y-type followed by a Z-type interaction chamber. Samples were processed with one and two cycles. Rheological properties were investigated with stress sweep tests and frequency sweep tests within the linear viscoelastic range (LVR). Size distributions of both fiber particles and oil droplets (in emulgels) were determined by laser diffraction; morphology was investigated by means of contrast phase optical microscopy, cryo-SEM, and confocal laser scanning microscopy, and, finally, physical stability of the emulgel samples was assessed via multiple light scattering (Turbiscan). Tests evidenced that a second cycle decreases consistency (in

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terms of plateau modulus and minimum loss modulus) and strength (in terms of limiting stress for LVR). The formation of smaller fiber particles after the second microfluidization cycle was associated with the weakening of the samples. Despite the different consistencies, all emulgels were physically stable for at least 14 days.

2.60. Microwave Drying of 3D-Printed Carrot Purée Using an Evanescent Wave Antenna

Tania Doménech Valiente [1], Diana Vicente-Jurado [1,2], Purificación García-Segovia [1], Marta Igual [1], Jose-Manuel Catalá-Civera [2] and Javier Martínez-Monzó [1]

1 i-Food Group, Instituto Universitario de Ingeniería de Alimentos-FoodUPV, Universitat Politècnica de València, 46022 Valencia, Spain
2 Institute of Information and Communication Technologies (ITACA), Universitat Politècnica de València, Camino de Vera, 46022 Valencia, Spain

Introduction: Three-dimensional printing is revolutionising food processing by enabling more efficient work with various food inks compared to other techniques. The integration of microwaves by means of an evanescent wave antenna is currently being investigated with the aim of applying a thermal treatment to food inks, favouring their drying to eliminate microbiological risks and ensure their stability. In formulations such as carrot purée, a high-water content necessitates efficient drying to ensure product stability and reduce the risk of contamination.

Methods: A carrot purée formulated with 3.13% konjac was utilised to print three-dimensional structures consisting of five lines. Subsequently, the samples were subjected to heat treatment using an evanescent wave antenna operating at a centre frequency of 2490 MHz. The impact of varying experimental conditions was evaluated through the modulation of antenna speed (1.5 mm/s and 2.25 mm/s) and the distance between the antenna and the printed surface (1.0 mm and 1.2 mm). Each combination of parameters was tested in triplicate. The loss of moisture was determined by gravimetry, and the maximum temperature reached at each point of the sample was recorded by means of optical thermography.

Results: The most favourable conditions were observed at the lowest antenna speed (1.5 mm/s) and shortest distance to the sample (1 mm), yielding the highest moisture loss (up to 35%) and a stable maximum temperature with minimal thermal fluctuations. In contrast, higher speeds resulted in greater temperature oscillations, leading to less uniform drying. Similarly, increasing the distance between the antenna and the carrot purée led to a reduction in maximum temperature during treatment, which in turn decreased moisture loss.

Conclusions: Evanescent microwave heating proved effective for the localised drying of carrot purée, with antenna speed and distance being critical to maximise moisture loss and ensure thermal uniformity.

2.61. Mild Alkali Treatment Changes the Structural and Physicochemical Properties of Different Starches

Zekun Xu [1], Zhongquan Sui [1] and Harold Corke [2]

1 Department of Food Science and Technology, School of Agriculture and Biology, Shanghai Jiao Tong University, Shanghai 200240, China
2 Department of Biotechnology and Food Engineering, Guangdong Technion-Israel Institute of Technology, Shantou 515063, China

Mild alkali environments are a common condition during starch isolation, processing, or modification, accompanied by hydrothermal treatment, but the effect of mild alkali environments on starch properties remains inadequately studied. The objective of this

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research was to determine the effect of mild alkali treatment on different starch properties. Normal maize starch (NMS), waxy maize starch (WMS), normal rice starch (NRS), and waxy rice starch (WRS) were subjected to mild alkali treatment (pH 8.5, 9.9, 11.3) under two temperature–time combinations (25 °C for 1 h and 50 °C for 18 h). Their morphology, composition, crystalline structure, pasting properties, gelatinization properties, and rheological properties were determined. The results showed that mild alkali treatment induced pores on the surface of starch granules, and obvious damage occurred in waxy maize and rice starch granules. The protein and lipid contents of starch were significantly reduced by mild alkali treatment. The crystalline structure of starch was unchanged by mild alkali treatment, but the gelatinization enthalpy of waxy maize and rice starches increased with the increase in alkali intensity. The pasting viscosities and storage modulus of starch increased first and then decreased with the increase in alkali intensity. With mild alkali treatment, the consistency of normal maize and rice starch pastes increased and the flow index decreased, showing the increase in pseudoplasticity. Their yield stress and area of the thixotropy ring also increased. This study showed that the mild alkali treatment reduced the starch granules' stability by removing proteins and lipids, but induced the rearrangement of amylopectin in waxy starch via ionization of hydroxy groups.

2.62. Modeling the Effects of Pretreatment and Solar Drying on Bitter Leaf's (Vernonia amygdalina) Chromatic Profile to Improve Its Market Value

Titilope Fasuan and Onaolapo Adeola Olatunji

[1] Product Development Programme, National Horticultural Research Institute, Ibadan, PMB 5432 Jericho, Idi-Ishin, Ibadan, Nigeria

[2] Department of Food Technology, University of Ibadan, Ibadan, Nigeria

Bitter leaf is a widely consumed African vegetable. The deep green colour of the leaves serves as a visual quality indicator that the international diaspora market demands, even when the leaf is in its dehydrated form.

This study investigates and models how pretreatment and raw material source affect the colour of solar-dried bitter leaf. Fresh bitter leaf samples were harvested from a rural (Ekere) and an urban community (Bodija) in Oyo State, Nigeria. The samples were pretreated by squeeze-washing, blanching, and steeping prior to solar drying. Using colourimetry measurements in the CIE L*a*b* colour space, this study monitored the colour profiles of the leaves before and during solar drying.

The data was fitted into four models (First-Order, Zero-Order, Fractional Conversion, and Arrhenius equations) using nonlinear regression analysis. The coefficient of determination (R^2) and sum of squared errors (SSEs) were used as fitness indicators. The results showed that after pretreatment, control samples from both sources exhibited higher initial L* values (31.45, 25.30), while blanched samples had lower initial L* readings (28.48, 27.68). Blanched samples also had higher initial a* values (17.33, 18.64). The study found that solar drying caused lightness fluctuations in all samples from Ekere, a decrease in redness in a blanched Bodija sample, and an increase in yellowness in control and squeeze-washed samples obtained from both sources. During solar drying, the squeeze-washed rural sample showed the highest average ΔE value (70.13), and the most significant ($p < 0.05$) colour change. Zero-Order kinetics provided the best overall fit (average $R^2 = 0.7949$), followed by Fractional Conversion ($R^2 = 0.5619$), with samples sourced from Bodija exhibiting slightly superior model fits. Based on this study's findings, bitter leaf processors should be sourced from urban locations; they should undergo minimal pretreatment, and blanching and squeeze-washing should be avoided to preserve the colour characteristics demanded by the export market.

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2.63. Obtaining Powders of Winemaking By-Products: Effect of Drying Methods and Particle Size on Functional Properties

Paula Andrea Sette, Carmen Maturano, Milagros Gomez Mattson and Daniela Salvatori

Chemistry Department, Engineering Faculty, Comahue National University, Neuquén Post 8300, Argentina

In the Norpatagonia region of Argentina, the wine industry has consolidated in recent years, generating large amounts of agro-industrial waste. Grape pomace and stalks are valuable sources of dietary fiber and phenolic compounds. This study aimed to valorize white wine production waste (pomace, WP, and stalks, WSs) by processing and characterizing it from physicochemical and techno-functional perspectives to assess its potential for use as food ingredients. The waste underwent air-drying (AD) and freeze-drying (F), followed by milling and sieving to obtain particle sizes of 210 μm and 590 μm. Eight particulate products were obtained (aw: 0.209–0.256). The powders were evaluated for their total polyphenol content (TPC), antioxidant capacity (DPPH), superficial color (CIELAB), and techno-functional properties, such as their water holding capacity (WHC), water retention capacity (WRC), and oil holding capacity (OHC). Both the particle size and drying method significantly affected all the parameters studied. The stalk powders had the highest polyphenol content and antioxidant capacity, with freeze-dried 210 μm samples showing the greatest TPC (WS-F210: 3339.4 ± 128.7 mg gallic acid equivalents (GAE)/100 g dry basis (db)) and DPPH value (WS-F210: 1870.4 ± 8.7 mg GAE/100 g db). All the powders presented a yellowish hue (a = 5.14 ± 0.76; b = 12.9 ± 0.6; L* = 48.5 ± 2.2). Generally, the WS powders absorbed more water (WHC: 8.5–10.04 g/g; WRC: 7.3–10.7 g/g). Freeze-dried samples with larger particle sizes exhibited the highest OHC values, particularly WP-F590 (2.93 g/g), suggesting a higher content of insoluble fiber. These results demonstrate the feasibility of obtaining products from winemaking waste with potential as ingredients rich in bioactive compounds for use in various food applications. WP waste could enrich solid foods such as breakfast cereals or dairy products like yogurts, providing fiber, polyphenols, and color. Grape stalks could be used in premixes for developing gluten-free or diabetes-friendly products due to their superior hydration properties and high polyphenol content.

2.64. Optimisation of Hydrothermal Treatment Parameters to Enhance the Techno-Functional Quality of Apple Pomace Powder

Magdalena Karwacka, Karolina Szulc, Sabina Galus, Agnieszka Ciurzyńska and Monika Janowicz

Department of Food Engineering and Process Management, Institute of Food Sciences, Warsaw University of Life Sciences (SGGW), Warsaw, Nowoursynowska 159c, 02-776 Warsaw, Poland

Apple pomace, a by-product of juice and cider production, is rich in dietary fiber, polyphenols, and other valuable nutrients, making it a promising ingredient for food applications. Its high fiber content contributes to improved water retention and viscosity, enhancing the structure and texture of food products by increasing thickness, moisture stability, and mouthfeel, especially in baked goods, meat analogues, and dairy alternatives.

The aim of the study was to investigate the impact of hydrothermal treatment parameters on the technological and functional properties of powder obtained from dried apple pomace based on the characteristics of the pulp rehydrated from it. This was tested in terms of texture properties, particle size, water holding capacity, bioactive compounds, and antioxidant activity.

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The results showed that treatment at temperatures ranging from 60 °C to 90 °C for 1 to 10 min improved the water-holding and binding capacity of the apple pomace powder, which was associated with the loosening of the material's structure. However, increasing the temperature negatively affected the polyphenol content and antioxidant activity of the resulting pulp due to the heat sensitivity of bioactive compounds. Higher processing temperatures also enhanced the texture-forming properties of the pulp. The duration of the hydrothermal treatment had a less significant effect, although a tendency was observed for reduced bioactive properties and increased water retention with longer processing times (1–10 min). The findings confirm that the parameters of the hydrothermal rehydration process determine the technological usefulness of dried apple pomace powder and should be optimized depending on its intended function in food products. Higher temperatures and longer durations are recommended for texture improvement, while lower temperatures should be used to preserve bioactive compounds.

2.65. Optimization of the Thin-Layer Drying of Brewers' Spent Grain to Obtain a Safe and Functional Food Ingredient

Maria Victoria Santos [1], Juliana Orjuela-Palacio [2], Natalia Ranalli [1] and Noemi Zaritzky [2,3]

1 Reference Center for Yeasts and Brewing Technology (CRELTEC), IPATEC-CONICET-National University of Comahue, San Carlos de Bariloche 8400, Province of Rio Negro, Argentina
2 CIDCA—Center of Research and Development in Food Science and Technology (University of La Plata—CONICET—CIC) Faculty of Exact Sciences, UNLP. 47 and 116, La Plata 1900, Province of Buenos Aires, Argentina
3 Chemical Engineering Department—Faculty of Engineering—National University of La Plata. 48 and 115, La Plata 1900, Province of Buenos Aires, Argentina

Brewers' Spent Grain (BSG) is the most abundant by-product of beer production; it is rich in fiber, protein, lignin, and bioactive substances. However, this product has environmental and health risks due to its high initial moisture content and susceptibility to microbial contamination.

The objective of the work was to design a thin-layer drying process of BSG that is coupled to the lethality evaluation of a pathogenic microorganism (*Bacillus cereus* spores) in order to optimize the industrial treatment.

Drying experiments were conducted using BSG with a high initial water content of 76.46% (wet basis), varying the air temperatures (75–120 °C) and thin-layer thicknesses (0.75–1.3 cm). Mathematical modeling based on water vapor diffusion and Arrhenius kinetics enabled the prediction of effective moisture diffusivity and drying times. The safety criterion was a minimum of a 2-log reduction in *B. cereus* spores, based on thermal death time (F) calculations using literature values for D- and z-parameters. Simultaneous measurement of thermal histories at the interphase between the bottom of the product layer and the hot surface of the dryer allowed precise estimation of microbial lethality.

The process ensured compliance with the Argentine Food Code requirement of $\leq$13% final moisture (wet basis) in the product and a maximum of 10^3 CFU/g of *B. cereus*. Under optimal conditions (such as a treatment time of 5.9 h for a 1 cm layer thickness at 100 °C), both drying targets and microbial lethality were achieved. In terms of total phenolic content (TPC) and antioxidant activity (AC), the highest values were obtained at 120 °C: the TPC was 19.8 mg GAE/g dry matter, and the ACs using DPPH and ABTS were 20.9 and 17.6 mmol trolox/g dry matter, respectively.

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The proposed method provides a scientifically validated drying process for BSG, promoting its use as a functional ingredient. It represents a sustainable approach aligned with circular economy goals.

2.66. Optimizing Compound Sourdough Incorporation to Improve Bread Quality and Extend Shelf Life

Yuqing Wu, Tingting Wang, Xu Dan and Xueming Xu

Department of Food Science and Technology, Jiangnan University, Wuxi 214122, Jiangsu, China

Microbial spoilage in bread, primarily driven by its high moisture and nutrient content, significantly impacts both its quality and shelf life. This study assesses the potential of compound sourdough, fermented with *Lactobacillus sanfranciscensis* and *Propionibacterium freudenreichii*, as a natural preservative in bread. Composite sourdough was incorporated at ten different levels (5–50%) to examine its effects on fermentation behavior, physicochemical properties, sensory attributes, staling, and microbial stability. The results indicated that with increasing sourdough incorporation, organic acid concentrations, including lactic and propionic acids, rose significantly, while pH decreased, reaching its lowest point at a 50% sourdough addition. At lower sourdough levels (5–20%), fermentation performance improved, as evidenced by a reduction in fermentation time, lower baking loss, and an increase in specific volume and height-to-diameter ratio. However, higher sourdough levels (25–50%) impaired fermentation due to excessive acidity, which inhibited yeast activity. Sensory evaluation revealed that moderate sourdough incorporation (5–20%) enhanced bread texture, making it softer and more elastic, with overall higher sensory scores. In contrast, excessive sourdough levels (25–50%) resulted in increased hardness, reduced springiness, and deteriorating taste. Additionally, appropriate sourdough levels improved bread's storage properties by enhancing moisture retention, reducing hardness, and slowing staling. On the other hand, excessive sourdough accelerated moisture loss and staling, resulting in firmer bread. Higher sourdough ratios also contributed to improved mold inhibition and extended shelf life, with the 50% addition extending the shelf life to 15 days, although this led to a significant compromise in quality. Ultimately, the study concluded that a 20% sourdough addition strikes an optimal balance between antimicrobial efficacy and the preservation of overall bread quality. This study optimized the compound sourdough ratio to balance fermentation, bread quality, and shelf life, offering a sustainable preservation solution for industrial production.

2.67. Performance and Biodegradability of Biopolymeric Films from Cassava By-Products Under Controlled Environmental Conditions

Mariana Lopes Geraldo, Nayana Hayss Araújo da Silva, Gabryelle Araújo Coutinho and Camila Argenta Fante

Programa de Pós-Graduação em Ciência de Alimentos, Faculdade de Farmácia; Universidade Federal de Minas Gerais (UFMG), Belo Horizonte 31270-901, Brazil

Brazil is recognized for its strong agricultural and agro-industrial sectors. While this production system plays a key role in the national economy, it also contributes significantly to the generation of agri-food waste and presents environmental and socioeconomic challenges. Among the various agri-food chains with potential for waste valorization, cassava (Manihot esculenta Crantz) processing stands out, as its peels and other non-edible fractions are often underutilized. In response to this issue, the adoption of circular economy practices emerges as an effective strategy. This study aimed to explore technological solutions to reduce waste and utilize biopolymeric matrices as raw materials for biodegradable packaging. Specifically, we investigated the biodegradation behavior of films produced from by-products of Cacau Branca cassava processing under controlled environmental

conditions. Biodegradable films F1, F2, F3, F4, and F5 were formulated with 0%, 20%, 50%, 80%, and 100% cassava peel flour, respectively. These films were placed in containers filled with alternating layers of vegetable soil and subjected to intermittent wetting to simulate natural biodegradation conditions in soil. Biodegradation was assessed through visual inspection and gravimetric analysis. After 15 days, visible signs of degradation were observed, including color changes and loss of mechanical integrity. The materials exhibited partial mass reductions of 84.90%, 77.57%, 71.73%, 70.78%, and 71.44% for formulations F1 through F5, respectively. Data followed a normal distribution, and significant differences were found among formulations ($p < 0.05$). F1 exhibited the greatest mass reduction, followed by F2. Formulations F3, F4 and F5 showed statistically equivalent degradation behavior. These results demonstrate that the evaluated films have promising biodegradability under simulated natural conditions and support the potential use of Cacau Branca cassava peel flour in the development of biodegradable packaging materials.

2.68. Phenolic Content and Antioxidant Activity of Apples Dehydrated by Freeze-Drying and Hot Air Drying

Daiana Fanesi [1,2], Manuel Wally [1], Camila Lier [1] and María Marcela Rodríguez [1,2]

1 Faculty of Engineering, National University of the Center of the Province of Buenos Aires, Olavarría B7400, Argentina
2 CCT Tandil (CONICET), Tandil B7000, Argentina

Fruits are highly nutritious due to their antioxidant content (phenolic). However, their utilization is limited because they are highly perishable and stationary. Therefore, the search for technologies that extend shelf life while preserving the quality attributes of fresh produce is of interest. The objective was to preserve diced apples by freeze-drying and hot air drying, comparing the effects of these technologies on phenolics and antioxidant activity. Red Delicious apple samples were cut into cubes (1.2 cm) and then dried in an air convection oven at 80 °C and freeze-dried (−50 °C, 26 Pa) to obtain a moisture content of 25% (wet basis). Dehydrated apples were evaluated for total phenol content (Folin–Ciocalteu) and antioxidant activity (ABTS). Additionally, rehydration capacity in distilled water and color parameters (L, a, b) were evaluated using image analysis software (ImageJ). Total phenol and antioxidant activity values were significantly higher ($p \leq 0.05$) in the hot air-dried samples, which could be attributed to the formation of Maillard reaction compounds that interact with the Folin–Ciocalteu reagent, resulting in an overestimation of total phenol content. These compounds also possess antioxidant activity. The apples had an initial moisture content of 85.32 ± 0.31%. After drying, the moisture content decreased to 25%, with durations of 2 and 24 h for hot air drying and freeze-drying, respectively. After rehydration, the diced apples dried by hot air reached a moisture content of 72.18 ± 0.01% in 80 min, while the freeze-dried apples rehydrated to 85.21 ± 0.68% in 5 min. The color parameters L and a were significantly influenced ($p < 0.05$) by the drying method, with the hot air-dried sample exhibiting the lowest luminosity and greatest redness due to browning reactions. While both methods allow for preserving diced apples, freeze-drying requires a higher investment cost and long processing times. However, it is the most appropriate option for preserving the quality in terms of the final product's appearance.

2.69. Physical and Cooking Properties of Analog Rice Developed from Fermented Kidney Bean Flour, Sago, and Modified Cassava Flour (Mocaf)

Dwi Ghina Nadhifa [1], Februadi Bastian [2,3,4] and Meta Mahendradatta [2,3,4]

1 Doctoral Program of Agricultural Sciences, Postgraduate School, Hasanuddin University, Makassar 90245, Indonesia

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[2] Department of Agricultural Technology, Hasanuddin University, Makassar 90245, Indonesia
[3] Center of Excellence in Science and Technology on Food Product Diversification, Hasanuddin University, Makassar 90245, Indonesia
[4] Functional Food Technology Research Group, Hasanuddin University, Makassar 90245, Indonesia

Analog rice has been developed as a promising alternative to traditional rice and a vehicle to fulfill public nutrition needs. The characteristics of analog rice, which is manufactured from various ingredients, greatly depend on the ingredients used and their ratio in the formulation. This study aims to analyze the physical and cooking properties of analog rice developed from fermented kidney bean flour (FKBF), sago, and modified cassava flour (Mocaf). Five formulations of analog rice were produced using extrusion technology, with a constant 20% Mocaf content and varying FKBF–sago ratios (30:50, 35:45, 40:40, 45:35, 50:30). These samples were then subjected to analyses to determine their physical and cooking properties, including their yield, bulk density, water absorption, color intensity (L*, a*, b*), cooking time, cooking weight, cooking loss, rehydration, and swelling power. No significant differences were found in the physical properties, including yield (69.83–82.58%), water absorption (96–109%), L (57.32–60.02), and a* values (1.86–3.08). However, bulk density (0.58–0.63 g/mL) and b* values (10.33–11.42) showed significant variation, with lower FKBF ratios (30:50 and 35:45) exhibiting higher bulk density and b* values (indicating a more yellow hue). For cooking properties, significant differences were observed in cooking time (8.16–10.52 min) and swelling power (12.49–20.45%) among formulations with higher FKBF ratios (45:35 and 50:30), showing shorter cooking times and greater swelling power. In contrast, cooking weight (177.14–191.28%), cooking loss (26.8–29.13%), and rehydration (77.14–91.28%) did not differ significantly. The results revealed that the increasing FKBF ratio in the formulation likely contributed to higher yield, water absorption, cooking weight, rehydration, and swelling power, while lowering the color intensity (L* and b*), cooking time, and cooking loss of analog rice.

2.70. Preparation and Characterization of Emulgel Structured with Citrus Fiber as Potential Carrier of Curcumin (Curcuma longa): Rheology, Physical Stability, Encapsulation Efficiency and Loading Capacity

Domenico Mammolenti [1], Patrizia Formoso [2], Daniela Demasi [2], Francesca Romana Lupi [1], Noemi Baldino [1] and Domenico Gabriele [1]

[1] Department of Information, Modeling, Electronics and Systems, (D.I.M.E.S.) University of Calabria, Via P. Bucci, Cubo 39C, 87036 Rende, Italy
[2] Department of Pharmacy, Health and Nutritional Sciences, University of Calabria, via A. Savino, Polyfunctional Building, 87036 Rende, Italy

Curcumin is an active component with interesting properties that suggest its potential use as a food supplement; nevertheless, its poor water solubility makes its delivery difficult, and oil-based or biphasic systems must be used. Among different potential carriers, emulgels, i.e., two-phase systems where the dispersing phase is structured, are recognized as very effective in the delivery of bioactive components in several food applications. In this work, O/W emulgels, with a water phase structured using citrus fiber, were produced using different methods and proposed as potential carriers of curcumin. Emulgels containing 0.4 *w*/*w* of Miglyol® 812N and different amounts of citrus fiber in the water phase (0.020 *w*/*w*, 0.025 *w*/*w*, 0.030 *w*/*w*) were produced by high-speed homogenization (HSH) and ultrasound-assisted emulsification (UAE). Samples with 0.030 *w*/*w* of citrus fiber were loaded with curcumin (*Curcuma longa*) in the oil phase at 3.34 mg/mL. The size of the droplets was qualitatively evaluated using optical microscopy at 10x and at different times

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from preparation. ζ-potential was measured at different times from preparation and at different temperatures (25 °C, 37 °C, and 50 °C). Rheological properties were investigated by conducting frequency sweep tests in linear conditions. For curcumin-loaded samples, the encapsulation efficiency and loading capacity were determined. No significant changes in droplet size (close to 10–100 μm) with varying times, and ζ-potentials (close to −30 mV), and temperatures were observed in all samples. HSH yields more consistent samples compared to UAE. Curcumin does not affect the consistency but decreases the structuring degree of the emulgel. The encapsulation efficiency of samples with curcumin was 91.90% when produced by HSH and 96.21% when produced by UAE, whereas loading capacities were 1.23 mg/g and 1.29 mg/g, respectively. The results are promising in view of using these emulgels as carriers of curcumin for potential applications as food supplements.

2.71. Preparation and Characterization of Vegan Biscuits Made with Vegetable Flours from Agro-Industrial Waste

Maria Eduarda Araujo Machado, Antonio Alves Pereira Filho, Carmen Luce Duarte da Silva, Adriana Rodrigues Machado, Wanya Sandra Bezerra Brito and Maria Inês Rodrigues Machado

Agricultural Sciences, Campus Crato, Universidade Federal do Cariri, Crato 63130-025, Brazil

The food industry produces a large volume of waste resulting from the production, preparation and consumption of food. The use and proper disposal of this waste has become a concern in recent years, such as the industrialization of cashew, Anacardium occidentale L, a fruit found in northeastern Brazil, which has great potential for use, as well as tubers and grains, thus enabling the supply of new foods, which have bioactive compounds with antioxidant properties. The methodology used to make the flours follows a process of forced air drying, using a mixture of flours to make the cookies. Given this alternative, the waste was processed into flour, guaranteeing a nutritional contribution to the food products supplied. Therefore, the general objective was to develop vegan cookies using vegetable flours from agro-industrial waste such as cashew nuts, beans and tubers. For the results obtained in the basic formulation, we highlight the physicochemical and phytochemical determination of the products: pH: 3.70, acidity: 26.80 mL sol. normal/100 g, ash: 1.13 g/100 g and humidity 4% and the bioactive compounds already identified, which confer functionality to the food, total phenols 2.8 mgEAG/100 g and vitamin C: 72 mg/100 g. The possibility of acceptance of the vegan, gluten-free and lactose-free cookie was tested by sensory analysis, with a significant percentage of acceptance. It is concluded that the product developed has promising commercial potential, in line with the principles of the circular economy by promoting the sustainable use of waste that would otherwise be discarded in the environment. The product demonstrates functional characteristics that qualify it as a healthy food alternative, contributing to nutritional diversification and more conscious consumption practices. This demonstrates not only the technical and market viability of the product but also its commitment to sustainability and the promotion of human health.

2.72. Process Optimization of Hybrid Dried Tender Jackfruit-Fortified Pasta by Response Surface Methodology

Nilesh Balasaheb kardile, Pranjal Kumawat, Shubhangi Mahadeo Thakre and Gauri Athawale

Department of Food Process and Product Engineering, School of Food Technology, MIT Art Design and Technology University Pune, India

This study aimed to develop nutritionally enriched pasta by using tender jackfruit flour, finger millet (ragi), and durum wheat flour. The tender jackfruit was dried using a hybrid dryer at 60 °C. The pretreatments were given prior to drying for tender jackfruit slices using potassium metabisulfite (KMS), citric acid (CA), and potassium sorbate (PS) solutions at different levels, ranging from 0.1% to 0.3%, respectively, for 5 min. The pretreated dried jackfruit with 0.2% KMS showed better color and nutrient retention. The dried jackfruit slices were subjected to comminution and sieved through a 60-mesh sieve with a particle size range of 180 µm to 250 µm to obtain fine flour for suitable pasta formulation. A Central Composite Design under Response Surface Methodology was employed to optimize the formulation for the preparation of pasta by considering dependent parameters like cooking quality and sensory attributes. The optimized level was found to be X_1, ender jackfruit flour 5 g, X_2, ragi flour 25 g, and X_3, durum wheat flour 75 g, which resulted in pasta with desirable pr acceptable qualities: a cooked weight of 23.71 g, minimal cooking loss (9.2%), high water absorption (128.57%), and high overall acceptability (7.78). In comparison to the control, the optimized pasta exhibited enhanced fiber, antioxidants (68.41% DPPH), phenolic content (312.6 mg GAE/100 g), and vitamin C (10.36 mg/100 g). The findings of this study emphasized jackfruit and millet as functional ingredients in contributing to value-added, health-oriented pasta with improved nutritional and sensory attributes.

2.73. Proposal of a Digital Maturity Model to Assess the Impact of Agriculture 4.0 Technologies on Small- and Medium-Sized Rural Properties: A Case Study in the Agrotechnological District (DAT) of Caconde (Brazil)

Franco da Silveira [1], Irem Kılınç [2], Çiğdem Takma [3], Berna Kılınç [3] and Jayme Garcia Arnal Barbedo [1]

1 Embrapa Digital Agriculture, Brazilian Agricultural Research Company, Campinas 13083-886, SP, Brazil
2 Fish Processing Technology Department, Fisheries Faculty, Katip Çelebi University, Çiğli-Izmir 35640, Türkiye
3 Animal Science Department, Agriculture Faculty, Ege University, Bornova-Izmir 35100, Türkiye

Technological modernization in rural areas has the potential to boost productivity, sustainability, and resilience in the agri-food sector, especially through the adoption of technologies associated with Agriculture 4.0. However, small- and medium-sized producers still face significant challenges in effectively incorporating these innovations, particularly in contexts such as Agrotechnological Districts (DATs), which aim to foster local innovation ecosystems. In Brazil, DATs are being implemented in several regions as part of a public strategy to promote digital inclusion and technological modernization in rural territories, with a strong emphasis on family farming and regional vocations. This study proposes a digital maturity model to assess the impact of emerging Agriculture 4.0 technologies in these territories, focusing on small and medium rural properties. The methodology includes a systematic literature review to identify key dimensions of digital maturity in agriculture; semi-structured interviews with 15 experts from academia, public agencies, and technical assistance institutions; and empirical validation through a case study of the Caconde DAT (São Paulo, Brazil), known for its digital innovation initiatives in family farming and coffee production. The study seeks to identify indicators for assessing digital maturity—such as infrastructure, digital skills, technological adoption, and institutional support—and to classify properties into different levels of maturity, mapping the main barriers and enablers for each stage. The Caconde case will serve to test and refine the model, allowing for the observation of best practices and ongoing challenges in the local

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context. The expected result is a tool capable of supporting public managers, technical assistance organizations, and producers in designing effective strategies for inclusive and sustainable rural digital transformation. Moreover, the model's broader application across different DATs may generate a multiplier effect, strengthening innovation networks and promoting regional development in rural areas. This study was financed by the São Paulo Research Foundation (FAPESP), Brazil. Process Number #2023/12215-3 and #2022/09319-9.

2.74. Response Surface Methodology for Natural Antioxidants Recovery from Pyropia Columbina Seaweed Using Pressurized Liquid Extraction

Melisa Fushimi [1,2,3], Cecilia Dauber [4], Patricia Raquel Quiroga [1,5], Valeria Nepote [1,6] and Ignacio Vieitez [4]

1 Multidisciplinary Institute of Plant Biology, National Council for Scientific and Technical Research, Córdoba 5000, Argentina
2 Department of Agrofoods, Faculty of Agricultural Sciences, National University of Córdoba, Córdoba 5000, Argentina
3 Faculty of Medical Sciences, National University of Córdoba, Córdoba 5000, Argentina
4 Department of Food Science and Technology, Faculty of Chemistry, University of the Republic, Montevideo, Uruguay
5 Faculty of Agricultural Sciences, National University of Córdoba, Córdoba 5000, Argentina
6 Faculty of Exact, Physical and Natural Sciences, National University of Córdoba, Córdoba 5000, Argentina

Argentina's extensive coastline harbors diverse macroalgae, with the red seaweed (Rhodophyceae) *Pyropia columbina* being particularly prominent in Patagonia. Seaweed composition varies with environmental and processing conditions. It is known to contain proteins, fiber, vitamins, minerals, and relatively low lipid content. In recent years, seaweed has also been studied due to its content of phenolic compounds, which can be harnessed as antioxidants for potential nutraceutical applications and the prevention of chronic diseases. Different extraction methods can be used for this purpose, among which pressurized liquid extraction (PLE) stands out as a greener option. The aim of this study was to determine the optimal extraction conditions through PLE using ethanol–water mixtures for seaweed *Pyropia columbina*, with a focus on its antioxidant activity. Extraction was performed at varying ethanol concentrations (50–100%) and temperatures (100–140 °C). Extraction yield (%/g), total phenolic content (TPC) using the Folin–Ciocalteu method (mg GAE/g), and radical scavenging activity via the ABTS assay (mg TEAC/g) were determined. Optimal conditions were assessed through the application of Expert Design (ED) methodology. Extraction yield varied across conditions, ranging from 4.3% (100% EtOH, 100 °C) to 70.9% (50% EtOH, 140 °C). Regarding TPC and ABTS, 100% Ethanol at 140 °C was the sample with the highest values (20.25 ± 1.33 mg GAE/g and 151.55 ± 5.24 mg TEAC/g) ($\propto 0.05$). Using ED, optimal conditions were 94% Ethanol at 140 °C for TPC (0.98 desirability) and 73% at 140 °C for TEAC (0.94 desirability). To optimize both parameters, final conditions were set at 83.5% EtOH and 140 °C. A new extract with 41.8% yield, 18.24 ± 1.79 mg GAE/g, and 141.21 ± 6.97 mg TEAC/g was obtained. Model validation confirmed the predicted values, supporting optimal conditions for antioxidant extraction from *Pyropia columbina* via PLE with satisfactory yield.

2.75. Rheological Modeling of Food Emulgels: The Role of Interfacial Contribution and Droplet Radius in Designing Biphasic Food Systems

Domenico Mammolenti [1], Olga Mileti [1], Francesca Romana Lupi [1], Elisabetta Bruno [1], Noemi Baldino [1], Maria del Carmen García [2], José Muñoz [2] and Domenico Gabriele [1]

[1] Department of Information, Modeling, Electronics and Systems, (D.I.M.E.S.) University of Calabria, Via P. Bucci, Cubo 39C, 87036 Rende, Italy
[2] Department of Chemical Engineering, University of Seville, EPS, C/Virgen de Africa, 7, 41011 Seville, Spain

In recent years, because of the need to design food with a desirable texture, the study of rheological modeling for investigating biphasic systems suitable for food applications has received attention.

In this work, O/W emulgels were obtained by emulsifying an oil phase made of extra virgin olive oil and soy lecithin with a particle hydrogel structured with citrus fiber. Samples were prepared using microfluidization and modeled according to composite gel theories. The fiber fraction (x_f) ranged from 0.01 w/w to 0.04 w/w, whereas that of the oil phase (φ) ranged from 0.05 w/w to 0.5 w/w. The viscoelastic behavior of samples in a linear region previously determined by the stress sweep test was investigated with frequency sweep tests. The relative complex modulus (G^*_r) was defined as the ratio between the complex modulus of the emulgel and the complex modulus of the continuous phase, and was adopted for discussing and comparing data and for rheological modeling. Microstructural and morphological investigations were carried out; laser diffraction and optical and confocal laser microscopy were adopted to support the rheological outcomes. The rheological results showed that G^*_r (0.23–1) decreased with x_f and φ, whereas the phase angle (δ) exhibited a more complex trend. Microstructural and morphological changes were observed at high φ (close to 0.5). For the rheological modeling of samples, both theoretical and semi-empirical models were used. The Kerner model for incompressible material and the Palierne model for monodisperse systems, which take into account interfacial properties, were used to fit the data in both original and modified form. Finally, a modified Kerner model was applied to design emulgels with a consistency similar to that of light mayonnaise and light spreadable cheese. The results suggest that the modified Kerner model can be effectively used for consistency prediction from a practical point of view.

2.76. Rheological Properties and Rolling Process of Alternative Pasta Doughs

Berkay Berk and Sevcan Ünlütürk

Department of Food Engineering, İzmir Institute of Technology, İzmir 35430, Türkiye

There is an increasing demand for alternative pasta formulations with non-conventional flours. Understanding how these non-conventional flours affect the torque and power requirements during dough handling is critical for both product design and process optimization. There is a limited number of studies examining the pasta dough rolling process and the rheological properties, but no study was found about pasta dough made of non-conventional flours.

This study aimed at establishing correlations between the rheological properties of various non-conventional pasta doughs and the mechanical parameters observed during their processing. Ten formulations were prepared using einkorn, whole wheat, spelt, maize, and rice flours in combination with different binding agents, including egg white powder, xanthan gum, and psyllium husk powder. The flour samples were 40% hydrated to knead the dough and the binding agents were added at 1% (w.b.). Different flour–binding agent combinations were used to provide a dataset for correlation analysis. Rheological measurements were performed using oscillatory frequency sweep tests and extensional-viscosity analysis to obtain key parameters such as storage modulus consistency coefficient (K_{SM}), complex-viscosity coefficient (K_{CV}), flow behavior indices (n_{SM}, n_{CV}), and extensional-viscosity (EV).

Dough samples were also processed through a household pasta roller equipped with an ammeter to measure current change that is derived to angular impulse (I_{Ang}),

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simulating biaxial deformation during rolling. Correlation analysis revealed strong positive relationships between I_{Ang} and K_{SM} (r = 0.865), K_{CV} (r = 0.855), and especially EV (r = 0.987), indicating that doughs with higher structural resistance required more energy during processing. Conversely, flow behavior indices were negatively correlated (r = −0.749 for n_{SM} and r = −0.695 for n_{CV}), suggesting that pseudoplastic doughs were easier to deform.

These findings suggest that real-time torque measurements during pasta dough rolling can serve as a practical predictor (r > 0.85) of rheological behaviors (K_{SM}, K_{CV} and EV), supporting rapid screening of novel formulations for alternative pasta development.

2.77. Sequential Microwave-Ultrasound-Assisted Extraction and Optimization of Phenolic Compounds from Black Tea Waste

Limon Chandra Shaha [1], Parvej Hasan Jon [1,2] and Wahidu Zzaman [1]

1 Department of Food Engineering and Tea Technology, Shahjalal University of Science and Technology, Sylhet-3114, Bangladesh
2 Department of Food Science, University of Arkansas, Fayetteville, AR 72701, USA

The fibrous waste generated during the processing of black tea presents a significant opportunity for recovering valuable bioactive compounds. Our study focused solely on establishing the optimum process conditions to maximize the yield and antioxidant activity of phenolic compounds from this readily available agro-industrial byproduct. For the extraction, a novel sequential microwave-ultrasound-assisted approach (MUAE) was employed with four key process parameters, including microwave power (300–900 W), irradiation time (50–200 s), ultrasound temperature (20–50 °C), and ultrasound time (15–45 min). The process was optimized using a four-factor, three-level Box–Behnken Design (BBD). Analysis of variance (ANOVA) demonstrated a strong fit of the second-order polynomial models for total phenolic content (TPC, R^2 = 0.92), total flavonoid content (TFC, R^2 = 0.93), and DPPH radical scavenging activity (R^2 = 0.87). The optimized conditions (199.98 s of irradiation time at 899.97 W power followed by 24.09 min of sonication at 36.26 °C temperature) yielded experimental values of 95.74 ± 1.09 mg GAE/g DM for TPC, 37.16 ± 1.23 mg QUE/g DM for TFC, and 78.09 ± 0.68% for DPPH activity. Additionally, the extraction efficacy was found to be superior for the sequential MUAE technique when compared to individual microwave, individual ultrasound, and combined ultrasound--microwave extraction methodologies. The findings of our study signify the utilization of factory tea waste as a source of phenolic compounds and further provide a sustainable and efficient extraction method, opening avenues for its application in the food, pharmaceutical, nutraceutical, and cosmetic industries.

2.78. Sprouting and Fermentation of Cowpea: Impact on the Physicochemical Properties, Nutritional Composition, and Consumer Acceptability of Composite Doughnuts Made Thereof

Nazir Kizzie-Hayford [1], Jerry Ampofo-Asiama [1], Rosemond Godbless Dadzie [2], Salifu Seidu-Larry [1], Vivianne Geraldo [1], Claudia Asantewaa Gyimah [1], Baffour Kyei-Asante [1], Godfred Inkoom [2], Bernice Hayford [1], Christiana Odumah Hood [3], Jesse Baidooh [4] and Aaron Tettey Asare [5]

1 Department of Biochemistry, School of Biological Sciences, University of Cape Coast, Cape Coast, Ghana
2 Department of Agricultural Engineering, School of Agricultural Sciences, University of Cape Coast, Cape Coast, Ghana
3 Department of Environmental Sciences, School of Biological Sciences, University of Cape Coast, Cape Coast, Ghana
4 Fountain Foods Limited, Cape Coast, Ghana

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[5] Department of Molecular Biology and Biotechnology, School of Biological Sciences, University of Cape Coast, Cape Coast, Ghana

Cowpea is a nutrient-rich legume, high in protein and fiber. However, its use in food products is limited due to the presence of anti-nutrients, phytochemicals, a strong beany aroma, and long cooking times. To broaden its application in food systems, various processing techniques—sprouting, fermentation, and a combination of both—were tested for making cowpea-based doughnuts. For the study, cowpea seeds were soaked for 1 h and blanched at 100 °C for 30 s (control). Separate treatments involved sprouting for 3 days (Sprouted, S), fermenting for 3 days using *Rhizopus oryzae* starter powder (10^5 viable spores/g seeds) (Fermented, F), and a combined sprouting and fermentation process (S + F). The processed seeds were then blanched, dried, milled into flour, and analyzed for nutrient composition, hexanal content (responsible for beany aroma), anti-nutrients, phytochemicals, and thermal properties. The cowpea flour was mixed with wheat flour (1:1) to prepare composite doughnuts, which were subsequently evaluated for sensory attributes. Among the treatments, the S + F process resulted in the highest protein content (35.65 ± 0.25 g/100 g), followed by S (32.26 ± 0.06 g/100 g), F (31.03 ± 0.03 g/100 g), and the control (24.91 ± 0.02 g/100 g). Processing significantly reduced hexanal levels from 44.41 ± 0.67 µg/100 g (control) to 24.36 ± 2.40 µg/100 g (S), 19.52 ± 0.18 µg/100 g (F), and 14.40 ± 0.66 µg/100 g (S + F). All treatments also led to reductions in oxalates, tannins, flavonoids, polyphenols, and lowered crystallization and decomposition temperatures. Sensory evaluation showed a stronger preference for doughnuts made from fermented cowpea, which had a particulate, rough, and brown appearance, compared to the control, which was beany, sweet, and gritty. These findings suggest that fermentation, alone or combined with sprouting, is a promising strategy to improve the nutritional and sensory qualities of cowpea-based food products.

2.79. Strategies to Overcome Barriers to the Implementation of Agriculture 4.0 Technologies in the Brazilian Agri-Food System

Franco da Silveira, Dheeraj Bharti, Thiago Teixeira Santos and Jayme Garcia Arnal Barbedo

Embrapa Digital Agriculture, Brazilian Agricultural Research Company, Campinas 13083-886, SP, Brazil

Agriculture 4.0 represents a new phase of agricultural modernization, characterized by the integration of emerging technologies such as the Internet of Things (IoT), artificial intelligence (AI), remote sensing, big data analytics, robotics, and blockchain. These technologies promise to enhance productivity, optimize resource use, and increase the sustainability and resilience of agri-food systems. However, their large-scale adoption remains limited, particularly in developing countries like Brazil, where producers face a complex combination of technical, economic, social, and institutional barriers, including high investment costs, limited infrastructure, low levels of digital literacy, and fragmented innovation ecosystems. This study aims to identify and propose comprehensive strategies to overcome these challenges and foster the effective implementation of Agriculture 4.0 technologies in the Brazilian agri-food sector. The methodology combines a systematic literature review, case study analysis, and expert consultation, while considering the heterogeneity of producer profiles, production systems, and regional conditions. The findings emphasize the importance of integrated public policies, investment in technical education and training, the formation of collaborative innovation networks, and the development of context-sensitive digital solutions. Additionally, the study highlights the role of multistakeholder engagement in facilitating the adoption and scaling of technological innovations. By presenting a set of feasible and inclusive strategies, this work contributes to the sustainable

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advancement of Agriculture 4.0 in Brazil, with a focus on promoting digital inclusion, increasing productivity, and supporting equitable rural development.

2.80. Structural Characterization of Edible Films with Incorporated Lactic Acid Bacteria from Dairy By-Products

Agne Vasiliauskaite [1], Elvidas Aleksandrovas [1], Joana T. Martins [2,3], Jorge M. Vieira [2,3], Antonio A. Vicente [2,3], Mindaugas Malakauskas [1] and Loreta Serniene [1]

1 Department of Food Safety and Quality, Faculty of Veterinary Medicine, Veterinary Academy, Lithuanian University of Health Sciences, Tilzes str. 18, LT-47181 Kaunas, Lithuania
2 Centre of Biological Engineering (CEB), University of Minho, Campus de Gualtar, 4710-057 Braga, Portugal
3 LABBELS—Associate Laboratory, 4710-057 Braga/Guimarães, Portugal

Recent studies have demonstrated that edible films serve as an effective vehicle for delivering functional components such as probiotics and prebiotics. However, the incorporation of probiotic lactic acid bacteria (LAB) may alter the structural and functional properties of these films.

In this study, edible films formulated from liquid acid whey protein concentrate (LAWPC) or liquid acid whey permeate (LAWP), containing sugar beet pectin, Tween 80, sunflower oil, and glycerol, were enriched with *Lacticaseibacillus paracasei* and *Lactobacillus helveticus* (~7 log CFU/g). The films were evaluated for their physicomechanical attributes, including thickness, tensile strength, elongation at break, water solubility, moisture content, and water vapor permeability (WVP).

The plain LAWP film exhibited significantly higher moisture content (28%), reduced thickness (54%), and greater stretchability (70%) compared to the plain LAWPC film ($p < 0.05$). Incorporation of both *L. paracasei* and *L. helveticus* into LAWPC films significantly enhanced their stretchability and tensile strength ($p < 0.05$). Additionally, *L. helveticus* reduced the thickness of LAWPC films, while *L. paracasei* increased the solubility of LAWP films ($p < 0.05$). However, the film type and LAB strain used did not affect water solubility, with mean values of 69.41% for LAWPC films and 77.26% for LAWP films ($p \geq 0.05$). No statistically significant differences were observed in WVP among the film samples, with an overall mean of $2.60 \times 10^{-6} \pm 1.03 \times 10^{-7}$ (g/(m.s.Pa)) ($p \geq 0.05$).

These findings indicate that the combination of dairy by-products and LAB in edible films has a positive effect on their physicomechanical properties. Moreover, embedding the bacteria in an edible hydrocolloid matrix provides an excellent way to integrate probiotics into food products.

2.81. Study of the Quality of a Dry Gluten-Free Pasta Formulated with Pregelatinized Flours

Estefanía Belén Coronel [1,2], Vanesa Yanet Ixtaina [3,4] and Marianela Ivana Capitani [1,2]

1 Departamento de Ingeniería Química y Tecnología de los Alimentos, Facultad de Ingeniería, Universidad Nacional del Centro de la Provincia de Buenos aires, Olavarría CP7400, Buenos Aires, Argentina
2 CONICET—CCT Tandil, Tandil CP 7000, Buenos Aires, Argentina
3 Centro de Investigación y Desarrollo en Ciencia y Tecnología de los Alimentos (CIDCA) CONICET La Plata, Facultad de Ciencias Exactas (UNLP), CICPBA, La Plata CP 1900, Buenos Aires, Argentina
4 Facultad de Ciencias Agrarias y Forestales, Universidad Nacional de La Plata, La Plata CP 1900, Buenos Aires, Argentina

Gluten-free foods are on the rise due to healthier lifestyle choices. Therefore, it is necessary to diversify the development of these types of foods based on alternatives that

incorporate nutritious raw materials, such as flours derived from legumes, pseudocereals, and oilseeds. However, given the technological limitations of gluten-free matrices, it is important to improve the functionality of ingredients through processes such as pregelatinization. Therefore, the objective of this research was to evaluate the effect of incorporating pregelatinized rice flours (PRF) and yellow pea flours (PYPF) into a gluten-free pasta base formulation made only with native rice, buckwheat, yellow pea flour, and chia expeller in a 40:32:18:10 ratio, respectively. To optimize the mix, a simplex-lattice design was used, replacing native rice and pea flours with their respective pregelatinized flours in ranges from 0 to 100%, keeping the proportion of the remaining ingredients fixed. Nine pasta formulations were prepared, and their quality was determined by analyzing hardness, optimal cooking time (TOC), water absorption, solids loss during cooking, and acidity. Analysis of variance (ANOVA) and regression models showed that hardness and TOC fit significantly ($p < 0.05$) to a quadratic model (R2 = 87.29; R2 = 74.44, respectively), indicating a relevant influence of the pregelatinized flours. No significant effects were found for acidity, water absorption, and solids loss. These results demonstrate the importance of studying the appropriate combination of ingredients to optimize properties that determine the final quality of a food product.

2.82. Sustainable Utilisation of Banana Peel: Pectin Extraction and Fat Replacement in Cookies

Theresa Reju, Nandana Jayaprakash, Aneena K. Justin, Theertha P. C., Rahmath MTP and Tony K. George

Kerala Veterinary and Animal Sciences University (KVASU), Pookode, Wayanad 673576, India

This study explores the sustainable utilization of banana peels, an often-discarded agro-waste, by extracting pectin and incorporating it as a fat replacer in cookies. Pectin, a natural polysaccharide with gelling and stabilizing properties, was extracted from banana peels using three different techniques: heat-assisted extraction, microwave-assisted extraction, and ultrasound-assisted extraction. The equivalent weight of the pectin obtained by each method was measured, the methoxy and anhydrouronic acid contents and degree of esterification were determined, and the values of pectin obtained by ultrasound methods were in the optimum range. The extracted pectin using the ultrasound-assisted method was then utilized as a partial fat replacer in the preparation of a simple three-ingredient cookie, aiming to reduce fat content while maintaining acceptable sensory and structural qualities. Various formulations were developed, and it was observed that up to 40% of the fat in the cookie recipe could be successfully replaced with banana pectin without significant differences in taste, texture, or appearance compared to the control. Sensory analysis performed by 16 panelists found that the cookies made with banana pectin were less chewy and had a better mouth feel compared to cookies made using the same percentage of commercial pectin. Texture analysis using a texture profile analyser revealed that the cookies replaced by banana pectin had a slightly higher value of hardness and fracturability, but other properties were comparable with the control. This substitution offers a promising approach to producing healthier bakery products while minimizing food processing waste. The study highlights the dual benefit of improving nutritional quality and contributing to environmental sustainability through the value-added utilization of banana peel waste. Further research can explore the long-term storage stability and consumer acceptance of such pectin-enriched, reduced-fat cookies.

2.83. Techno-Functional and Antioxidant Properties of Plant and Insect-Based Flours

Shewangzaw Addisu Mekuria [1,2] and Joanna Harasym [1,3]

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[1] Department of Biotechnology and Food Analysis, Wroclaw University of Economics and Business, Komandorska 118/120, 53-345 Wroclaw, Poland
[2] University of Gondar, Gondar P.O. Box 196, Ethiopia
[3] Adaptive Food Systems Accelerator-Science Centre, Wroclaw University of Economics and Business, Komandorska 118/120, 53-345 Wroclaw, Poland

This study evaluated the techno-functional and antioxidant properties of soybean, maize, red teff and insect bee larvae. Approximately 95.5% of maize and soybean had similar particle sizes (>0.355 µm), followed by teff (60%), and bee larvae (0.250 µm, 12.9%). Significant differences ($p < 0.001$) were observed in the functional properties (g/g) of water-holding capacity (WHC), water absorption index (WAI), oil absorption capacity (OAC), water solubility index (WSI), swelling power (SP), foaming capacity (FC), foam stability (FS) and least gelation capacity (LGC) among the flours. Bee larvae had the highest WHC (6.00), OAC (2.16), and FS (98.15) than the other flours. Maize had the highest record in WAI (7.65) and SP (8.64). The highest WSI (40.18) was recorded in soybeans. The highest and lowest LGC values were found in bee larvae (28) and teff (18), respectively. Also, bee larvae had the highest ($p < 0.01$) OAC (2.16) and the lowest in HLI (1.17). Soybean had the highest in FC (57.5). Significant difference ($p < 0.001$) in colour space ($L^*a^*b^*$) of CIELAB measurement recorded between flours. Soybean had the lightest colour ($L^* = 93.8$) with strong yellow, whereas bee larvae had the darkest ($L^* = 43.82$). As a reference of maize flour, the $\Delta L/\Delta a/\Delta b$ showed that teff was $\Delta L = -21.26$ units darker, bee Larvae were $\Delta L = -43.22$ units extremely darker, and soybean was $\Delta L = 93.88$ units lighter. The highest Antioxidant (FRAP, DPPH, ABTS and TPC) properties were recorded in Teff and the highest reducing sugar in Bee larvae. In general, soybean and bee larvae are used for high water retention and teff and maize for fry and gel formation, and red teff had the highest antioxidant properties.

2.84. The Application of Unconventional Raw Materials in the Production of Gluten-Free Bread

Katarzyna Marciniak-Lukasiak [1], Piotr Lukasiak [2] and Anna Zbikowska [3]

[1] Department of Food Technology and Assessment, Warsaw University of Life Sciences—SGGW, Nowoursynowska St. 159c, 02-776 Warsaw, Poland
[2] Faculty of Computing and Telecommunications, Poznan University of Technology, 2 Piotrowo Street, 60-965 Poznan, Poland
[3] Faculty of Food Technology and Assessment, Warsaw University of Life Sciences—SGGW, Nowoursynowska St. 159c, 02-776 Warsaw, Poland

A gluten-free diet is the only effective treatment for celiac disease, which affects around 1% of the global population. This study aimed to develop a high-quality gluten-free bread using unconventional raw materials. The recipe included acorn flour, potato protein, transglutaminase, and oligofructose, partially replacing maize flour. Various parameters were analyzed: mass, volume, specific mass, moisture, water activity, texture (TPA test), color, and sensory attributes.

Bread mass ranged from 106.08 to 114.48 g, with volumes between 151.67 and 247.33 cm^3. Specific mass varied from 0.16 to 0.24 g/cm^3, and water activity from 0.98 to 0.99. Moisture content ranged from 45.75 to 48.19% after 24 h and from 43.51 to 47.84% after 48 h. Hardness increased from 4.49 to 26.19 N at 24 h and from 8.06 to 34.55 N at 48 h. L* colour values ranged from 40.77 to 71.32, while taste and aroma scores exceeded 70 c.u.

The addition of acorn flour and transglutaminase (TG) has resulted in increased bread weight after baking, while the specific weight of gluten-free bread has decreased as the proportion of acorn flour has increased. The incorporation of acorn flour in the recipe is found to have a substantial impact on the color of the crumb of the bread. Conversely, the incorporation of potato protein results in an enhancement of the product's nutritional profile. An increase in moisture content and hardness was observed in the bread samples

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during the storage period. Texture profile analysis indicated that prolonged storage time resulted in a statistically significant increase in bread hardness.

Sensory evaluation showed that the best combination of taste and aroma was achieved with 2.5% acorn flour and 2.5% acorn addition, suggesting this ratio as optimal for gluten-free bread enhancement.

2.85. The Effect of Adding Black Chokeberry Pomace on the Physicochemical, Organoleptic, and Microbiological Quality Attributes of Beef Burgers

Aneta Cegiełka [1], Marta Chmiel [1] and Elżbieta Hać-Szymańczuk [2]

1 Department of Food Technology and Assessment, Warsaw University of Life Sciences-SGGW, 02-776 Warsaw, Poland

2 Institute of Food Sciences, Department of Food Biotechnology and Microbiology, Warsaw University of Life Sciences-SGGW, 02-776 Warsaw, Poland

Introduction: Managing waste products generated in the food industry is a pertinent topic in food science, driven by the pursuit of an ideal model of sustainable production and consumption.

This study aimed to assess the effect of adding shredded black chokeberry (*Aronia melanocarpa*) pomace in amounts of 0.0%, 0.5%, 1.0%, 2.0%, and 3.0% on the quality of beef burgers subjected to heat treatment and stored in vacuum packaging at refrigeration (+4 °C) for 14 days.

Methods: On the day of production, the heat loss, "shrinkage", and the content of basic chemical components were determined in the burgers. During the storage of the burgers, pH, shear force, and colour parameters L^*, a^* and b^* were measured; an organoleptic assessment was conducted, and an evaluation of microbiological quality was performed.

Results: It was found that using chokeberry pomace as an ingredient in beef burgers does not cause technological difficulties, but it does affect the quality of the product. With the increase in pomace addition, a significant ($p < 0.05$) rise in heat losses, greater shrinkage, and an increased fat content were observed. The addition of pomace also resulted in a gradual decrease in the shear force of the burgers. Compared to the control product, burgers with chokeberry pomace were characterised by a significantly ($p < 0.05$) darker colour, less redness, and less yellowness. In the organoleptic evaluation of all attributes, burgers produced with a lower addition of chokeberry pomace, i.e., 0.5% and 1.0%, received scores similar to the control product. The addition of chokeberry pomace did not cause a deterioration in the microbiological quality of the beef burgers.

Conclusions: The amount of chokeberry pomace added to the beef can reach 1.0% without negatively affecting the quality of the product.

2.86. The Effect of Walnut Skin Extract on the Physicochemical, Antioxidant, Textural and Sensory Properties of Plant-Based Ice Cream

Cristina Popovici [1], Xin Mei Teng [2,3] and Ravi Jadeja [2,3]

1 Department of Food and Nutrition, Faculty of Food Technology, Technical University of Moldova, 168 Stefan cel Mare si Sfant blvd., MD 2004 Chisinau, Republic of Moldova

2 Robert M. Kerr Food & Agricultural Products Center, Oklahoma State University, Stillwater, OK 74078, USA

3 Department of Animal & Food Sciences, Oklahoma State University, Stillwater, OK 74078, USA

A lactose-free walnut milk substitute was used as the main ingredient to produce a novel plant-based ice cream enriched with water/ethanol walnut skin extract (WSE). Plant-based ice cream formulations were characterized regarding their physicochemical

characteristics, total polyphenol (TPC) and flavonoid (TFC) content, antioxidant activity, texture parameters and sensory attributes. The ice cream formulations with WSE had a slightly decreased pH (5.24) and titratable acidity (0.25%). The phenolic profile of the plant-based ice cream involved a TPC of 217 mg GA/100 g and a TFC of 83 mg QE/100 g. WSE increased the DPPH and ABTS values of the formulation by 46.89% and 89.93% in comparison with the values in the reference sample of 10.21% and 17.56%, respectively. Although the extract had an effect on the color characteristics of the ice cream, the formulation containing WSE recorded the lowest L^* index and the highest a^* and b^* indexes, at 59.23, 14.33 and 0.17, respectively. The reference sample exhibited the highest L^* index and the lowest a^* and b^* indexes, measuring 70.17, 12.76 and 0.03, respectively. The formulation with WSE had high scores for all sensory attributes ($\geq$8.15). Notably, the formulation with WSE demonstrated a hardness value of 651.99 g, similar to that of the reference sample, at 674.46 g (p <0.05). The Pearson's correlations revealed the contribution of the phenolic compounds to all of the evaluated parameters. The TPC analysis achieved very strong positive correlations with DPPH (r^2 = 0.9792), ABTS (r^2 = 0.9897), hardness (r^2 = 0.9903) and overall sensory acceptability (r^2 = 0.9653), while a positive correlation was attained with pH (r^2 = 0.7783) and TA (r^2 = 0.7579). The implications of these results are significant for advancing the sustainable recovery of natural bioactive compounds from walnut skin within the plant-based ice cream industry.

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2.87. The Influence of the Material Drying Process on the Chemical Composition and Biological Activity of Hydrodistilled Laurel Essential Oil (Laurus nobilis L.)

Jelena Bajac [1], Milena Terzić [1], Igor Antić [1], Gökhan Zengin [2], Milana Maričić [1] and Branislava Nikolovski [1]

[1] Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

[2] Science Faculty, Selcuk University, Campus Konya 42130, Turkey

Laurel (*Laurus nobilis* L.) is a natural source of nutritionally and biologically valuable essential oils that are widely used in the culinary, food, and cosmetics industries. The plant material used to isolate the essential oil was fresh bay leaves, naturally dried leaves, and leaves oven-dried at 45 °C for 72 h. The extraction of laurel essential oil was carried out using the Clevenger hydrodistillation (HD) method. The influence of the drying process on the essential oil yield, chemical composition, and biological activity was investigated. The biological and pharmacological potential was investigated using various in vitro antioxidation tests: ABTS (2,2′-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid), DPPH (2,2-diphenyl-1-picrylhydrazyl), and CUPRAC (copper-reducing antioxidant capacity), FRAP (ferric-reducing antioxidant capacity), and metal chelating and total antioxidant capacity. The inhibitory effect of the enzyme was analysed against cholinesterases (AChE and BChE), tyrosinase, α-amylase, and α-glucosidase.

The yield of the essential oil obtained was significantly influenced by the drying process of the plant material, with the highest yield (2.33% (m/m)) being obtained when the material was dried at 45 °C for 72 h. The dominant components of laurel essential oil are α-terpinyl acetate, sabinene, 1,8-cineole, methyl eugenol, and α-pinene. The composition is dominated by oxidized monoterpenes (56.5–62.51%), followed by monoterpenes (29.99–36.84%), while sesquiterpenes and oxidized sesquiterpenes are represented at a slightly smaller percentage (1.07–3.00% and 0.92–4.50%, respectively). The best antiox-

idant activities were achieved with oil extracted from oven-dried laurel leaves (DPPH, ABTS, CUPRAC, FRAP and PBD, with 69.34 ± 0.04 mg TE/g, 107.28 ± 0.16 mg TE/g, 573.22 ± 18.66 mg TE/g, 833.01 ± 20.69 mg TE/g, and 69.08 ± 1.03 mg EDTAE/g, respectively). The laurel essential oil extracted from naturally dried material showed inhibition of the enzymes AChE and BChE. The inhibition of tyrosinase and α-amylase was similar for all examined essential oils and independent of the drying material preparation process.

2.88. Three-Dimensional Printing of Sustainable Food Inks from Fruit By-Products: Rheology, Printability, and Sensory Evaluation

Riya Sharma [1,2], Prakriti Sharma [1,3], Sakshi Sukhija [3], Geoffrey Robert Mitchell [4,5] and Manoj Kumar Patel [1,2,4]

1 CSIR–Central Scientific Instruments Organisation, Chandigarh 160030, India
2 Academy of Scientific and Innovative Research (AcSIR), Ghaziabad 201002, India
3 Amity Institute of Food Technology, Amity University Uttar Pradesh, Noida 201313, India
4 Centre for Rapid and Sustainable Product Development (CDRSP), Polytechnic Institute of Leiria, 2430028 Marinha Grande, Portugal
5 Visionary Equation lda, 2430-085 Marinha Grande, Portugal

The current study explores a sustainable strategy for repurposing fruit processing waste through the development of a 3D printable ink derived from muskmelon rind, sugar, lemon peel powder, and sodium alginate. The research focuses on extrusion-based 3D food printing, which is an emerging additive manufacturing technology that enables the precise layer-by-layer fabrication of complex, customisable edible structures. The formulations with varying alginate concentrations (1.2%, 1.8% and 2.4% *w*/*w*) were optimised for extrusion-based 3D printing. Textural analysis and rheological profiling, represented as critical parameters for smooth extrusion, shape fidelity, and post-print stability, were performed to establish a correlation between material properties and their suitability for 3D printing. Shear-thinning behaviour and adequate structural integrity of the developed formulations confirmed their compatibility with the 3D printing process. Sensory evaluation of the 3D-printed product revealed favorable taste and appearance, indicating potential for consumer acceptance. Among the tested formulations, the blend containing 1.8% sodium alginate demonstrated optimal printability, especially when extruded through a nozzle diameter of 1.04 mm. Aligned with the principles of circular economy, this study demonstrates the potential of 3D food printing as a tool offering a scalable and customisable solution to transform agri-food waste into innovative, value-added food products that contribute to environmentally conscious processes for the future of food manufacturing.

2.89. Tissue-Dependent Antioxidant Response to UV-C Irradiation in Carrot Root Slices

Lucia Valerga [1,2], Roxana Elizabeth Gonzales [2], Mariano Tomás Mauricci [1,2] and Pablo Federico Cavagnaro [1,2,3]

1 Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Av. Rivadavia 1917, Ciudad Autónoma de Buenos Aires C1425, Argentina
2 Instituto Nacional de Tecnología Agropecuaria (INTA) E.E.A. Mendoza, Luján de Cuyo, Mendoza, La Consulta M5567, Argentina
3 Instituto de Horticultura, Facultad de Ciencias Agrarias, Universidad Nacional de Cuyo, Lujan de Cuyo, Mendoza M5528AHB, Argentina

Carrots (*Daucus carota* L.) contain health-promoting phytochemicals, including carotenoids and phenolic compounds such as chlorogenic acid (CGA). Orange-rooted cultivars are rich in α- and β-carotene, while purple carrots also accumulate anthocyanins, contributing to their distinctive coloration. Among purple carrots, there are cultivars with

differing pigment profiles; for example, in the Purple Elite cultivar, anthocyanins are localized primarily in the outer tissues (periderm and phloem), while the inner tissues (phloem and xylem) remain orange. This study focused on the orange and purple cv. Purple Elite carrots to investigate tissue-specific responses to UV-C irradiation. Freshly cut carrot slices were UV-C treated (8 kJ m^{-2}) and stored at 20 °C for 5 days; no significant color changes were observed. Antioxidant capacity (AOX, via ABTS), total phenolic content (TP, via Folin–Ciocalteu), total anthocyanins (ANT, via the pH differential method), and CGA (via HPLC) were analyzed in separate tissues. In orange-rooted carrots, AOX increased 2.3- and 2.4-fold; TP increased 3.3- and 3.5-fold; and CGA increased 9.5- and 7.2-fold, in the inner and outer tissues, respectively. In the purple-rooted cultivar, AOX and TP increased only in the inner (orange) tissue by 2.4- and 2.3-fold, respectively, with no significant changes in the outer (purple) tissue. However, CGA increased significantly in both tissues, by 6.1-fold in the inner and 1.99-fold in the outer tissue. In a complementary experiment, orange carrot root slices were coated with anthocyanin solutions (40 and 137 mg L^{-1}) extracted from completely purple carrots prior to UV-C exposure. A concentration-dependent reduction in AOX and TP response was observed, confirming the photoprotective effect of anthocyanins. These results highlight a pigment- and tissue-dependent antioxidant response to UV-C in carrots, with anthocyanins modulating or attenuating phenolic accumulation. These results could be used to develop postharvest strategies, such as the use of UV-C irradiation to increase the nutraceutical value of minimally processed carrots and potentially other vegetables.

2.90. Ultrasound-Assisted Extraction Optimization of Soluble Dietary Fiber from Pleurotus ostreatus Spent Mushroom Substrate Using Box–Behnken Design

Vanessa Grifoll [1], Patricia Bermúdez Gómez [1,2], Paula Bravo [1], Margarita Pérez-Clavijo [1], Manuel Viuda Martos [2] and Juana Fernández López [2]

[1] Mushroom Technological Research Center of La Rioja (CTICH), Carretera Calahorra, km 4, 26560 Autol, La Rioja, Spain

[2] IPOA Research Group, Institute for Agri-Food and Agri-Environmental Research and Innovation (CIAGRO), Miguel Hernández University, Ctra. Beniel Km 3.2, 03312 Orihuela, Alicante, Spain

Spent mushroom substrate (SMS) is the main co-product generated during the cultivation of *Pleurotus ostreatus*. This by-product is currently used almost exclusively for composting, and thus represents a significant management and environmental challenge for mushroom growers. However, SMS is rich in dietary fiber, making it a promising matrix for the recovery of bioactive compounds, particularly polysaccharides with potential functional properties. In this context, conventional extraction methods are being progressively replaced by more efficient and sustainable emerging technologies, such as ultrasound-assisted extraction (UAE), which relies on acoustic cavitation to disrupt cellular structures, enhance mass transfer, and increase extraction yields. Therefore, the present study aims to optimize the extraction of soluble dietary fiber (SDF) from SMS of *Pleurotus ostreatus* using UAE.

The response surface method (RSM) combined with the Box–Behnken design method (BBD) was used to optimize the content of SDF. The effects of the solid–liquid ratio (15–40 g/L), ultrasound power (200–500 J/mL), and particle size (0.25–2 mm) on the content of SDF were examined. The experimental data obtained were fitted to a second-order polynomial equation using multiple regression analysis and analyzed by Statgraphics 19.0. It was found that two factors represented a significant effect (ratio and particle size). The coefficient of determination (R^2) for the model was 80.8%. The optimal conditions for the extraction of SDF were a 27 g/L solid–liquid ratio, 200 J/mL of ultrasound power, and

a 2 mm particle size. Under the optimal conditions, the corresponding response value predicted for SDF production was 39.52%, which was confirmed by validation experiments (n:5). The findings of this study demonstrate that the utilisation of UAE not only enhances yields but also enables the extraction of 10% higher soluble fibre content compared to conventional extraction methods, with reduced extraction times.

2.91. Valorization of Palm Heart (Chamaerops humilis) and Sambo (Cucurbita ficifolia B.) By-Products for the Development of Gluten-Free and Low-Calorie Cookies

Martina Burneo Cordovez [1], María José Andrade Cuvi [1] and Carlota Martina Moreno Guerrero [2]

1 Laboratorio de Investigación en Ingeniería en Alimentos (LabInAli), Departamento de Ingeniería en Alimentos, Colegio de Ciencias e Ingenierías, Universidad San Francisco de Quito USFQ, Quito 170901, Ecuador
2 Centro de Investigación de Alimentos, CIAL, Facultad de Ciencias de la Ingeniería e Industrias, Universidad UTE, Quito EC171029, Ecuador

Palm hearts that do not meet export quality standards are typically used as animal feed, while sambo seeds are rarely consumed and often discarded. Both are promising raw materials for the development of high-value-added food products. This study aimed to develop gluten-free cookies by partially replacing oat flour and dairy fat with palm heart flour and sambo seed paste, respectively. Cookies were produced under good manufacturing practices using an all-in mixing method. The formulation included oat and palm heart flour (29.7%), sunflower and sambo seed paste (17.7%), erythritol (17%), egg (16.0%), vanilla extract (0.6%), cocoa powder (4.2%), and chocolate chips (14.8%). Response surface methodology (RSM) with a 2^2 factorial central composite design was employed to quantify the individual and interactive effects of the substitutes on texture (fracture strength, hardness, and gumminess), moisture, and color. Proximate composition and sensory acceptability were also determined using standardized methods. The optimized formulation achieved an overall desirability of 0.70, incorporating 19.47% palm heart flour (relative to total flours) and 40.70% sambo seed paste (relative to total fat). The product provided 14.0% protein, 30.0% fat, 6.4% crude fiber, 3.2% moisture, and 2.0% ash and exhibited a balanced texture profile (fracture strength: 0.3 N; hardness: 80 N; gumminess: 11). Sensory acceptability was moderately high (7.17/9): flavor and aroma received the highest scores, whereas color was penalized due to the greenish hue imparted by the sambo paste. A significant interaction between ingredients strongly influenced textural attributes, underscoring the importance of formulation optimization to maximize overall acceptance. These results demonstrate that agro-industrial by-products such as palm heart flour and sambo seed paste can be effectively leveraged to formulate functional, sustainable, gluten-free cookies. Further studies should address amino acid and fatty acid profiles, mineral content, and advanced sensory analysis to enhance product characteristics and increase consumer acceptance.

2.92. What's Inside a "Metato"? The Case Study of Chestnut Flour Obtained by a Traditional Drying Method: Chemical, Aromatic, and Sensory Properties

Sofia Panzani [1], Francesca Venturi [1], Alessandro Bianchi [1], Pierina Dìaz Guerrero [1], Ylenia Pieracci [1], Guido Flamini [2], Giuseppe Ferroni [1], Isabella Taglieri [1] and Chiara Sanmartin [1]

1 Department of Agriculture, Food and Environment, University of Pisa, Via del Borghetto 80, 56124 Pisa, Italy
2 Department of Pharmacy, University of Pisa, Via Bonanno Pisano 12, 56126 Pisa, Italy

Chestnuts are traditionally dried and processed into flour, which is gluten-free and rich in starch and micronutrients. Over the past decade, demand for chestnut flour has steadily increased, driven by consumer perception of its associated health benefits. As the market for chestnut flour expanded from small-scale to large-scale production, alternative methods were developed to replace traditional processes. However, these innovations often result in a loss of product identity, particularly in terms of sensory attributes and typicity. Despite this shift, traditional production methods remain active in Italy, as evidenced by the certification of 15 chestnut-based products, including two PDO chestnut flours.

This study aimed to evaluate the quality of traditional chestnut flour produced through firewood drying in structures known as "*metati*", in terms of sensory and chemical features. For this purpose, two producers of traditional chestnut flour were selected and the processing conditions of their metato were monitored.

The impact on flour was assessed through the analysis of water activity, dry matter, lipid content, starch, glucose, fructose, sucrose, ascorbic acid, total phenolic content, and antioxidant activity. Colorimetry, volatile organic compound (VOC) profiles, and descriptive sensory analysis were also performed.

Although the traditional process typically reduces the content of antioxidant compounds compared to more standardized industrial systems, sensory analysis and VOC profiling revealed that the traditional process imparts a distinctive aromatic profile, primarily due to smoke exposure during drying. In contrast, commercially produced chestnut flours generally exhibit a flatter sensory profile, lacking in typicity and recognizable aromatic traits.

However, a weakness of this type of process lies in the poorly controlled conditions within the drying facilities, which can lead to inconsistent drying and affect the final product quality. To address this issue, control methodologies could be developed to improve product quality and simplify process management for producers, **in order to reduce the manufacturing costs.**

2.93. Wheat Dry Pasta Enriched with Aromatic Herb Powders: Technological and Textural Properties

María Belén Vignola [1], Mariela Cecilia Bustos [2], Luciano Neyra [1], Gabriela Teresa Pérez [2] and Alfonsina Ester Andreatta [1]

[1] Centro UTN—Research Group InProSus, Facultad Regional San Francisco, Universidad Tecnológica Nacional (UTN), San Francisco, Córdoba X2400DQR, Argentina
[2] Instituto de Ciencia y Tecnología de los Alimentos Córdoba (ICYTAC), CONICET—Universidad Nacional de Córdoba (UNC), Córdoba 5000, Argentina

The incorporation of plant-based ingredients into staple foods is a growing trend aimed at enhancing their nutritional and functional properties without compromising quality. This study aimed to evaluate the effects of substituting wheat flour with basil, oregano, or rosemary powders at 2.5%, 5%, and 7.5% on the quality of dry pasta. Pasta samples were produced using common wheat flour (*Triticum aestivum*), and their technological quality, color, and texture parameters were analyzed. Cooking losses of all samples remained within the desirable range (7–8%). Pastas with basil at all levels and those with 2.5% oregano or rosemary showed cooking losses comparable to the control, while higher levels of oregano or rosemary showed increased losses. Pasta with basil percentages of 2.5% and 5% showed no significant differences compared to the control in terms of water absorption, whereas other formulations exhibited significantly higher values (up to 170.21%), likely due to the high water-holding capacity of dietary fiber in the aromatic powders. No significant differences in the swelling index were observed between the control and most herb-enriched samples, highlighting that despite the higher water absorption reported

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in some formulations (which was attributed to their higher fiber content), the pasta did not undergo structural deformation during cooking. Color analysis revealed decreased L* and b* values due to the green pigments of the herbs used; the darkest sample was 7.5% oregano pasta (L* = 27.07). Pasta samples formulated with all levels of basil and oregano substitution showed higher texture values compared to the control pasta. Cohesiveness and chewiness increased at moderate herb levels but declined at higher concentrations, likely due to disruption of the protein–starch matrix. The inclusion of aromatic herb powders in pasta formulations did not significantly affect technological quality up to 2.5% substitution. Basil-containing pastas exhibited the most favorable technological performance across all levels.

2.94. Whey Protein Isolate (Wpi) and Carboxymethyl Cellulose (Cmc) Blend Films: Effect of Processing Temperature on Physicochemical Properties

Raquel Vaz, Ana Gabriela Azevedo, Lorenzo Pastrana and Miguel Ângelo Cerqueira

International Iberian Nanotechnology Laboratory, Av. Mestre José Veiga, 4715-330 Braga, Portugal

Currently, food packaging is focused on substituting conventional plastics for bio-based materials, with polysaccharides and proteins being commonly chosen. Polysaccharides impact the hardness and adhesiveness of films, while proteins contribute to their gas barrier properties. This study aimed to develop edible films containing carboxymethyl cellulose (CMC) and whey protein isolate (WPI) and evaluate the effect of processing temperature on their properties.

Mixtures of CMC (2% w/v) and WPI (4% w/v) were heated between 50 °C and 85 °C for 15 min, and films were formed via the solvent casting method (dried at 37 °C for 16 h). The physicochemical properties of the films were analysed through Scanning Electron Microscopy (SEM), Attenuated Total ReflectanceFourier Transform Infrared Spectroscopy (ATR-FTIR), and mechanical testing by measuring the tensile strength (TS) and elongation at break (EB).

The CMC-WPI films obtained were homogeneous and compact, suggesting good incorporation of WPI into the CMC. FTIR showed alterations in the absorption bands with increasing temperature: the disappearance of peaks at 1633 and 1542 cm^{-1}, associated with protein denaturation; the appearance of a peak at 1594 cm^{-1}, attributed to the Maillard reaction; and alteration at 3280 cm^{-1}, attributed to a secondary amine from the reaction between polymers. These results were corroborated by the SEM images, which show a smoother surface and cross-section when $T \leq 70$ °C and different structures and increased roughness with $T \geq 75$ °C. Additionally, the films exhibited a tendency to increase in their TS and decrease in their EB with increasing temperature. For example, the TS increased from 1.86 N mm^{-2} to 2.48 N mm^{-2} and the EB decreased from 98.81% to 79.38% from 50 °C to 70 °C.

This study demonstrates that temperature affects the structural and functional attributes of the films. Higher temperatures enhanced the crosslinking and triggered Maillard reactions, as evidenced by FTIR and SEM, and improved the mechanical strength and robustness. Overall, the results highlight the potential of thermally modified CMC-WPI films for bio-based packaging.

3. Session B: Nutritional and Functional Foods

3.1. Camellia Japonica Leaves: A Promising Ingredient for Health-Promoting Plant-Based Beverages

Ezgi Nur YUKSEK [1], A. Gonzalez Pereira [1,2], Javier Echave [1,3], F. Chamorro [4], P. Donn [1], S. Seyyedi-Mansour [1] and M. A. Prieto [1]

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[1] Instituto de Agroecoloxía e Alimentación (IAA), Universidade de Vigo, Nutrition and Food Group (NuFoG), Campus Auga, 32004 Ourense, Spain
[2] Investigaciones Agroalimentarias Research Group, Galicia Sur Health Research Institute (IIS Galicia Sur), SERGAS-UVIGO, 36213 Vigo, Spain
[3] CIMO, LA SusTEC, Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal
[4] Instituto de Agroecoloxía e Alimentación (IAA), Universidade de Vigo, Nutrition and Food Group (NuFoG), Campus Auga, 32004 Ourense, Spain

Camellia japonica, widely appreciated as an ornamental plant, has recently attracted interest for its leaves as a potential source of nutritional and bioactive compounds. This study investigated the nutritional composition, total phenolic content (TPC), and antioxidant capacity of *C. japonica* leaves to assess their functional food potential. Nutritional analysis showed that the leaves contain 4.19% protein and 2.90% lipids, suggesting a low-fat, plant-based protein source. The total phenolic content (TPC), quantified using the Folin–Ciocalteu assay, was 36.67 $\pm$ 4.05 mg GAE/g dry weight, reflecting a substantial abundance of polyphenolic compounds.

Antioxidant activity, assessed via DPPH and ABTS radical scavenging assays, yielded IC_{50} values of 33.11 $\pm$ 7.25 µg/mL and 23.75 $\pm$ 10.97 µg/mL, respectively, demonstrating notable antioxidant potential. These findings suggest that *C. japonica* leaves have both nutritional and functional value, supporting their potential use in the development of health-oriented food products. A promising application would be the formulation of a functional or fermented beverage such as kombucha, using *C. japonica* leaf extracts. These products could deliver natural antioxidants and polyphenols to consumers, offering benefits related to oxidative stress reduction and general well-being. Additionally, using leaves from ornamental pruning supports circular economy strategies and sustainable ingredient sourcing.

In conclusion, *C. japonica* leaves, traditionally underutilized, exhibit significant potential as a novel ingredient in the functional food sector. Their integration into plant-based beverages represents an innovative, sustainable approach to valorizing horticultural byproducts while contributing to the development of antioxidant-rich dietary options.

3.2. Ferocactus Pilosus Inflorescence: Extraction, Quantification of Polyphenols, and Antioxidant Activity

Bosede Ruth Faleye [1], Raul Rodriguez-Herrera [1], Adriana C. Flores-Gallegos [1], Juan A. Ascacio-Valdes [1], Sandra C. Esparza-Gonzalez [2], Sonia Y. Silva- Belmares [1], Sendar D. Nery-Flores [1] and Lizeth G. Campos-Muzquiz [1]

[1] Department of Food Research, Facultyof Chemistry, Autonomous University of Coahuila, Saltillo Campus, Saltillo 25280, Coahuila, Mexico
[2] School of Dentistry, Autonomous University of Coahuila, Saltillo Campus, Saltillo 25125, Coahuila, Mexico

Plant-based foods have long been recognized for their health-promoting properties, particularly in combating oxidative stress-related disorders. *Ferocactus pilosus* inflorescences have been consumed in Mexico since pre-Hispanic times; however, their nutritional potential remains largely unexplored, with limited research on their polyphenolic composition and antioxidant properties. This study aims to bridge that gap by quantifying the polyphenolic content of *F. pilosus* inflorescences and assessing their antioxidant activity. Methodology: Inflorescences were collected from Ejido Guadalupe Victoria, Coahuila, Mexico, then cleaned, dehydrated, ground into flour, and sieved for uniformity. Phytochemical extraction was performed using 70% and 35% ethanol with a hybrid microwave–ultrasound reaction system. The extracts underwent partial purification via column chromatography

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using Amberlite XAD-16 resin, yielding polyphenols in powdered form. Hydrolysable polyphenols (HP) and condensed polyphenols (CP) were quantified, while antioxidant activity was evaluated using DPPH, ABTS, and FRAP assays. The extracts contained moderate levels of HP (4.76 mg/g GAE DW) and CP (6.91 mg/g CE DW), demonstrating notable antioxidant potential: DPPH (0.73 mg TE/g), ABTS (0.37 mg TE/g), and FRAP (0.66 mg TE/g). *F. pilosus* inflorescences represent a valuable source of polyphenols with significant antioxidant capacity, suggesting potential applications in nutraceuticals and functional foods. Further research is warranted to explore their bioavailability and health benefits.

3.3. In Vitro Antioxidant Properties of Coffee Pulp and Cocoa Shell Infusions for Sustainable Functional Beverages

Silvia Cañas [1,2], María Paz Jiménez-Losilla [1], Sandra García-Muñoz [1], Shuai Hu [1,2], Miguel Rebollo-Hernanz [1,2], Yolanda Aguilera [1,2] and María A. Martín-Cabrejas [1,2]

[1] Department of Agricultural Chemistry and Food Science, Universidad Autónoma de Madrid, 28049 Madrid, Spain

[2] Institute of Food Science Research, CIAL (UAM-CSIC), 28049 Madrid, Spain

Coffee pulp and cocoa shells are by-products from coffee and cocoa processing, rich in bioactive compounds with antioxidant and anti-inflammatory properties. Evaluating the combination of these materials in a single infusion intended for human consumption represents a promising strategy to enhance their functional potential. This study aims to evaluate the antioxidant capacity of the combined infusion before and after simulated in vitro digestion, through in vitro and cell-based assays, to explore synergistic effects and support sustainable functional beverage development. Infusions were prepared using different concentrations of coffee pulp and cocoa shells. A standardized simulated in vitro digestion protocol based on the INFOGEST model was applied to the coffee pulp and cocoa shell infusions to mimic gastrointestinal conditions. The total phenolic content (TPC) was quantified using the Folin–Ciocalteu method. Antioxidant activity was assessed through FRAP and ABTS assays. Additionally, intracellular reactive oxygen species (ROS) levels were measured in IEC-6 (rat intestinal epithelial) and HepG2 (human hepatocellular carcinoma) cell lines after oxidative stress was induced with *tert*-butyl hydroperoxide (*t*-BOOH). TPC was significantly higher in the infusion made exclusively from coffee pulp (1341.3 mg GAE/L), decreasing progressively with increasing cocoa shell content, down to 308.4 mg GAE/L in the 100% cocoa shell infusion. Antioxidant capacity (ABTS and FRAP) followed the same trend: ABTS dropped from 3.2 to 0.1 mg TE/mL and FRAP from 14.9 to 0.6 mmol TE/mL. This same trend was observed in infusions after in vitro digestion. Infusions and digested infusions were not toxic to IEC-6 and HepG2 cells, maintaining $\geq$93% viability. *t*-BOOH-induced ROS were prevented by the infusions (48–114%) and the digested infusions (43–112%) in both intestinal and hepatic cells. In conclusion, coffee pulp and cocoa shell infusions retain antioxidant activity after digestion and reduce cellular oxidative stress, supporting their use as sustainable functional beverages.

3.4. Nannochloropsis sp. Extract as a Potential Functional Ingredient for Food Applications

Valter Filipe Reis Martins, Ana Isabel Lopes, Manuela Machado, Manuela Pintado, Rui M.S.C. Morais and Alcina M.M.B. Morais

CBQF-Centro de Biotecnologia e Química Fina—Laboratório Associado, Escola Superior de Biotecnologia, Universidade Católica Portuguesa, 4169-005 Porto, Portugal

Sustainability is a worldwide concern, and the exploration of natural resources contributes to it. Microalgae biomass can source nutrients. *Nannochloropsis* sp. is a saltwater microalga, known for its bioactive compounds, such as phenolics, fatty acids (PUFAs including EPA), and carotenoids (e.g., violaxanthin and zeaxanthin). Therapeutic applications

can be achieved via these bioactives, like cholesterol reduction with anti-atherosclerotic or anti-cancer properties. *Nannochloropsis* sp. biomass was supplied by A4F—Algae for Future (Portugal). The nutritional characterization of the biomass was performed via standard methodology (A.O.A.C.). Its bioactive compounds were extracted through maceration (hydroethanolic solution 90%, 50 °C, 120 rpm, 2 h, repeated twice). The total phenolic content (TPC), the antioxidant activity (ABTS, DPPH, ORAC), the antimicrobial activity and the lipid profile of the extracts were determined. The results demonstrated that fat (36.6 ± 0.0 g/100 g DW) is the majority macronutrient of the biomass, followed by carbohydrates (31.4 ± 0.0 g/100 g DW) and protein (22.9 ± 0.1 g/100 g DW). The TPC of the extract was 0.57 ± 0.10 mg GAE/100 mg DW, and ABTS, DPPH, and ORAC were 1.35 ± 0.27, 0.25 ± 0.06 and 7.53 ± 0.28 µmol TE/100 mg DW, respectively. The antimicrobial activity assay was performed, determining the minimal inhibitory concentration against bacteria Gram-*Echerichia coli* (1.25 mg/100 µL), *Yersinia enterocolitica* (0.63 mg/100 µL), *Salmonela enterica serovar* Enteridis (1.25 mg/100 µL), Gram+ *Staphylococus aureus* (1.25 mg/100 µL), *Bacillus cereus* (5 mg/100 µL), and *Listeria monocytogenes* (1.25 mg/100 µL). The minimal bactericidal concentration was above 5 mg/100 µL for all bacteria tested. The major fatty acids in the extract were palmitic acid (310.7 ± 21.04 mg/g) and palmitoleic acid (235.0 ± 11.25 mg/g).

Nannochloropsis sp. biomass has a good nutritional profile with healthy benefits, presenting an alternative to other unhealthy fats. The bioactive-rich extract presented antioxidant and antimicrobial activities. This extract has interesting functionality to be used as an ingredient in the food and feed sectors.

3.5. Development and Characterization of a Functional Nutritional Bar Incorporating Black Rice, Seeds, and Natural Sweeteners

Karthick Ajay B [1], Dinesh Suriya B [2], Barath T [2], Gayathri M [2], Jayasri B [2] and Elanchezhian P [2]

1 National Institute of Food Technology Entrepreneurship and Management—Thanjavur (NIFTEM-T), Thanjavur 613005, Tamil Nadu, India
2 Paavai Engineering College, Pachal 631018, Tamil Nadu, India

In recent years, nutritional bars have become more popular health-conscious snacks for people who are concerned more about their health, especially athletes and those with hectic schedules. With this growing demand, these bars are now enhanced with natural ingredients and rich bioactive compounds. Against this background, our current study focused on the development of a functional nutritional bar using black rice as the core ingredient, combined with sunflower seeds, sesame seeds, mixed nuts, and palm sugar. The developed bar demonstrated significant functional benefits, including the presence of key phytochemicals such as flavonoids, saponins, and anthocyanin, with notable antimicrobial activity against common pathogens such as *E.coli, S.aureus*, and *B.* subtilis, with the highest zone of inhibition observed at 60 µL extract concentration. Further, the bar delivered 378 kcal, 9.66 g protein, 7.28 g fiber, 350 mg calcium, and 8.02 mg iron per 100 g, making it significantly richer in protein and minerals than conventional cereal-based bars. Compared to the control samples, the developed bar had a lower pH (4.97–5.23), reduced water activity, and better shelf stability, as well as higher sensory scores, offering higher consumer acceptability. This functional bar holds a strong potential for use in the commercial health snack market and school meal programs aimed at addressing increasing nutrient deficiency, making it suitable for athletes, adolescents, working professionals, and individuals with elevated nutritional needs.

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3.6. Does Gender Matter? Emotional and Cognitive Attitudes Toward Entomophagy

Agnieszka Orkusz [1], Katarzyna Ostasiewicz [2] and Maria Yotova [3]

[1] Department of Biotechnology and Food Analysis, Faculty of Production Engineering, Wroclaw University of Economics and Business, 53-345 Wroclaw, Poland
[2] Department of Statistics, Wroclaw University of Economics and Business, 53-345 Wroclaw, Poland
[3] College of Gastronomy Management, Ritsumeikan University, Shiga, Kusatsu 525-8577, Japan

Entomophagy, or the consumption of insects, is increasingly recognized as a component of sustainable food systems, reducing greenhouse gas emissions, lowering resource use, and improving animal welfare. Nevertheless, it continues to face resistance in Western societies, mainly driven by psychological, cultural, and emotional factors. This study aimed to explore gender differences in emotional and cognitive attitudes toward edible insects—understood as variations in knowledge, acceptance, and emotional responses to the idea of insect consumption.

This study involved 227 students from the Wrocław University of Economics and Business (53% women, 47% men). Participants completed a questionnaire assessing their knowledge and attitudes toward entomophagy before and after viewing a short educational video. At the same time, their emotional responses were recorded using FaceReader software, which analyzes facial expressions in real time.

The results showed that women experienced more frequent and intense negative emotions (such as sadness, anger, and disgust) and demonstrated greater emotional variability than men, who remained more neutral and emotionally consistent. However, women were also more likely to shift their attitudes after watching the video, more often expressing increased acceptance of insects as part of their diet, particularly when presented in invisible forms (e.g., insect flour). The strongest predictor of rejection was disgust, which was notably higher among female participants.

These findings suggest that gender plays a significant role in shaping responses to entomophagy. Integrating self-reported data with real-time emotional analysis can offer a more nuanced understanding of the psychological barriers to insect consumption. The results also underscore the importance of tailoring educational strategies and communication efforts to different levels of emotional sensitivity to effectively promote sustainable dietary choices.

3.7. Association Between Perception of Kombucha and Lifestyle in the Kombucha Consumer Community

Audrey Nasywa Lathifa Zanra Pulungan and Anggita Dian Cahyani

Psychology Department, Faculty of Humanities, Bina Nusantara University, Jl. Kemanggisan Ilir III No. 45, West Jakarta, DKI Jakarta 11480, Indonesia

Over the years, Indonesia has been facing a wide range of health issues. One of these rising public health concerns is non-communicable diseases (NCDs). Besides the effect of the COVID-19 pandemic back in 2021, NCDs have also become a major factor causing death, exceeding 52.2% cases. These health issues are harder to prevent due to unhealthy lifestyle habits, such as a lack of physical activity, low consumption of fruits and vegetables, and high intake of processed foods and beverages. Kombucha, a traditionally fermented beverage made out of tea and a symbiotic culture of bacteria and yeast (SCOBY), has become an alternative health product to help face these complex health challenges due to its probiotic content and perceived health benefits, particularly for the gastrointestinal system. The growth of Kombucha consumption has been rampant in Indonesia's product market,

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especially through social media, as evidenced by the existence of Kombucha consumer communities with thousands of followers. Thus, this study aims to explore the relationship between consumer perceptions of Kombucha and the lifestyle of Indonesian-based online communities of Kombucha consumers. This research took the form of a correlational design through data collection, where participants were recruited online and given a structured questionnaire using Google Forms. This comprised sociodemographic information, perceptions of probiotics and Kombucha, and lifestyle habits. Through statistical analysis using Pearson's correlation, the data uncovered a positive, but significantly low correlation between the perception of Kombucha and the lifestyle habits of the Kombucha consumer community (r = +0.241, n = 130, and two-tailed *p* 0. 006). On average, participants have a highly positive perception of Kombucha (M = 4.047, Std. dev. = 0.364) and an overall Health Lifestyle Habits (HLHs) score of 6.26 (Std. dev. = 0.781), which means participants need to improve their lifestyle.

3.8. Designing Brain-Boosting Functional Foods: Using Galician Macroalgae for Smart Nutrition

P. Barciela [1], A. Perez-Vazquez [1], M. Carpena [1], A.O.S. Jorge [1,2], E. Yuksek [1], A. Silva [1,3] and M.A. Prieto [1]

1 Instituto de Agroecoloxía e Alimentación (IAA), Universidade de Vigo, Nutrition and Food Group (NuFoG), Campus Auga, 32004 Ourense, Spain
2 REQUIMTE/LAQV, Department of Chemical Sciences, Faculty of Pharmacy, University of Porto, R. Jorge Viterbo Ferreira 228, 4050-313 Porto, Portugal
3 REQUIMTE/LAQV, Instituto Superior de Engenharia do Porto, Instituto Politécnico do Porto, Rua Dr António Bernardino de Almeida 431, 4200-072 Porto, Portugal

In the burgeoning field of future food sources, marine macroalgae are emerging as a functional category with high added value, owing to their diverse biochemical composition, low environmental footprint, and biotechnological versatility. The Galician coast is home to several species of seaweed, including brown algae (Fucus vesiculosus and Saccharina latissima "sugar kelp") and red algae (Palmaria palmata), which have been found to be suitable for industrial applications. They concentrate bioactive compounds of interest, such as phenolic acids, sulphated polysaccharides, phlorotannins, and essential amino acids, as well as pigments, including xanthophylls (lutein, fucoxanthin), β-carotene, and phycobiliproteins. These compounds are associated with antioxidant, anti-inflammatory, and neuroprotective properties in the published scientific literature. Nootropics, otherwise labeled as smart drugs, are compounds that have been formulated over several decades and were initially intended to treat specific cognitive imbalances. This systematic review was carried out using the ScienceDirect, PubMed, and Scopus databases to compile articles from Q1 journals between 2020 and 2025. The inclusion criteria were based on keywords including "future foods," "functional foods," "Macroalgae," "nootropics," and "bioactive compounds." Data screening and extraction were conducted in accordance with PRISMA guidelines. The review focuses on bioactive compounds associated with mechanisms that enhance neuroplasticity, synaptogenesis, and the modulation of oxidative stress in the brain. The results suggest the nootropic potential of these algal matrices, thereby paving the way for further research on the isolation, structural elucidation, and in vitro/in vivo validation of neuroactive compounds from Galician macroalgae. Additionally, the study evaluates the industrial feasibility of using these compounds to develop smart and functional foods within the context of future food strategies.

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3.9. Green Extracts of Luzuriaga Radicans Berries Ruiz & Pav. with Potential Against Chronic Diseases

Alfredo Torres-Benítez [1], Sebastian Scharf [2], Javier Romero-Parra [3], Peter Winterhalter [2], Mario Simirgiotis [4] and Recep Gök [2]

1 Chemistry and Pharmacy Department, Faculty of Sciences, Universidad San Sebastián, General Lagos 1163, Valdivia 5090000, Chile
2 Institute of Food Chemistry, Technische Universitat Braunschweig, Schleinitzstrase 20, 38106 Braunschweig, Germany
3 Department of Organic Chemistry and Physicochemistry, Faculty of Chemical and Pharmaceutical Sciences, Universidad de Chile, Santiago 6640022, Chile
4 Institute of Pharmacy, Faculty of Sciences, Austral University of Chile, Valdivia 5110566, Chile

Fruits are rich sources of antioxidants, bioactive compounds, and their consumption is associated with a lower risk of chronic non-communicable diseases. Native fruits such as Luzuriaga radicans Ruiz & Pav. are used as food and are an alternative in traditional medicine. In Chile, these fruits grow in the southern regions of the country. Natural deep eutectic solvents (NaDESs) have emerged as a new class of sustainable, non-toxic, and biodegradable solvents. They have been used in the extraction of many compounds from natural sources, and are used to extract compounds to prepare nutraceuticals that can also be used as food additives. The objective of our research was to evaluate the total phenolic content (TPC), total flavonoids (TFC), and antioxidant capacity of Luzuriaga radicans Ruiz & Pav. using ultrasound-assisted deep eutectic solvent extraction (NaDES). The berries were collected in the Parque Saval in Valdivia, Chile, and subsequently extracted with ethanol, ethanol/water 1:7 *v*:*v*, and several NADES employing ultrasound and microwaves. UHPLC-DAD, HPLC-APCI(+)-MS, and UHPLC-ESI(+)-TOF-MS analysis allowed for the identification of several carotenes and carotenoid ester species. The NADES showed better antioxidant capacity compared to hydroalcoholic extraction in some cases, measured by the bleaching of the DPPH and ABTS radicals, ORAC, and the FRAP antioxidant test. In addition, some antienzymatic activity was found for the hydroalcoholic extraction (ACHe and BuCHE: IC50: 6.904 $\pm$ 0.42 and 18.38 $\pm$ 0.48, respectively). The berries of this species show potential for the treatment of Alzheimer's disease, which can be attributed to the content of carotene compounds. The research suggests the fruits could have beneficial effects at least in the prevention of this neurodegenerative disease.

3.10. Nutritional and Metabolomic Profiles of Solanum quitoense Lam. Fruit Fractions: Implications for Functional Food Development

Mikel Añibarro-Ortega [1,2], Maria Inês Dias [1], Alexis Pereira [1], Lillian Barros [1] and José Pinela [1,3]

1 CIMO, LA SusTEC, Polytechnic Institute of Bragança, Campus of Santa Apolónia, 5300-253 Bragança, Portugal
2 Nutrition and Bromatology Group, Department of Analytical and Food Chemistry, Faculty of Food Science and Technology, University of Vigo, Ourense Campus, E-32004 Ourense, Spain
3 National Institute for Agricultural and Veterinary Research (INIAV, I.P.), Rua dos Lágidos, Lugar da Madalena, Vairão, 4485-655 Vila do Conde, Portugal

Solanum quitoense Lam. (naranjilla or lulo) is a little-explored Andean fruit with high potential for functional and nutraceutical applications [9]. This study comprehensively characterizes the nutritional, phytochemical, and bioactive profiles of its peel, pulp, and seeds. Standard AOAC methods were used to determine the proximate composition, while

atomic absorption spectroscopy and GC-FID enabled mineral and fatty acid quantification, respectively. Targeted HPLC-DAD-ESI/MS^n analyses identified and quantified 25 phenolic compounds, including flavonoids, phenolic acids, and spermidine-derived phenolamides. Results revealed a distinct distribution of nutrients and bioactives across fruit parts. The seeds had the highest contents of protein (4.37 g/100 g fw), unsaturated fatty acids (oleic acid 44.9%), and spermidine derivatives (37.8 mg/g extract), supporting their antifungal capacity (MIC = 1.5 mg/mL against *Aspergillus versicolor*). The peel showed high levels of dietary fiber (16.5 g/100 g fw), α-tocopherol (7.9 mg/100 g fw), and flavonoids (14.2 mg/g extract), with strong antioxidant activity (OxHLIA IC_{50} = 202 μg/mL, Δt = 60 min). The pulp, rich in citric acid (4.2 g/100 g fw) and sucrose (2.7 g/100 g fw), also showed moderate antioxidant and antibacterial properties [10]. This is the first report to detail the spatial distribution of phenolamides in *S. quitoense*, demonstrating their concentration in seeds and linking them to bioactivity. The findings provide new insights for the valorization of naranjilla by-products and reinforce its candidacy for inclusion in food composition databases. These data support its use as a source of dietary fiber, antioxidants, and natural antimicrobials in functional food formulations, contributing to circular bioeconomy strategies.

3.11. Polydextrose Addition Improves the Softness and Looseness of Chinese Steamed Bread Through the Formation of a Sticky, Elastic Network Structure

Chang Liu [1,2], Bing Dai [1,3], Xiaohong Luo [1], Hongdong Song [2] and Xingjun Li [1,2]

1 Academy of National Food and Strategic Reserves Administration, National Engineering Research Center for Grain Storage and Transportation, Beijing 102209, China
2 College of Health Science and Engineering, University of Shanghai for Science and Technology, Shanghai 200093, China
3 College of Grain and Strategic Reserves, Henan University of Technology, Zhengzhou 450001, China

This study explored the effects of a new polydextrose addition on the sensory score, textural parameters, and microstructure of steamed bread, as well as the pasting, thermal, and thermal–mechanical properties of high-gluten wheat flours. Compared with the control sample, 3–10% polydextrose addition significantly increased the hardness, adhesiveness, gumminess, and chewiness of steamed bread, but other textural parameters like springiness, cohesiveness, and resilience remained basically the same. Additionally, 3–10% polydextrose addition significantly reduced the specific volume and width/height ratio of steamed bread but increased the brightness index, yellowish color, and color difference, improved the internal structure, and maintained the other sensory parameters and total score. Polydextrose addition decreased the peak, trough, final, breakdown, and setback viscosity of the pasting of wheat flour suspension solutions but increased the pasting temperature. Polydextrose addition significantly reduced the enthalpy of gelatinization and the aging rate of flour paste but increased the peak temperature of gelatinization. Polydextrose addition increased the crystalline regions of starch, the interaction between protein and starch, and the β-sheet percentage of wheat dough without yeast and that of steamed bread. Amorphous regions of starch were increased in dough through the addition of polydextrose, but decreased in steamed bread. In addition, 3–10% polydextrose addition decreased the number of random coils, α-helixes, and β-turns in the dough, but 3–7% polydextrose addition maintained or increased these conformations in steamed bread, while 10% polydextrose decreased them. In steamed bread, as a hydrogel, 5–7% polydextrose addition resulted in the formation of a continuous three-dimensional network structure with certain adhesiveness and elasticity, with increases in the porosity and gas-holding capacity of the product. Moreover,10% polydextrose addition further increased the viscosity, softness, and looseness of the steamed bread, with smaller and more numerous holes and indistinct boundaries between starch

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granules. These results indicate that 3–10% polydextrose addition increases the softness and looseness of steamed bread by improving the gluten network structure.

3.12. Therapeutic Potential of Lemongrass Extract in Monosodium Glutamate-Induced Metabolic Disorders in Mice

Anindita Bhattacharjee [1], Md. Kamrul Hasan Kazal [1], Rakhi Chacrabati [2] and Chayon Goswami [1]

[1] Department of Biochemistry and Molecular Biology, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh

[2] Interdisciplinary Institute for Food Security (IIFS), Bangladesh Agricultural University, Mymensingh 2202, Bangladesh

Monosodium glutamate (MSG)-rich diets have been associated with various metabolic disorders, including obesity, diabetes, dyslipidemia, and hepatotoxicity, underscoring the need for effective preventive strategies. A previous study reported that lemongrass (*Cymbopogon citratus*) contains quercetin (23.9 ± 0.3 mg/g), caffeic acid (445.21 ± 32.77 µg/g), chlorogenic acid, p-coumaric acid, catechin, and pyrogallol, among others (Tazi et al., 2024 [11]). These phytochemicals were reported to exert beneficial effects in managing metabolic imbalances. Therefore, this study aimed to evaluate the efficacy of the ethanolic extract of lemongrass to mitigate the effects of MSG consumption. Shade-dried lemongrass leaves were powdered and extracted with 70% ethanol. The extract was filtered, concentrated by rotary evaporation, and freeze-dried to obtain the ethanolic extract. Swiss Albino male mice were divided into four groups (6 mice in each group): a control group on a normal diet, an MSG-treated group (5% MSG mixed pellet), and two groups receiving MSG along with lemongrass extract at doses of 200 mg/kg (LLG) and 400 mg/kg (HLG) body weight, respectively. International guidelines for biomedical research were followed for animal care and the procedures were approved (AWEEC/BAU/2024/14) by the Animal Welfare and Experimentation Ethics Committee, Bangladesh Agricultural University; dosage was decided based on previous reports. After an eight-week feeding trial, MSG administration significantly elevated food intake, body weight, and blood glucose levels, alongside inducing lipid and hematological imbalances and hepatic abnormalities such as steatosis and cellular swelling. The ethanolic extract of lemongrass significantly alleviated MSG-induced metabolic dysfunction by reducing body weight change (10.6 ± 0.92 g for MSG vs. 7.67 ± 0.76 g for MSG + HLG), improving glucose tolerance, reducing liver weight (46.5 ± 1.84 mg/g BW for MSG vs. 43.16 ± 1.34 mg/g BW for MSG + HLG), correcting dyslipidemia, mitigating taste aversion, and restoring hepatic histoarchitecture in a dose-dependent manner. These findings position lemongrass extract as a potent natural candidate for preventing and managing MSG-related metabolic disorders. Incorporating lemongrass into dietary or nutraceutical strategies may offer a safe, multi-targeted approach to improving metabolic health. Future research should focus on elucidating the detailed mechanisms of action of lemongrass extract in MSG-related complications.

3.13. Zinc Enrichment of Triticum aestivum L. (cvs. Roxo and Paiva): Nutritional Characterization and Influence of Tecnifol Zinc in Flours and Grains

Inês Carmo Luís [1,2], Cláudia Campos Pessoa [1,2], Diana Daccak [1,2], Ana Coelho Marques [1,2], Ana Rita Fonseca Coelho [1,2], Maria Manuela Silva [1,2], Manuel Patanita [2,3], José Dôres [3], Ana Sofia Almeida [2,4], Fernando Henrique Reboredo [1,2], Paulo Legoinha [1,2], Manuela Simões [1,2], Isabel P. Pais [2,4], José N. Semedo [2,4], Paula Scotti-Campos [2,4], Ana Sofia Bagulho [2,4], José Moreira [4], José C. Ramalho [2,5] and Fernando C. Lidon [1,2]

[1] Earth Sciences Department, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, Campus da Caparica, 2829-516 Caparica, Portugal

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[2] GeoBioTec Research Center, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, Campus da Caparica, 2829-516 Caparica, Portugal
[3] Escola Superior Agrária, Instituto Politécnico de Beja, R. Pedro Soares S/N, 7800-295 Beja, Portugal
[4] Instituto Nacional de Investigação Agrária e Veterinária, I. P. (INIAV), Estrada de Gil Vaz 6, 7351-901 Elvas, Portugal
[5] PlantStress & Biodiversity Lab, Centro de Estudos Florestais (CEF), Laboratório Associado TERRA, Instituto Superior Agronomia (ISA), Universidade de Lisboa, Quinta do Marquês, 2784-505 Oeiras, Portugal

There is growing concern about the increase in micronutrient deficiencies, particularly in zinc, along with the pathologies associated with this deficiency, as well as the need to feed a growing world population. Therefore, the agronomic biofortification of a staple crop (bread wheat) with zinc is a promising strategy, also enabling the production of a functional food with added value. The aim of this work was to characterize a functional product with prophylactic potential and to compare the Roxo and Paiva varieties, with and without foliar application of tecnifol Zinc. In an experimental field, located in Beja (Portugal), an agronomic biofortification of *Triticum aestivum* L. (*cvs*. Roxo and Paiva) workflow was implemented, involving foliar spraying with tecnifol zinc (control—0 (P0Te, R0Te), 1.3 (P1Te, R1Te) and 2.6 (P2Te, R2Te) kg/ha^{-1}). Mineral elements (S, K, Ca and Zn) were quantified in both whole and refined flours. The protein content of wheat grains was also determined, along with the quantification of soluble sugars in whole flours. An increase in protein content was observed with higher Zn application rates, with the Roxo variety exhibiting higher values. The decreasing order of mineral element concentrations was as follows: K > S > Ca > Zn in both whole and refined flours, with refined flours showing lower levels for all of the elements. The Roxo variety prevailed over Paiva for Ca and Zn, in both types of flour. In general, the soluble sugars followed an increasing concentration order of fructose > sucrose > raffinose > glucose. To sum up, the results support the potential of zinc-biofortified wheat as a functional food with prophylactic properties, helping to address nutritional deficiencies, such as Zn.

3.14. A Functional Approach to Dairy Innovation: Development of Digestive-Aiding Garlic Milk Powder

Dinesh R [1], Srivarshini S [1], Gowtham P [1] and Baghya Nisha R [2]

[1] B. Tech Fourth Year Food Technology Manakula Vinayagar Institute of Technology, Kalitheerthalkuppam, Puducherry 605 107, India
[2] Department of Food Technology Manakula Vinayagar Institute of Technology, Kalitheerthalkuppam, Puducherry 605 107, India

This study reports the development and evaluation of a spray-dried functional milk powder infused with garlic essence and fortified with turmeric (*Curcuma longa*) and black pepper (*Piper nigrum*), formulated to support digestive health. Garlic (*Allium sativum*) is a well-documented source of allicin, a bioactive compound known for its antimicrobial, antifungal, and anti-inflammatory properties. In combination with curcumin and piperine, the formulation aims to provide synergistic effects for gastrointestinal function and immune enhancement. Fresh garlic cloves were processed to extract a clarified essence, which was incorporated into standardized cow milk (3.0% fat; 8.5% SNF) at four varying concentrations: T1 (1.5 mL/L), T2 (2.5 mL/L), T3 (3.5 mL/L), and T4 (4.5 mL/L). Each formulation was supplemented with turmeric (0.3 g/L) and black pepper (0.2 g/L), homogenized, and subjected to spray-drying. Process parameters were optimized to maximize allicin retention (up to 80%), using an inlet temperature of 170 °C, an outlet temperature of 75 °C, a feed rate of 7 kg/h, and an atomization pressure of 2.0 bar. The final milk powder exhibited a

moisture content below 5%, ensuring shelf stability. Rehydrated samples were analyzed for physicochemical properties (pH, titratable acidity, total solids, ash content, and density) and sensory attributes using a 9-point Hedonic Scale. Among the tested concentrations, formulation T2 (2.5 mL/L) showed the highest overall acceptability with optimal flavor balance and aroma, maintaining pH 6.71, acidity 0.183%, ash 0.42% (*w*/*w*), and density 1080 kg/m^3.

3.15. A Functional Approach to Dairy Innovation: The Development of Digestive-Aiding Garlic Milk Powder

Dinesh R, Srivarshini S, Gowtham P and Baghya Nisha R

Department of Food Technology, Manakula Vinayagar Institute of Technology, Puducherry 605 107, India

This study reports the development of a spray-dried functional milk powder infused with garlic essence and fortified with turmeric (*Curcuma longa*) and black pepper (*Piper nigrum*), aimed at supporting digestive health. Garlic (*Allium sativum*) is a known source of allicin, a bioactive compound with antimicrobial and anti-inflammatory properties. Combined with curcumin and piperine, the formulation offers synergistic benefits for gastrointestinal and immune function. Fresh garlic cloves were processed to extract clarified essence and incorporated into standardized cow's milk (3.0% fat, 8.5% SNF) at four concentrations: T1 (1.5 mL/L), T2 (2.5 mL/L), T3 (3.5 mL/L), and T4 (4.5 mL/L). Each variant was fortified with turmeric (0.3 g/L) and black pepper (0.2 g/L), homogenized, and spray-dried. The feed mixture had a total solids content of 13.2%, water content of 86.8%, and specific mass of 1042 kg/m^3. The processing parameters were optimized using an inlet temperature of 170 °C, outlet temperature of 75 °C, feed rate of 7 kg/h, and atomization pressure of 2.0 bar to maximize allicin retention. Allicin was quantified via UV-Vis spectrophotometry at 412 nm using DTNB reagent. The final powder had a moisture content below 5% and a water activity of 0.40, indicating good shelf stability. Rehydrated powders were assessed for pH, titratable acidity, total solids, ash, density, and sensory attributes using a 9-point Hedonic Scale. Among the formulations, T2 (2.5 mL/L) achieved the highest acceptability, with pH 6.71, acidity 0.183%, ash 0.42% (*w*/*w*), and density 1080 kg/m^3, indicating a balanced flavor profile and functional potential.

Conclusions: The developed garlic-infused milk powder represents a scientifically validated, shelf-stable functional dairy product with retained bioactivity and favorable sensory properties, suitable for application in the nutraceutical and functional food sectors.

3.16. A Novel Avocado Puree with Encapsulated Tomato By-Products: Impact of Processing Techniques on Bioactive Compound Retention

Laleh Mozafari, Lorena Martínez Zamora, Marina Cano Lamadrid and Francisco Artés Hernández

Postharvest and Refrigeration Group, Department of Agricultural Engineering, Universidad Politécnica de Cartagena, Cartagena, 30203 Murcia, Spain

This work presents an innovative strategy to enhance the nutritional quality—specifically the retention and delivery of polyphenols and carotenoids—of plant-based foods. Bioactive compounds extracted from tomato pomace (skins and seeds) were concentrated, encapsulated using a 1:1 maltodextrin–inulin blend, and spray-dried into powders that were incorporated into a spreadable avocado matrix. Focusing on a spreadable avocado matrix, the study explored how integrating these encapsulated compounds—rich in health-promoting carotenoids—could improve both shelf stability and nutritional properties. Multiple preservation techniques were tested, including conventional thermal processing (CT), ultrasound treatment (US), and high hydrostatic pressure (HHP), to assess

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their influence on the stability of bioactive content, antioxidant activity, and microbial safety during refrigerated storage. Encapsulation played a crucial role in protecting sensitive compounds by reducing their degradation by 5–25%, supporting their retention over time and contributing to a more stable antioxidant profile throughout the product's shelf life. Among the preservation methods, HHP demonstrated a synergistic effect, improving microbial safety, reducing 2–4 log CFU/g without the thermal degradation commonly associated with conventional heat treatments. This approach also preserved a greater proportion of phenolic compounds (~1.35 g GAE/kg), underscoring the advantages of non-thermal technologies in maintaining nutritional quality. In contrast, thermal treatment showed a noticeable reduction in phenolics (~40%), highlighting the trade-offs between microbial control and nutrient preservation. The integration of encapsulated ingredients derived from horticultural by-products offers a dual benefit—improving food quality while advancing sustainable practices through the upcycling of agro-industrial waste. This study underscores the promise of combining encapsulation and gentle preservation techniques to create clean-label, functional foods aligned with consumer demand for health, sustainability, and transparency.

3.17. A Novel Functional Pasta from Red Teff (Eragrostis tef (Zucc.)) and Soybean (Glycine max): Nutritional Enhancement and In Vitro Antioxidant Properties

Shewangzaw Addisu Mekuria [1,2] and Joanna Harasym [3]

1 Department of Biotechnology and Food Analysis, Wroclaw University of Economics and Business, Komandorska 118/120, 53-345 Wrocław, Poland
2 College of Veterinary Medicine and Animal Sciences, University of Gondar, Gondar P.O. Box 196, Ethiopia
3 Adaptive Food Systems Accelerator-Science Centre, Wrocław University of Economics and Business, Komandorska 118/120, 53-345 Wroclaw, Poland

Currently, the demand for gluten-free products is increasing due to their health and nutritional benefits. Gluten-free pasta (fusilli) was developed using flour made from red teff (*Eragrostis tef* (Zucc.)), alone and mixed with soybean (*Glycine max*). Durum wheat semolina flour served as the positive control. The amount of each flour was adjusted at different proportions. The production process of teff with soybean mixtures involved 100%, 90%, 80%, 70%, and 60% teff (T) and 0%, 10%, 20%, 30%, and 40% soybean flour (S), named as 100T0S, 90T10S, 80T20S, 70T30S, and 60T40S, respectively. Pasta made only from teff and semolina was used as a control. Analyses included cooking quality, chemical composition, antioxidant activity, texture profile, and Rapid Visco Analysis (RVA). Results showed that the highest weight gain, water absorption, and texture profile were recorded in 80T20S. The highest ash (3.49%) and protein (22.56%) contents were observed in 60T40S, with the lowest in 100T alone. As the level of soybeans increased, the protein percentage also increased. The highest fat content was recorded at 20% soybean inclusion. The lowest antioxidant activity in FRAP (0.03 mg $FeSO_4$/g of DM) and reducing sugar (33.87 mg glucose equivalents/g of DM) ($p < 0.001$) was found in semolina pasta. However, the ABTS and TPC contents showed no significant difference ($p > 0.05$) between the developed pastas. The highest peak viscosity (1129.5 mPa.s) was observed in semolina pasta compared to the others. Nonetheless, as soybean content increased, peak viscosity decreased. Therefore, the 80T20S pasta would be acceptable due to its quality, nutritional, and antioxidant properties.

3.18. A Study on the Emulsification of Algal Oil Using Quillaja Saponin

Dhanya George and Jeyan A. Moses

Department of Food Process Engineering, National Institute of Food Technology, Entrepreneurship and Management, Thanjavur 613005, Tamil Nadu, India

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Introduction: Algal oil is a vegan-friendly source of DHA (Docosahexaenoic acid), a primary omega-3 fatty acid essential for brain, eye, and heart health. However, its lipophilicity, oxidative sensitivity, and poor oral bioavailability adversely affect its functional efficacy. Emulsions facilitate the delivery of lipophilic compounds by enhancing their aqueous dispersibility and physicochemical stability. This work outlines the formulation of algal oil emulsion using *Quillaja saponin* as a natural surfactant.

Methodology: *Quillaja saponin* weighing 1 g was dissolved in 90 mL of the water phase, followed by glycerol (1 mL) and ascorbic acid (200 mg) using a magnetic stirrer for 10 min. Further, 10 g of oil phase (Algal oil) was added dropwise and homogenized at 12,000 rpm for 10 min. The coarse emulsion was then ultrasonicated using a probe sonicator at 75% amplitude. The resulting pale white emulsions were qualitatively assessed based on particle size, polydispersity index (PDI), and zeta potential, with variations in the water phase, additives, and ultrasonication time.

Results and Discussion: The choice of water phase, whether phosphate buffer or distilled water, and the inclusion of additives such as glycerol and ascorbic acid did not markedly influence the particle size. However, different ultrasonication times (10 and 15 min) showed a notable impact. Higher ultrasonication times increased particle size, which could be attributed to intensified cavitation, creating strong shear forces that break oil droplets into smaller sizes. Across all trials, a PDI less than 0.5 and a zeta potential greater than −30 was obtained, indicating good colloidal stability. This study is prospective in the development of functional formulations of lipophilic nutrients.

3.19. A Sustainable Approach for Recovering High-Value Bioactive Lipids from Coffee Pulp Using Ethanol-Modified Supercritical Carbon Dioxide

Shuai Hu [1,2], Shandilya Baira [3], Miguel Rebollo-Hernanz [1,2], Silvia Cañas [1,2], María Ángeles Martín-Cabrejas [1,2], Peter Spégel [3] and Alicia Gil-Ramírez [1,2]

1 Department of Agricultural Chemistry and Food Science, Faculty of Science, Universidad Autónoma de Madrid, 28049 Madrid, Spain
2 Department of Production and Characterization of Novel Foods, Institute of Food Science Research, CIAL (UAM-CSIC), 28049 Madrid, Spain
3 Centre for Analysis and Synthesis, Department of Chemistry, Lund University, P.O. Box 124, 221 00 Lund, Sweden

Fats derived from coffee by-products, i.e., coffee pulp (CP), could constitute a valuable source of bioactive lipids for neuroprotective nutraceutical development. Sustainable recovery of these lipids and comprehensive compositional profiling using high-throughput lipidomics are essential steps in valorizing CP waste streams. This work aimed to explore the impact of the ethanol-modified supercritical carbon dioxide (EtOH-scCO_2) extraction technique on the profile of recovered lipid fractions under several extraction conditions (45 and 65 °C; 20 and 30 MPa; and 5 and 10% *w*/*w* co-solvent) by UHPLC/ESI-timsTOF, alongside conventional Folch extraction. Profiling analysis revealed that the Folch method yielded a higher number of lipids (266) compared to EtOH-scCO_2 (from 249 to 263), but the overall lipid abundance was decreased. Glycerolipids and triacylglycerols were the dominant categories and classes, respectively, across all groups. Differential analysis demonstrated that glycerophospholipids, phosphatidylinositols, and sulfoquinovosyldiacylglycerol 16:0_18:3 lipid exhibited the most significant expression differences at the category, class and species level, respectively. EtOH-scCO_2 extraction, in comparison with the Folch method, favored the extraction of long-chain lipids containing more double bonds, with a lower EtOH proportion (5%) resulting in a longer chain and a higher unsaturation degree. Multivariate analysis (PCA, PLS-DA, and hierarchical clustering) showed a clear difference in lipid profiles between EtOH-scCO_2 and Folch extracts. More-

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over, EtOH-scCO_2 extracts were further distinguished according to EtOH percentages, with lower ethanol content (5%) diverging most from Folch extracts, which reflected a tunable extraction selectivity driven by the relatively lower polarity of the supercritical phase. This trend was further supported by the significantly high correlation between EtOH and lipid species, highlighting the notable contribution of EtOH in lipid extraction. Overall, these results suggested that the EtOH-scCO_2 extraction offered a promising and selective approach for obtaining extracts enriched in long-chain polyunsaturated lipids from CP, with a prospective ability to enhance nerve function and brain health. These findings guide the targeted recovery of specific lipid species from coffee by-products for high-value applications.

3.20. Analysis of Chemical, Physicochemical, and Sensorial Properties of Healthy Cocoa Cream Formulated with Sweet Potato (Ipomoea batata) and House Cricket (Acheta domesticus) Flour

Raquel Lucas-Gonzalez [1], Marco A. Trindade [2], José A. Pérez-Alvarez [1], Juana Fernández-López [1] and Manuel Viuda-Martos [1]

[1] IPOA Research Group, Institute for Agri-Food and Agri-Environmental Research and Innovation (CIAGRO-UMH), Miguel Hernández University, 03312 Orihuela, Alicante, Spain

[2] Department of Food Engineering, Faculty of Animal Science and Food Engineering, University of São Paulo, Pirassununga 13635-900, São Paulo, Brazil

Sweets are the most commonly consumed snacks. In this sense, the food industry is focused on designing foods with reduced sugar and a high protein content. As such, cricket (*Acheta domesticus*) powder may be used as a protein-rich additive, as the European Food Safety Authority has approved its use. Thus, the aim of this work was to determine the chemical composition and physico-chemical and sensorial properties of a healthy cocoa cream substituted with sweet potato and house cricket (*A. domesticus*) flour. Two cocoa cream formulations were tested: The control formulation (CCC) was made with 65% roasted sweet potato, 15% roasted hazelnut, 10% agave syrup, and 5% cocoa powder. In the second formulation, the roasted sweet potato (10%) was replaced with 10% house cricket flour (CCHC). The creams were tested for their chemical composition, pH, texture (spreadability), and color values, and a hedonic sensory analysis was also performed. The results obtained showed that the replacement of sweet potato with cricket flour increased ($p < 0.05$) the protein and fat content from 4.81 to 11.64 and 9.05 to 12.94 g/100 g, respectively. On the other hand, the moisture and total carbohydrate content decreased in CCHC with respect to the CCC sample; reduction percentages were 8.73% and 15.84% for moisture and carbohydrates. For spreadability, the addition of house cricket flour increased the firmness and the work of shear with values of 6.56 and 13.20 kg and 2.97 and 8.28 kg·s for CCC and CCHC, respectively. Regarding color properties, only lightness (L*) was affected with increasing values. Sensorially, the CCC had the highest score in all attributes assessed. The addition of cricket flour improved the nutritional profile of cocoa cream by increasing the protein content and also providing a firmer product. However, cocoa cream with crickets needs to be improved from a sensory perspective to avoid the bitter flavour produced by the addition of cricket flour.

3.21. Antioxidant Peptides Released by the Simulated Digestion of a Novel Chickpea Genotype (GB Cappuccino): A First Insight

Lara Borim and Olga Luisa Tavano

Federal University of Alfenas, Alfenas 37130-001, Brazil

Chickpeas have gained prominence as a sustainable source of protein, combining high nutritional value with potential health benefits. Recently, bioactive peptides derived from

chickpea proteins have been investigated for their antioxidant properties, including their ability to neutralize free radicals and chelate metals. In this context, the new Cappuccino variety has emerged as a promising yet underexplored material. Preliminary studies suggest that protein hydrolysates from chickpeas may release active peptides, paving the way for applications in functional foods and nutraceuticals.

This study aimed to evaluate the release of antioxidant peptides during the simulated digestion of globulins, the major protein fraction (60–70%) of chickpeas, correlating the degree of hydrolysis with antioxidant activity. In vitro digestibility was assessed using the pepsin–pancreatin method. The amount of α-amino groups released (nmol leucine equivalents/mg protein) and antioxidant activity (μmol TROLOX equivalents—TE/mL hydrolysate) were quantified via ABTS assay.

The hydrolysis profiles indicated low protein breakdown during the gastric phase (point A), with 596.8 nmol leucine/mg protein released, whereas the intestinal phase (point C) led to a significant increase in hydrolysis, reaching 1650.83 nmol leucine/mg. Antioxidant activity showed a direct correlation with the degree of hydrolysis. For the obtained hydrolysates, antioxidant activity ranged from 854.99 to 1378.35 nmol TE/mg protein or from 2858.4 to 4838.7 μmol TE/mL hydrolysate.

These findings suggest a progressive release of peptides with higher antioxidant activity throughout simulated digestion. The in vitro digestion of globulins from the GB Cappuccino chickpea variety revealed a phase-dependent pattern of antioxidant peptide release, with a marked intensification during the intestinal phase. The correlation between protein hydrolysis and increased antioxidant activity reinforces the potential of this variety as a promising source of bioactive peptides for functional and nutraceutical formulations.

3.22. Application of Bioactive Compounds from Citrus By-Products in Shortbread Biscuits

Roukia Bouizar, Nabila Brahmi, Rania Agabi and Abel Zenati

Laboratory of Biomathematics, Biophysics, Biochemistry and Scientometrics, University of Bejaia, Bejaia 06000, Algeria

Citrus peels, often regarded as waste products in the food industry, hold significant potential for valorization due to their rich composition of bioactive compounds. The valorization process involves transforming these underutilized by-products into valuable ingredients for various applications, including functional foods, cosmetics, and pharmaceuticals.

This study focuses on the valorization of citrus peels from oranges and lemons to develop functional food products. We conducted a comparative study by incorporating citrus peel powder and carotenoids extracted from these peels into shortbread biscuits, comparing them to synthetic colorants. Our physicochemical analyses revealed that incorporating peel powder enhances the nutritional quality of the biscuits, increasing their content of polyphenols, flavonoids, tannins, and carotenoids. Our results indicated that the biscuit enriched with orange peel powder has a pH of 6.635, DPPH antioxidant activity of 92.59%, and carotenoid content of 1344.76 mg/mL.

Additionally, this research highlights the importance of citrus peels as natural sources of antioxidants, contributing to better human health. The findings also indicate significant potential for creating functional beverages from these by-products, which could reduce agro-industrial waste and promote sustainable resource use. Overall, these efforts pave the way for future research on optimizing processing methods and valorizing citrus peels, with positive implications for both the agro-industry and public health.

3.23. Application of Citrus Fibre in Gluten-Free Bread

Miglė Galvydytė [1], Eglė Purvaneckaitė [1], Aivaras Anužis [1] and Jovita Jovaišaitė [2]

[1] St. Ignatius of Loyola College, Vilniaus g. 29, LT-44286 Kaunas, Lithuania

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[2] Department of Food Science and Technology, Kaunas University of Technology, LT-50254 Kaunas, Lithuania

Growing concerns about global food waste have encouraged the development of strategies to repurpose agro-industrial by-products into value-added food ingredients. One such approach involves the use of dietary fibre extracted from fruit residues, which has demonstrated potential for improving the functional properties of gluten-free baked goods. Gluten-free bread, in particular, often suffers from poor texture, low moisture retention, and reduced shelf life due to the absence of gluten.

This study investigated the incorporation of citrus fibre—derived from freeze-dried orange peel and a commercial fibre source—into gluten-free bread formulations at levels of 1%, 3%, and 6% (*w*/*w* flour basis). The effects on moisture content, crumb structure, and technological attributes were evaluated.

The chemical composition of freeze-dried orange peel was analyzed by determining its moisture content, protein concentration, using the Kjeldahl method, fat content, via Soxhlet extraction, and total carbohydrate and dietary fibre content. Technological properties, including water absorption capacity (WAC) and water swelling capacity (WSC), were also assessed for both fibre types.

Chemical analysis of freeze-dried orange peel revealed that it consists mainly of carbohydrates—74.87 g/100 g. The protein and fat content were 6.75 g/100 g and 3.31 g/100 g, respectively. Experimental trials demonstrated that citrus fibre significantly enhanced water-binding capacity, leading to improved crumb softness and overall bread quality. Among the tested concentrations, a 3% addition yielded the most favorable outcomes, offering an optimal balance between textural softness and crumb elasticity. Conversely, higher concentrations (6%) adversely affected the bread's volume and contributed to a denser, less appealing texture.

These findings support the use of citrus fibre as a functional ingredient in gluten-free bread, aligning quality enhancement with sustainable food system goals.

3.24. Aqueous Extraction of Chickpea (Cicer arietinum) Protein Assisted by Papain: Impacts on Bioactivity

Larissa Dias Costa and Olga Luisa Tavano

Colloid Chemistry Group, Chemistry Institute, Federal University of Alfenas (UNIFAL-MG), 700 Gabriel Monteiro da Silva street, Alfenas 37130-000, MG, Brazil

Chickpea (*Cicer arietinum*) is a leguminous seed primarily distinguished by its favorable protein profile, the presence of bioactive compounds, and other essential nutrients that contribute to the promotion of human health. Its aqueous extracts represent a promising alternative for the development of protein-rich beverages. However, considering that not all protein fractions are water-soluble, the application of specific processing strategies may be beneficial to enhance extraction yields. Enzymatic extraction is particularly promising, as it not only increases the solubilization of proteins but also facilitates the release of bioactive peptides, which are relevant to health promotion and disease prevention. Therefore, the objective of this study was to evaluate the bioactivity of aqueous chickpea extracts obtained through enzymatic hydrolysis assisted by papain. Desi chickpeas (var. GB Cappuccino) were provided by AgroGarbanzo (Brazil). Whole seeds were ground and passed through an 80-mesh sieve. The resulting flour was suspended in water and treated with papain at an enzyme-to-protein ratio of 1:100, then incubated for 24 h at 37 °C. The degree of hydrolysis was determined using the o-phthaldialdehyde (OPA) method, based on the quantification of free α-amino groups. Antioxidant activity was assessed by the ABTS radical scavenging assay. The data indicated that the antioxidant activity of the extract increased progressively and was directly correlated with the degree of protein hydrolysis.

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After 1 min of hydrolysis, the extract presented 96.3 nmol of free α-amino groups per mg of sample and 0.619 nmol Trolox equivalents per mg of sample. After 24 h, these values increased to 411.93 nmol and 1.895 nmol, respectively. These findings clearly demonstrated that prolonged papain-mediated hydrolysis enhances both the concentration of free α-amino groups and the antioxidant capacity of chickpea extracts. This potential bioactivity was found to be closely associated with the increased degree of protein hydrolysis.

3.25. Assessing the Impact of Different Drying Techniques on the Quality of Sorghum bicolor Microgreens

Praveena B, Mamtha Shafika I, Anuja D. Divate and Jeyan Arthur Moses

Computational Modeling and Nanoscale Processing Unit, National Institute of Food Technology, Entrepreneurship and Management—Thanjavur, Ministry of Food Processing Industries, Government of India, Thanjavur 613005, Tamil Nadu, India

Introduction: Microgreens are becoming increasingly popular because of their unique nutritional profile, diverse phytochemical composition, and intense flavor. Given their highly perishable nature, considering futuristic applications, this study explored the scope of using different drying techniques to retain the quality of fresh *Sorghum bicolor* microgreens.

Materials: This study investigates the drying behavior of microgreens using three different drying techniques: oven drying (OD) at 60 °C, conductive hydro drying (CHD) at 60 °C, and freeze drying. In addition, a drying kinetics analysis was conducted to understand the moisture removal pattern and optimize the drying process. The impact of the physical characteristics and phytochemical composition of the microgreens was evaluated to assess the quality retention.

Result and Conclusions: In determining drying kinetics, the higher R^2 value observed in OD indicates the faster moisture removal and higher drying efficiency in OD of ~40% than in CHD. The time taken for each drying method is FD > CHD > OD. The phytochemical analysis revealed that the microgreens are rich in phenols and flavonoids (although ~20% and ~13% contents, respectively, were lost). Among the drying techniques, CHD preserved the quality of microgreens most effectively, showing comparable results to FD. More greatly enhanced powder flow properties (CI15) were observed in CHD than in OD and FD. Furthermore, the application of appropriate drying techniques addresses the challenges related to the shelf life of microgreens and highlights the strategies for drying microgreens to enhance shelf life and consumer acceptance, for market expansion.

3.26. Assessment of the Content of Selected B Vitamins in the Microgreens of Rare Oilseed Plants

Karolina Dereń [1], Joanna Kapusta-Duch [1], Sylwester Smoleń [2], Elżbieta Jędrszczyk [3], Barbara Borczak [1] and Dominika Kwaśny [1]

[1] Department of Human Nutrition and Dietetics, Faculty of Food Technology, University of Agriculture in Krakow, Al. Mickiewicza 21, 31-120 Krakow, Poland
[2] Department of Plant Biology and Biotechnology, Faculty of Biotechnology and Horticulture, University of Agriculture in Krakow, Al. Mickiewicza 21, 31-120 Krakow, Poland
[3] Department of Horticulture, Faculty of Biotechnology and Horticulture, University of Agriculture in Krakow, Al. Mickiewicza 21, 31-120 Krakow, Poland

Introduction: There is a limited understanding of the nutritional properties of rare oilseed plants' microgreens. This study aims to assess the content of selected B vitamins in the microgreens of safflower (*Carthamus tinctorius* L.), camelina (*Camelina sativa* L.), and black cumin (*Nigella sativa* L.).

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Methods: The plants were grown in a greenhouse and harvested when they had developed one true leaf. The content of vitamins B_1, B_2, B_3, B_5, B_6, B_7, and B_9 was determined using high-performance liquid chromatography coupled with tandem mass spectrometry and electrospray ionization.

Results: Safflower microgreens exhibited the lowest statistically significant ($p \leq 0.05$) vitamin B_1 content at 0.15 µg per 100 g of fresh weight (f.w.). Conversely, camelina and black cumin microgreens showed no statistically significant differences, with values of 0.76 and 0.73 µg per 100 g f.w., respectively. For vitamin B_2, the concentration ranged from 0.42 to 1.34 µg per 100 g f.w. Camelina had the highest statistically significant content, while no significant differences were observed between safflower and black cumin. In terms of vitamin B_6, camelina also contained the highest level at 0.39 µg per 100 g f.w., while safflower had the lowest level at 0.10 µg per 100 g f.w. Regarding vitamin B_3, the content varied between 1.58 and 3.50 µg per 100 g f.w. Safflower had the lowest content, and no significant differences were found between camelina and black cumin. Black cumin microgreens had the highest statistically significant contents of vitamins B_5, B_7, and B_9, measured at 3.66, 0.31, and 1.96 µg per 100 g f.w., respectively.

Conclusions: In all of the microgreens tested, the levels of selected B vitamins were present, but generally low. These findings suggest that the plants evaluated do not serve as a significant source of these B vitamins in the human diet.

3.27. Bioactivity and Hydrolysis Degree of Aqueous Extracts from Hermetia illucens Larvae Obtained with the Aid of Pineapple Juice

Arthur Amorim de Santana Marques, Olga Luisa Tavano and Sinézio Inácio da Silva Junior

Campus Sede—Alfenas, Universidade Federal de Alfenas, Alfenas 37130-001, Brazil

Introduction: Demographic transition and population aging pose challenges to food and nutritional security and environmental sustainability. In this context, FAO recommends the use of edible insects, such as *Hermetia illucens*, due to their nutritional advantages over conventional livestock: rapid growth, utilization of organic waste, and low environmental impact. This study aimed to evaluate the degree of proteolysis, total phenolic content, and antioxidant activity in extracts from defatted *Hermetia illucens* larval flour obtained using pineapple juice.

Methodology: The sample consisted of *Hermetia illucens* larvae defatted by Soxhlet extraction with petroleum ether, ground with a mortar, and sieved through a 35-mesh screen. Aqueous extracts were prepared using 1:30 (*w*/*v*) sample-to-liquid ratios with pineapple juice, boiled pineapple juice (heated to 97 °C for 5 min to inactivate proteolytic activity), and deionized water. The mixtures were incubated in a water bath at 37 °C for 3 h. The degree of hydrolysis was determined by quantifying free α-amino groups using the OPA reagent.

Results: The extract obtained with pineapple juice showed the highest antioxidant activity (ABTS assay: 1372.56 µmol TE/g), approximately 60% higher than that obtained with boiled juice (805.66 µmol TE/g) and with water (787.18 µmol TE/g), which did not differ significantly. The DPPH assay did not detect differences in antioxidant activity among the extracts. The pineapple juice extract also showed the highest degree of hydrolysis (1,053,615.00 free α-amino groups/g) compared to the boiled juice extract (670,981.20 nmol TE/g) and the water extract (130,535.30 nmol TE/g), with increases of approximately 35% and 12%, respectively.

Conclusions: The results indicate that the use of pineapple juice in producing extracts from defatted *Hermetia illucens* larval flour enhances the availability of free α-amino groups and the antioxidant activity of the extract. This suggests potential benefits in using

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pineapple juice for developing *Hermetia illucens*-based beverages with improved protein solubilization and bioactivity.

3.28. Biochemical Analysis, GC-MS Profiling and Phytochemical Screening of Brown algae (Sargassum tenerrimum) Isolated from Kunkeshwar District of India

Mukul Machhindra Barwant

Department Botany, Sanjivani Rural Education Society, Sanjivani Arts Commerce and Science College, Kopargaon, Ahmednagar, Maharashtra, India

Recently, seaweeds—a group of marine macroalgae—have been increasingly explored for their potential benefits to human society. Seaweeds are marine macroalgae found in coastal habitats and are known for their diverse biochemical and pharmacological properties. Among them, *Brown algae* (Phaeophyceae) represent the most diverse group, with Sargassum tenerrimum being a prominent species along the western coast of Maharashtra. In this study, the bioprospective potential of Sargassum tenerrimum was evaluated using various solvent extracts, including ethanolic, aqueous, and acetone extracts. Qualitative phytochemical analysis revealed the presence of several bioactive compounds such as alkaloids, flavonoids, glycosides, saponins, tannins, steroids, carbohydrates, proteins, terpenoids, coumarins, quinones, anthraquinones, phenols, anthocyanins, and lipids. Mineral analysis indicated the presence of essential elements, including iron (Fe), copper (Cu), zinc (Zn), potassium (K), magnesium (Mg), and phosphorus (P). Chromatographic techniques such as paper chromatography (PC) and thin-layer chromatography (TLC) were employed to characterize the extracts. The retention factor (Rf) values obtained through PC were 0.90 for ethanolic and 0.86 for aqueous extracts, while TLC analysis yielded Rf values of 0.63 for ethanolic and 0.56 for aqueous extracts. Biochemical profiling indicated the presence of proteins (4.69%), carbohydrates (42.53%), free fatty acids (6.40%), and chlorophyll-a (0.92 mg/mL), supporting the nutritional and therapeutic potential of *Sargassum tenerrimum*. Furthermore, a total of 44 compounds were identified, representing various functional groups, including alkanes, alkynes, hydrocarbons, alcohols, aldehydes, ketones, and proteins. These findings highlight *Sargassum tenerrimum* as a rich source of bioactive and nutritional compounds, underscoring its relevance in future nutraceutical and pharmaceutical applications.

3.29. Biochemical and Nutritional Profiling of Fig Seed Oils and Defatted Cakes by FTIR-ATR Spectroscopy

Charaf Ed-dine Kassimi [1,2], Souhaila Bouchelta [2], Souhaila Hadday [2], Ibtissame Guirrou [2], Fedoua Diai [1], Abdelhafid Keli [3], Aziz Fadlaoui [2], Lhoussain Hajji [1] and Lahcen Hssaini [2]

1 BioActives, Health and Environment Laboratory, Faculty of Science, Biology Department, University Moulay Ismail, Zitoune, P.O. Box 11201, Meknes 50100, Morocco
2 Agro-Food Technology and Quality Laboratory, Regional Center of Agricultural Research of Meknes, National Institute of Agricultural Research, Rabat, Morocco Avenue Ennasr, BP 415 Rabat Principale, Rabat 10090, Morocco
3 Department of Animal Production and Pastoralism, National School of Agriculture, P.O. Box S/40, Meknes 50001, Morocco

This study valorizes the defatted seeds and seed cakes of 21 fig genotypes, an atypical resource that remains scientifically underexplored. Few studies based on rigorous analytical approaches have been published regarding fig seed oils, and to our knowledge, no research has addressed the valorization of the seed cakes derived from these seeds. The major innovation lies in the combination of advanced analytical methods: chemical extraction using Soxhlet, gas chromatography with flame ionization detection (GC-FID) for fatty acid

quantification, spectrophotometric colorimetric assays for phenolic and flavonoid compounds, and antioxidant activity evaluation using DPPH and ABTS radical scavenging tests. FTIR-ATR spectroscopy is used for the rapid, non-destructive, and reliable characterization of oils, allowing for their discrimination based on molecular composition.

The results reveal significant intergenotypic variability, with linolenic acid content ranging from 18.11% to 42.76%, reaching a maximum in the "Amtala Arch" genotype. The dominant saturated fatty acids are palmitic and stearic acids. Total phenolic content ranges between 30 and 100 mg gallic acid equivalents per 100 g, flavonoids between 20 and 40 mg quercetin equivalents per 100 g, and antioxidant activity varies from 30% to 90%. The seed cakes show an interesting nutritional profile: 14% to 25% protein, 28% to 50% neutral detergent fiber (NDF), 2% to 5% residual lipids, and 4% to 6% moisture.

This research establishes a solid database on the biochemical and functional properties of fig seed oils and seed cakes. It offers new perspectives for sustainable valorization in nutraceutical and functional food sectors, fitting within a circular economy framework. The FTIR-ATR method confirms its potential as an innovative tool for rapid quality control.

3.30. Bioinformatics-Assisted Peptidomic Profiling of Microalgal Protein Hydrolysates Reveals Novel Multifunctional Peptides for Nutraceutical Use

Montassar Romdhani [1,2], Jihen Dhaouafi [1,2], Naima Nedjar [1] and Rafik Balti [3]

[1] UMR Transfrontalière BioEcoAgro N°1158, Université Lille, INRAE, Université Liège, UPJV, YNCREA, Université Artois, Université Littoral Côte d'Opale, ICV—Institut Charles Viollette, F-59000 Lille, France

[2] Laboratory of Functional Physiology and Valorization of Bioresources, Higher Institute of Biotechnology of Beja, University of Jendouba, Avenue Habib Bourguiba, BP, 382, Beja 9000, Tunisia

[3] CentraleSupélec, Laboratoire de Génie des Procédés et Matériaux, Centre Européen de Biotechnologie et de Bioéconomie (CEBB), Université Paris-Saclay, 3 rue des Rouges Terres, 51110 Pomacle, France

Microalgae are increasingly recognized as sustainable and versatile sources of high-value bioactive compounds, particularly functional proteins and peptides. Among them, *Arthrospira platensis* and *Tetraselmis chuii* stand out due to their high protein content, balanced amino acid profiles, and potential for use in food and health applications. This study aimed to investigate the bioactive potential of peptides derived from these two species through a comprehensive approach combining enzymatic hydrolysis, peptidomic analysis, and in silico bioactivity prediction. Proteins were extracted from *A. platensis* and *T. chuii* biomass and hydrolyzed using food-grade pepsin under optimized conditions and varying enzyme-to-substrate (E/S) ratios. The resulting protein hydrolysates—*A. platensis* protein hydrolysate (APPH) and *T. chuii* protein hydrolysate (TCPH)—were subjected to peptide profiling using reverse-phase high-performance liquid chromatography (RP-HPLC) coupled with tandem mass spectrometry (MS/MS). Identified peptides were then analyzed using multiple bioinformatics tools to assess their molecular weight, hydrophobicity, amphipathicity, potential toxicity, and predicted biological activities. A total of 265 unique peptides were identified, with 187 peptides derived from APPH and 78 derived from TCPH. The peptides exhibited favorable physicochemical properties and bioaccessibility features. In silico predictions highlighted significant multifunctional bioactivities, including antihypertensive, antidiabetic, anti-inflammatory, and antimicrobial potentials. None of the APPH peptides showed any predicted cytotoxic or hemolytic effects, whereas only one peptide from TCPH presented a potential cytotoxicity risk. Notably, the most promising peptides originated from highly conserved proteins such as RuBisCO, ATP synthase subunits, and phycobiliproteins. These findings underscore the promise of *A. platensis*

and *T. chuii* as valuable sources of novel, safe, and multifunctional peptides suitable for nutraceutical development. The integrated use of peptidomics and computational screening provides an efficient strategy for peptide discovery and prioritization, paving the way for future validation and application in functional foods, dietary supplements, and health-oriented formulations.

3.31. Capsaicin Enhances Hypothermia Tolerance and Accelerates Recovery from Hypothermic Shock

Yiwen Gong, Yutong Li, Hexiang Qiu, Dan Wu, Haomiao Ma, Li Fan, Hongxia Cai, Yan Pan and Bo Xian

Laboratory of Aging Research, School of Medicine, University of Electronic Science and Technology of China, Chengdu 610056, China

Capsaicin, a natural bioactive component extracted from chili peppers, is important in food flavoring and food preparation. Currently, the global climate is changing rapidly, extreme cold wave events occur frequently, and direct cell damage and secondary ice crystal effects triggered by low-temperature stress seriously threaten the survival of organisms, so analyzing the cold tolerance mechanism is of great significance for biological protection and low-temperature medicine. As an important model organism in pharmaceutical research, Cryptococcus hidradii is of great significance in the testing of functional foods. In this study, we used Cryptobacterium hidradii as a model to investigate the protective effect of capsaicin, a natural food active ingredient, in low-temperature stress. A control group and three experimental groups (capsaicin concentrations of 10 μM, 50 μM, and 250 μM) were set up to compare the locomotor indexes of different groups of nematodes after treatment at 4 °C, 30 min, and we found that different concentrations of capsaicin enhanced the locomotor ability of nematodes at low temperatures, with a significant enhancement of the head bobbing, body bending, and pharyngeal pumping rate. In the −20 °C, 5 min cold shock recovery experiment, capsaicin was able to shorten the recovery time of nematodes. In three consecutive cold shock experiments, the recovery rate of nematodes increased significantly, showing adaptation to cold shock, and capsaicin was able to accelerate the adaptation of nematodes to cold shock recovery. The study showed that capsaicin could enhance the nematode's locomotor ability in the low-temperature environment, promote the nematode's recovery after cold shock, and synergize with the nematode's adaptive memory to promote the self-protection and adaptation to the nematode in the low-temperature environment.

3.32. Cereal Bars in Portugal: Alignment with Nutrient Profile Models and School Snack Guidelines

Marta Barriga [1], Mafalda Alexandra Silva [1,2], Renata Ramalho [3], Helena Soares Costa [1,2] and Tânia Gonçalves Albuquerque [2,4]

1 National Institute of Health Dr. Ricardo Jorge, Av. Padre Cruz, 1649-016 Lisbon, Portugal
2 REQUIMTE-LAQV/Faculty of Pharmacy from University of Porto, R. de Jorge de Viterbo Ferreira 228, 4050-313 Porto, Portugal
3 Nutrition Lab, Egas Moniz Center for Interdisciplinary Research, Egas Moniz School of Health and Science, Campus Universitário, Quinta da Granja, Monte de Caparica, 2829-511 Caparica, Portugal
4 Estoril Higher Institute for Tourism and Hotel Studies, Estoril, 2769-510 Estoril, Portugal

The growing prevalence of childhood overweight and obesity in Portugal, rising from 29.7% to 31.9% for overweight and from 11.9% to 13.5% for obesity between 2019 and 2022, has raised concerns about the nutritional quality of foods frequently consumed by

children. Snacking habits, particularly those involving packaged and processed products such as cereal bars, play a significant role in children's overall dietary patterns. Although often marketed as healthy options, many cereal bars may not comply with public health recommendations. This study assessed the nutritional composition of cereal bars available on the Portuguese market, evaluating their alignment with the Portuguese Nutrient Profile Model and the National Guidelines for Healthy School Snacks.

A total of 135 cereal bar products were analysed based on their labelled nutritional information, focusing on energy, total fat, saturated fat, sugars, fibre, and salt. The results showed that all bars exceeded the recommended energy threshold (40 kcal per serving). Only 23% met the total fat limit ($\leq$8 g/100 g), and 36.3% complied with the saturated fat limit ($\leq$3 g/100 g). The average sugar content was 23.5 g/100 g, well above recommended levels. Regarding salt, 28% of the bars met the recommended limit (0.3 g/100 g).

These findings highlight a significant gap between product formulations and national nutrition policies targeting school-aged populations. This study underscores the need for product reformulation, clearer front-of-pack labelling, and improved nutritional education to promote healthier snack choices for children and support obesity-prevention strategies.

3.33. Characterization and Antioxidant Activity of Bioactive Protein Extracted from Channa Striata (Bloch, 1793) by Ammonium Sulfate Fractionation

Ela Sulkifli [1], Abu Bakar Tawali [2], Nuri Andarwulan [3] and Dennizer Sakti Tangdileluk [2]

1 Faculty of Agriculture, Hasanuddin University, Makassar 90245, Indonesia
2 Department of Agricultural Technology, Hasanuddin University, Makassar 90245, Indonesia
3 Department of Food Science and Technology, IPB University, Bogor 16110, Indonesia

Snakehead fish (Channa striata (Bloch, 1793)) has long been recognized in traditional medicine for its ability to accelerate wound healing, particularly after surgery and childbirth. This therapeutic potential is largely attributed to its rich content of bioactive proteins, especially albumin. However, the detailed protein profile and functional properties of this species remain underexplored. This study aimed to characterize the soluble protein components extracted from Channa striata using ammonium sulfate fractionation and to evaluate their antioxidant activity. Fractionation was performed at saturation levels of 20%, 40%, 60%, and 80%, followed by dialysis and freeze-drying. The 40–60% fraction yielded the highest protein recovery (75%) and protein concentration (55%), indicating optimal enrichment of soluble proteins. SDS-PAGE analysis revealed a dominant band at ~66 kDa, consistent with albumin, while additional bands indicated the presence of other bioactive proteins. FT-IR spectra confirmed the presence of amide I and II absorption bands, indicating α-helix and β-sheet structures typical of albumin. The antioxidant activity of the protein extract was evaluated using the DPPH assay, showing a strong radical-scavenging capacity with an IC_{50} value of 47.2 μg/mL. These findings support the potential of snakehead fish as a promising source of functional protein ingredients. The use of ammonium sulfate fractionation in this study offers a simple, cost-effective, and eco-friendly method for isolating bioactive proteins with nutritional and therapeutic relevance. This research not only contributes to the scientific understanding of Channa striata protein composition but also enhances its value as a traditional food resource with modern health applications. It offers a novel approach to developing protein-rich functional foods and highlights the untapped potential of local aquatic species for food and health industries.

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3.34. Comparative Evaluation of Maceration and Ultrasound-Assisted Extraction Methods on Total Phenolic, Flavonoid, and Anthocyanin Contents and Antioxidant Activity of Extracts from Selected Pigmented Rice Varieties from the Philippines

Niña Lynn Alegado and Nesteve John Agosto

[1] Department of Chemistry, University of Science and Technology of Southern Philippines, Cagayan de Oro City 9000, Philippines
[2] Center for Natural Products Research, University of Science and Technology of Southern Philippines, Cagayan de Oro City 9000, Philippines

Rice is a globally important staple crop valued not only for sustenance but also for its potential health benefits, yet Philippine pigmented rice varieties remain underexplored. This study evaluated the phytochemical composition and antioxidant activity of five Philippine rice varieties cultivated in the Cordillera region—white rice, brown rice, red rice, purple rice, and black rice—using two extraction techniques: maceration and ultrasound-assisted extraction (UAE). Both methods used 80% methanol as the solvent (1:10 w/v); maceration (48 h, room temperature) and UAE (30 min, room temperature). Total phenolic content (TPC), total flavonoid content (TFC), and total anthocyanin content (TAC) were quantified using the Folin–Ciocalteu, aluminum chloride colorimetric, and pH differential methods, respectively. Antioxidant activity was assessed via the DPPH assay and expressed as EC_{50} values. Pigmented rice varieties exhibited higher levels of phenolics and anthocyanins, along with stronger antioxidant activity, compared to non-pigmented rice. Among all samples, red rice extracted via UAE showed the highest TPC (731.25 $\pm$ 0.02 mg GAE/100 g), highest TFC (9.69 $\pm$ 1.56 mg QE/100 g), and one of the highest TAC values (183.69 $\pm$ 16.70 mg C3G/100 g), with the lowest EC_{50} value (52.49 $\pm$ 0.23 µg/mL), indicating strong antioxidant potential. UAE outperformed maceration in enhancing phytochemical yield and antioxidant activity, likely due to better cell disruption and compound release. Pearson correlation analysis revealed a strong positive correlation between TPC and TAC (r = +0.745), and significant negative correlations between antioxidant EC_{50} and both TPC (r = −0.847) and TAC (r = −0.804). These results suggest that phenolic and anthocyanin contents strongly contribute to antioxidant capacity and support the potential of pigmented Philippine rice as a functional food and antioxidant source.

3.35. Comparative Nutritional and Mineral Analysis of Cucumis sativus at Ripened and Over-Ripened Stages and Its Implication for Functional Food Product Development

Amarnath V and Lakshay Srivastav

Department of Food Technology, School of Allied Sciences, Dev Bhoomi Uttarakhand University, Dehradun 248007, India

Cucumis sativus L., commonly known as cucumber, is a member of the Cucurbitaceae family and is commonly consumed in its ripened stage for its high moisture content, low caloric content, and refreshing texture. The present study focuses on the Malini variety of cucumber, which is often discarded at the overripened stage due to undesirable changes in appearance and palatability, resulting in considerable post-harvest waste. This research evaluates the nutritional, phytochemical, and proximate profiles of Malini cucumbers at both ripened and overripened stages to investigate their potential for sustainable food product development. Their proximate composition, including moisture, ash, protein, and fiber content, was determined using AOAC methods. Mineral content was assessed via ICP-OES, and vitamin levels were measured using spectrophotometric techniques. Phytochemical screening was conducted to identify the presence of bioactive compounds such as flavonoids, alkaloids, tannins, saponins, and cucurbitacins using HPLC and GCMS. Proximate analysis revealed that ripened cucumbers contained higher moisture content

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(97.6%) and amounts of vitamin K (9.6–24 mg per 100 g), while overripened samples exhibited elevated levels of dietary fiber (0.52–0.56%) and phenolic compounds. Cucumber has a modest amount of mineral content, mainly Ca, Cu, Mg, Fe, Na, and Al in the ripened stage, but P and Zn are higher at the overripened stage, and Se and Mo are lowest in both stages. All these compounds are linked to health benefits, including antioxidant, anti-inflammatory, anti-diabetic, anti-carcinogenic, and cardioprotective effects. Despite the rich phytochemical composition of over-ripened cucumbers, their application in functional foods remains underexplored. This work aims to utilize the nutritional potential of overripe Malini cucumbers to formulate value-added products such as fiber-enriched snacks, fermented beverages, and nutraceutical ingredients. The findings support a sustainable approach to food innovation by converting agricultural surplus into functional food resources, thereby reducing food loss and promoting health through bioactive-rich diets.

3.36. Consumer Perceptions of Rabbit Meat in the Mathole and Buffalo City Metropolitan Municipalities of Eastern Cape, South Africa

Ziyanda Goli, Ishmael Festus Jaja and Irene Rumbidzai Mazhangara

Department of Livestock and Pasture Sciences, University of Fort Hare, Alice, South Africa

Introduction: As global food systems evolve and the population increases, there is increasing interest in alternative protein sources to meet the demands of a growing population. Rabbits are a good alternative animal protein source due to their high biological value protein, health benefits, and environmental sustainability. However, acceptance of rabbit meat is influenced by consumer perceptions. This study aimed to investigate consumers' perceptions of rabbit meat at Amathole and Buffalo City Metropolitan Municipalities.

Methods and Results: Data was collected from 312 respondents using a questionnaire. Most respondents (60.9%) had never consumed rabbit meat before the study. When respondents were asked what they associate rabbit meat with, the most frequent answer was hunting. Furthermore, most respondents (87.7%) who had previously eaten rabbit meat sourced it from hunting. Respondents were asked to state in what form they would like to purchase rabbit meat. About 36.5% of them would not buy rabbit meat in any form. However, rabbit meat was notably rejected when sold as whole carcasses (3.5%). This study found that most respondents (69.2%) would be encouraged to eat rabbit meat if they found it healthier than conventional meats. Other factors the respondents paid attention to when making purchasing decisions included price (61.9%) and packaging (52.9%). The lean nature of rabbit meat did not appeal to most respondents (52.9%). When consumers were asked to rate meat types according to their preference, rabbit meat received the lowest rating ($\bar{x}$ = 1.88), while beef had the highest rating ($\bar{x}$ = 3.75), followed by chicken ($\bar{x}$ = 3.44), pork ($\bar{x}$ = 3.41), and mutton ($\bar{x}$ = 3.08).

Conclusions: Consumer perceptions influence meat purchasing decisions and strategic methods of promoting rabbit meat must be carefully adopted to encourage the consumption of rabbit meat in the Eastern Cape province.

3.37. Cooked Common Bean (Phaseolus vulgaris L.) Flours Exhibited Antioxidant and Anti-Inflammatory Effects In Vitro

Sandra Celada-Martinez [1], Ivan Luzardo-Ocampo [2], Rocio Campos-Vega [1], Marcela Gaytán-Martínez [1], Jorge Acosta-Gallegos [3], María de la Luz Reyes-Vega [1] and Guadalupe Loarca-Piña [1]

[1] Food Science Graduate Program, School of Chemistry, Autonomous University of Queretaro, Queretaro 76010, Mexico

[2] The Institute for Obesity Research, Tecnologico de Monterrey, Monterrey 64700, Mexico

[3] Bean Genetic Improvement, National Institute of Forestry, Agricultural and Livestock Research, Celaya 38110, Mexico

Common beans (*Phaseolus vulgaris* L.) are a staple food widely consumed in Mexico and around the world, offering numerous health benefits primarily due to their high content of protein, dietary fiber, and other components, including phenolic compounds, saponins, and phytosterols. Polyphenolic compounds have been linked to antioxidant and anti-inflammatory effects, making them targeted beneficial phytochemicals in plant-based foods. Since beans are typically cooked before consumption, this research aimed to assess the antioxidant and anti-inflammatory properties of cooked common beans in vitro. Beans were digested in vitro, and the colonic fraction was evaluated in RAW 264.7 cells treated with lipopolysaccharide (LPS, 1 μg/mL) for 24 h (post-treatment). Cooked flour contained 18.87% protein and 69.97% total carbohydrates, of which 85% was quantified as total dietary fiber. Gallic acid and (+)-catechin were the most abundant phenolic compounds in the colonic fraction, which showed antioxidant capacity as measured using the ABTS and DPPH methods (4.65–7.66 μmol Trolox equivalents per gram of sample). When LPS-induced RAW 264.7 cells were challenged with various concentrations of the extract, dilutions up to 30% v/v were not cytotoxic (metabolic activity > 80%) and significantly ($p < 0.05$) reduced nitrite content by up to 60%. A blank of digestion (digested and fermented water, dissolved in DMEM) was also tested and showed no cytotoxic effects on the cells. These results suggest that the anti-inflammatory and antioxidant effects of cooked common bean flours make them a promising functional ingredient with potential health benefits.

3.38. Defatted Rice Bran as a Source of Functional Compounds: Enzymatic Release of Bioaccessible Peptides and Phenolics

Carla Bonifacino [1], Luis Alberto Panizzolo [1], Gonzalo Gastón Palazolo [2], Analía Rodríguez [1], Alejandra Medrano [1] and Cecilia Abirached [1]

[1] Department of Food Science and Technology, Chemistry School, Universidad de la República, Montevideo 11800, Uruguay

[2] Food Functionality and Technology Research Laboratory, Department of Science and Technology, National University of Quilmes, Roque Sáenz Peña 352, Bernal B1876BXD, Buenos Aires, Argentina

In recent years, interest in the circular economy has grown as a paradigm for promoting sustainable food production and minimizing waste along the production chain. In this context, rice bran—a by-product of rice processing (*Oryza sativa*)—stands out due to its high nutritional value, low cost, and wide availability. This study aimed to evaluate the bioactive properties and in vitro bioaccessibility of protein hydrolysates derived from a concentrate (DRBC), enriched in protein and total dietary fiber (TDF), obtained from defatted rice bran (DRB) powder. Enzymatic hydrolysis of DRBC was carried out using 1.0 mL L^{-1} of *Bacillus licheniformis* protease (Subtilisin A, ≥2.4 U g^{-1}, P4860) at 50 °C, under stirring (150 rpm) and pH 8.0. The reaction was stopped at intervals ranging from 5 to 120 min to monitor changes in the hydrolysates' properties.

The assessment of bioaccessibility, performed via in vitro gastrointestinal simulation following the standardized INFOGEST 2.0 protocol, revealed a significant increase in the antioxidant and antihypertensive capacities of DRBC and its hydrolysates—particularly after 120 min of hydrolysis. Thus, enzymatic hydrolysis emerged as an effective strategy to enhance the bioactive potential of DRBC by releasing functional peptides without affecting total polyphenol content. In the bioaccessible fraction, ferulic and gallic acids were identified and quantified via HPLC-DAD. An increase in ferulic acid content and a decrease in gallic acid content were observed post-digestion. The stability of ferulic acid during digestion may be attributed to a protective effect provided by its association with TDF.

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These results suggest that both acids may be absorbed and metabolized after digestion, enabling systemic bioactivity. Overall, these findings support the potential application of DRBC hydrolysates as functional food ingredients and offer a promising strategy for the sustainable valorization of defatted rice bran.

3.39. Development and Assessment of Ixora Coccinea-Based Probiotic Carbonated Beverage

Karthick Ajay B [1], Thabitha Zelin Rachel V [2] And Dinesh SURIYA B [2]

[1] National Institute of Food Technology, Entrepreneurship and Management—Thanjavur (NIFTEM-T), Thanjavur 613005, India

[2] Paavai Engineering College, Namakkal 637018, India

In recent years, the demand for non-dairy probiotic beverages has increased due to growing health consciousness and lactose intolerance among consumers. This study focuses on the development of a carbonated floral juice using *Ixora coccinea* flowers supplemented with the probiotic strain *Lactobacillus acidophilus*, aiming to enhance its functional and nutritional properties. *Ixora coccinea*, known for its rich phytochemical profile and therapeutic properties, was selected for juice extraction. The floral juice was prepared by blanching dried petals, followed by extraction using distilled water (1:50 g/mL), and then fortified with stevia and orange juice. Two formulations were prepared: **Sample A** (control, no probiotics) and **Sample B** (probiotic-inoculated). The probiotic culture was incubated in juice for 18 h at 37 °C before carbonation using dry ice and subsequent storage at 4 °C.

The **physicochemical analysis** showed a gradual decline in pH and total soluble solids (TSS) over 30 days, with a more pronounced change in Sample B due to probiotic metabolism. **Proximate analysis** indicated that Sample B had increased levels of protein, vitamin C, and lipid content compared to the control. **Microbial analysis** confirmed that *L. acidophilus* remained viable above 8 log CFU/mL for up to four weeks, and no coliform contamination was detected. **Sensory evaluation** using a nine-point hedonic scale revealed that Sample B was more acceptable in terms of taste, aroma, and overall appeal.

In conclusion, the study demonstrates that incorporating *L. acidophilus* into *Ixora coccinea* floral juice not only enhances its nutritional value but also maintains sensory quality and microbial safety, making it a promising non-dairy carbonated probiotic beverage.

3.40. Development and Evaluation of a Goat Milk and Plant Protein-Based Infant Formula: A Hypoallergenic and Bioactive Alternative to Conventional Formulas

Zainab Khaliq

Department of Food and Nutrition, Era University, Lucknow 226004, India

This study presents the development and evaluation of a novel infant formula (IF) derived from goat milk and fortified with plant-based proteins (rice and pea isolates), aiming to address allergenicity and enhance bioactivity compared to conventional bovine and commercial IFs. The formulation was designed to mimic the macronutrient profile of human milk, comprising 16% protein, 45% carbohydrate, and 39% fat, with added micronutrients per USDA guidelines. Simulated infant gastrointestinal digestion (SIGID) was employed to assess protein digestibility, antioxidant capacity, and anti-inflammatory potential.

The goat milk-based IF fortified with 10% rice protein isolate (GMIF-10%R) exhibited the highest degree of hydrolysis (DH: 3125.4 μg NH_3/g), surpassing both commercial IF (CIF: 1287.6 μg NH_3/g) and bovine IF (BIF: 1102.3 μg NH_3/g). SDS-PAGE and RP-UPLC analyses confirmed extensive protein breakdown and diverse peptide generation in GMIF-10%R post-digestion. Fluorescence microscopy revealed uniform protein and lipid dispersion, with reduced coagulum formation compared to bovine IF.

Bioactivity assays demonstrated superior antioxidant activity in GMIF-10%R (ABTS: 10,245 μM TEAC; DPPH: 7890 μM TEAC) and enhanced anti-inflammatory response (Di-

clofenac sodium equivalent: 7980 µg/mg protein) following SIGID. Notably, plant protein fortification contributed to improved emulsification and reduced allergenic potential, as evidenced by the absence of β-lactoglobulin and lower particle aggregation. These findings suggest that goat milk combined with plant-based proteins offers a promising alternative for hypoallergenic infant formula with enhanced digestibility and bioactive properties. Further in vivo studies are warranted to validate its clinical efficacy and safety.

3.41. Development and Evaluation of a Multi-Ingredient Functional Spread Incorporating Olea Europaea, Nigella Sativa, and Sesamum Indicum

Sanaa M Khaled [1,2], Nour Elhoda Ayache [2], Mazen Jabbour [3] and Maha Krayem [1]

1 Department of Biological & Chemical Sciences, School of Arts & Sciences, Faculty of Sciences, Bekaa Campus, Lebanese International University-LIU, Khyara, West Bekaa, P.O. Box 5, Jeb Jenine 146404, Lebanon
2 Department of Food Sciences & Technology, School of Arts & Sciences, Faculty of Sciences, Bekaa Campus, Lebanese International University-LIU, Khyara, West Bekaa, P.O. Box 5, Jeb Jenine 146404, Lebanon
3 Department of Statistics and Data Science, School of Sciences, Hadath Campus, Lebanese University, Hadath, Lebanon

Introduction: With increasing demand for functional, clean-label food products, natural spreads offer a promising alternative to synthetic, additive-rich formulations. This study presents the development of a nutrient-dense, plant-based spread composed of *Sesamum indicum* (sesame seeds), *Nigella sativa* (black seeds), *Apis mellifera* honey, and *Olea europaea* (olive oil). The formulation harnesses the bioactive properties of its ingredients, known for their antioxidant, anti-inflammatory, and cardioprotective potential. **Methods:** The spread was developed using a simple blending technique, followed by consumer testing and sensory evaluation. A structured questionnaire was validated through pilot testing and administered to 24 participants to assess awareness, preferences, and willingness to adopt the product. Sensory evaluation was conducted with eight trained panelists in accordance with ISO 13299:2016 standards [12], evaluating appearance, aroma, taste, texture, and overall acceptability on a 5-point hedonic scale. Statistical analysis was performed using SPSS software. **Results:** The product demonstrated strong consumer acceptability (mean = 4.63/5). High scores were recorded for appearance (4.36), sweetness (4.33), smoothness (4.50), and aftertaste (4.29). The spread was perceived as well-balanced in flavor (4.21), with minimal bitterness and stickiness. Herbal/spicy aroma notes were moderately detected (3.42), while fruity/grassy notes were subdued. Texture and aftertaste showed significant positive correlations with overall acceptability ($p < 0.05$). **Conclusions:** This multi-ingredient functional spread, composed of *Olea europaea*, *Nigella sativa*, *Sesamum indicum*, and honey, achieved high consumer satisfaction and favorable sensory performance. The formulation holds promise as a clean-label, health-promoting alternative to conventional spreads, and minor enhancements in aroma complexity may further improve consumer experience and market potential.

3.42. Development and Quality Evaluation of Coconut Protein-Based Functional Cheese Analogs Fortified with Dairy Skim Milk Powder

Bannek Gedara Ranahansi Rangadharee Bandara [1], Dileesha Eshan Manawadu [2], Loku Liyana Waduge Chandi Yalegama [1], Hewa Pathiranage Dilani Thilanka Hewa Pathirana [3] and Chandika Niroshan Jayasooriya [2]

1 Coconut Processing Research Division, Coconut Research Institute, Lunuwila 61150, Sri Lanka

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[2] Department of Food Science and Technology, Faculty of Applied Sciences, Sabaragamuwa University, Belihuloya 70140, Sri Lanka
[3] Department of Functional Food Products Development, Faculty of Biotechnology and Food Science, Wroclaw University of Environmental and Life Sciences, 50-375 Wroclaw, Poland

Introduction: Defatted Desiccated Coconut Residue (DDCR), a byproduct of virgin coconut oil extraction, is a nutritious food source. This study focused on enhancing the value of DDCR by developing a cheese analog using coconut protein concentrated from lactic acid-coagulated DDCR and dairy skim milk powder. **Method:** The DDCR was soaked in water at a 1:2 ratio, and coconut skim milk was extracted. The skim milk was then heated with lactic acid until the desired pH was reached to form a curd (protein concentrate), which was then separated and pressed. Ingredients were added based on the curd's weight, including corn flour (3%), salt (2.5%), cheese flavor (0.12%), turmeric powder (0.05%), and varying amounts of SMP (0% T1, 5% T2, 10% T3, 15% T4, and 20% T5). The mixture was homogenized, pasteurized, molded, sliced, and stored in the refrigerator at 4 °C. **Results:** Evaluations of cheese yield, texture, meltability, and sensory characteristics were conducted, along with fatty acid composition analysis and shelf-life assessment under vacuum, paraffin wax, and cling film for one month. Formulation T5 achieved a significantly higher cheese yield of 35.72 ± 0.486%, with a notable texture characterized by a maximum hardness of 289.33 ± 0.577 g and minimal meltability at 18.85 ± 0.006 mm^2. It ranked significantly higher in sensory scores. Compositional analysis showed moisture at 52.09 ± 0.593%, crude protein at 22.85 ± 0.159%, crude fat at 10.55 ± 0.126%, and negligible crude fiber at 0.24 ± 0.006%. Predominant fatty acids included lauric, myristic, and palmitic acids. Vacuum sealing improved texture, maintaining hardness at 287.26 ± 0.017 g. After four weeks, moisture was 53.348 ± 0.000%, pH was 5.73 ± 0.058, TTA was 0.066 ± 0.001%, total plate count was 2.7×10^3, and yeast and mold counts were 3.2×10^2, which are all within acceptable limits. **Conclusions:** Incorporating 20% SMP relative to curd weight improved the physicochemical, nutritional, and sensory qualities of the coconut milk cheese analogs. Vacuum packaging is recommended for their extended storage.

3.43. Development of a Drink with Antioxidant Potential from the Aqueous Extract of Guayusa (Ilex guayusa Loes, Aquifoliaceae)

Luis G. Sequeda-Castañeda [1], Laura D. Berme [1,2] and Yuri M. Quiroga-Castillo [2]

[1] Department of Chemistry, Faculty of Sciences, Pontificia Universidad Javeriana, Bogotá 110231, Colombia
[2] Department of Nutrition & Biochemistry, Faculty of Sciences, Pontificia Universidad Javeriana, Bogotá 110231, Colombia

The development of non-communicable diseases (NCDs) is conditioned by multiple factors; among these factors are dietary practices and lifestyles, which are essential for the prevention and/or treatment of these diseases. Plant species such as guayusa have attracted the attention of the scientific community because, in addition to being located in the Amazon region, they contain compounds such as polyphenols, caffeine, triterpenes, and chlorogenic acids, which confer beneficial effects on health and the treatment of NCDs, thus reinforcing the use of plant species and protecting the sovereignty and food security of the main consumers, such as indigenous communities. The objective of this research was to develop a hot drink with antioxidant potential from the aqueous extract of guayusa; to this end, a bromatological characterisation was performed, followed by the design and formulation of the drink, in order to evaluate its sensory acceptability and antioxidant activity. For the formulation, a block model consisting of four factors corresponding to the extraction method, two particle sizes, and three concentrations, which contributed to the

study response variable (extraction of 2.5–16.9%), was taken into account. The extraction yields obtained allowed for the development of acceptability tests, carried out through the implementation of a hedonic scale that demonstrated significant differences ($p < 0.05$) in the sensory attributes of flavour, aroma, and body, which were evaluated between the two techniques. Additionally, in the paired test, there was a greater preference for the drink made using the percolation method at 5.3% w/v. At the same time, it was evident that antioxidant activity did not present a significant difference with the extraction methods used. In this way, it is possible to design and obtain a hot drink with antioxidant potential per portion of consumption, with the inclusion of guayusa.

3.44. Development of a Novel Avocado-Based (Persea americana) Spread Incorporating Selected Spices

Sakuni Sandeepani Senarath, Tharindi Wehella and Madhura Jayasinghe

Department of Food Science and Technology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Gangodawila, Nugegoda 10250, Sri Lanka

The avocado (*Persea americana*), known as butter fruit, is typically consumed fresh in developing countries. The quality of the avocado fruit normally diminishes along marketing and packaging processes—often not reaching its destination in its optimal condition. To increase commercialization and add value, it is important to develop avocado-based food products with a shelf life that is long enough to maintain supply chain integrity. This study was conducted to develop a healthy avocado-based spread, incorporating selected spices, with an extended shelf life as a functional food product. Commercially available spreads mostly contain saturated fats, thereby raising health concerns. This avocado-based spread is a developed product that offers a nutritious alternative aligned with the growing demand for healthier vegan food options. Eight formulations were developed, varying the ingredients according to the Taguchi method. The most preferred formulation was selected based on a sensory evaluation. The spread exhibited an extended shelf life up to three weeks without undesirable color changes under refrigerated conditions. Proximate composition revealed a high moisture content (72.83%), moderate fat (11.04%), low fiber (5.26%), and an even lower protein content (1.8%). The fatty acid profile showed that the spread has a high monosaturated fatty acid content, mainly consisting of oleic acid at around 65.73%. The mineral profile revealed that the spread is rich in potassium and sodium. The photochemical profile showed the product's potential as a functional food, including the presence of phenolic compounds (1.92 $\pm$ 0.16 mg GAE/g), flavonoid compounds (0.08 $\pm$ 0.0026 mg QE/g), and antioxidant compounds (5.27 $\pm$ 0.09 mg TE/g). The rate of peroxide value increased over time and varied significantly between refrigerated and room temperature conditions ($p < 0.001$). The developed avocado spread offers a nutritious, vegan-friendly alternative with an extended shelf life.

3.45. Development of a Plant-Based Milk from Local Ancient Oat Varieties: Optimized Processing and Sustainable Formulation

Margherita Modesti, Diana De Santis and Serena Ferri

Department for Innovation in Biological, Agro-Food and Forest System (DIBAF), Tuscia University, 01100 Viterbo, Italy

The increasing demand for sustainable and plant-based food products has encouraged the development of innovative beverages based on traditional cereals. This study presents the formulation of an oat-based milk using ancient oat varieties cultivated in the Lazio region, Tuscia area, Central Italy, aiming to promote local biodiversity and support a short food supply chain. The beverage was produced through enzymatic hydrolysis of dehulled oat grains, preceded by a careful selection of enzymatic blends and optimization of their

working conditions (temperature and reaction time). Extra virgin olive oil was added as a natural emulsifier, and a small amount of salt was used to improve product stability. The final recipe was adapted in collaboration with local producers to ensure feasibility for small-scale production. Process performance was evaluated through key technological parameters, including extraction yield, emulsion stability, and viscosity. Compositional analyses confirmed the presence of complex carbohydrates, beta-glucans, and a balanced macronutrient profile, without the addition of sugars or synthetic additives. Sensory evaluation, carried out by a trained panel, highlighted a pleasant cereal aroma, smooth mouthfeel, and good overall acceptability. This study demonstrates the feasibility of producing a clean-label, nutritionally balanced, and locally sourced plant-based milk. The use of ancient oat varieties, combined with a tailored processing approach and involvement of local actors, represents a sustainable strategy to meet consumer demand for healthy and eco-friendly dairy alternatives.

3.46. Development of NanoBoost Bar: A Moringa-Powered Calcium-Rich Nutribar for Enhanced Nutritional Supplementation

Saakshi S Katwe [1] and Sushma Ishwar Havanur [2]

[1] Department of Food Technology, Davangere University, Shivagangotri Campus, Davangere 577007, India

[2] Department of Food Safety & Quality, DSLD College of Horticultural Engg, & Food Technology, Devihosur-Haveri 581110, Karnataka, India

The present study aimed to develop a functional food product by formulating a moringa-based nutribar enriched with nano calcium and to evaluate its nutritional and sensory properties. Moringa (*Moringa oleifera*) leaves, known for their rich nutritional profile, were incorporated along with food-grade nano calcium to enhance calcium bioavailability. The nutribar was prepared using natural ingredients, including moringa leaf powder, jaggery, roasted flaxseeds, roasted sesame seeds, and chia seeds. Once the jaggery syrup had reached a one-thread consistency, the seed mixture, along with moringa leaf powder and nano calcium were added and mixed uniformly. The product was evaluated for proximate composition, water activity, energy content, and sensory acceptability. The proximate analysis was performed by different methods, like estimation of protein by the Kjeldahl method, fat analysis by the Soxhlet apparatus, crude fiber analysis by the enzymatic-gravimetric method, and ash content by the muffle furnace. Results showed that the nutribar contained 14% moisture, 7.5% ash, 13.3% protein, 18.5% fat, 4.5% crude fiber, and 46.7% carbohydrates, contributing to an energy value of 406.5 kcal/100 g. The water activity at 33.3 °C was recorded at 0.639, indicating good microbial stability and shelf life under ambient conditions. The incorporation of nano calcium significantly improved the mineral content without negatively impacting texture, taste, or appearance. Sensory evaluation using a nine-point hedonic scale revealed good acceptability across all attributes. The balanced nutritional profile and positive sensory feedback suggest the product is suitable as a plant-based, ready-to-eat snack for a wide consumer base, including vegetarians, athletes, and nutritionally vulnerable groups. This fortified nutribar addresses micronutrient deficiencies, particularly calcium, through an innovative food-based approach and aligns with current trends in clean-label, functional, and sustainable nutrition. Further research on in vivo calcium bioavailability and consumer studies can support its potential for commercial application and contribution to public health.

3.47. Development, Sensory Evaluation and Characterization of Buckwheat-Based Gluten-Free Synbiotic Products Using Ayurvedic Herbs Having Prebiotic Potential

Jyoti Arora [1], Luxita Sharma [2] and Kanwalpreet Kochhar [3]

[1] Department of Integrative Dietetics and Nutrition, All India Institute of Ayurveda, Ministry of AYUSH, Gautampuri, Sarita Vihar, New Delhi 110076, India
[2] Department of Food and Nutrition, Amity Medical School, Amity University Haryana, Manesar, Gurugram 122413, Haryana, India
[3] Department of Physiology, All India Institute of Medical Sciences (AIIMS), Ansari Nagar, New Delhi 110029, India

This study aimed to develop innovative synbiotic food products derived from buckwheat by culturing Lactobacillus plantarum (MTCC No-13002), Lactobacillus rhamnosus (MTCC No-13028), and Streptococcus salivarius (MTCC No-13009) with a formulation based on Punica granatum peel and Aegle mermelos, along with prebiotics such as licorice. Blanching and germination processes were employed to mitigate anti-nutritional factors. Optimized variations were evaluated using a hedonic scale in conjunction with the Analytic Hierarchy Process (AHP) and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) methods. The mean values of all sensory attributes assessed in the product samples exceeded 6. Analysis of variance (ANOVA) indicated significant variance among the mean product samples ($p < 0.05$). The taste and consistency of all product samples showed substantial variation at a confidence level of $p < 0.001$; however, all chocolate samples received comparable scores for appearance. The chocolate samples were ranked as follows: 202 > 201 > 204 > 203, while sample 302 was the highest-rated thandai, and sample 102 was the best-rated among jelly variations. The total microbiological counts for thandai, chocolate, and jelly were 7.25 log/cfu g, 7.76 log/cfu g, and 7.79 log/cfu g, respectively. Nutritional qualities were favorable, with moderate levels of protein and carbohydrates and low to moderate levels of fat. Buckwheat serves as an effective substrate for non-dairy synbiotics, and the high probiotic viability of Ayurvedic herbs provides a novel aspect to the research, suggesting potential benefits for gluten-related disorders (GRD) in enhancing gut and overall health.

3.48. Digested or Extracted? Edible Insect Effects on Human Cells and Probiotics

Ivo Doskocil [1], Barbora Lampova [1], Petr Šmíd [2], Martin Kulma [3] and Lenka Kourimska [1]

[1] Department of Microbiology, Nutrition and Dietetics, Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences Prague, 165 00 Prague, Czech Republic
[2] Department of Chemistry, Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences Prague, 165 00 Prague, Czech Republic
[3] Department of Zoology and Fisheries, Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences Prague, 165 00 Prague, Czech Republic

The global demand for sustainable protein has brought edible insects into focus as an eco-friendly alternative to conventional livestock, given their reduced resource needs and lower greenhouse gas emissions. Although their safety is widely supported by existing research, widespread consumer acceptance is still lacking.

Therefore, this study explored the influence of different sample preparation techniques on cytotoxicity and probiotic interactions. We tested three commonly consumed insect species—*Tenebrio molitor* (yellow mealworm), *Acheta domesticus* (house cricket), and *Locusta migratoria* (migratory locust). Samples were processed using two methods: simulated gastrointestinal digestion based on the INFOGEST protocol (5 g per sample) and ethanol extraction with 80% ethanol for 24 h, followed by evaporation and resuspension in DMSO (final concentration: 51.2 mg/mL). All samples were sterile-filtered (0.22 µm). Cytotoxic effects were assessed in non-differentiated human intestinal cell lines (Caco-2 and HT29) using the MTT assay. Both digested and ethanol-extracted samples were tested in a concentration range of 10–0.31% for digested samples and 512–16 µg/mL for extracts. In

parallel, we evaluated the ability of selected probiotic strains (*Lactobacillus gasseri*, *Lacticaseibacillus rhamnosus*, and *L. brevis*) to adhere to these epithelial models in the presence of insect-derived samples, which were tested at concentrations of 1, 0.75, and 0.5% for digested material.

Our results showed that the ethanolic extracts were non-toxic to both cell lines, whereas digested samples exhibited dose-dependent cytotoxicity, with IC_{50} values around 2.5% of the original digest. Because probiotic adhesion is influenced by both the insect species and the preparation of samples, suggesting a range of bioactive compounds, these findings indicate that previously published safety assessments, often based on selected extracts or simplified models, may not fully capture the complexity of biological responses, and their interpretation should therefore be approached with appropriate caution.

3.49. Effect of Free and Encapsulated Olive Leaf Extract on the Functional and Quality Characteristics of Cantal-Type Cheese During Refrigerated Storage

Ines Tarchi [1], Mohamed Bouaziz [1,2] and Abderrahmane Aït-Kaddour [3]

1 Laboratory of Electrochemistry and Environment, National School of Engineers of Sfax (ENIS), University of Sfax, BP 1175, Sfax 3038, Tunisia
2 Institut Supérieur de Biotechnologie de Sfax, Université de Sfax, BP1175, Sfax 3038, Tunisia
3 INRAE, VetAgro Sup, Unité Mixte de Recherche sur le Fromage UMRF, Université Clermont-Auvergne, 63370 Lempdes, France

This study investigates the effects of free (OLE) and encapsulated olive leaf extract (E-OLE) on the functional and quality parameters of Cantal-type cheese during 63 days of cold storage at 2 °C. Cheeses were supplemented with 1.0%, 2.0%, and 3.0% (*w*/*w*) of OLE or E-OLE. To ensure comparability between extract forms, E-OLE concentrations were normalized based on total phenolic content (TPC) to match the corresponding OLE levels.

Analyses were conducted to evaluate effects on physicochemical composition, antioxidant activity (TPC and ABTS), microbial counts, texture, rheological behavior, and color. E-OLE significantly increased protein and dry matter content while reducing fat and chloride levels. Both extracts enhanced antioxidant capacity and reduced the abundance of total aerobic mesophilic bacteria, indicating improved microbial stability.

Textural analysis showed that E-OLE increased firmness and cohesiveness while reducing elasticity, likely due to interactions between phenolics and the cheese matrix. OLE caused minimal textural changes, especially at 1.0–2.0%. In terms of color, both extracts caused a concentration-dependent reduction in lightness (L*) and an increase in redness (a*) and yellowness (b*). OLE led to more pronounced and progressive color changes over time, attributed to pigment diffusion. In contrast, E-OLE caused more moderate and stable changes due to the protective effect of the encapsulation matrix (sodium caseinate and maltodextrin), which limited pigment release and preserved visual clarity.

Although no sensory analysis was conducted, the integrated data suggest that 2.0% E-OLE achieves an optimal balance of antioxidant activity, microbial quality, physicochemical integrity, texture, and acceptable color. For OLE, this balance appears optimal at 1.0%. These findings support E-OLE as a promising natural additive for enhancing the functional quality of dairy products, particularly in cheese fortification.

3.50. Effect of In Vitro Gastrointestinal and Colonic Digestion on the Bioactive Properties of Yogurt Enriched with Microencapsulated Red Grape Pomace Extracts

Maria Eugenia Sabatino [1], Mariana Soledad Lingia [2] and Maria Verónica Baroni [1]

1 Instituto de Ciencia y Tecnología de Alimentos Córdoba (ICYTAC-CONICET), Córdoba X5000HUA, Argentina

[2] Instituto Nacional de Tecnología Agropecuaria, Estación Experimental Rafaela (INTA Rafaela), Santa Fe, Rafaela S2300, Argentina

Red grape pomace, a by-product generated during red wine manufacturing and rich in phenolic compounds, particularly anthocyanins, can be used to obtain natural food additives with antioxidant properties, thus improving their functional characteristics. As polyphenols, and anthocyanins specifically, tend to oxidize, which results in a loss of bioactivity, the microencapsulation of these compounds is proposed to prolong their stability during processing and storage. From a mixture of red grape pomace obtained as residues from *Vitis vinifera L.* wine production, microencapsules (maltodextrin, whey proteins, and chitosan) rich in pomace polyphenols were developed by means of spray drying. These microcapsules were then added to yogurt (skim, natural, and sweetened with Stevia), a dairy matrix for mass consumption, with low cost and variable storage periods. The resulting yogurts (YM) were subjected to in vitro gastrointestinal and colonic digestion. Then, polyphenol extracts were obtained from the different stages of digestion. These extracts were purified using SPE columns, and their polyphenol content was evaluated via FOLIN CT. The impact of these processes on bioactivity was assessed by analyzing the effect on antioxidant and antiproliferative responses in vitro in human intestinal cells via flow cytometry. The results obtained contribute to our understanding of how the modifications that occurred during the digestion process impact the final biological response achieved.

3.51. Effects of Lactic Acid and Glyceryl Lactate on Growth Performance, Antioxidant Capacity, and Intestinal Health of Piglets

Shuaiju Guo, Bangwang Peng, Junlong Niu and Zhixiang Wang

College of Animal Science and Technology, Henan Agricultural University, Zhengzhou 450046, China

The aim of this study was to evaluate the effects of lactic acid and glyceryl lactate on growth performance, antioxidant capacity, and intestinal health in piglets. This study included 240 castrated male piglets (initial body weight: 7.50 $\pm$ 0.54 kg) assigned to four groups: CON (basal diet), LA (basal diet + 0.5% lactic acid), GL (basal diet + 0.5% glyceryl lactate), and LG (basal diet + 0.5% lactic acid + 0.5% glyceryl lactate). Each group had six replicates of 10 piglets. The trial lasted 28 days. Compared with the control group, the GL and LG groups showed enhanced growth performance and reduced diarrhea rates in piglets. The LA and LG groups showed decreased intestinal chyme pH and increased digestive enzyme activities. Moreover, the GL and LG groups displayed elevated jejunal mRNA levels of the tight junction protein occludin and mucin MUC2, enhanced expression levels of Nrf2 signaling pathway genes, increased activities of the antioxidant enzymes GPX and CAT, and reduced MDA content. Acidifier supplementation also modulated cecal bacterial abundance and short-chain fatty acid (SCFA) content. Genera such as Faecalibaculum, Nocardiopsis, Collinsella, CAG269, Allobaculum, and Enterococcus were affected. In conclusion, glyceryl lactate and its combination with lactic acid improved piglet growth performance by enhancing intestinal barrier function, antioxidant capacity, microbial community structure, and SCFA production.

3.52. Enhanced Mineral Recovery from Tiger Nut By-Products Using PEF and ASE Technologies

Katarzyna Dawidowicz, Juan Manuel Castagnini, Manuel Salgado-Ramos, Noelia Pallares, Patricia Roig, Francisco J. Barba and Francisco J. Marti-Quijal

ALISOST Research Group in Innovative Technologies for Sustainable Food, Department of Preventive Medicine and Public Health, Food Science, Toxicology and Forensic Medicine, Faculty of Pharmacy and Food Science, University of Valencia, Valencia, Spain

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This study investigates the efficiency of various green extraction technologies on the recovery of mineral elements from tiger nut (Cyperus esculentus L.) by-products using water as a solvent. A conventional maceration method served as the control, while two advanced extraction approaches were applied: Pulsed Electric Fields (PEF) and Accelerated Solvent Extraction (ASE). Maceration and PEF extraction were carried out using 20 g of a sample and 200 mL of water, while ASE extraction was performed using 3 g of a sample and 65 mL of water. PEF was conducted under four different energy and electric field conditions: 2 kV/cm at 100 and 200 kJ/kg and 3 kV/cm at 100 and 200 kJ/kg. ASE extractions were carried out at 40 °C and 120 °C, both at 1500 psi. The results revealed substantial differences in mineral extraction efficiencies across the methods. Notably, PEF at 3 kV/cm and 200 kJ/kg and ASE at 120 °C resulted in the highest concentrations of key minerals such as phosphorus (P), potassium (K), magnesium (Mg), and iron (Fe) compared to the control. ASE at 120 °C showed a marked increase in iron content (2.02 mg/100 g), nearly ten times higher than the control (0.216 mg/100 g). Additionally, zinc (Zn) and copper (Cu) also exhibited significant enhancement under high-intensity extraction conditions. This study uniquely demonstrates the transformative potential of PEF and ASE over conventional methods for sustainably recovering critical bioavailable minerals (P, K, Mg, Fe, Zn, and Cu) from tiger nut by-products. The application of these technologies could contribute to the valorization of tiger nut by-products, promoting a circular economy and improving the mineral content of food applications.

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3.53. Enhancing Pork Burgers with Cricket (Acheta domesticus) Flour: A Feasibility Study on Quality Attributes

Judith Rodríguez Párraga, Raquel Lucas-González, Carmen Botella-Martínez, Manuel Viuda-Martos, José Ángel Pérez-Álvarez and Juana Fernández-López

IPOA Research Group, Institute on Agri-Food and Agri-Environmental Research and Innovation (CIAGRO-UMH); Miguel Hernández University, Crta. Beniel km 3.2, 03312 Orihuela, Spain

There is a growing demand for alternative protein sources due to concerns about the unsustainability of traditional protein sources. Edible insects have emerged as an interesting option due to their healthy nutritional composition (high protein content, essential fatty acids and minerals) and sustainable production (high conversion rates and low environmental impact). Currently, European consumers reject direct consumption of insects (neophobia), but they could be introduced in the form of powders as part of mass-market foods such as burgers. The aim of this study was to evaluate the feasibility of using house cricket (*Acheta domesticus)* flour (CF) in the development of fortified pork burgers and its effect on their quality. Pork burgers (70% lean meat and 30% backfat, water, salt, and spices) were used as a Control. CF was added at different concentrations [10% (F10) and 20% (F20)], and its effect on the technological [pH, Aw, color, texture (TPA), and cooking properties], nutritional (proximate composition), and sensory properties was evaluated. The reformulated burgers showed a higher protein (F10: 20%; F20: 22%) and dietary fiber content (F10: 0.6%; F20: 1.1%) than the Control (18% protein; 0% dietary fiber). They were also darker and showed higher cohesivity and hardness than the Control. The pH and Aw values were not modified by reformulation. The cooking losses decreased in the reformulated burgers (by almost 50% in F20) due to the water and oil holding capacity of CF. The worst score for "general acceptance" was obtained when CF was used at the highest concentration (20%), with the burger's color, bitterness, and off flavor being the

attributes that most influenced this valuation. CF shows high potential for use in the meat industry in order to obtain a healthier hybrid meat product; however, some actions should be implemented (i.e., the use of aromatic and hot spices and natural colorants) to overcome the devaluation of the product by consumers (mainly due to color and odor changes) when it is added at high concentrations.

3.54. Enzymatic Valorization of Wheat Bran: A Sustainable Route to Functional Food Ingredients

Ornella Ontañon [1], Juliana Topalian [1], María Cerón Cucchi [2], Victoria Hracek [1], Laura Navas [1] and Eleonora Campos [1]

[1] Instituto de Agrobiotecnología y Biología Molecular (IABIMO), CICVyA, Instituto Nacional de Tecnología Agropecuaria (INTA)-Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Hurlingham B1686IGC, Argentina

[2] Instituto de Patobiología Veterinaria (IPVet), CICVyA, Instituto Nacional de Tecnología Agropecuaria (INTA), Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Hurlingham B1686IGC, Argentina

Xylooligosaccharides (XOS) derived from plant hemicellulose viaenzymatic hydrolysis are promising multifunctional ingredients for food applications due to their potential prebiotic, antioxidant, and sweetening properties. To develop sustainable bioprocesses for valorizing agro-industrial by-products, we assessed three recombinant xylanases from *Cellulomonas* sp. B6 (*Cs*Xyn10A, *Cs*Xyn10D, and *Cs*Xyn11) for their ability to release XOS from destarched wheat bran. Structural analysis by means of TLC, HPAEC-PAD, and NMR confirmed the presence of enzyme-specific linear and arabino-XOS (AXOS): *Cs*Xyn10A/D yielded mainly xylose, xylobiose, and different versions of arabino-xylotriose, while *Cs*Xyn11 generated longer (A)XOS with undetectable xylose.

A scalable charcoal-based method was used to purify crude hydrolysates (H), yielding enriched fractions (E) with around 10% xylose and up to tenfold (A)XOS concentration.

The antioxidant activity of both H and E for each enzyme was measured with the $ABTS^+$ assay using gallic acid as a positive control; *Cs*Xyn11-derived (A)XOS showed the highest antioxidant capacity, with better results observed for *Cs*Xyn11-H than for *Cs*Xyn11-E.

The prebiotic potential of all H and E fractions was tested using *Lactobacillus casei*, *Lactobacillus rhamnosus*, and *Bifidobacterium animalis* in glucose-free MRS medium. All strains grew on both H and E. However, while *B. animalis* completely consumed A(XOS) up to DP4 in all samples, Lactobacilli showed a preference for oligosaccharides present in H over those in E. Notably, xylobiose—a mildly sweet, low-glycemic sugar—was poorly fermented when present in E.

Our results highlight the key role of enzyme selection in shaping (A)XOS structure and bioactivity. To enhance biomass valorization, we propose an integrated process that combines the enzymatic production of (A)XOS with the yeast fermentation of recovered xylose into xylitol, paving the way for clean-label, multifunctional food ingredients. Ongoing work focuses on elucidating the factors underlying the variable prebiotic potential of different (A)XOS fractions.

3.55. Evaluation of the Functional and Rheological Properties of Grape Pomace Flour with Different Particle Sizes

Elsa M. Gonçalves [1,2], Diogo Gonçalves [3], Patrícia Fradinho [4], Sandra Gomes [1], Nuno Alvarenga [1,2], Marisa Nicolai [5], Maria L. Palma [5] and Paula Pereira [3,5,6]

[1] INIAV—Instituto Nacional de Investigação Agrária e Veterinária, Unidade de Tecnologia e Inovação, 2780-157 Oeiras, Portugal

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[2] GeoBioTec—Geobiociências, Geoengenharias e Geotecnologias, FCT-UNL, 2829-516 Caparica, Portugal
[3] EPCV, Department of Live Sciences, School of Phycology and Life Science, Universidade Lusófona, Campo Grande 376, 1749-024 Lisboa, Portugal
[4] Colab4Food—Collaborative Laboratory for Innovation in the Agri-Food Sector, 4485-655 Vairão, Portugal
[5] CERENA, Center for Natural Resources and Environment, Instituto Superior Técnico (IST), Universidade de Lisboa, Av. Rovisco Pais, 1049-001 Lisboa, Portugal
[6] CBIOS—Research Center for Biosciences & Health Technologies, Universidade Lusófona, Campo Grande 376, 1749-024 Lisboa, Portugal

Grape pomace, a by-product of the winemaking industry, contains nutritionally relevant compounds, including proteins, lipids, carbohydrates, phenolic compounds, vitamins, and dietary fibers. Given its functional and technological potential, this by-product has been valorized as a flour for use in food formulations. The particle size of the flour directly influences its physicochemical and rheological properties, affecting its performance in food matrices. This study evaluated the functionality of grape pomace flour with different particle sizes. Samples were subjected to drying, milling, and sieving, followed by the analysis of water absorption capacity (WAC; g water/g flour), oil absorption capacity (OAC; g oil/g flour), milk absorption capacity (MAC; g milk/g flour), water solubility (%), moisture retention capacity (g/g), and rheological properties (M.A.R.S iQ Air Rheometer, Thermo Scientific), including viscosity (Pa·s), elasticity, and flow behavior (Pa).

The results showed that the flour exhibited a high absorption capacity for all the tested solvents (water, oil, and milk), with values exceeding 1.5 g solvent/g flour, indicating strong potential for retention and interaction with both polar and non-polar components. These properties are particularly relevant for applications in food products requiring emulsifying stability. The gelling capacity was more pronounced at ratios of 1:1.5 and 1:2 (flour-to-water), with a significant increase in viscosity, suggesting the formation of a cohesive three-dimensional structure. Rheological analyses revealed a viscoelastic behavior suitable for structured food systems such as gels, emulsions, and moldable doughs. Moreover, samples with finer particle sizes showed improved functional performance, indicating greater technological potential for incorporation into value-added food formulations with specific texture and stability requirements.

3.56. Evaluation of the Nutritional Quality and Value of Wild Terrestrial Orchids Tubers Used in the Production of a Traditionally Textured Product (Nyam ngub) Eaten as Meat in the North West and Western Regions of Cameroon

Dobgima Fonmboh [1], Noumo Thierry Ngangmo [1], Fokunang Charles Ntungwen [2,3] and Ejoh Richard Aba [1,4]

[1] Department of Nutrition, Food and Bioresource Technology, College of Technology, The University of Bamenda, Bambili, North West Region, Cameroon
[2] Department of Pharmaco-Toxicology and Pharmacokinetics, Faculty of Medicine and Biomedical Sciences, University of Yaoundé 1, Yaounde, Centre Region Cameroon
[3] Laboratory for Preclinical Animal and Toxicology Research of the Faculty of Medicine and Biomedical Sciences of the University of Yaoundé 1, Yaounde, Centre Region, Cameroon
[4] National School of Agro-Industrial Science, University of Ngaoundere, Ngaoundere, Adamawa Region, Cameroon

Wild edible plants and foods continue to be underrated due to supply or consumption constraints, poor consumer awareness, and unrecognized nutritional value despite diverse recommendations. The study determined the physicochemical properties of wild terres-

trial edible orchid tubers used to produce *Nyam ngub*, a seasonal delicacy endogenously processed and eaten as a meat surrogate.

Tubers were collected from AbongPhen, Kedjom Ketingoh, Tubah subdivision, North West Region, Cameroon, washed, and peeled to separate into peelings, whole and peeled tubers. Phytochemicals were screened by standard techniques, while the secondary metabolites were assessed by FTIR. The proximate, mineral, and amino acid compositions and functional properties were evaluated by referenced methods.

Phytochemical screening indicated that betacyanin, anthocyanin, carotenoids, mucilage, protein, carbohydrates, and fats were present, but oxalate, phytate, and polyphenols were absent. FTIR scanning presented peaks between 3903.75 cm^{-1} and 402.77 cm^{-1}. The peaks at 3305.05 cm^{-1}, 3291.77 cm^{-1}, and 3290.10 cm^{-1} were specific to the N-H stretch of amines and amides, while 500 cm^{-1} and 430 cm^{-1} were attributed to polydisulfide and aryl sulfide. The results of triplicate tests for unpeeled, peeled tubers and peelings showed that dry matter and ash were significantly different ($p \leq 0.005$) with unpeeled, peeled tubers and peelings yielding 88.23 ± 0.60% and 2.42 ± 0.56%; 84.78 ± 0.94% and 2.03 ± 0.11%; and 72.75 ± 0.71% and 3.26 ± 0.73, respectively. The total and reducing sugar contents were, respectively, 57.56 ± 2.37 g/1000 mL and 5.78 ± 0.75 g/1000 mL; 69.88 ± 2.58 g/1000 mL and 2.03 ± 0.11 g/1000 mL; and 67.85 ± 3.53 g/1000 mL and 4.88 ± 0.71 g/1000 mL. The crude fibre and fats contents were 1.29 ± 0.24 g/100 g and 2.87 ± 0.64 g/100 g; 0.92 ± 0.05 g/100 g and 0.80 ± 0.40 g/100 g; and 3.47 ± 1.14 g/100 g and 1.68 ± 0.04 g/100 g. The total nitrogen, calcium, magnesium, potassium, and phosphorous were 0.81 ± 0.06%, 0.05 ± 0.00%, 0.6 ± 00, 0.68 ± 0.00%, 0.01 ± 0.00%, respectively. The sodium, zinc, copper, manganese, and iron contents were 484.85 ± 45 µg/g, 41.31 ± 1.86 µg/g, 2.83 ± 0.00 µg/g, 24.47 ± 0.94 µg/g, and 260.01 ± 11.13 µg/g.

Orchid tubers represent a source of diverse nutrients that can contribute to food security and represent a means to raise the status of traditional foods and reawaken neglected or forgotten cultures.

3.57. Extra Virgin Olive Oils from Rio Grande do Sul: A Comprehensive Study of Their Identity, Quality Parameters, and Sensory Attributes

Lucas Tolio, Julia Serres, Hortência Velloso, Laís Machado, Isabel Kasper Machado and Juliano Garavaglia

Department of Nutrition, Federal University of Health Sciences of Porto Alegre, Rua Sarmento Leite, 245, Porto Alegre 90050-170, Brazil

The consumption of olive oil has surged due to its health benefits and role in a better quality of life, particularly as part of the Mediterranean diet. Extra virgin olive oil (EVOO), recommended at 25–50 mL daily, is rich in bioactive compounds like phenolics, tocopherols, and fatty acids, offering antimicrobial, antioxidant, and anti-inflammatory properties. Proper sensory classification into "Extra Virgin," "Virgin," and "Lampante" is crucial for its recommendation. This study evaluated the sensory and nutritional characteristics of EVOOs from Rio Grande do Sul, Brazil, aiming to determine their quality, bioactive composition, and sensory/volatile profiles, differentiating them by production region. Samples from various areas were analyzed for basic physicochemical composition, phenolic compounds, volatile aroma compounds, fatty acid profile, and tocopherols, following International Olive Council (IOC) protocols. All samples were classified as Extra Virgin based on free acidity, peroxide value, and UV absorbance. Total Phenolic Compounds (TPC), quantified in 65 samples, varied from 186.80 mg/Kg to 1167.43 mg/Kg, showing a broad range of concentrations. Sensory analyses performed by a trained and certified IOOC panel confirmed the high quality of the EVOOs, displaying high medians for positive

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attributes like fruitiness, pungency, and bitterness. These results collectively highlight the high quality of olive oils produced in Rio Grande do Sul.

3.58. Fatty Acid Profile and Sensory Characteristics of Canola (Brassica napus) Oil-Based Mayonnaise Sweetened with Date (Phoenix dactylifera) Paste

Linda Oluchi Akajiaku [1], Justina N. Nwosu [1], Jane Chigozie Nwakanma [2], Euphresia N. Odimegwu [1], Serah Ogechi Alabgaoso [1] and Somtochukwu Emmanuel Ndukwe [1]

[1] Department of Food Science and Technology, Federal University of Technology, Owerri P.M.B. 1526, Imo State, Nigeria

[2] Department of Public Health, Federal University of Technology, Owerri P.M.B. 1526, Imo State, Nigeria

The excessive consumption of refined sugar and unhealthy fats in traditional mayonnaise recipes has raised nutritional concerns and interest in healthier alternatives. This study investigated the effects of replacing conventional soya bean oil and refined sucrose with canola oil and date paste in mayonnaise production, focusing on fatty acid composition and sensory properties. Six samples were developed: a control sample (CM0) with soya bean oil and sucrose and five further samples (CM1–CM5) with canola oil and increasing proportions of date paste (5–25%): 5% (CM1), 10% (CM2), 15% (CM3), 20% (CM4), and 25% (CM5). Standard analytical methods were used to determine the fatty acid composition and conduct sensory evaluation. The fatty acid analysis revealed that canola-based mayonnaise had a healthier lipid profile, with a notable increase in oleic acid (C18:1) from 5.33% in CM0 to 9.26% in CM5, linoleic acid (C18:2) from 40.23% to 43.47%, and α-linolenic acid (C18:3) from 10.04% to 14.59%, indicating an increased content of beneficial monounsaturated and polyunsaturated fatty acids. The saturated fatty acid content remained relatively low, with a moderate increase in lauric acid (from 15.08% to 17.03%) and stearic acid (from 6.99% to 11.62%) in all samples. Sensory evaluation showed that samples CM1 to CM3 were well accepted, with CM2 (10% date paste) receiving the highest ratings for overall acceptability (8.47), flavour (8.53), and texture (8.80), while CM0 received the best ratings for appearance (8.53). Samples CM4 and CM5, which contained a higher proportion of date paste, had significantly lower flavour and acceptability scores ($p \leq 0.05$), indicating a threshold above which sweetness negatively affects sensory properties. Replacing conventional ingredients with canola oil and date paste improved the fatty acid profile and maintained the desirable sensory properties up to a level of 15% date paste. This recipe offers a novel and nutritionally enhanced mayonnaise alternative that meets the demand for heart-healthy, environmentally friendly, and functional foods.

3.59. Fermentation of Tomato Juice by Probiotic Yeast

Andrea Maria Patelski, Urszula Dziekońska-Kubczak, Katarzyna Dębska, Jakub Szerment, Maria Balcerek and Katarzyna Pielech-Przybylska

Department of Biotechnology and Food Sciences, Institute of Fermentation Technology and Microbiology, Lodz University of Technology, 90-530 Lodz, Poland

Recent years have seen trends in the production of foods with recognised health benefits, including those containing probiotic microorganisms. Tomatoes are rich in bioactive compounds, including lycopene, vitamins C and A, potassium, saponins, and polyphenols, which possess antioxidant, anti-inflammatory, anti-carcinogenic, and cardioprotective properties. In the EU, the annual production of fresh tomatoes is approximately 16 million tonnes. Our study investigated the potential of fermenting tomato juice with the probiotic yeast *Saccharomyces cerevisiae* var. *boulardii*. We used tomato juice from "Tłocznia Szymanowice", Poland, as the raw material. Sugar, organic acid, and ethanol analyses were

performed using HPLC. Polyphenols were determined using the Folin–Ciocalteu method. The *Saccharomyces cerevisiae* var. *boulardii* CNCM-I-745 culture was obtained from the commercial product Enterol 250 (Biocodex, France). The second dry wine strain—*Saccharomyces bayanus* BCS103 (Fermentis (Lesaffre), France)—was used to obtain reference results. Due to the low initial sugar content, we added 60 g/L of glucose as a fermentation substrate for the yeast. The fermentation process was carried out at 35 °C for 7 days. The ethanol concentration of the tomato juices fermented with added glucose ranged from 28.87 to 31.23 g/L, depending on the strain. The polyphenol content in the fermented samples was close to the initial polyphenol content in the juices (24–26 mg GAE/100 g). The fermented tomato juice retained much of its colour but lost its distinctive tomato taste and aroma, becoming dominated by a sour, yeasty, and alcoholic sensation. Although fruit and vegetable fermentation is a "newly" rediscovered trend, as is the appreciation of the role of probiotic foods, in the case of tomato juice, the unfavourable sensory changes in the final product, in our opinion, disqualify the potential market implementation of tomato juices fermented by *S. boulardii*.

3.60. Feruloylated Sugar Beet Pulp Pectic Substances Extracted by Microwave-Assisted Process

Azeez Ayodele Alimi, Juan Carlos Contreras-Esquivel, Karina Yadira Reyes-Acosta, Juan Alberto Ascacio-Valdes, Alfredo Valentin Reyes-Acosta and Cristobal Noe Aguilar

School of Chemistry, Autonomous University of Coahuila, Saltillo, CP 25250 Coahuila, Mexico

Sugar beet pulp serves as an emerging pectin source with unique functional properties. This study investigated the ferulic acid (FA), a bioactive substance, present in the pectic extracts isolated from sugar beet pulp by a microwave-assisted (MAE) process. Sugar beet pulp (SB, 10 g) was subjected to a pressurized microwave-autoclave (2.67 Bar, 134.8 °C) at three pH levels (2.5, 3.5, and 4.3). Water extraction (WE) was also performed at all pH levels. Other physicochemical properties of SB pectic extracts, including neutral sugar composition using gas chromatography, and FTIR spectroscopies to estimate the degrees of esterification (DE), degree of acetylation (DA), and thermal degradation using a universal TGA analyzer, were also analysed. The results obtained revealed that MAE and lower pH significantly ($p < 0.05$) improved the pectic yields (% dry basis) (pH 2.5, 19.9 ± 0.05; pH 3.5, 17.10 ± 0.03; pH 4.3, 15.50 ± 0.06) more than WE pectic extracts (pH 2.5, 11.80 ± 0.49; pH 3.5, 11.30 ± 0.12, pH 4.3, 9.10 ± 0.03). Moreover, MAE significantly improved the FA (%) (pH 2.5, 2.71 ± 0.33; pH 3.5, 2.54 ± 0.11; pH 4.3, 2.44 ± 0.17) compared to WE (pH 2.5, 2.29 ± 0.18; pH 3.5, 2.34 ± 0.17; pH 4.3, 2.27 ± 0.77). FTIR spectroscopies of all pectic extracts revealed high DEs (56.68–64.55%). Higher proportions of galactose were observed in the MAE SB pectic extracts compared to those of WE extracts, and generally, a high DA is obtained from all pectic substances (14.32 ± 1.24–17.41 ± 0.76%). The thermal degradation of SB pectic extracts resulted in low ash residues (3.54–4.72%). In conclusion, the microwave-assisted technique promotes the extraction of feruloylated pectic substances from sugar beet pulp.

3.61. Filling the Gap in Grateloupia Turuturu and Porphyra Umbilicalis Nutritional and Functional Profiling: Red Seaweeds as Sustainable Alternatives to Terrestrial Crops

João Ferreira [1,2], Marcos Trigo [3], Carlos Martins-Gomes [1], Santiago P. Aubourg [3], Ricardo Prego [4], Luís M. M. Ferreira [1,2], Mário Pacheco [5], Amélia M. Silva [1] and Isabel Gaivão [2]

[1] Centre for Research and Technology of Agro-Environmental and Biological Sciences (CITAB), University of Trás-os-Montes and Alto Douro (UTAD), Quinta de Prados, 5000-801 Vila Real, Portugal

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[2] Animal and Veterinary Research Centre (CECAV), UTAD, Quinta de Prados, 5000-801 Vila Real, Portugal
[3] Department of Food Technology, Marine Research Institute (CSIC), c/Eduardo Cabello 6, 36208 Vigo, Spain
[4] Department of Oceanography, Marine Research Institute (CSIC), c/Eduardo Cabello 6, 36208 Vigo, Spain
[5] Centre for Environmental and Marine Studies (CESAM) and Department of Biology, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

Seaweed farming and wild harvesting offer environmentally sustainable alternatives to conventional crop cultivation. Among red seaweeds, *Grateloupia turuturu* and *Porphyra umbilicalis* have gained attention due to their rich nutritional profiles and the presence of valuable bioactive compounds. Traditionally consumed in East Asia as vegetables, seasonings and sushi wrappings, their full potential remains underexplored, particularly regarding their detailed nutritional composition and functional bioactivities. In this study, proximate composition analyses were conducted following AOAC protocols, while mineral profiling was carried out using ICP-OES/ICP-MS. Hydroethanolic and aqueous seaweed extracts were prepared to assess acetylcholinesterase (AChE) inhibitory activity using Ellman's assay. Additionally, the immunostimulatory effect of seaweed extracts was evaluated in RAW 264.7 macrophages through the colorimetric measurement of •NO production. Dietary fibre stood out as the predominant nutritional component (50% dw of *P. umbilicalis*). *G. turuturu* exhibited greater ash content (30.98% dw) than *P. umbilicalis* (21.61% dw), but a lower protein level (20.16% vs. 22.32% dw, respectively). Both seaweeds showed residual lipid levels (1.52% dw). Sodium, zinc, iron, and iodine were identified as the most relevant minerals in both species. All extracts inhibited AChE activity by more than 20%, with the decoction of *P. umbilicalis* reaching nearly 50% inhibition. For immunostimulation, the decoction of *G. turuturu* at 0.20 mg/mL produced the highest increase in •NO levels, 153.17%. Through a literature-anchored review, when benchmarked against commonly consumed terrestrial plants with a high environmental footprint—namely wheat, white rice and tomatoes—*G. turuturu* and *P. umbilicalis* showed higher levels of protein, fibre, and minerals. Unlike conventional agricultural crops, these seaweeds can grow without the need for land, freshwater or chemicals, and display great bioactive potential. These results reinforce the potential of *G. turuturu* and *P. umbilicalis* as promising functional foods, highlighting their relevance as sustainable, nutrient-rich resources with promising neuroprotective and immunomodulatory properties.

3.62. Flash Profile and Acceptance of Low-Calorie Coconut Ice Cream: Sensory Perception of Consumers Who Presented Acute Respiratory Syndrome Caused by COVID 19

Sarah Liberatti de Almeida Prado and Helena Maria Andre Bolini

Department of Food Engineering and Technology, University of Campinas, UNICAMP, Campinas 13083-862, Brazil

We developed a new low-calorie coconut ice cream with total sucrose replaced with different sweeteners—sucrose, sucralose, stevia rebaudioside A60, stevia rebaudioside A95, stevia rebaudioside D, and acesulfame Kmesh—all of them with sweetness equal to 15% sucrose. The main goal is to sensorially analyze them to see how the different samples are evaluated by consumers that had and did not have COVID-19, so we can verify if this condition influences the sensory perception and acceptance of this product. The six formulations were analyzed by 140 habitual ice cream consumers from UNICAMP, with an average age of 21 and a balanced distribution of males and females. Participants were recruited through advertisements posted on flyers and social media platforms. All candidates who reported being healthy and free from chronic illnesses that could interfere

with sensory perception were accepted. The Flash Profile was used to rapidly determine the sensory profile of each sample, along with affective acceptance tests and CATA. The results showed that samples sweetened with sucrose, sucralose, and stevia rebaudioside D were the most preferred (6.9, 6.2, and 6.2, respectively, on the hedonic scale 1–9), while the others scored a 5. In general, no significant differences were observed between consumers with or without a history of COVID-19, with differences smaller than 5.5% on the hedonic scale. An exception occurred for the sample sweetened with sucrose ($p < 0.05$), where individuals without prior COVID-19 reported higher acceptance and better flavor perception, with a 12% difference. This may indicate that COVID-19-related sensory changes can persist, affecting the perception of more complex sweeteners like sucrose. This study followed the procedure defined by the university and was approved by the Ethics Committee of the State University of Campinas (case 60511622.0.0000.5404). Written consent was obtained from all volunteers before the tests, after informing them about the experiment.

3.63. Flavonoid-Rich Plant Matrices Selectively Modulate Human Gut Microbiota: An Integrated In Vitro Analysis Using MICODE

Lorenzo Nissen [1,2], Davide Addazii [1], Alice Cattivelli [3], Davide Tagliazucchi [3] and Andrea Gianotti [1,2]

1 DiSTAL—Department of Agricultural and Food Sciences, Alma Mater Studiorum—University of Bologna, P.za G. Goidanich, 60, 47521 Cesena, Italy
2 CIRI—Interdepartmental Centre of Agri-Food Industrial Research, Alma Mater Studiorum—University of Bologna, P.za G. Goidanich, 60, 47521 Cesena, Italy
3 Department of Life Sciences, University of Modena and Reggio Emilia, Via Amendola, 2—Pad. Besta, 42100 Reggio Emilia, Italy

Phenolic compounds, especially flavonoids, are abundant in plant-based foods and are increasingly recognized for their interaction with the human gut microbiota (GM). This study explored the mutual relationship between dietary flavonoids and GM by assessing four flavonoid-rich food matrices (i.e., blonde orange, rooibos tea, dark chocolate, and blueberry), each enriched in specific flavonoid subclasses. After in vitro gastrointestinal digestion, samples underwent 48 h colonic fermentation using the standardized MICODE model inoculated with GM from 3 healthy donors. Microbial and metabolic responses were analyzed via qPCR, 16S rRNA sequencing, and SPME-GC-MS, while flavonoid bioaccessibility and biotransformation were quantified by means of high-resolution mass spectrometry. Blueberry showed the strongest prebiotic potential, increasing the abundance of beneficial taxa (*Bifidobacteriaceae*, *Faecalibacterium prausnitzii*, *Lactobacillales*, and *Akkermansia muciniphila*) and reducing the abundance of opportunistic groups (*Enterobacteriaceae*, *Desulfovibrio*, *Clostridium group I*). Orange and rooibos exhibited moderate activity, whereas dark chocolate displayed a mixed profile, enhancing some beneficial taxa but also supporting potential pathobionts. Metabolomic analysis revealed diverse low-molecular-weight phenolics resulting from microbial transformation, particularly 3-(3′-hydroxyphenyl)propanoic acid and valerolactones. Functional ecological indicators, including *Firmicutes/Bacteroidota* ratio, quantitative Prebiotic Index (qPI), and bifidogenic effects, validated blueberry's superior impact on GM eubiosis. This work confirms the role of flavonoid-rich foods in shaping GM structure and function and underscores the importance of polyphenol type and matrix. MICODE proved effective in elucidating the complex GM–metabolite–food. Future studies integrating meta-transcriptomics and host cell models are warranted to extend these findings to personalized nutrition strategies and microbiome-based dietary interventions.

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3.64. Food Applications of Grape Pomace: Nutritional, Antioxidant, and Functional Insights

Gonçalo Mendes [1], Manuela Lageiro [2,3,4], Maria Lídia Palma [1,5], Paula Pereira [5,6,7] and Marisa Nicolai [1,5]

1 Universidade Lusófona, Campo Grande 376, 1749-024 Lisboa, Portugal
2 INIAV—Instituto Nacional de Investigação Agrária e Veterinária, Unidade de Tecnologia e Inovação, 2780-157 Oeiras, Portugal
3 FCT-NOVA, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal
4 GeoBioTech Research Center, FCT-NOVA, Campus da Caparica, 2829-516 Caparica, Portugal
5 CBIOS—Research Center for Biosciences & Health Technologies, Universidade Lusófona, Campo Grande 376, 1749-024 Lisboa, Portugal
6 EPCV, School of Psychology and Life Science, Department of Life Sciences, Universidade Lusófona, Campo Grande 376, 1749-024 Lisboa, Portugal
7 CERENA, Center for Natural Resources and Environment, Instituto Superior Técnico (IST), Universidade de Lisboa, Av. Rovisco Pais, 1049-001 Lisboa, Portugal

The wine industry, a major player in the global agri-food sector, generates millions of tonnes of grape pomace annually as a by-product. Although rich in polyphenols, fiber, and antioxidants with proven health benefits, most pomace remains underutilized, often being discarded or repurposed as low-value compost or animal feed. This study highlights the untapped potential of grape pomace flour by analyzing its bioactive profile, emphasizing its viability for high-value applications in nutraceuticals, functional foods, and pharmaceuticals.

Six samples from two Portuguese grape varieties (Arinto and Touriga Nacional) were sourced from three wineries (Carmim, Cerrado da Porta, Mingorra) and analyzed. Total phenolic content (114.94–128.31 mg GAE/100 g) and flavonoids (452.74–2214.27 mg quercetin equivalents/100 g) were quantified spectrophotometrically, demonstrating potent antioxidant activity (FRAP: 110.56–543.00 μmol $FeSO_4$/100 g; DPPH: 586.93–698.71 μmol Trolox/100 g). Dietary fiber stood out (45.29–64.97%), surpassing many conventional sources, while HPLC analysis confirmed B-vitamins and calculated macronutrient profiles.

The findings reveal grape pomace as a sustainable, nutrient-dense ingredient. In food production, it could enrich baked goods, snacks, or supplements, leveraging its fiber for gut health and its polyphenols for oxidative stress reduction. Cosmetic applications include anti-aging serums, harnessing their free radical-scavenging properties. Pharmaceutical uses extend to anti-inflammatory formulations or controlled-release delivery systems, with emerging research supporting its role in mitigating metabolic syndrome and cognitive decline.

By transforming waste into value-added products, this approach aligns with circular economy principles, reducing environmental impact while creating new revenue streams for wineries. Further research should optimize extraction methods and evaluate bioavailability to maximize commercial adoption.

3.65. Formulation and Evaluation of Nitro Boost Beetroot Bites: A Natural Functional Food for Enhancing Athletic Performance and Cardiovascular Health

Sumaira Saeed [1], Jahan Zaib Ashraf [2], Kainat Saleem [3], Roheen Shahbaz [3], Sehar Sahrosh [3], Syeda Andleeb Zahra [3], Hassan Wakeel [3] and Anam Iqbal [3]

1 Università degli Studi della Campania "Luigi Vanvitelli", 81100 Caserta, Italy
2 Department of Agriculture, Food, Natural Resources and Engineering (DAFNE), University of Foggia, 71122 Foggia, Italy

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[3] Department of Human Nutrition and Dietetics, School of Health Sciences, University of Management and Technology, Lahore 54770, Pakistan

Athletes and individuals with cardiovascular concerns often rely on supplements to enhance their performance and heart health. However, there is a growing demand for natural, functional alternatives. This study aimed to develop Nitro Boost Beetroot Bites, a functional snack/food formulated using beetroot, jaggery, and coconut, to promote improved blood circulation, energy generation, and cardiovascular health. In this study, an observational research design was employed to compare a control group with an experimental group that consumed the product. Proximate analysis was performed for nutritional characterization, along with sensory analysis using a hedonic scale. The proximate analysis showed an increase in carbohydrates to 61.96 g and a decrease in protein content to 11 g in the experimental product. Despite these changes, the high nitrate content from beetroot is expected to contribute to enhanced athletic endurance and cardiovascular health. Despite these changes, the elevated nitrate levels of 47.31 g per serving in beetroot are anticipated to improve athletic endurance and cardiovascular health. In terms of organoleptic characteristics, including appearance, texture, taste, and overall acceptability, the scores given by those who consumed the formulated Nitro Boost Beetroot Bites were significantly higher than those given by the control group. Nitro Boost Beetroot Bites demonstrate potential as a natural, nitrate-dense supplement for enhancing athletic performance and cardiovascular health.

It is advised that the amount of Nitro Boost Bites consumed be kept to about 8.63 g daily to maintain a nitrate intake within the range of 0–3.7 mg/kg bodyweight, which is the ADI. Although sensory attributes have been enhanced, additional modifications to the formulation are necessary to equilibrate the nutritional content. Future clinical research is necessary to validate the long-term efficacy of the product and enhance its health advantages.

3.66. Fortification of a Lebanese "saj" Bread with Chia Seed Flour (Salvia hispanica L.)

Maha Krayem [1], Yulia Tatarinova [2], Reem Tlais [2] and Sanaa Khaled [1,2]

[1] Department of Biological Sciences, School of Arts and Sciences, Bekaa Campus, Lebanese International University, West Bekaa, Lebanon

[2] Department of Food Sciences and Technology, School of Arts and Sciences, Bekaa Campus, Lebanese International University, West Bekaa, Lebanon

Chia seeds are recognized for their high content of omega-3 fatty acids, dietary fiber, protein, and bioactive compounds. This study investigates the fortification of Lebanese saj bread with chia seed flour (*Salvia hispanica* L.) in order to enhance its nutritional profile and evaluate consumer perceptions toward functional bakery products. Bread samples were formulated by substituting wheat flour with chia flour at levels of 5%, 10%, 15%, 20%, and 25% (*w*/*w*), alongside a control. Sensory analysis was performed by a panel of nine trained assessors using a 9-point hedonic scale, while pH values and mold growth were evaluated to assess shelf life. Additionally, a validated questionnaire (n = 215) was administered to examine consumer awareness, attitudes, and willingness to purchase chia-fortified bread. The results indicated that fortification up to 10% maintained acceptable sensory qualities, while higher concentrations negatively affected texture and aroma. Nutritional value improved proportionally with chia content, although samples with $\geq$15% chia showed earlier mold growth (since day 3) compared to the control and lower levels of chia flour addition (since day 4). Survey data revealed strong consumer interest in functional foods, particularly among females, despite partial knowledge gaps. This study concludes that moderate chia flour incorporation can improve bread's nutritional and functional value without compromising consumer acceptance, offering a practical avenue for healthier bak-

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ery innovations. Recommendations include maintaining substitution at ≤10%, expanding microbial analysis, and enhancing consumer education on chia's health benefits.

3.67. Functional and Antimicrobial Properties of Camel Milk-Based Kefir: Physicochemical Stability and Biopreservation Potential

Mohamed Wahbi, Mohamed Amellal, Imad Achlaih, Ahmed Elidrissi, Abir El-Araby and Fouad Achemchem

Bioprocess and Environment Team, LASIME Laboratory, Agadir Superior School of Technology, University Ibn Zohr, BP 33/S, Agadir 80150, Morocco

Camel milk possesses unique nutritional and therapeutic properties, yet its valorization through fermentation remains limited, particularly in arid and semi-arid regions. This study aimed to assess the functional and antimicrobial potential of kefir produced from camel milk using kefir grains as a natural fermenting agent, without the addition of selected probiotic strains. Raw camel milk was aseptically collected, mildly pasteurized, and fermented at 22 °C for 48 h using 5% kefir grains. For comparison, traditional spontaneously fermented products—*lfrik* (camel milk) and *lben* (cow milk)—as well as cow milk kefir, were prepared under similar fermentation conditions. Physicochemical parameters, including the pH, titratable acidity, total solids (TSs), and water activity (aw), were measured. Microbial viability was assessed through the enumeration of lactic acid bacteria (LAB) on MRS agar. Camel milk kefir exhibited a final pH of 3.8–4.3, titratable acidity of 0.73% lactic acid equivalent, water activity of 0.992, and total solids of approximately 10%. These values remained stable after 24 h, indicating fermentation completion. During 15 days of cold storage at 4 °C, LAB counts were maintained around 7 log CFU/mL, demonstrating good microbiological stability. Challenge tests performed with *Listeria monocytogenes* CECT935 and *Staphylococcus aureus* ArFMSA019 revealed significant antimicrobial activity, with reductions of approximately 3 log CFU/mL and 4 log CFU/mL, respectively, after exposure to the kefir matrix. These results highlight the potential of camel milk kefir to ensure its own microbial stability and safety during storage through the action of its naturally occurring fermentative microbiota, without the need for added preservatives or antimicrobial agents, and without having direct antimicrobial effects on the consumer.

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3.68. Functional Properties and Antidiabetic Effects of Moroccan Bee Pollen

Fedoua Diai [1], Toufik Bouddine [2,3], Hassan Laaroussi [4], Charaf Eddine Kassimi [2,5], Mohamed Reda Kachmar [1,6], Ibtissame Guirrou [5], Said Chakir [1] and Lhoussain Hajji [1,3]

1 Valorisation of Medicinal and Aromatic Plants and Environment Team, Faculty of Sciences, Moulay Ismail University, Meknes, MA 50000, Morocco
2 Bioactive and Environmental Health Laboratory, Faculty of Sciences, Moulay Ismail University, Meknes, MA 50000, Morocco
3 Laboratory of Biotechnology and Bioresources Valorization, Faculty of Sciences, Moulay Ismail University, Meknes, MA 50000, Morocco
4 Laboratory of Biotechnology, Conservation and Valorization of Bioresources (BCVB), Api-Phytotherapy, Physiology, Environment and Health, Department of Biology, Faculty of Sciences Dhar Mehraz, Sidi Mohamed Ben Abdellah University, Fez 30000, Morocco
5 Agro-Food Technology and Quality Laboratory, Regional Center of Agricultural Research of Meknes, National Institute of Agricultural Research, Rabat, Morocco
6 High Institute of Nursing Professions and Health Techniques, Beni Mellal, MA 23000, Morocco

This comprehensive study evaluated the quality parameters and bioactive potential of eight bee pollen samples collected from different regions of Morocco, including Meknes, Tanger, and other geographical areas. Through rigorous physicochemical analysis, we determined key quality indicators: moisture content (15–28%), pH (4.2–5.0), water activity (0.3–0.4), and ash content (2.1–4.2%), all meeting international quality standards. Nutritional profiling revealed substantial protein content (16.36–29.12 mg/100 g) and significant concentrations of essential minerals, particularly potassium and magnesium, with only trace amounts of heavy metals detected in two samples.

Spectrophotometric analysis demonstrated remarkable phenolic (23.47 ± 0.80 mg GAE/g) and flavonoid (2.17 ± 0.26 mg QE/g) content, which correlated with strong antioxidant capacity as evidenced by DPPH radical scavenging activity (IC50: 40–60 μg/mL). HPLC characterisation identified gallic acid, caffeic acid, kaempferol, vanillic acid, and p-coumaric acid as the predominant polyphenolic compounds. Of particular therapeutic interest, the samples exhibited significant dose-dependent inhibition of carbohydrate-metabolising enzymes α-amylase (IC50: 195.09–963.79 μg/mL) and α-glucosidase (IC50: 90.99–876.24 μg/mL), suggesting potential applications in diabetes management.

These findings collectively highlight Moroccan bee pollen as a nutritionally dense, bioactive-rich natural product that meets global quality benchmarks. The demonstrated antioxidant and enzyme inhibitory properties, coupled with its favourable nutritional profile, position it as a promising candidate for functional food development and nutraceutical applications. This study provides a scientific foundation for the valorisation of Moroccan bee pollen and suggests directions for future research, including investigation of regional variations, in vivo studies, and potential commercial applications in the apiculture and health food industries.

3.69. Functional Sour Beer Development Using Apple Pomace: Evaluation of Pre-Fermentation and Co-Fermentation with Levilactobacillus brevis

Corina Maria Șutea [1], Elena Mudura [1], Carmen Rodica Pop [2], Petruț-Cristian Balaș [1], Ioana-Susana Macea [1], Mariana Mărginean [1], Elena Denisa Mândruț [1] and Teodora Emilia Coldea [1]

[1] Department of Food Engineering, Faculty of Food Science and Technology, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, 400372 Cluj-Napoca, Romania

[2] Department of Food Science, Faculty of Food Science and Technology, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, 400372 Cluj-Napoca, Romania

The increasing demand for sustainable and health-conscious fermented beverages has positioned sour beer as a compelling product for innovation. Apple pomace from "Golden Delicious" and "Pinova" varieties was sourced from a local orchard in Cluj-Napoca, Romania (46°48′23.26″N 23°35′18.05″E), and incorporated during wort boiling at ratios of 1:3, 1:5, and 1:10 (pomace to wort). Two fermentation approaches were employed: pre-fermentation with *Levilactobacillus brevis*, followed by alcoholic fermentation with *Saccharomyces cerevisiae*, and co-fermentation with both strains simultaneously. Control samples for both fermentation strategies were also made.

Fermentation kinetics were monitored through standard physicochemical parameters. Results showed that the presence of apple pomace contributes to a more pronounced acidification, as evidenced by a decrease in pH (from 4.25 to 4.06 in co-fermented samples and from 3.83 to 3.60 in the pre-fermented ones) and an increase in total titratable acidity (from 4.1 to 5.04 g/L lactic acid in pre-fermented conditions and from 2.5 to 3.01 g/L lactic acid in the co-fermented conditions). Regarding the alcohol content, the samples with

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pre-fermentation conditions and apple pomace had the lowest concentration (6.31 ± 0.04% ABV), but they had the highest value for total acidity (5.04 ± 0.07 g/L lactic acid). Apple pomace also affected the colour of the sour beer, making it lighter (from 15 EBC to 9 EBC in co-fermented conditions and from 13 EBC to 8 EBC in pre-fermented ones). The total polyphenol content was slightly higher in the co-fermented sour beers (0.459 mg GAE/mL) compared with pre-fermented beers (0.442 mg GAE/mL). The use of apple pomace from a local juice and cider producer supports sustainability by reducing food waste and promoting the circular use of local agro-resources. From a safety perspective, all fermentations were carried out under controlled conditions, ensuring the exclusion of contamination or spoilage.

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3.70. Green Pea Microgreens as Novel Foods: A Study on Nutritional Composition and Antioxidant Properties

Matilde Rodrigues [1], Cátia Magalhães [1,2] and José Pinela [1,3]

1 Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Campus Santa Apolónia, 5300-253 Bragança, Portugal
2 Escola Superior Agrária, Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal
3 National Institute for Agricultural and Veterinary Research (INIAV), I.P., Rua dos Lágidos, Lugar da Madalena, Vairão, 4485-655 Vila do Conde, Portugal

Microgreens have gained attention as promising functional foods due to their high concentrations of essential nutrients and bioactive compounds, which can contribute to diet diversification and the prevention of malnutrition. Among them, green pea (*Pisum sativum* L.) microgreens stand out for their nutritional value and appealing organoleptic properties [13,14]. However, a comprehensive characterization of their nutritional composition and bioactive properties is still limited. This study aimed to cultivate green pea microgreens and evaluate their nutritional profile and antioxidant activity. The microgreens were grown under greenhouse conditions using Siro Bio substrate (NPK 9:2:2, 2 kg/m^3), with irrigation via nebulization. They were harvested 25 days after sowing, and the emergence rate was monitored daily. Post-harvest, biomass yield and moisture content were determined. Chlorophyll content was analyzed via spectrophotometry, mineral composition was analyzed using atomic absorption spectrometry, and soluble sugars and organic acids were analyzed by means of high-performance liquid chromatography. A hydroethanolic extract was prepared to quantify total phenolics (Folin–Ciocalteu method) and evaluate antioxidant activity through DPPH free radical scavenging and TBARS formation inhibition assays [15]. The microgreens showed an emergence rate of approximately 80% and a predominance of chlorophyll *a* over chlorophyll *b*. Glucose was the sole detected soluble sugar (2.18 g/100 g dw). Among organic acids, oxalic (13.75 g/100 g dw), citric (0.51 g/100 g dw), and fumaric (0.02 g/100 g dw) acids were quantified, while ascorbic acid was found only in trace amounts. Mineral analysis revealed high levels of potassium (5.67 g/100 g dw), calcium (3.14 g/100 g dw), iron (10.17 mg/100 g dw), and zinc (6.38 mg/100 g dw), highlighting the microgreens' potential as a mineral-dense food. The hydroethanolic extract showed a total phenolic content of 133 mg GAE/g but demonstrated moderate antioxidant activity compared to the positive control, Trolox. This study expands the current knowledge on the nutritional value and antioxidant properties of green pea microgreens, reinforcing their suitability for inclusion in balanced and sustainable diets.

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3.71. Green-Engineered Zinc Fertilizers from Soy Proteins: Boosting Crop Nutrition with Low Environmental Impact

Andrea Crespo-Barreiro [1], Tamara Joglar [1], Carmen M.ª Granados-Carrera [2] and Mercedes Jiménez-Rosado [1]

1 Chemical, Environmental and Bioprocess Engineering Group, I4 Institute, University of León, 24071 León, Spain
2 Department of Chemical Engineering, Faculty of Chemistry, University of Seville, 41012 Seville, Spain

Introduction: Micronutrient malnutrition in crops is a persistent obstacle to global food security and the development of sustainable agricultural systems. Among micronutrients, zinc plays an important role in several biological processes affecting plant development, and its limitations in soil are widely known. In this context, the development of soy protein-based matrices as biofertilizers enriched with Zn emerges as an innovative and sustainable solution.

Methods: Soy protein-based biofertilizer matrices enriched with Zn were developed via incorporating (i) zinc sulphate ($ZnSO_4$-H_2O) as a reference inorganic salt, (ii) chemically synthesized Zn nanoparticles, and (iii) green nanoparticles synthesized with reducing agents of plant origin, using agro-industrial by-products. Nanoparticles were synthesized via colloidal precipitation using $ZnCl_2$ as a precursor and NaOH (chemical NPs) or a polyphenol-rich extract from pepper waste (green NPs) as reducing agents. The matrices were evaluated for controlled Zn release, physicochemical stability, water retention, and mechanical integrity, and tested in *Capsicum annuum* cultivation. A cradle-to-grave life cycle analysis (LCA) was also conducted to assess environmental impact.

Results: The green nanoparticle system exhibited superior performance in controlled Zn release, water retention, and mechanical stability. When tested in pepper cultivation, these matrices enhanced foliar Zn content and reduced irrigation needs without compromising plant growth. The LCA revealed that the green formulations had the lowest environmental impact compared to the other two strategies, with low energy demand, reduced Global Warming Potential (GWP), and lower toxicity. This was attributed to the use of eco-compatible synthesis routes and low-impact raw materials.

Conclusions: These results demonstrate that green-engineered soy protein carriers are a promising, scalable technology for crop biofortification. They contribute to more efficient, low-impact farming practices aligned with the goals of sustainable food systems.

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3.72. Hepatoprotective Effects of a Cricket-Enriched Pasta in an In Vitro Intestine–Liver Model Under Oxidative Stress Conditions

Mussa Makran [1], Leonardo Musto [1], Dario Mercatante [2], Ivan Albano [3], Maria Teresa Rodriguez-Estrada [2,4], Antonio Cilla [1] and Guadalupe Garcia-Llatas [1]

1 Nutrition and Food Science Area, Faculty of Pharmacy and Food Sciences, University of Valencia, Avda. Vicente Andrés Estellés s/n, Burjassot, 46100 Valencia, Spain
2 Department of Agricultural and Food Sciences, Alma Mater Studiorum-Università di Bologna, Viale Fanin 40, 40127 Bologna, Italy
3 Italian Cricket Farm, Via Vigone 20, 10060 Scalenghe, Italy
4 CIRI-Agrifood (Interdepartmental Centre of Industrial Agrifood Research), Alma Mater Studiorum-Università di Bologna, Piazza Goidanich 60, 47521 Cesena, Italy

Oxidative stress contributes to liver diseases by promoting inflammation and endothelial dysfunction. Edible insects like the house cricket (*Acheta domesticus*) are promising bioactive sources, but their hepatoprotective effects remain unknown. This study evaluated the hepatoprotective potential of 10% cricket-enriched pasta compared to conventional wheat pasta using an in vitro bicameral intestine–liver model. Simulated gastrointestinal digestion (INFOGEST 2.0) was performed to obtain the bioaccessible fractions (BFs) of pasta samples. Caco-2 cells were cultured on Transwell® inserts until differentiation (12 days), while HepG2 hepatocytes were seeded basolaterally and cultured for 48 h. After 24 h of apical exposure to the BFs (1/30, *v*/*v* diluted in DMEM), HepG2 cells were treated with *tert*-butyl hydroperoxide (800 µM) for 24 h to induce oxidative stress. Inflammatory cytokines (IL-10 and IL-1β), endothelial dysfunction markers (endothelin-1 and ICAM-1), and intracellular oxidative stress indicators (GSH/GSSG ratio, ophthalmic acid, *o*-Tyr/Phe ratio) were measured. Both pasta samples reduced the inflammatory response by increasing the anti-inflammatory IL-10 levels, with cricket pasta inducing a significantly greater increase (744%) compared to wheat pasta (255%). Only cricket pasta reduced the pro-inflammatory IL-1β secretion (20%). Regarding endothelial dysfunction, both pasta samples lowered endothelin-1 levels, with cricket pasta showing a greater effect (55% vs. 23%). Moreover, only cricket pasta significantly decreased ICAM-1 levels (10%), indicating enhanced endothelial protection. Neither pasta improved intracellular oxidative stress markers. However, wheat pasta increased ophthalmic acid (63%) and showed a non-significant trend toward a higher *o*-Tyr/Phe ratio (30%), both suggesting elevated oxidative stress. In contrast, cricket pasta maintained lower levels of these markers, supporting a more favorable redox profile. In conclusion, cricket-enriched pasta showed anti-inflammatory and endothelial-modulating effects in an in vitro liver injury model. Although oxidative stress was not improved, cricket pasta exhibited a more favorable redox response, underscoring the importance of food matrix composition in functional food design.

3.73. How the Processing of Sardines and Sprats Affects the Adhesion of Lactobacillus spp. in an Intestinal Cell Model

Barbora Lampova [1], Petr Šmíd [2] and Ivo Doskocil [1]

[1] Department of Microbiology, Nutrition and Dietetics, Czech University of Life Sciences Prague, Prague, Czech Republic

[2] Department of Chemistry, Czech University of Life Sciences Prague, Prague, Czech Republic

Culinary processing is an integral part of food preparation, affecting not only sensory properties but also the biological activity of nutrients. This study investigates how different thermal treatments of sardines (*Sardina* spp.) and sprats (*Sprattus* spp.)—rich sources of polyunsaturated fatty acids with proven anti-inflammatory and probiotic-modulating effects—influence the adhesion of selected probiotic strains to intestinal epithelial cells.

Samples of sardines and sprats were subjected to boiling, steaming, frying, and baking, with raw samples serving as controls. All samples were then digested using the standardised INFOGEST in vitro digestion protocol. After digestion, the samples were incubated with FITC-labelled probiotic strains (*Lactobacillus brevis*, *Lacticaseibacillus rhamnosus*, and *Lactobacillus gasseri*) on two epithelial co-culture models: Caco-2 + HT29 and Caco-2 + HT29-MTX. Adhesion was quantified via fluorescence measurement after washing off non-adherent bacteria.

The results showed that adhesion capacity was significantly influenced not only by the bacterial strain and cell model but, most notably, by the type of heat treatment. *L. rhamnosus* exhibited the highest adhesion, particularly on the Caco-2 + HT29 model, with increases exceeding 100% for raw sardine digests and nearly 95% for boiled samples compared to controls. In contrast, *L. gasseri* showed the lowest adhesion levels across all conditions,

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while *L. brevis* displayed moderate responses (e.g., over 50% increase with baked sprats and over 40% decrease with baked sardines).

Gentler cooking methods, such as boiling and steaming, enhanced bacterial adhesion, likely due to reduced protein denaturation and limited oxidation. These findings confirm the strain-specific nature of adhesion and highlight the importance of appropriate culinary processing for preserving the probiotic potential of foods. This knowledge may contribute to the development of functional foods aimed at supporting gut health.

3.74. Human Milk as a Growth Regulator of Infant Clostridia

Nikol Modrackova, Vera Neuzil Bunesova, Blanka Krausova and Eugenio Ingribelli

Department of Microbiology, Nutrition and Dietetics, Czech University of Life Sciences Prague, Kamycka 129, 6, 165 00 Prague, Czech Republic

Introduction: The neonatal gut undergoes massive microbial colonisation starting at birth, influenced by maternal microbiota, human milk, and the surrounding environment. Human milk, with its unique composition and antimicrobial properties, fosters a bifidobacteria-dominant microbiota, whereas formula-fed infants have a more diverse microbiome with often reduced bifidobacterial and increased clostridial representation. Despite their lower abundance and detection challenges, clostridia are among the important commensal members of the infant gut microbiota. This study investigates whether human milk affects the occurrence of clostridia at the species and strain level.

Methods: The growth ability of 30 infant strains of various clostridial species in pasteurised human milk, infant formula, control glucose–peptone, and a nutrient-poor medium was tested in microtiter plates at 37 °C under anaerobic conditions. After 24 h incubation, the cultivation counts were determined and related to the real inoculation dose.

Results: Human milk supported the growth of *C. perfringens*, while *C. tertium*, *C. butyricum*, *Clostridioides difficile*, and *Paeniclostridium sordellii* were inhibited, and *Paraclostridium bifermentans* only survived. Infant formulas allowed the growth of *C. perfringens*, *P. bifermentans*, and *C. tertium*. All strains tested used control medium, and some even used a nutrient-poor medium.

Conclusions: *C. perfringens* was the most competent in utilising human milk and infant formulas of all the clostridial species tested; however, this ability was highly strain-specific and likely reflected the origin of the strain and milk. Human milk appears to significantly regulate the growth of several clostridial species, except for *C. perfringens*, which probably possesses adaptive mechanisms that allow human milk utilisation despite milk's antimicrobial nature. These findings suggest a regulatory role of early nutrition in modulating the occurrence of clostridia in the infant gut.

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3.75. Hypoglycemic Effect of Alphas1-Casein Hydrolysates Extracted from Milk of Gir Cows

Sathish Kumar MH [1], Rajani CS [1], Kaustav Majumder [2], Prabhashis Bose [2] and Priyanka Singh Rao [1]

[1] ICAR-National Dairy Research Institute, Karnal, Haryana 132001, India
[2] Department of Food Science & Technology, University of Nebraska–Lincoln, Lincoln, NE 68588-6205, USA

Introduction: Recent research in food and nutrition sciences has explored milk peptides for their nutraceutical and therapeutic benefits. In this study, an attempt was made

to assess the hypoglycemic effect of αS1-casein (αS1-CSN) isolated from the milk of *Gir* through dipeptidyl peptidase—IV (DPP-IV) inhibition.

Methods: The enzymatic hydrolysis of extracted αS1-CSN was carried out using Flavourzyme, pepsin and trypsin individually at 1%, 2% and 4% enzyme–substrate (E-S) ratios for a period of 2–12 h. This hydrolysate was ultra-filtered through 10 and 3 kDa cutoff membranes in order to obtain low-molecular-weight peptides. Permeate of 3 kDa was subjected to preparatory RP-HPLC in order to collect time-bound fractions. Later, peptide sequencing was performed through LC-MS/MS. Furthermore, the α-CSN hydrolysate was assessed with a peptide transportation assay using the caco2 cell line model.

Results: The hydrolysate obtained from pepsin treatment after 4 h at a 4% E-S ratio showed maximum DPP-IV inhibition (92.08 ± 1.77%) with an IC_{50} value of 140.3 μg/mL, and the corresponding degree of hydrolysis was 11.22 ± 1.06%. A total of 45 time-based (collected every 30 s) peaks were recorded and evaluated for % DPP-IV inhibition; among them, fraction 27 showed the highest DPP-IV inhibition (65.31 ± 2.41%), and this fraction was subjected to UHPLC and LC-MS/MS analysis, through which 40 unique peptides were identified. Most of the peptides identified (~85%) belonged to the region of f193-213 and f137 to 154 in αS1-CSN. Among them, two low-molecular-weight peptides were synthesized, *viz.*, IPNPIGSENSE and IQKEDVPSE, and assessed for DPP-IV inhibition; later, one showed the lowest IC50 value of 1.67 mM. Cell viability was not affected by up to 100 μg of product per well, and about 10% of the peptides were transported from the apical to the basal chamber in a time of 2 h.

Conclusions: The developed hydrolysate of αS1-CSN could be a potential hypoglycemic product.

3.76. Impact of Apple Pomace Addition on the Chemical Composition of Blends and the Rheological Properties of Wheat Dough

Agata Wojciechowicz-Budzisz, Ewa Pejcz, Agata Milcarz, Oliwia Paroń, Patryk Słota, Rafał Wiśniewski and Joanna Harasym

Department of Biotechnology and Food Analysis, Wroclaw University of Economics and Business, Komandorska 118 Street, 53-345 Wrocław, Poland

The growing interest in reintroducing agro-industrial by-products into food production is driven by both environmental concerns and the demand for nutritionally enhanced products. Apple pomace, a by-product of juice processing, is rich in dietary fiber, polyphenols, and residual sugars and may serve as a functional ingredient in cereal-based formulations. This study evaluated the incorporation of apple pomace (5%, 10%, 15%, and 20% *w*/*w*) into two wheat-based raw materials—wheat flour type 750 and semolina—to assess its impact on flour composition and dough performance. Control samples consisting of 100% wheat flour or 100% semolina were also analyzed.

Chemical composition analyses, amylographic tests, Mixolab tests, and farinographic measurements were conducted to characterize both the flour blends and the resulting doughs. Our results showed that semolina-based blends had higher protein content (up to 12.2%), gluten yield (21.2%), and peak paste viscosity (1049 AU) compared to flour-based ones. However, as the proportion of apple pomace increased, a consistent decline in total protein content (down to 10.4%), gluten yield (down to 13.4%), and dough extensibility was observed, along with a marked increase in water absorption (from 54.7% to 62.9%).

These changes have significant implications for product development. Higher apple pomace levels impaired gluten quality, which may limit its use in breadmaking or other leavened applications. Nonetheless, lower inclusion levels (5–10%) maintained acceptable dough behavior, indicating potential for applications in pasta or flatbreads, where high extensibility is not critical.

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This study highlights the potential of apple pomace as a sustainable, value-added ingredient that supports circular economy strategies in the food industry. Its use in cereal-based formulations can contribute to both nutritional enhancement and by-product valorization, provided that functional properties are carefully optimized depending on the target application.

3.77. Impact of Millet and Agro-Industrial By-Products on the Technological Quality and Shelf Life of Gluten-Free Breads

Karen Florencia Irigoytia [1,2], Carolina Elizabeth Genevois [1,2] and Marina Francisca de Escalada Pla [2,3]

1 Institute of Food Science and Technology of Entre Ríos (ICTAER, CONICET-UNER), Pte. Perón 1154, Gualeguaychú E2820, Argentina
2 National Scientific and Technical Research Council (CONICET), Godoy Cruz 2290, Autonomous City of Buenos Aires C1425FQB, Argentina
3 Institute of Food Technology and Chemical Processes (ITAPROQ, CONICET-UBA), Intendente Güiraldes 2160, Autonomous City of Buenos Aires C1428EGA, Argentina

Gluten-free breads (GFBs) are usually formulated with refined flours, starches, or premixes that are low in fibre, micronutrients, and have a high glycaemic index. In addition, these formulations often stale rapidly, leading to crumb hardness, reducing shelf life, and decreasing consumer acceptance. This study aimed to evaluate the effect of gluten-free raw materials such as rice bran (RB), millet, and extruded soybean expeller (SEE) on the staling kinetics and physico-chemical quality of GFBs. Millet and SEE were milled using an HC-1000Y mill (Arcano, China) and then sieved together with RB through an 840 µm mesh (Zonytest, Argentina). Two GFB formulations were prepared: optimal (GFB-O) and control (GFB-C). Both contained xanthan gum (0.5%), sunflower oil (6%), salt (2%), sugar (5%), and dry yeast (3%). GFB-O included 15% each of RB, millet, and SEE and rice flour (22.5%), corn starch (32.5%), and water (115%), while GFB-C was made with 100% corn starch and 90% water. Moisture content (AACC, 2000), water activity, and crumb hardness (peak force during the first compression cycle of the texture profile analysis) were evaluated during storage (0–168 h, 25 °C, 70% RH, LDPE bags). Hardness data were fitted to the Avrami equation to model staling kinetics. ANOVA with Fisher's LSD test (95% confidence) revealed significant effects of formulation and storage time on crumb water activity, moisture, and hardness ($p < 0.0001$). GFB-O exhibited lower crumb hardness and improved moisture retention throughout the storage period. Avrami modelling supported this, showing that GFB-O had a lower final hardness (Finf = 23.4 N), lower rate constant ($k = 0.035\ h^{-n}$), and exponent (n = 0.24), indicating a slower staling process and prolonged freshness. In contrast, GFB-C showed Finf ≈ 120 N, $k = 0.05\ h^{-n}$, and n = 1, consistent with faster staling. These results demonstrate that the addition of RB, millet, and SEE could modify the bread matrix, improving the technological properties and shelf life of FGFs.

3.78. Impact of Protein-Enriched Soy Milk on Phenolic Bioaccessibility and Antioxidant Capacity of Coffee Pulp Infusions

Miguel Rebollo-Hernanz [1,2], Silvia Gomez-Pontes [2], Silvia Cañas [1,2], Shuai Hu [2], Vanesa Benitez [1,2], Alicia Gil-Ramirez [1,2] and Maria A. Martin-Cabrejas [1,2]

1 Department of Production and Characterization of Novel Foods, Institute of Food Science Research (CIAL, CSIC-UAM), 28049 Madrid, Spain
2 Department of Agricultural Chemistry and Food Science, Faculty of Science, Universidad Autónoma de Madrid, 28049 Madrid, Spain

Coffee pulp is a phenolic-rich by-product with antioxidant potential; however, its use in functional foods may be restricted by stability and bioaccessibility issues. This study

aimed to evaluate how the incorporation of protein-enriched soy milk influences a coffee pulp infusion's digestibility and functional performance.

Eleven formulations were prepared by modifying both the proportion of soy milk added to the infusion (0–30%) and the protein content in the soy milk (3.9–11.7%), based on a central composite circumscribed design (CCC) within a response surface methodology (RSM) framework, to model and predict the effects of these two variables on the stability and bioaccessibility of phenolic compounds. The samples underwent standardized in vitro gastrointestinal digestion following the INFOGEST protocol. Total phenolic content (TPC), total flavonoid content (TFC), and antioxidant capacity (ABTS and FRAP) were determined before and after digestion.

The statistical models exhibited high validity and predictive performance (R^2 and $Q^2 > 0.9$ in most cases), capturing the complex influence of both the proportion of soy milk and its protein enrichment on the behavior of phenolic compounds during digestion. In particular, quadratic effects and protein–soy interactions accounted for a significant proportion of the explained variance, up to 65.5% in some cases, highlighting the nonlinear and synergistic nature of the formulation's impact on antioxidant functionality. The results showed that a formulation containing 18% soy milk and 9.4% protein yielded the optimal functional profile, favoring the bioaccessibility of phenolics and their antioxidant capacity, likely due to interactions with soy proteins that enhance compound stability and release during digestion. Compared to the infusion without soy, the optimized formulation led to post-digestion bioaccessibility improvements of 33% for TPC, 46% for TFC, 51% for ABTS, and 42% for FRAP.

This study highlights the value of plant-based matrices and multivariate modeling for enhancing and optimizing polyphenol-rich functional beverages.

3.79. Impact of Roasting on the Amino Acid Profile of Pumpkin Seeds (Cucurbita moschata)

Agustín Serrudo [1], María Natalia Oviedo [2], Roxana Elizabeth Gonzalez [3] and Pamela Yanina Quintas [4]

1 Facultad de Ciencias Exactas y Naturales (FCEN), Universidad Nacional de Cuyo (CUYO), Mendoza M5500, Argentina
2 Laboratorio de Química Analítica para Investigación y Desarrollo (QUIANID), Facultad de Ciencias Exactas y Naturales, Universidad Nacional de Cuyo/Instituto Interdisciplinario de Ciencias Básicas (ICB), CONICET UNCUYO, Mendoza M5500, Argentina
3 EEA La Consulta, Instituto Nacional de Tecnología Agropecuaria (INTA), Mendoza M5567, Argentina
4 Instituto de Investigación y Desarrollo en Ingeniería de Procesos, Biotecnología y Energías Alternativas, PROBIEN (CONICET-UNCo), Facultad de Ingeniería, Universidad Nacional del Comahue, Neuquén Q8300, Argentina

Pumpkin (*Cucurbita moschata*) is recognized as a functional food due to its rich content of nutrients and bioactive compounds with health-promoting properties. Its seeds, often discarded, are a valuable source of lipids, proteins, fiber, minerals, vitamins, carotenoids, phytosterols, tocopherols, and polyphenols. Notably, their high protein content results in a significant concentration of amino acids (AAs), essential for various metabolic and physiological processes. Roasting is a traditional cooking method that can enhance sensory attributes and improve the bioaccessibility and bioavailability of nutrients and phytochemicals, including AAs. This study aims to evaluate the impact of traditional roasting methods on the AA profile of pumpkin seeds (*Cucurbita moschata*) from the Cuyano INTA and Cokena INTA cultivars. Seeds were roasted in a non-stick pan (180 °C, 10 min) and an oven (180 °C, 15 min). Protein-bound AAs were extracted following the AOAC method 994.12 and quantified by means of RP-UHPLC. Twenty AAs, including the essential ones,

were identified. ANOVA showed significant differences in AA levels among cultivars and treatments; however, no significant interaction was observed. Cooking treatment explained 60.69% of the variation, while cultivar accounted for 15.23%, indicating that the roasting method was the dominant factor. Seeds of Cuyano INTA exhibited the highest AA concentrations. For essential AAs, Cuyano INTA seeds had 1.8 times higher levels than Cokena INTA (14.77 vs. 8.39 mg g^{-1}). Roasting significantly affected the AA composition, especially affecting heat-sensitive AAs. Compared to raw seeds, roasting caused AA losses of up to 50%. These findings demonstrate that roasting strongly influences the nutritional quality of pumpkin seeds, with potential implications for their use in functional foods and dietary applications.

3.80. Impact of Sodium and Starch Reduction on the Mineral Profile and Bioaccessibility of Mortadella Enriched with Agaricus bisporus and Pleurotus ostreatus By-Products

Patricia Bermúdez Gómez [1], Manuel Viuda Martos [2], Juana Fernández López [2], Raquel Lucas González [2] and Margarita Pérez Clavijo [1]

1 Mushroom Technological Research Center of La Rioja (CTICH), Carretera Calahorra, km 4, 26560 Autol, La Rioja, Spain

2 Institute for Agri-Food and Agri-Environmental Research and Innovation, Miguel Hernández University (CIAGRO-UMH), Ctra. Beniel km 3.2, 03312 Orihuela, Alicante, Spain

Mushroom stems, which represent around 20% of total mushroom production, are frequently discarded despite their valuable nutritional content. At the same time, high sodium consumption—primarily from processed foods—continues to pose a major global public health issue. This study addresses both global problems by investigating the application of edible flours obtained by dehydrating the stems of *Agaricus bisporus* (ABSF) and *Pleurotus ostreatus* (POSF) as partial replacements for sodium chloride, sodium tripolyphosphate, and potato starch in *mortadella* formulations.

Five prototypes were produced: one control with a traditional recipe; two formulations with a 50% sodium reduction and potato starch substitution using either ABSF or POSF; and two with a 50% sodium reduction along with a complete (100%) replacement of potato starch using the same mushroom flours. Mineral analysis was conducted on all *mortadella* samples using ICP-MS. All prototypes were digested following the INFOGEST method, and the mineral profile was also determined in all intestinal phases of the *mortadella* digestion to calculate mineral bioaccessibility.

Results demonstrated an effective sodium reduction of up to 49%, qualifying the reformulated products for a "reduced sodium" label under European Regulation (EC) No. 1924/2006. The ABSF formulation notably increased calcium content (from 13.22 to 37.71 mg/100 g, $p < 0.05$). However, in vitro digestion tests showed that calcium and zinc bioaccessibility remained below quantification limits in all samples. In contrast, the bioaccessibility of copper, magnesium, and manganese significantly increased in the mushroom-enriched samples compared to the control.

These results highlight the promising role of mushroom stem flours as sustainable ingredients for the reformulation of processed meat products. Their incorporation not only improves the nutritional profile—particularly through sodium reduction and mineral enhancement—but also increases the bioaccessibility of copper, magnesium, and manganese. This study aligns with the principles of sustainability and circular economy by revalorizing an underutilized agro-industrial by-product.

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3.81. Impact of Thermal Processing and Simulated Digestion on Polyphenol Content, Antioxidant Activity, and Enzyme Inhibition of Fenugreek Seeds

Laryssa Peres Fabbri, Andrea Cavallero and Morena Gabriele

National Research Council of Italy (CNR), Institute of Biology and Agricultural Biotechnology (IBBA), 56124 Pisa, Italy

Fenugreek (*Trigonella foenum-graecum L.*) seeds are rich in polyphenols and flavonoids, which are compounds known for their antioxidant and enzyme-inhibitory activities and relevant to metabolic health. This study evaluated the effects of soaking and roasting, followed by simulated gastrointestinal digestion, on the bioactive profiles of fenugreek seeds.

Seeds were divided into two groups: raw (R) and soaked-roasted (SR) seeds. Each group was subjected to one of three treatments: no digestion (control), gastric digestion, or complete digestion (gastric plus intestinal phases). Total polyphenol and flavonoid contents were measured, alongside antioxidant capacity via FRAP and ORAC assays, and inhibitory activity was assessed against pancreatic lipase and α-amylase enzymes. Flavonoid levels remained stable throughout processing and digestion, whereas total polyphenols significantly increased during digestion, especially in the intestinal phase, reaching up to 17.86 mg GAE/g. Antioxidant activity showed differing trends: raw seeds had higher FRAP values (8.86 mg Fe^{2+}/g), while processed seeds exhibited greater ORAC values (143.96 vs. 117.65 μmol TE/g). Simulated digestion enhanced antioxidant capacity in both groups, peaking after intestinal digestion, with a strong positive correlation between total polyphenols and ORAC. Thermal processing greatly reduced pancreatic lipase inhibition from 82.64% to 7.98%, although gastric digestion partially restored activity in processed seeds (51.01%). No lipase inhibition was detected after intestinal digestion. α-Amylase inhibition was only observed after intestinal digestion, with raw extracts showing higher inhibition (73.17%) than processed extracts (25.05%), indicating heat sensitivity of the bioactive compounds.

These results highlight that gastrointestinal digestion, particularly the intestinal phase, enhances polyphenol bioaccessibility and antioxidant potential, while enzyme inhibitory effects are more vulnerable to thermal processing and digestion. This provides useful insights into designing fenugreek-based functional supplements for metabolic health.

3.82. Impacts of Tropical Climate and Foraging Bee Species on Antioxidant Capacity of Stingless Bee Honey

Choon Boq Loo [1], Wen Jie Ng [2,3] and Tuck Meng Lim [4,5]

1 Faculty of Science, Universiti Tunku Abdul Rahman, Kampar 31900, Perak, Malaysia
2 Department of Allied Health Sciences, Faculty of Science, Universiti Tunku Abdul Rahman, Kampar 31900, Perak, Malaysia
3 Centre for Biomedical and Nutrition Research, Universiti Tunku Abdul Rahman, Kampar 31900, Perak, Malaysia
4 Department of Chemical Science, Faculty of Science, Universiti Tunku Abdul Rahman, Kampar 31900, Perak, Malaysia
5 Centre for Agriculture and Food Research, Universiti Tunku Abdul Rahman, Kampar 31900, Perak, Malaysia

Stingless bee honey is a functional food increasingly valued for its distinctive taste and diverse health-promoting properties. Although its antioxidant activity is well documented, the influence of the climatic conditions and bee species on its bioactive properties remains underexplored. This study investigated the effects of seasonal variation and the bee species on the antioxidant capacity of stingless bee honey under a tropical climate. Honey samples were collected throughout the year, during both the dry and rainy sea-

sons. A comprehensive set of antioxidant assays was employed, including assays for the total phenolic content, ABTS, DPPH, superoxide anion and nitric oxide radical scavenging activities, iron-chelating activity, and ferric reducing antioxidant power (FRAP). Honey samples collected during the dry season exhibited a higher overall antioxidant capacity than those from the rainy season. Despite this trend, statistical analysis revealed no significant differences between the seasons, likely due to the consistently warm and humid conditions provided by the tropical climate. In contrast, the bee species showed a notable impact. Chaste tree honey produced by *Heterotrigona itama* showed significantly greater nitric oxide scavenging activity (365.31 ± 64.62%) and FRAP (1.90 ± 0.39 mmol Fe (II)/kg) than honey with the same botanical origin produced by *Geniotrigona thoracica* (276.55 ± 61.39%; 1.47 ± 0.43 mmol Fe (II)/kg), highlighting the considerable influence of the bee species on the antioxidant potential. These findings suggest that the stingless bee species contributes more substantially to the antioxidant profile than seasonal variation in tropical climates. These findings offer valuable insights for the industry into optimizing stingless bee honey production, particularly improving its nutritional and functional value as a health-enhancing food product.

3.83. Indian Almond Leaf (Terminalia catappa L.) Extract as Natural Antioxidant in Food Systems: Extraction, Estimation and Application

Simmi Jain and Anjali Ajith

Food Technology and Management, M.O.P. Vaishnav College for Women, Chennai, India

Indian almond leaves (*Terminalia catappa L.)* are a good source of natural antioxidants, including flavonoids and polyphenols. This study utilized the antioxidant potential and application of Indian almond leaf extracts in a food system. Indian almond leaf powder was extracted using ethanol and water at a 1:10 ratio, then concentrated. The phytochemical contents, namely Total Phenolic Content (TPC) and Total Flavonoid Content (TFC), were analysed using the Folin–Ciocalteu reagent method and the aluminium chloride ($AlCl_3$) reagent method, respectively, whereas antioxidant activity was analysed using $DPPH^+$ radical-scavenging activity. The extracts were then infused into coconut oil at different concentrations (200 ppm and 400 ppm, namely Sample 1 and Sample 2) and stored. After repetitive frying (with the same oil being reused for frying 4 times each day, at 6 min intervals per session), oil stability was monitored by measuring peroxide value, free fatty acids, refractive index and thiobarbituric acid value (TBA). These were compared to the standard, synthetic antioxidant, Tert-butylhydroquinone (TBHQ). By day 3, the peroxide values were 4 meq/kg and 2 meq/kg, FFA values were 0.6768% and 0.5076%, RI values were 1.5617 and 1.5613, and TBA values were 0.035 and 0.0262 for the standard and samples (1 and 2), respectively. This study substantiates the efficacy of *Terminalia catappa L.* (Indian almond) leaf extract powder as a potent natural antioxidant, demonstrating its significant ability to enhance oil stability and inhibit oxidative degradation. The extract showed comparable, and in some cases superior, performance to conventional synthetic antioxidants, even at lower concentrations. These findings not only address the rising demand for clean-label and naturally derived food additives but also underscore the extract's commercial viability due to its cost-effectiveness and ease of integration into existing food processing systems. In addition, its origin from plant-based waste material further adds to its sustainability profile, making it an attractive alternative in efforts to reduce dependency on synthetic preservatives.

3.84. Influence of Dairy Production Systems on Milk Fatty Acid and Mineral Profiles

Laura Sanjulián, Salvador Fernández-Rico, Nerea González-Rodríguez, Cristina Fente, Alexandre Lamas and Patricia Regal

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Food Hygiene, Inspection and Control Laboratory (LHICA), Department of Analytical Chemistry, Nutrition and Bromatology, Veterinary School, Campus Terra, Universidade de Santiago de Compostela, 27002 Lugo, Spain

Introduction: In recent years, there has been a diversification of dairy production systems, with the emergence of practices such as robotic milking, pasture-based milk, and organic production. The objective of this study is to evaluate how different dairy production systems affect the fatty acid and mineral profiles of milk.

Methods: A total of 40 bulk tank milk samples were collected from four production systems: conventional intensive (n = 10), intensive with robotic milking (n = 10), pasture-based (n = 10), and organic. Fatty acid profiles were analyzed using GC-FID, while mineral content (Na, Ca, K, P, Mg, and I) was determined by ICP-MS. Statistical analysis was performed using R (version 4.4.2), employing ANOVA combined with Fisher's LSD test for multiple comparisons.

Results: Significant differences were observed in the fatty acid profiles among the different production systems. Oleic acid levels were significantly lower (p 0.05) in milk from intensive systems, while linoleic acid levels were significantly lower in pasture-based milk ($p < 0.05$). Conversely, levels of linolenic acid and eicosenoic acid were significantly higher ($p < 0.05$) in organic milk. Although not statistically significant, the atherogenic index was higher in milk from intensive systems compared to the other production types, particularly when compared to pasture-based systems. Regarding minerals, sodium levels were significantly higher ($p < 0.05$) in organic (364.51 $\pm$ 38.73 mg/kg) and pasture-based milk (360.42 $\pm$ 25.87 mg/kg). Phosphorus levels were lower in pasture-based milk (945.09 $\pm$ 47.92 mg/kg) compared to milk from intensive systems (991.95 $\pm$ 58.56 mg/kg). Iodine levels were significantly lower in organic (0.07 $\pm$ 0.04 mg/kg) and pasture-based production (0.10 $\pm$ 0.04 mg/kg).

Conclusions: The type of dairy production systems has a clear impact on the nutritional profile of milk. Identifying the optimal production conditions to achieve the best nutritional profile may help improve consumer health.

3.85. Investigating the Role of Probiotic Lactic Acid Bacteria Strains in Improving the Antioxidant Properties of Fermented White Cabbage

Jesica Blajman [1,2], Pierina Scarafia [2], María Estela Tarchini [2], Ariel Risso [1], Melisa Puntillo [3], Roxana Paez [1] and Mariana Lingua [1]

1 Instituto de Investigación de la Cadena Láctea (IdICaL, CONICET-INTA), Ruta 34 Km. 227, Rafaela CP 2300, Santa Fe, Argentina
2 Universidad Nacional de Rafaela, Bv. Presidente Julio A. Roca 989, Rafaela CP 2300, Santa Fe, Argentina
3 Instituto de Lactología Industrial (INLAIN, CONICET-UNL), Santiago del Estero 2829, CP 3000, Santa Fe, Argentina

Administration of probiotic cultures would increase the functional attributes of plant-based matrices and consequently the competitiveness of production. Hence, the current study investigated the antioxidant properties of sauerkraut utilising natural fermentation or the commercial probiotic strains, *Lactiplantibacillus plantarum* 01 (LP01) and *Lacticaseibacillus rhamnosus* 04 (LR04) (Probiotical SpA, Novara, Italy), as single starter cultures.

White cabbages were shredded, mixed with sea salt (2.0% w/v), and packed into glass jars. The experimental samples were inoculated with spray-dried LP01 or LR04 (1×10^6 cfu/g of sauerkraut) and compared to a non-inoculated control group. Sauerkraut was fermented under anaerobic conditions at 20 °C. The Folin–Ciocalteu method was used for the determination of total phenolic content (TPC) at 0, 21, and 28 days. The in vitro

antioxidant capacity was assessed using ferric reducing antioxidant power (FRAP assay) and free radical scavenging activity (ABTS and DPPH assays).

The highest TPC (202.38 mg GAE/100 g DW), FRAP (205.3 mg GAE/100 g DW), and DPPH (57.5 mg GAE/100 g DW) values were observed in LP01 samples at day 21, but the amount declined for LP01 and LR04 groups at the final fermentation stage ($p \leq 0.05$). In this sense, excessive fermentation time may result in nutrient depletion, which can negatively affect the vitality of fermenting microorganisms and consequently the antioxidant activity. Regarding the ABTS assay, control values at day 21 were similar to those obtained with LP01 and LR04 treatments ($p \geq 0.05$). However, at day 28, ABTS scavenging activity was higher for naturally fermented cabbages (542.4 mg GAE/100 g DW) ($p \leq 0.05$).

In light of the growing consumer interest in vegetable-based functional foods, cabbage fermentation with LP01 for 21 days presents an opportunity to create a probiotic-rich sauerkraut that increases TPC and antioxidant activity estimated by FRAP and DPPH methods.

3.86. Isopropyl Cinnamate Prolongs the Lifespan of C. elegans, Promising Functional Foods

Yijin Chen, Ruofei Li, Zhuo Cheng, Haomiao Ma, Yan Pan and Bo Xian

Laboratory of Aging Research, School of Medicine, University of Electronic Science and Technology of China, Chengdu 610072, China

Isopropyl cinnamate is widely used in food flavors as a compound with a specific flavor. Its homologous derivatives exhibit anti-aging potential to reduce the accumulation of reactive oxygen species. In the context of accelerated global aging, the development of novel anti-aging functional food ingredients has become a research hotspot. Caenorhabditis elegans are ideal models for aging research because of their short life cycle and highly homologous genomes with humans. In this study, the anti-aging efficacy of isopropyl cinnamate and its potential mechanism in the field of oxidative damage were investigated usingCaenorhabditis elegan as a model organism. The results of longevity experiments showed that isopropyl cinnamate treatment significantly prolonged Caenorhabditis elegan lifespan among four groups, with the best effect in the 50 μM group. Through network pharmacological analysis, molecular docking simulation and pathway enrichment analysis, this study revealed the potential mechanism of action of isopropyl cinnamate: it may target the active site of PDE4A and effectively inhibit its hydrolytic activity. This inhibition led to an increase in intracellular cAMP levels, which in turn activated the downstream PKA/CREB signaling axis, ultimately promoting the expression of antioxidant enzyme genes and significantly attenuating ROS-mediated oxidative damage. Studies have shown that isopropyl cinnamate can prolong the lifespan of Caenorhabditis elegans and has great anti-aging potential. Isopropyl cinnamate is not only used for food flavouring, but also has the prospect of becoming a new anti-aging food ingredient, which is of great significance in promoting the development of anti-aging functional foods. It should be noted that the present study is mainly based on Caenorhabditis elegans modeling, and the generalizability of its targets and mechanisms in mammalian systems and the specific molecular details need to be verified by further in vitro and in vivo experiments.

3.87. Maternal Fructose Intake Worsens the Detrimental Effects of Tagatose Consumption in Rat Male Descendants

Madelín Pérez Armas, Elena Fauste Alonso, Cristina Donis, Paola Otero, Mª Isabel Panadero and Carlos Bocos De Prada

Facultad de Farmacia, Universidad San Pablo-CEU, CEU Universities, Montepríncipe, Boadilla del Monte, 28668 Madrid, Spain

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Introduction: We have previously shown that maternal fructose consumption induces harmful effects in foetuses, which remain present in adulthood. However, this sugar is not contraindicated during pregnancy. On the other hand, the use of low-caloric sweeteners such as tagatose is worldwide recommended. Given this background, we have studied whether the consumption of tagatose compared to fructose affects lipid metabolism in the offspring of mothers who were supplemented with fructose during their pregnancy.

Methods: Three-month-old male offspring from control or fructose mothers received liquid 10% fructose or tagatose for 21 days. A control group (without any additive) was also performed. Biochemical and molecular parameters were determined in plasma, tissues and feces.

Results: Both tagatose and fructose consumption caused hypertriglyceridemia in descendants of fructose-fed mothers. Whereas fructose consumption led to a greater hepatic lipogenesis, tagatose supplementation provoked a higher enterohepatic bile acids recirculation, a greater expression in genes involved in intestinal lipid absorption, and lower faecal triglyceride levels. Moreover, GLP1 is a molecule that affects lipid intestinal absorption, with its production dependent on bile acid and sugar concentration. Curiously, although proglucagon gene expression was stimulated by tagatose in fructose-fed mother descendants, plasma GLP1 was unchanged. However, FGF21, a molecule sensitive to GLP1 that regulates lipid metabolism, was augmented in the plasma and liver of tagatose-supplemented descendants regardless of their maternal diet. Searching for the mechanism explaining this tagatose-mediated effect, neither ChREBP nor PPARa signalling seemed to be involved. Interestingly, Angiotensin 2 (Ang2), which is also able to induce FGF21 production to counteract its harmful actions, was increased in the plasma of all animals that ingested tagatose. However, the deleterious effects of Ang2 were not effectively reversed by FGF21 in descendants of fructose-fed dams.

Conclusions: Maternal fructose consumption determines the response of the offspring to tagatose intake, causing an increased intestinal lipid absorption, dyslipidaemia and steatosis.

3.88. Metabolomic and Phytochemical Characterization of Kombucha Prepared from Butea monosperma (Palash) Flower Tea

Suman Bharti, Dinesh Chandra Rai and Arvind Kumar

Department of Dairy Science and Food Technology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi 221005, India

This study explores the development and characterization of a kombucha beverage prepared using *Butea monosperma* (Palash) flower tea as an alternative substrate to conventional black or green tea. *B. monosperma* is a traditional Indian medicinal flower known for its rich content of flavonoids and polyphenols. The objectives were to assess the metabolomic and phytochemical changes that occur during a 14-day fermentation period, as well as the sensory qualities of the product.

A sweet infusion (unfermented tea) of *B. monosperma* flowers was prepared and fermented (kombucha) using a symbiotic culture of bacteria and yeast (SCOBY) under controlled conditions. The fermentation process significantly reduced pH from 3.32 to 2.72 and decreased total soluble solids from 11 to 5 °Brix, while titratable acidity increased to 1.95%. Antioxidant activity markedly improved, with DPPH radical scavenging rising from 55.56% in the unfermented tea to 78.34% in the fermented product. Total phenolic content increased from 126.77 to 263.54 mg GAE/100 g, indicating enhanced bioactive potential. Additionally, unfermented tea's total flavonoid content increased from 18.34 mg QE/mL to 98.12 mg QE/mL in kombucha.

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ATR-FTIR spectroscopy confirmed the formation of functional compounds, including hydroxyl, carbonyl, and aromatic groups, indicative of the development of organic acids and polyphenols. HRAMS analysis identified newly formed metabolites, such as homobutein 4-glucoside, quercetin-3β-D-glucoside, and salicylic acid derivatives, which were absent in the unfermented infusion, supporting robust microbial biotransformation and metabolic enrichment.

Sensory evaluation revealed higher panelist preference for the flower kombucha beverage in terms of mouthfeel, aroma, and overall acceptability compared to green tea kombucha.

In conclusion, *B. monosperma* flower kombucha exhibits a strong antioxidant potential, a strong phenolic profile, and a good sensory profile. This study illustrates how fermentation technology can successfully transform traditional Indian botanicals into novel, health-conscious functional drinks.

3.89. Microbiological Evaluation of Seaweed-Enriched Meatballs as a Strategy to Enhance Iodine Intake

Ana Sofia Rodrigues [1], Cátia Morgado [1,2], Mafalda Alexandra Silva [3,4], Gilberto Costa [1,2], Carlos Brandão [1,2], Helena Soares Costa [3,4] and Tânia Gonçalves Albuquerque [1,3,4]

1 Estoril Higher Institute for Tourism and Hotel Studies, Estoril, 2769-510 Estoril, Portugal
2 Centre for Tourism Research, Development and Innovation (CiTUR) Estoril, Estoril, 2769-510 Estoril, Portugal
3 Department of Food and Nutrition, National Institute of Health Dr. Ricardo Jorge, Lisbon, 1649-016 Lisbon, Portugal
4 REQUIMTE-LAQV/Faculty of Pharmacy, University of Porto, Porto, 4050-313 Porto, Portugal

Introduction: Iodine deficiency continues to affect populations globally, and seaweeds have emerged as natural, sustainable sources of this essential micronutrient. Their incorporation into conventional food products, such as meatballs, represents a promising strategy to develop functional foods with enhanced nutritional profiles.

Objectives: To develop a functional food product, meatballs were enriched with edible seaweeds (*Undaria pinnatifida* and *Himanthalia elongata*), aimed at improving iodine intake and to assess their microbiological quality according to current food safety standards.

Methodology: Six meatball samples were prepared: two control samples without seaweed (sautéed and oven-baked) and four seaweed-enriched samples using both preparation methods. Microbiological analysis was conducted following the guidelines from the Portuguese National Institute of Health (INSA, 2019) and Regulation (EC) No 2073/2005. The parameters evaluated included *Listeria* spp., *Listeria monocytogenes*, *Pseudomonas* spp., *Staphylococcus aureus*, *Bacillus cereus*, moulds, yeasts, *Enterobacteriaceae*, total viable counts, *Escherichia coli*, and *Clostridium perfringens*.

Results: Most samples were microbiologically satisfactory. However, all tested samples showed unsatisfactory results for *Listeria monocytogenes*, which may indicate environmental or cross-contamination, inadequate surface sanitation, or handling deficiencies. Additionally, the sautéed *Himanthalia elongata* sample presented an unsatisfactory total viable count (8.9×10^4 cfu/g), potentially due to poor raw material quality, thermal processing failure, or cold chain disruption.

Conclusions: Although seaweed incorporation can enhance the nutritional profile of meat-based products, these findings highlight the need for strict hygienic measures during formulation and processing. Corrective actions are essential to mitigate microbial risks and ensure product safety without compromising functional benefits.

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3.90. Millets as Natural Functional Food with Medicinal Properties: An Updated Review

Gitishree Das, Han-Seung Shin and Jayanta Kumar Patra

Department of Food Science & Biotechnology, College of Life Science and Biotechnology, Dongguk University-Seoul, Goyang-si 10326, Republic of Korea

In recent times, numerous edible resources, such as millets, have proven highly effective in combating a variety of ailments, including cancer, diabetes, inflammation, cardiovascular disease, and gastric ulcers. Millets have a rich nutritional profile and have the capability to survive harsh environmental conditions. Millets with a low glycemic index can regulate the release of glucose into the bloodstream at a very slow rate. This functional food is rich in a variety of nutraceuticals and antioxidant compounds, offering numerous health benefits, including improved digestive system function, reduced cholesterol levels, cardiovascular disease prevention, diabetes protection, and reduced risks of tumors and gastrointestinal diseases. Millets comprise several bioactive compounds, like phenolic compounds, flavonoids, and antioxidants, which display potential anti-inflammatory and antioxidant effects, which are relevant not only for diabetes management but also for gastroprotection. Preclinical studies demonstrated that millets and their bioactive compounds could prevent oxidative stress, reduce inflammation, and maintain the integrity of the gastric mucosa. Regardless of the potential health benefits of these grains, there is still a need to increase responsiveness amongst populations worldwide about their health, nutritional, and nutraceutical properties. This updated review discusses the major bioactive compounds, the extraction process, and the enormous medicinal value of millets.

3.91. Mineral and Vitamin Contents of Pretreated Bambara Groundnut (Vigna subterranean) Cake

Nkiru Euphresia Odimegwu [1], Oluchi Linda Akajiaku [1], Uchenna Luvia Ezeamaku [2], Ezidimma Anthonia Uzoukwu [1], Chukwuma Munachiso Umelo [1], Franscis Arinze Ofoedum [1] and Ikeckukwu Emmanuel Nzeribe [1]

[1] Department of Food Science and Technology, Federal University of Technology, Owerri P.M.B 1526, Imo State, Nigeria

[2] Department of Polymer and Textile, Federal University of Technology, Owerri P.M.B 1526, Imo State, Nigeria

Cakes are convenient semi-dry food foams that have air pockets enclosed in a protein and starch network. It is produced with soft wheat flour and fat, sugar, eggs, milk, baking powders, emulsifiers, etc. Bambara groundnut (*Vigna subterranean)* is a potential food security crop in the South Eastern part of Nigeria. It is highly nutritious but has a beany flavor. Thus, the mineral, vitamin and sensory profiles of the cakes prepared from pretreated Bambara groundnut flour were evaluated. Cake samples were produced from Bambara groundnuts pre-treated with water (Sample BGW) and sodium bicarbonates (Sample BGSB) separately to reduce their beany flavor. Wheat flour (Sample WF) cake served as the control. The mineral, vitamin and sensory profiles of the cake samples were determined using standard methods. The pretreatment of the Bambara groundnuts reduced the mineral and vitamin contents of the pretreated cake samples (BGSB and BGW) when compared to the control cake. The overall acceptability of the control cake samples wasnot significantly ($p > 0.05$) different from the pretreated cake samples. The samples BGSB and BGW showed considerable mineral (3.67–3.46 mg/100 g Zn, 3.83–3.61 mg/100 g Fe, 48.47–44.84 mg/100 g Ca, 109.37–106.77 mg/100 g Na, 269.63–268.5 mg/100 g K, 178.29–175.72 mg/100 g) and vitamin (4.72–3.85 mg/100 g Vit.C, 4.56–4.18 mg/100 g Vit.A, 1.09–1.05 mg/100 g Vit.B1, 0.94–0.71 mg/100 g Vit.B2) contents when compared to the control cake sample (WF). This suggests that the samples BGSB and BGW could be used as a vital source of micronutrients in cake production. However, the sample BGW had the highest Vitamin B2

(0.94 mg/100 g) content, while the sample BGSB had the highest Calcium (48.47 mg/100 g) content. Therefore, pre-treated Bambara groundnut flour could be used as an alternative to wheat flour in cake making since the overall acceptability was enhanced and the beany flavor was reduced.

3.92. Moldavian Consumer Perceptions and Preferences for Plant-Based Food

Cristina Popovici [1], Xin Mei Teng [2,3] and Ravi Jadeja [2,3]

1 Department of Food and Nutrition, Faculty of Food Technology, Technical University of Moldova, 168 Stefan cel Mare si Sfant blvd., 2004 Chisinau, MD, Republic of Moldova
2 Robert M. Kerr Food & Agricultural Products Center, Oklahoma State University, Stillwater, OK 74078, USA
3 Department of Animal & Food Sciences, Oklahoma State University, Stillwater, OK 74078, USA

Plant-based food (PBF) has developed rapidly in recent years as a response to growing interest in sustainable options, with challenges in consumer beliefs/perceptions. In this study, opinion surveys were carried out to identify Moldavian consumers' perceived benefits/barriers regarding PBF. This study was conducted according to Regulation (EU) 2016/679, the Declaration of Helsinki, and approved by the Ethics Committee of the Technical University of Moldova (TUM) (protocol code 011/2024). Before filling out a questionnaire, participants were informed that their participation in the survey would be made anonymous and that it would be carried out at the TUM and they were told what the purpose of this study was, having to choose if they would voluntarily participate or not. An online survey was conducted using the Google Forms platform. Recruitment was carried out by sending email invitations and disseminating the survey on social networks, using the snowball sampling method. The sample size was 186 valid cases, the confidence level was 95% (k = 2), p = q = 50, and the sampling error was 4.9%. The survey was composed of closed questions and divided into four sections: *(1)* participants' sociodemographic, economic, and diet factors; *(2)* perceived PBF knowledge and purchase intention; *(3)* perceived PBF barriers; and *(4)* perceived PBF benefits and market extension. Data were analysed with SAS 9.4 software (SAS Institute, USA). Of the participants, 69.7% were women and 63.5% had completed university studies. Consumers (88.9%) had intermediate knowledge about PBF and 79.6% expressed a desire to consume PBF. An important factor in the PBF purchase decision was its positive effect on health and the environment ($p < 0.05$). Participants (45.3%) experienced barriers with PBF's high price, its low availability and difficulties in changing eating habits. Popular PBFs were meat substitutes, dairy alternatives and beverages ($p \leq 0.05$). Conjoint analysis showed that interest towards PBF did not differ between genders but did between participants' age, education and diet ($p < 0.05$). Future studies for specific PBF groups may offer new outcomes in consumer perception studies.

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3.93. Monitoring Probiotic Lactic Acid Bacteria Strains During Sauerkraut Production by Pulsed-Field Gel Electrophoresis

Jesica: Blajman [1,2], Pierina Scarafia [2], Mariana Lingua [1], María Estela Tarchini [2], Ariel Risso [1] and María Virginia Zbrun [1]

1 Instituto de Investigación de la Cadena Láctea (IdICaL, CONICET-INTA), Ruta 34 Km. 227, Rafaela CP 2300, Santa Fe, Argentina

[2] Universidad Nacional de Rafaela, Bv. Presidente Julio A. Roca 989, Rafaela CP 2300, Santa Fe, Argentina

The intrinsic health-promoting properties of sauerkraut can be successfully improved by developing effective combinations with probiotics in order to obtain innovative functional products. This study aimed to evaluate the viability and persistence of the commercial probiotic strains *Lactiplantibacillus plantarum* 01 (LP01) and *Lacticaseibacillus rhamnosus* (LR04) when used as adjunct starter cultures during the production of traditional probiotic sauerkraut.

Each strain was made resistant to rifampicin (100 μg/mL) in order to track down the inoculum during the in vivo study. Shredded cabbage was mixed with 2.0% (*w*/*v*) sea salt to create the brine. This mixture was transferred into sterilised glass jars. Control samples underwent spontaneous fermentation, while experimental samples were inoculated with spray-dried powder of either the resistant LP01 or LR04 strain, targeting a concentration of about 1×10^6 cfu/g of sauerkraut. All the samples were incubated at 20 °C for 28 days. The number of lactic acid bacteria (LAB) in the cabbage extracts was counted on MRS agar and on MRS agar plus rifampicin at days 0, 21, and 28. The administered strains were monitored by pulsed-field gel electrophoresis (PFGE) to confirm the persistence and genotypic identity of the isolates.

Both probiotic strains maintained high viability and predominance during the fermentation process, with only a slight but significant decline by day 28. After 21 days of fermentation, LP01 and LR04 showed viable counts of 7.43 and 7.94 $\log_{10}$ cfu/g, respectively. At day 28, the counts decreased to 7.09 and 7.24 $\log_{10}$ cfu/g ($p < 0.001$). The rifampicin-resistant colonies accounted for 87% to 99% of the total LAB population in the inoculated samples. The strains analysed had identical PFGE pulsetypes, confirming the presence of LP01 or LR04 throughout the whole study. In conclusion, sauerkraut fermented with the LP01 or LR04 strain can be considered a probiotic food, containing approximately 10^7 cfu/g of the product.

3.94. Multifunctional Bioactivities of Avocado, Hedge Mustard, and Fireweed Seed Oils: From Inflammation Modulation to Enzyme Inhibition

Florinda Fratianni [1], Francesca Coppola [2], Maria Neve Ombra [1], Beatrice De Giulio [1], Raffaele Coppola [3] and Filomena Nazzaro [1]

[1] Institute of Food Sciences, CNR-ISA, Via Roma 64, 83100 Avellino, Italy
[2] Department of Agricultural Sciences, University of Naples Federico II, Piazza Carlo di Borbone 1, 80055 Portici, Italy
[3] Department of Agricultural Environmental and Food Sciences (DiAAA), University of Molise, Via F. de Sanctis s.n.c., 86100 Campobasso, Italy

Vegetable oils obtained from non-conventional seeds are increasingly being recognized for their functional bioactivities, particularly in the fields of neuroprotection, inflammation control, and skin health. This study aimed to evaluate the anti-inflammatory, antioxidant, and enzyme-inhibitory properties of three commercial cold-pressed seed oils: avocado (*Persea americana*), hedge mustard (*Erysimum* spp.), and fireweed (*Epilobium* spp.). Oil samples were evaluated for biological activity using in vitro assays. Anti-inflammatory activity was measured through the inhibition of protein denaturation (IC50 values). Antioxidant capacity was assessed using the DPPH radical scavenging assay (IC50 values). Enzyme inhibition was tested against acetylcholinesterase (AChE), butyrylcholinesterase (BChE), and tyrosinase. Avocado seed oil showed the strongest anti-inflammatory (IC50 = 12.75 μg/mL) and antioxidant activity (DPPH IC50 = 4.31 μg/mL), as well as the most potent tyrosinase inhibition (IC50 = 6.43 μg/mL), suggesting its high potential for dermo-cosmetic applications as well. Fireweed oil exhibited the lowest IC50 value for AChE (13.5 μg/mL) and an

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IC50 for BChE of 78.4 µg/mL, along with the highest BChE inhibition (48%), indicating a broad-spectrum neuroprotective profile. Hedge mustard oil exhibited the highest percentage inhibition of AChE (70.5%) despite a higher IC50, indicating good enzyme affinity but lower potency. The oils exhibited distinct biological profiles: avocado oil emerged as a candidate for anti-inflammatory and cosmetic applications, fireweed oil for neuroprotective formulations, and hedge mustard oil as a selective acetylcholinesterase (AChE) inhibitor. These findings support the valorization of non-traditional seed oils as multifunctional ingredients for nutraceutical, cosmeceutical, and phytotherapeutic applications.

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3.95. Native Australian Citrus as a Valuable Source of Vitamins and Antioxidants

Joel Benjamin Johnson [1], Natasha Hungerford [2], Yasmina Sultanbawa [1] and Michael Netzel [1]

1 Centre for Nutrition and Food Sciences, Queensland Alliance for Agriculture and Food Innovation (QAAFI), The University of Queensland, Health and Food Sciences Precinct, Coopers Plains, Qld 4108, Australia

2 Centre for Animal Science, Queensland Alliance for Agriculture and Food Innovation, The University of Queensland, Health and Food Sciences Precinct, Coopers Plains, Qld 4108, Australia

Australia has six endemic species of *Citrus*: *Citrus australasica* (finger lime), *C. australis* (Gympie lime), *C. garrawayi* (Mount White lime), *C. glauca* (desert lime), *C. gracilis* (Humpty Doo lime) and *C. inodora* (Russell River lime). However, the nutritional and chemical composition of the fruit from many species remains largely unknown. An analysis of five of the native Australian *Citrus* species by HPLC-UV revealed that the vitamin C content of *C. inodora* flesh was 4× higher than that of commercial Tahitian lime (*C.* × *latifolia*), while *C. glauca* had almost 7× higher vitamin C. Two species (*C. australasica* and *C. glauca*) contained quantifiable levels of pro-vitamin A (β-carotene; 7–18 mg/kg DW) in their pulp, compared to no detectable β-carotene in Tahitian lime, while the peel of C. australis contained 3× more β-carotene than Tahitian lime peel. *C. australasica* and *C. glauca* pulp contained comparable vitamin E (α-tocopherol) content to Tahitian lime, while the α-tocopherol of *C. inodora* was 3× higher. Furthermore, the peel of four *C. australasica* varieties contained 18–33× higher α-tocopherol content compared to Tahitian lime. Finally, the antioxidant capacity (DPPH assay) of *C. glauca* pulp was double that of Tahitian lime. These results show the promising nutritional composition of native Australian Citrus, with potential uses for fresh consumption, food processing, or in cosmetic products.

3.96. Nutritional and Glycemic Modulation of Sri Lankan Flatbread via Fortification with Defatted Coconut (Cocos nucifera L.) Testa Flour

Hewa Pathirange Dilani Thilanka Hewa Pathirana [1,2], Ranahansi Rangadharee Bandara [2], Loku Liyana Waduge Chandi Yalegama [2] and Lushan Lilruksha [2]

1 Department of Functional Food Products Development, Faculty of Biotechnology and Food Science, Wroclaw University of Environmental and Life Sciences, 51-630 Wroclaw, Poland

2 Coconut Processing Research Division, Coconut Research Institute, 61150 Lunuwila, Sri Lanka

Introduction: The outer brown layer of the coconut kernel is called "Testa", a byproduct of the coconut processing industry. After the oil extraction process, it can be converted

into fine flour, which is a nutritious flour for food formulation. Therefore, this research aims at developing a nutritional flat bread with defatted coconut testa flour and performing its quality evaluation. **Method**: The testa flour (T1;0%, T2;20%) was substituted with wheat flour to make a selected composite flour for coconut flatbread preparation. Then, the composite flour (50%) of each treatment was mixed with grated coconut (33%), water (15%), and salt (2%). The dry ingredients were mixed first, followed by the addition of water to make a consistent dough. The dough was flattened with uniform thickness (15 cm diameter and 5 mm thickness) and baked on a pan for 3 min on each side. **Results:** The crude fibre content (7.04 ± 1.15%), total phenolic content (3.05 galic acid equivalent mg/g), and scavenging activity of 2,2-diphenyl-1-picrylhydrazyl (DPPH;5 mM) (69.88%) of the T2 treatment were significantly ($p < 0.05$) higher than those of T1 (1.80 ± 0.16%, 0.92 galic acid equivalent mg/g, and 40.67%, respectively). Significantly higher mineral content of Fe (47.83 mg/kg), Mg (1364 mg/kg), and K (3841 mg/Kg) was observed in the T2 treatment compared to T1 (12.94 mg/Kg, 743.33 mg/Kg, and 1800 mg/Kg, respectively). In the glycemic index analysis, however, healthy subjects confirmed that testa flour (Glycemic Index: 28.32) incorporation has the potential to reduce blood glucose concentration compared to the T1 treatment (Glycemic Index: 35.47). **Conclusions:** The researchers concluded that the incorporation of defatted testa flour into the coconut flatbread improves the nutritional and glycemic-lowering potential.

3.97. Nutritional and Quality Evaluation of Wheat Bread Enriched with Amaranth Sourdough

Agata Wojciechowicz-Budzisz, Ewa Pejcz, Agata Milcarz, Oliwia Paroń, Patryk Słota, Rafał Wiśniewski, Alona Tiupova and Joanna Harasym

Department of Biotechnology and Food Analysis, Wroclaw University of Economics and Business, Komandorska 118 Street, 53-345 Wrocław, Poland

Amaranth (*Amaranthus* spp.), a gluten-free pseudocereal, is rich in protein and bioactive compounds (phenolic compounds, squalene, phytosterols, tocopherols, and dietary fiber), making it a valuable ingredient for improving the nutritional quality of baked goods. Incorporating amaranth flour into wheat bread, especially via sourdough fermentation, may enhance both nutritional and sensory properties. This study investigates the impact of adding amaranth sourdough at various levels on the quality characteristics and nutritional value of wheat bread. Commercial wheat flours of type 405 and 750 were used, with a portion of the wheat flour substituted by ground amaranth grain at levels of 5%, 10%, and 15% in the form of sourdough. A control sample consisting of wheat bread without amaranth flour (0%) was also prepared.

The research included the assessment of the quality parameters of amaranth grain flour and wheat flours, such as protein, ash content, and moisture, as well as gluten yield and spreadability, falling number, and Zeleny sedimentation index. For the baked breads, evaluations included overbake, specific volume, crumb porosity (Dallman scale), crust and crumb color, texture profile analysis (TPA), organoleptic assessment, and nutritional analysis based on crumb moisture, protein, and total ash content. The average energy value and nutritional content per 100 g of flour blends used in baking (protein, lipids, carbohydrates, and fiber) were also calculated.

The enrichment of wheat bread with amaranth sourdough positively influenced the quality parameters and nutritional profile of the final products, particularly in terms of protein and ash content. The addition of amaranth flour contributed to an increase in loaf volume. Bread containing 5% amaranth flour in the form of sourdough demonstrated improved hardness, springiness, gumminess, and chewiness compared to the control sample. The maximum share should not exceed 10%.

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3.98. Nutritious Cracker Fillings Developed with Lyophilized Sheep Milk Cheese and Xanthan Gum

Laura Lorena Battaiotto [1,2], Paula Andrea Conforti [1] and Marina Dello Staffolo [3,4]

1 Center for Research and Development in Food Science and Technology (CIDCA), CICPBA, CONICET, National University of La Plata (UNLP), 47 y 116, La Plata CP 1900, Argentina
2 Department of Basic Sciences, Faculty of Engineering, UNLP, 1 y 47, La Plata CP 1900, Argentina
3 Chemical Engineering Pilot Plant—PLAPIQUI, National University of the South (UNS)—National Scientific and Technical Research Council (CONICET), Bahía Blanca 8000, Argentina
4 Department of Chemical Engineering, Faculty of Engineering (FI), National University of La Plata (UNLP), La Plata 1900, Argentina

Introduction: Filled crackers are classified as ready-to-eat snack products characterized by minimal preparation requirements, extended shelf life, and functional versatility. The objective of this study was to reformulate cheese cracker fillings in order to improve their nutritional quality while maintaining their sensory appeal.

Methods: Two formulations were developed with freeze-dried sheep milk cheese and high-oleic sunflower oil, with or without xanthan gum. Moisture content and water activity (a_w) were measured to assess the preservation over time of the filling formulations. Sensory analysis was conducted with regular consumers of the product using a 9-point structured hedonic scale (1 for "dislike extremely", and 9 for "like extremely"). The fillings were evaluated in sandwich conformations to simulate the usual consumption conditions. Participants assessed color, texture, taste, overall acceptability, and purchase intent. They provided informed consent prior to their involvement in the study.

Results: Nutritionally, these formulations surpass conventional products. They exclude shortening and margarine, lowering trans-fat content. Traditional fats are replaced with sheep milk fat and high-oleic sunflower oil, both known for their hypocholesterolemic effects. Sheep milk fat also provides bioactive compounds with health-promoting properties. Additionally, xanthan gum contributes dietary fiber, supporting physiological function and offering antioxidant benefits. The moisture and a_w showed no significant differences between the fillings with and without xanthan gum. The a_w remained below 0.6, indicating suitable conditions for product preservation. In the acceptability test, no significant differences were found in the scores obtained between the formulations with and without xanthan gum for any of the evaluated attributes ($p > 0.05$). Both formulations were rated very favorably (score higher than 5) by over 60% of participants. The xanthan gum concentration employed had no significant effect on the parameters evaluated.

Conclusions: Therefore, the reformulation led to an enhanced nutritional profile of cheese cracker fillings while preserving favorable sensory perception among consumers.

3.99. Optimization of Phlorotannin Extraction viaPressurized Liquid Extraction: Exploring New Brown Macroalgae for Novel Food Applications

María Carpena [1], P. Barciela [1], A. Silva [1,2], A. Perez-Vazquez [1], A.O.S. Jorge [1,3], F. Chamorro [1] and M. A. Prieto [1]

1 Instituto de Agroecoloxía e Alimentación (IAA), Universidade de Vigo, Nutrition and Food Group (NuFoG), Campus Auga, 32004 Ourense, Spain
2 REQUIMTE/LAQV, Instituto Superior de Engenharia do Porto, Instituto Politécnico do Porto, Rua Dr António Bernardino de Almeida 431, 4200-072 Porto, Portugal
3 REQUIMTE/LAQV, Department of Chemical Sciences, Faculty of Pharmacy, University of Porto, R. Jorge Viterbo Ferreira 228, 4050-313 Porto, Portugal

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In recent years, macroalgae have gained relevance as a new source of active compounds with potential use in the food industry. However, *Ecklonia cava* is currently the only macroalga approved by the European Food Safety Authority (EFSA) as a source of phlorotannins for novel foods, specifically, an ethanolic extract marketed as SeaPolynol™. Other brown algae species contain phlorotannins and have demonstrated various biological activities, including antioxidant, anti-inflammatory, and antidiabetic effects. However, these species have not been authorized by the EFSA as novel foods, and deeper knowledge of their composition, concentration, and safety is needed. This study aimed to optimize the extraction of phlorotannins via pressurized liquid extraction (PLE) in two brown macroalgae, *Pelvetia canaliculata* and *Laminaria ochroleuca*. The experiments were designed using response surface methodology (RSM), and the independent variables were set at the following ranges: time (t, 1–25 min), temperature (T, 50–200 °C), and solvent concentration (S, 0–100% ethanol). Phlorotannins were identified and quantified via HPLC-ESI-QqQ-MS/MS. In total, 45 phlorotannins were identified, highlighting their content in difucol, deshydroxyhexafuhalol, and eckstolonol, and in higher concentration for *L. ochroleuca* (176.3 mg/g extract, E) compared to *P. canaliculata* (81.4 mg/g E). Generally, the extraction system prefers short times, mild temperatures, and a high percentage of ethanol. This study contributes to a deeper understanding of the phlorotannins present in brown macroalgae and highlights *L. ochroleuca* as a promising source for the development of novel food ingredients with potential health benefits.

3.100. Optimization of Polyphenol Extraction from Nuts Using Multivariate Experimental Design

Emilia Carla Brandolin [1], Mariana Piccione [1], Cecilia Estefanía Luján [2], Pamela Y. Quintas [3] and Roxana Elizabeth Gonzalez [1,4]

[1] Facultad de Ciencias Exactas y Naturales, Universidad Nacional de Cuyo (UNCUYO), Padre J. Contreras 1300, Mendoza 5500, Argentina
[2] Laboratorio de Química Analítica para Investigación y Desarrollo (QUIANID), Facultad de Ciencias Exactas y Naturales, Universidad Nacional de Cuyo/Instituto Interdisciplinario de Ciencias Básicas (ICB), CONICET UNCUYO, Mendoza 5500, Argentina
[3] Instituto de Investigación y Desarrollo en Ingeniería de Procesos, Biotecnología y Energías Alternativas, PROBIEN (CONICET-UNCo), Facultad de Ingeniería, Universidad Nacional del Comahue, Buenos Aires 1400, Neuquén 8300, Argentina
[4] Estación Experimental La Consulta (EEA La Consulta), Instituto Nacional de Tecnología Agropecuaria (INTA), Centro Regional Mendoza-San Juan (CR Mza-SJ), Mendoza 5560, Argentina

Nuts are a natural source of phenolic compounds (PCs), which are characterized by their wide biological activities, particularly their role in preventing diseases associated with oxidative stress. The extraction efficacy of phenolic compounds from nuts can be significantly influenced by many factors, such as solvent composition, extraction time, extraction temperature, and solvent-to-solid ratio. In this context, the application of non-conventional techniques such as ultrasound-assisted extraction (UAE) and the use of solvents generally recognized as safe has gained growing attention for the efficient recovery of PCs. This study aimed to develop an optimized and eco-friendly method for the extraction of PCs from nuts. A multivariate experimental design was employed to evaluate key factors that influence extraction efficiency, including sample mass (0.2–0.4 g), solvent type for both defatting and extraction, pH (2–10), and extraction time (4–8 min) under UAE. An initial screening was followed by optimization using response surface methodology (RSM). The optimal conditions identified were 0.4 g of sample, 8.0 mL of hexane for defatting, 4.0 mL of methanol/water (80:20 *v*/*v*) at pH 2 for extraction, and 4 min of UAE. Extraction efficiency was assessed through spectrophotometric analysis of total phenolic content using

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the Folin–Ciocalteu method at 760 nm. The optimized protocol was applied to different nuts, walnuts, almonds, pistachios, hazelnuts, and cashews, commercially available in local markets in Mendoza, Argentina. Additionally, the antioxidant activity of the extracts was evaluated via the DPPH radical scavenging assay. The results revealed notable variability in PC content and antioxidant capacity among the different nuts, suggesting that the health-promoting potential of each nuts type may differ depending on its phenolic profile.

3.101. Oxidative and Hydrolytic Stability and Composition of Flaxseed Oil Ethyl Ester and Milk Thistle Oil Blends During Storage

Joanna Bryś [1], Diana Mańko-Jurkowska [1], Marta Siol [1], Eunika Nowicka [1], Bartłomiej Zieniuk [1] and Andrzej Bryś [2]

[1] Department of Chemistry, Institute of Food Sciences, Warsaw University of Life Sciences, 159c, Nowoursynowska St., 02-776 Warsaw, Poland

[2] Department of Fundamental Engineering and Energetics, Institute of Mechanical Engineering, Warsaw University of Life Sciences, 02-776 Warsaw, Poland

Milk thistle (Silybum marianum) is a valuable source of nutrients and bioactive compounds, particularly silymarin, known for its hepatoprotective and antioxidant properties. Its oil contains high levels of unsaturated fatty acids, especially linoleic and oleic acids, which may help prevent cardiovascular diseases, among other health conditions. Fatty acid ethyl esters, derived from flaxseed oil, are rich in omega-3 fatty acids and exhibit better oxidative stability than the corresponding oil due to reduced oxygen solubility and the absence of pro-oxidant components. Blending milk thistle oil with fatty acid ethyl esters can increase both the nutritional and functional value of lipid formulations.

This study evaluated blends of milk thistle oil and flaxseed ethyl esters in ratios of 25:75, 50:50 and 75:25, alongside pure ingredients. Samples were stored at room temperature and analyzed at baseline, after one month, and after two months of storage. Acid and peroxide values were determined by titration, oxidative stability was assessed by Pressure Differential Scanning Calorimetry (PDSC), and fatty acid composition was assessed by Gas Chromatography (GC).

Fatty acid profiles remained stable during storage. Acid values increased with time, with the highest values observed in milk thistle oil and its blends containing lower proportions of esters. Peroxide values increased most rapidly in ethyl esters and their blends, indicating active primary oxidation. Oxidation induction time measured by PDSC decreased with storage in all samples, especially in ethyl esters. Blends with higher milk thistle oil content showed longer induction times and greater resistance to oxidative degradation. These results suggest that the incorporation of milk thistle oil into ester-based lipid systems can improve oxidative stability and extend shelf life, thus supporting the development of functional and stable lipid ingredients for food or nutraceutical applications.

3.102. Picroside I Prolongs Lifespan and Enhances Muscle Vigor in C. elegans: A Study on the Potential of an Anti-Aging Functional Food Ingredient

Haomiao Ma, Yijin Chen, Zhuo Cheng, Ruofei Li, Yiwen Gong, Yutong Li, Hexiang Qiu, Yan Pan and Bo Xian

Laboratory of Aging Research, School of Medicine, University of Electronic Science and Technology of China, Chengdu 611731, China

Anti-aging functional foods have garnered widespread attention for their ability to provide health benefits through daily diets. Picroside I is a natural compound extracted from the rhizome of Picrorhizae Rhizoma. Picrorhizae Rhizoma, a common traditional Chinese medicinal material, is also frequently used as an ingredient in health teas. Its rhizome is rich in various bioactive components. *Caenorhabditis elegans*, a classic model

organism for aging research, holds significant importance in the study of functional foods. In this study, we used *C. elegans* as a model to investigate the effects of the natural compound Picroside I from traditional Chinese medicine on the lifespan and locomotor ability of the worms. The results showed that Picroside I increased the head thrashing and pharyngeal pumping rates of the worms on day 8, thereby enhancing their muscle vitality. Moreover, Picroside I at a concentration of 10 μM significantly extended the healthspan of the worms. Further network pharmacology and molecular docking analyses revealed that Picroside I may be associated with glycation end-product receptors and lipid metabolism. Additionally, it was found that the compound acts on the disulfide bond region of the asymmetric dimer of kinase domains of the EGFR protein, reducing the stability of the protein and thereby affecting downstream signaling pathways in cells, such as the PI3K/Akt pathway and the MAPK pathway, which in turn influence cellular metabolic processes. Our study indicates that Picroside I has significant potential to extend the lifespan and enhance the muscle vitality of *C. elegans*. It holds promise as a novel anti-aging food ingredient and is of great significance for the development of traditional Chinese medicine-based anti-aging functional foods.

3.103. Postharvest Quality of Fresh-Cut Baby Leaf Lettuce as Affected by Packaging Type and LED Light Treatment

Roxana Elizabeth Gonzalez [1,2] and Verónica Carolina Soto Vargas [3]

1 Estación Experimental La Consulta (EEA La Consulta), Instituto Nacional de Tecnología Agropecuaria (INTA), Centro Regional Mendoza-San Juan (CR Mza-SJ), Mendoza 5560, Argentina
2 Facultad de Ciencias Exactas y Naturales, Universidad Nacional de Cuyo (UNCUYO), Padre J. Contreras 1300, Mendoza 5500, Argentina
3 Instituto de Biología Agrícola de Mendoza (IBAM), CONICET, Facultad de Ciencias Agrarias, Mendoza 5507, Argentina

The fresh-cut processing industry has provided a means for enhancing the consumption of vegetables, preserving their freshness for considerable periods, and making their distribution easier through convenient packaging and storage conditions. Nowadays, light-emitting diodes (LEDs) are emerging as a promising tool for food preservation due to their low heat irradiance and greater efficacy. The aim of this study was to evaluate the effect of packaging type combined with white LED treatment on the quality of fresh-cut baby leaf lettuce during postharvest preservation. The lettuce cultivar (Tango) was grown at a density of 800 plants/m^2 in raised beds. When the leaves reached the optimal size of baby leaf lettuce (5–9 cm), they were harvested, followed by processing. Low-density polyethylene (LDPE) and polypropylene (PP) were tested as polymeric film packaging. The samples were stored at 4 °C under two conditions: (1) continuous darkness throughout the storage period and (2) under short treatments (2 d) with intermittent light (2 h on/2 h off), followed by storage in darkness. The quality of fresh-cut baby leaf lettuce was determined by measuring weight loss, chlorophyll, carotenoids, phenols, antioxidant activity, and microbial quality. Weight loss gradually increased during storage time and significant changes were observed for each treatment and packaging. The lowest weight loss was recorded in the LDPE packaging under LED treatment. Microbial counts (aerobic mesophilic bacteria, enterobacteriaceae, yeasts, and moulds) increased significantly by the end of the storage period in LDPE packaging with LED treatment. Psychrophilic aerobic growth was not detected during the evaluation period. Total chlorophyll content, total phenolic compounds, and antioxidant activity did not change during storage. However, the carotenoid content was significantly higher in samples packaged in LDPE. Overall,

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the packaging in PP combined with LED treatment showed the most favorable results for maintaining postharvest quality in fresh-cut lettuce.

3.104. Potential Health Benefits of Optimised Whole-Wheat Flour Fermentation on Intestinal Cells

Elena Tomassi [1], Agnese Sgalippa [2], Nafiou Arouna [1] and Laura Pucci [1]

[1] Institute of Agricultural Biology and Biotechnology, National Research Council, 56124 Pisa, Italy

[2] Laboratory of Biochemistry and Molecular Biology, CNR Institute of Clinical Physiology, Via Giuseppe Moruzzi 1, 56124 Pisa, Italy

Increased reactive oxygen species (ROS) production can activate nuclear factor kappa-light-chain-enhancer of activated B cells (NF-κB) and initiate the transcription of pro-inflammatory mediators, such as cytokines, leading to inflammatory diseases. The ability of fermented food to scavenge ROS and mitigate oxidative stress-related damage may represent a promising preventive and therapeutic strategy for the treatment of inflammatory bowel disease. The aim of this study is to investigate the antioxidant and anti-inflammatory potential of fermented wheat flour, with specific consortia of yeast and acid lactic bacteria strains, on intestinal cells by quantifying intracellular ROS levels and evaluating the expression of genes involved in inflammatory pathways. There were no significant differences in intracellular ROS levels after 24 and 48 h of treatment with fermented and unfermented wheat flour compared to untreated cells. The effect of a 24 h treatment with fermented and unfermented flour extracts on the modulation of genes involved in inflammation (IL-1, IL-6, and IL-8) and oxidative stress (HMOX-1) was evaluated by quantitative real-time PCR. The unfermented wheat flour extract increased the basal expression of IL-6 and IL-8 (* $p < 0.05$) compared to fermented flour and untreated cells, respectively, while exposure to fermented wheat flour did not alter the basal expression of pro-inflammatory cytokines. Moreover, treatment with both flour extracts increased HMOX-1 expression. These findings suggest that fermented wheat flour does not induce a pro-inflammatory response in intestinal cells, unlike unfermented wheat flour, which increases IL-8 expression. Additionally, both fermented and unfermented flour extracts upregulate HMOX-1, indicating a potential role in oxidative stress modulation and supporting the possible benefits of fermented wheat flour in inflammatory bowel disease management.

3.105. Potential of Using Sugar-Rich Fruits as Natural Sweetening Food Ingredients

Claudia Sánchez and Inês Jesus

National Institute for Agricultural and Veterinary Research (INIAV), I.P., Alcobaça, Portugal

The clean label concept is undergoing continuous development, driven by increasing consumer demand for transparency regarding food ingredients. Incorporating fruit pulps into processed foods offers a promising strategy for natural sweetening, promoting healthier formulations while aligning with consumer preferences for recognizable, minimally processed ingredients.

To promote the valorization of Portuguese regional varieties of apples and pears—both for their organoleptic quality and their potential use as natural food additives—this study analyzed four apple cultivars, 'Pêro de Borbela', 'Pardo Lindo', 'Repinau', and 'Pêro Coimbra', and six pear cultivars, 'Noiva' and 'Bela-Feia', 'Torres Novas', 'Carapinheira', 'Carapinheira Roxa', 'Lambe-os-Dedos', and 'Amorim'. Total soluble solids (TSS) content was determined by refractometry, and sugar profiles were characterized using high-performance liquid chromatography (HPLC).

'Pardo Lindo' apple exhibited a higher TSS content, at about 17 °Brix, indicating superior quality compared to the other samples. Among the pear cultivars, 'Carapinheira

Roxa' was the sweetest, with a value of 17 °Brix, although all pear samples demonstrated a notably high sweetness, with values exceeding 14 °Brix.

In apples, sugar composition followed a consistent pattern: fructose > sucrose > glucose > sorbitol. Similarly, fructose was the dominant sugar in all pear cultivars, with levels exceeding 250 mg/g DW and reaching up to 450 mg/g DW.

Given its high sweetening power, the predominance of fructose in these varieties highlights their potential as natural ingredients for use as alternatives to refined sugars in food formulations.

3.106. Preparation and Characterisation of Galactooligosaccharide-Rich Spray-Dried Paneer Whey Powder

Borkar Subodh Chanda, Sathish Kumar M. H., Laxmana Naik N., Manoj Kumar C. T. and Priyanka Singh Rao

Southern Regional Station, ICAR-National Dairy Research Institute, Bengaluru 560030, India

Paneer whey (PW), a significant by-product of the Indian dairy industry, contains nearly 50% of the total milk solids. Despite its nutritional value, a substantial portion of PW remains underutilized and is often discarded, leading to both nutrient loss and environmental pollution due to its high organic load. Leveraging its rich nutrient profile, PW can be transformed into value-added products, such as galactooligosaccharides (GOS), which are recognized as prebiotics. The objective of this study was to develop a GOS-rich paneer whey powder and assess its storage stability. Paneer whey was concentrated to 40% lactose content and hydrolyzed using commercial β-galactosidase enzymes in a sequential process at 40 °C for 4 h. The resulting GOS-rich hydrolyzed concentrated paneer whey (HCPW) syrup was characterized and stored in polyethylene terephthalate (PET) bottles at 7 ± 2 °C for 180 days. Initially, the HCPW contained 24.34% GOS (based on initial lactose content) and 6.94 μM/L hydroxymethylfurfural (HMF), with no significant changes observed during storage. For spray-drying, the Taguchi method was used to optimize processing conditions. Moisture content, insolubility index, drying yield, and encapsulation efficiency were selected as response variables. The optimized GOS-rich whey powder exhibited an encapsulation efficiency of 55.43% and excellent solubility and dispersibility (93.03%). To evaluate storage stability, the spray-dried GOS-rich paneer whey powder was packed in aluminium-laminated pouches and stored at 30 ± 2 °C for 90 days. Microbiological parameters remained within permissible limits throughout the storage period. Although moisture content increased significantly, it remained below 5%. The browning index rose from 5.59 to 8.07, and HMF content increased from 45.41 to 57.18 μM/L, indicating the progression of Maillard browning. However, the encapsulation efficiency and GOS content of the powder remained stable during storage.

3.107. Process Optimization and Gelation Mechanism of Bangia fusco-purpurea-Based Vegetarian Sausages

Xiaoting Chen [1], Shiqing Zhuo [2], Nan Pan [3], Yongchang Su [3], Zhiyu Liu [3] and Jingna Wu [2]

[1] Key Laboratory of Cultivation and High-Value Utilization of Marine Organisms in Fujian Province, National Research and Development Center for Marine Fish Processing (Xiamen), Xiamen 361013, China

[2] Xiamen Key Laboratory of Marine Medicinal Natural Products Resources, Fujian Universities and Colleges Engineering Research Center of Marine Biopharmaceutical Resources, Xiamen Medical College, Xiamen 36102, China

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[3] Fisheries Research Institute of Fujian, National Research and Development Center for Marine Fish Processing (Xiamen), Key Laboratory of Cultivation and High-value Utilization of Marine Organisms in Fujian Province, Xiamen, China

To develop highly nutritious *Bangia fusco-purpurea* (BFP)-based vegetarian sausages, we investigated the effects of BFP, gluten, and complex gels (CG) on the gel strength and sensory quality of the sausages. The formulation process was optimized through single-factor and orthogonal tests, while the gel formation mechanism of the key factors was explored. The orthogonal test results showed that the optimal addition levels of BFP, gluten, and CG were 5%, 56%, and 37%, respectively. Variance analysis revealed that both gluten and CG significantly affected gel strength ($p < 0.05$), with gluten notably influencing the overall sensory quality ($p < 0.05$). Texture profile analysis (TPA) and rheological properties demonstrated that as gluten (33–37%) and CG (52–56%) concentrations increased, the gel strength and elastic modulus exhibited concentration-dependent enhancement. Further analysis of the sulfhydryl content, disulfide bonds, surface hydrophobicity, and microstructure revealed that higher gluten content promoted intermolecular disulfide crosslinking and hydrophobic group exposure, whereas CG contributed to physical filling via hydrogen and ionic bonds, resulting in a uniform and dense gel network structure. The synergistic effects of gluten and CG enhanced the gel properties of BFP-based vegetarian sausages. This study establishes a theoretical framework for the development of high-quality plant protein meat substitutes, presenting an opportunity to drive innovation in the food industry and address the increasing demand for environmentally sustainable dietary alternatives.

3.108. Profiling of Reference and Commercial Echinacea Extracts via Liquid and Gas Chromatography, In Vivo and Planar Assays

Antonio Inarejos [1], Patricia Martorell Guerola [2], Sonia Guilera Bermell [2], Miren Maicas [2], Fernando Campos [3], Ines Helbig [4] and Gertrud E. Morlock [5]

[1] Department of Botanical Extracts Health & Wellness, ADM Biopolis, 46980 Paterna (Valencia), Spain
[2] Nutrition Archer Daniels Midland (ADM) Health & Wellness, Biopolis S. L. Parc Cientific, Universitat de València, 46980 Paterna, Spain
[3] R&D Innovation Center, Archer Daniels Midland, 21079 Hamburg, Germany
[4] Analytical Department, Archer Daniels Midland, 13597 Berlín, Germany
[5] Institute of Nutritional Science, Justus Liebig University Giessen, Heinrich-Buff-Ring 26-32, 35392 Giessen, Germany

Introduction: Numerous echinacea extracts are available on the market, all intended for the same application—enhancing immune system function—but exhibiting different standardization profiles. The aim of this study is to analyze the most feasible chromatographic technique for the authentication and standardization of Echinacea reference materials and commercial samples. Moreover, a functional evaluation of both is conducted to confirm the standardization process.

Methods: Echinacea raw materials (13) and their corresponding water extracts as reference samples, together with commercial echinacea extracts (15), were analyzed by chromatography (HPLC-DAD/MS, HPTLC-UV/Vis/FLD, and GC-FID/MS). In addition, the organism model of *Caenorhabditis elegans* was used to evaluate in vivo functionality.

Results: HPLC and GC analyses revealed that the concentrations of chicoric and caffeic acids varied among the commercial samples, ranging from 0.2% to 5.6% and from 0.0% to 2.6%, respectively. The main volatile compounds found in most Echinacea samples were benzaldehyde and hexanal; however, some commercial extracts also contained unexpected organic solvents.

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In HPTLC analysis, multiple active compound zones were observed, e.g., caffeic acid exhibited multipotent activity, detectable across several assays. The strongest effect was antioxidant activity. However, highly lipophilic antibacterial compounds and α-amylase inhibitors were also detected. In addition, more polar α-/β-glucosidase and cholinesterase inhibitors were identified, which may be beneficial for supporting metabolic and cognitive health, respectively. Furthermore, tyrosinase and β-glucuronidase inhibitors were present.

The functional effects of an Echinacea extract standardized to chicoric and caffeic acids (4% and 1%, respectively) were demonstrated using the *C. elegans* model under oxidative stress conditions.

Conclusions: The acquisition of comprehensive data and information on complex Echinacea extracts facilitates more informed decision-making. Besides in vivo assays, effect-directed information is essential. The comparative analysis performed in parallel on the same planar assay plate demonstrates high reliability and represents a significant advantage of planar chromatographic techniques.

3.109. Proximate Composition and Energy Content of Fibrous Byproducts from Raw and Roasted Cachichín (Oecopetalum mexicanum) Seeds

Alejandro Esli Hernández-Mora [1], José Andrés Herrera-Corredor [1], María Magdalena Crosby-Galván [2], Libia Iris Trejo-Téllez [3] and Fernando Carlos Gómez-Merino [1]

[1] Sustainable Agri-Food Innovation; Colegio de Postgraduados, Campus Córdoba, Amatlán de los Reyes, C. P. 94953 Veracruz, México
[2] Genetic Resources and Productivity—Livestock, Colegio de Postgraduados Campus Montecillo, Texcoco, C. P. 56264 Estado de México, México
[3] Edaphology, Colegio de Postgraduados Campus Montecillo, Texcoco, C. P. 56264 Estado de México, México

Cachichín (*Oecopetalum mexicanum*) is a fruit tree endemic to southern Mexico and Central America, whose seed is still considered underutilized but valued for its bioactive composition and potential therapeutic effects, including hypoglycemic properties, blood pressure regulation, and antioxidant activity. Previous research has explored its biochemical, phytochemical, and mineral profiles, as well as the impact of applied thermal treatments, thus confirming its nutritional potential. Nevertheless, information regarding the fibrous fraction obtained following oil extraction, a key component for the integral valorization of this resource, is limited. Therefore, we evaluated the proximal composition (moisture, ash, protein, NDF/ADF fiber) and energy content (gross energy on wet and dry matter bases) of raw (T1) and control-toasted (134 °C, 25 min) (T2) cachichín seeds, and their fibrous byproducts from raw (F1) and control-toasted (F2) seeds after oil extraction. All analyses were performed using standardized methods (AOAC). Treatment F1 exhibited the highest energy concentration on both a fresh basis (5.06 kcal g^{-1} FBW) and a dry basis (5.43 kcal g^{-1} DBW) compared to treatment T1. Fibrous byproducts (F1, F2), though higher in moisture, showed increased protein (F1: 10.45%; F2: 11.16%) and fiber content (NDF in F1: 66% increase compared to T1; F2: 52% increase compared to T2). Therefore, cachichín seeds possess high energetic and nutritional value. These fibrous co-products represent a promising source of high-value dietary fiber and protein for the agri-food industry. Their potential application includes the development of functional food ingredients (e.g., bakery products, cereals, nutritional bars), animal feed enrichment, or as a base for nutraceuticals, directly contributing to waste reduction and the promotion of a circular bioeconomy. It is crucial to consider that, for human food consumption, future studies should validate the absence of relevant antinutrients or contaminants in these fibrous fractions.

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3.110. Quality Evaluation and Sensory Acceptability of Yoghurt Partially Supplemented with Beetroot Extract (Beta vulgaris)

Samuel Olufemi Owolade, Adebisi Omolola Akinrinola, Olufemi Temitope Ademoyegun, Balikis Oluwakemi Mustapha, David Olamide Raphael and Onaolapo Adeola Olatunji

Product Development Programme, National Horticultural Research Institute, P.M.B. 5432, Idi-Ishin, Jericho GRA, Ibadan, Nigeria

This study aimed to evaluate the effect of partial inclusion of beetroot extract at different concentrations (0%, 10%, 20%, and 30%) on the nutritional and sensory acceptability of yoghurt. The four samples formulated were coded as YGTA, YGTB, YGTC and YGTD. The yoghurt was made from 20% reconstituted Dano powder milk (200 g/1 L), pasteurized at a temperature of 85 ± 0.1 °C, and cooled to 43 ± 0.1 °C. Beetroot extracted was added, and each mixture was inoculated with 3% starter culture containing Streptococcus thermophilus and Lactobacillus bulgaricus and allowed to ferment for 9 hrs. The yoghurt formed was then refrigerated at 4 ± 0.1 °C and thereafter, its parameters were analyzed. The results show significant variation at $p < 0.05$ on proximate, total soluble solid (TSS), vitamin C, phenolic content, antioxidant activity, and sensory parameters among the samples. The YGTA sample had the highest protein (4.10%) value, and YGTD had the lowest (3.55%). Also, the energy value was highest in YGTA (82.90 kcal/100 g), followed by YGTB (77.65 kcal/100 g), and YGTD had the lowest (71.43 kcal/100 g). Sample YGTB had the highest vitamin C (8.20 mg/100 g) and total phenol (0.970 mg/100 g). The iron concentration of the samples ranged between 2.38 mg/100 g and 6.41 mg/100 g. Sample YGTA, which did not contain beetroot extract, had the lowest iron (Fe) content of 2.38 mg/100 g. The sensorial assessment, which was performed by selected staff of the institute, revealed that YGTB had the best appearance and overall acceptability of 5.2 out of a scoring scale of 7.0. All microbial counts are recorded as the number of colonies formed per 1 mL (cfu/mL) of sample. The Total Microbial Count (TMC) was between 3.7 × 103 cfu/mL and 6.8 × 104 cfu/mL, the total fungi count (TFC) was 1.0 × 103 cfu/mL to 4.5 × 104 cfu/mL, and no coliform growth was detected (NG). The microbial counts showed the samples were fit for consumption.

3.111. Seeds of Color: Cholinesterase-Inhibitory and Antioxidant Activities of Pigmented Fruit Seed Oils

Florinda Fratianni [1], Francesca Coppola [2], Maria Neve Ombra [1], Beatrice De Giulio [1], Raffaele Coppola [3], Gockhan Zengin [4] and Filomena Nazzaro [1]

1 Institute of Food Sciences, CNR-ISA, Via Roma 64, 83100 Avellino, Italy
2 Department of Agricultural Sciences, University of Naples Federico II, Piazza Carlo di Borbone 1, 80055 Portici, Italy
3 Department of Agricultural Environmental and Food Sciences (DiAAA), University of Molise, Via F. de Sanctis s.n.c., 86100 Campobasso, Italy
4 Physiology and Biochemistry Laboratory, Department of Biology, Science Faculty, Selcuk University, Konya 42130, Türkiye

Seed oils extracted from vividly pigmented fruits, such as blackcurrant (Ribes nigrum), cranberry (Vaccinium macrocarpon), and tomato (Solanum lycopersicum), have gained attention for their unique phytochemical profiles and potential health benefits. Seeds may contain bioactive molecules that can act as natural antioxidants and inhibitors of cholinesterase enzymes, which are targets in the management of neurodegenerative disorders [16,17]. Cold-pressed seed oils were assessed for their antioxidant activity using the Trolox Equivalent Antioxidant Capacity (TEAC) assay and for their inhibitory effects on acetylcholinesterase (AchE) and butyrylcholinesterase (BchE) using spectrophotometric

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IC_{50}-based methods. Blackcurrant seed oil exhibited the strongest inhibition of both AchE (IC_{50}: 9.83 μg) and BchE (IC_{50}: 10.64 μg), alongside a moderate TEAC value (7.25 μM TE/g). Cranberry oil showed the highest antioxidant capacity (19.01 μM TE/g), with AchE and BchE IC_{50} values of 11.35 μg and 13.3 μg, respectively. Tomato seed oil displayed lower enzyme inhibition and antioxidant activity (6.92 μM TE/g). The results highlight the potential of pigmented fruit seed oils as multifunctional food-derived agents for cognitive health support. Their combination of antioxidant and cholinesterase-inhibitory activities supports further research into their role in functional foods and "food as medicine" approaches [18,19].

3.112. Spanish Agri-Food Byproducts as Potential Sources of Adaptogens for the Development of Functional Foods and Beverages

Ana Pérez Vázquez [1], P. Barciela [1], A.O.S Jorge [1,2], A.G. Pereira [1,3], M. Carpena [1], Ezgi Nur Yuksek [1] and M.A. Prieto [1]

[1] Instituto de Agroecoloxía e Alimentación (IAA), Universidade de Vigo, Nutrition and Food Group (NuFoG), Campus Auga, 32004 Ourense, Spain
[2] REQUIMTE/LAQV, Department of Chemical Sciences, Faculty of Pharmacy, University of Porto, R. Jorge Viterbo Ferreira 228, 4050-313 Porto, Portugal
[3] Investigaciones Agroalimentarias Research Group, Galicia Sur Health Research Institute (IIS Galicia Sur), SERGAS-UVIGO, 36312 Vigo, Spain

Adaptogens are bioactive compounds that enhance the body's resilience to physical, chemical, and biological stressors, supporting homeostasis and overall well-being. Their beneficial effects are mediated through modulation of key stress-response pathways, including regulation of the hypothalamic–pituitary–adrenal (HPA) axis, attenuation of pro-inflammatory cytokines (e.g., TNF-α, IL-6), activation of antioxidant defense systems (e.g., Nrf2 pathway), and preservation of mitochondrial function. While traditionally associated with plants such as *Panax ginseng*, *Eleutherococcus senticosus*, *Rhaponticum carthamoides*, *Rhodiola rosea* or *Schisandra chinensis*, compounds with adaptogenic properties are increasingly recognized in a broader range of plant sources, being byproducts of the agri-food industry. This systematic review examines Spanish agri-food byproducts, including grape peel, olive tree leaves, citrus peels, apple peel, cacao residues, and tomato and beetroot pulp, as promising sources of adaptogenic compounds for functional food development. The review focuses on key bioactives such as resveratrol, hesperidin, theobromine, quercetin, oleuropein, betalains, and lycopene, summarizing their occurrence, bioactivity profiles, and potential roles in modulating neuroinflammation, metabolic disorders, arthritis, and stress-related conditions such as adrenal fatigue. The literature was critically evaluated to identify both compositional data and evidence of adaptogenic effects or bioactivity-related adaptogenic effects in vitro and in vivo. The findings highlight the potential of these byproducts to contribute to the formulation of functional foods and beverages for the support of cognitive health, metabolic balance, and inflammatory control, while advancing circular economy practices within the Spanish agri-food sector.

3.113. Sustainable Antioxidant Recovery: Optimizing the Extraction of Bioactive Compounds from the Peels and Bagasse of Actinidia deliciosa and Actinidia chinenesis

Franklin Chamorro, Rafael Nogueira-Marques, Maria Carpena, A. Perez-Vasquez, Ezgi Nur Yuksek, Javier Echave and M.A. Prieto

Instituto de Agroecoloxía e Alimentación (IAA), Universidade de Vigo, Nutrition and Food Group (NuFoG), Campus Auga, 32004 Ourense, Spain

Currently, the utilization of agro-industrial by-products has gained popularity due to the presence of bioactive compounds such as polyphenols. In this context, processing

residues from green kiwi (*Actinidia deliciosa*) and yellow kiwi (*Actinidia chinensis*), including peels and bagasse, represent an underutilized source of bioactive compounds, especially flavonoids with proven antioxidant and anti-inflammatory properties. To obtain these compounds, the optimization of the parameters involved in the extraction process, such as temperature, time, and solvent concentration, plays a crucial role in identifying the best conditions and potential interactions to maximize the desired results. This is key to the circular economy and food innovation. The main objective of this work was to optimize the recovery of flavonoids using the heat-assisted extraction (HAE) technique, considering time (5–60 min), temperature (30–90 °C), and solvent concentration (0–100% ethanol) as variables to be optimized, in four kiwifruit by-products—green kiwifruit peel (GKP), green kiwifruit bagasse (GKB), yellow kiwifruit peel (YKP) and yellow kiwifruit bagasse (YKB)—using Response Surface Methodology (RSM). HPLC-ESI-QqQ-MS/MS was used to identify and quantify three main flavonoids: epigallocatechin, rhoifolin, and dihydroisorhamnetin. The data show that YKP concentrates the highest amount of total flavonoids (33.2 µg/mL of extract) among the matrices evaluated, with epigallocatechin being the main flavonoid, reaching a concentration of 16.01 µg/mL of extract, which is of importance since this compound has high antioxidant capacity and is associated with cardioprotective, anti-inflammatory, and neuroprotective effects. The experimental conditions that allowed the highest recovery of flavonoids were 5 min, 30 °C, and 100% ethanol as solvent. These results represent an opportunity to enhance the value of yellow kiwifruit peel by incorporating it into functional food, nutraceuticals, and even cosmetic formulations, aligning with trends in sustainability, waste reduction, and the development of high-value bioactive ingredients with a positive impact on health and sustainability.

3.114. Sustainable Cricket Farming and the Circular Economy: Diet Supplementation with Microalgae Reared on Cricket Frass to Improve the Nutritional Profile of Crickets

Behixhe Ajdini [1], Irene Biancarosa [2], Federico Girolametti [1], Lorenzo Massi [3], Alessandra Petrucciani [1], Anna Annibaldi [1], Silvia Illuminati [1], Alessandra Norici [1] and Cristina Truzzi [1]

1 Department of Life and Environmental Sciences, Polytechnic University of Marche, 60130 Ancona, Italy
2 Department of Marine Biotechnology, Stazione Zoologica "Anton Dohrn", Fano Marine Center, Fano, Italy
3 DAIS, Università Ca' Foscari Venezia, Via Torino 155, 30172 Mestre, Italy

The increasing global demand for sustainable, high-quality protein sources has grown interest in edible insects, particularly in *Acheta domesticus* (house cricket), recently authorized as a novel food in the European Union (EU 2022/188). However, the main challenge of cricket farming is identifying a sustainable, nutritious, and cheaper feed than the current diets (e.g., poultry feed) [20]. This study investigated a circular economy approach by valorizing (i) cricket frass—a nutrient-rich by-product of insect farming—as a cultivation medium for microalgae (*Chlorella vulgaris*, *Phaeodactylum tricornutum*, and *Nannochloropsis salina*), which could make microalgae production more environmentally friendly and cost-effective, and (ii) using microalgae grown on frass-based media as diet supplementation to optimize the nutritional value of insects, particularly in terms of fatty acid (FA) composition. The microalgae *C. vulgaris* showed the best adaptation to a medium composed solely of water and frass and was selected to implement the crickets' diet, adding its biomass to the drinking water. Crickets were divided into three experimental groups: (i) control (no supplementation), (ii) supplementation with *C. vulgaris* extract grown in standard media, and (iii) supplementation with *C. vulgaris* extract grown in frass-based media. The FA composition of microalgae species and insects was carried out using Gas

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Chromatography–Mass Spectrometry (GC-MS). Our results showed that the inclusion of *C. vulgaris* in drinking water did not affect the performance parameters of crickets, in terms of individual weight, yield, and feed conversion ratio. Significant variations in FA composition were evidenced: (i) in microalgae grown on frass-based media compared to microalgae grown on standard media; (ii) in AD reared on *C. vulgaris* cultivated on frass compared to AD reared on standard diet. The fatty acid profile was enriched with essential fatty acids such as linoleic and alpha-linolenic acids, and nutritional quality indices confirmed that the house cricket presented healthy values.

3.115. Sustainable Valorisation of Sea Buckthorn Leaves for the Development of Functional Beverages

Jolita Jagelavičiūtė and Karolina Almonaitytė

Food Institute, Kaunas University of Technology, Radvilenu Rd. 19 C, LT 50254 Kaunas, Lithuania

The sustainable use of agricultural by-products is vital for circular bioeconomy goals. Sea buckthorn leaves (SBLs), an underused by-product of berry harvesting, show promise for value-added uses. However, their application in beverages is limited due to the lack of eco-friendly extraction methods that preserve heat-sensitive compounds. Pressurised cyclic solid–liquid (PCSL) extraction offers a novel solution, though it has rarely been applied to this matrix. This study aimed to valorise SBL by extracting bioactive compounds using the innovative PCSL method for the development of a functional beverage—kombucha. Five different kombucha samples were prepared using different ratios of SBL extract and green tea: 100% SBL; 75% SBL + 25% green tea; 50% SBL + 50% green tea; 25% SBL + 75 green tea; 100% green tea. Fermentation was carried out for 10 days, and at different time points, the concentrations of biologically active compounds and the antioxidant effectiveness, antimicrobial activity, and sensory properties of the beverages were evaluated. The kombucha prepared with SBL extract exhibited the highest phenolic compound concentration (1.21 ± 0.03 g_{GAE}/L) and the least variation in antioxidant activity throughout fermentation (72.83–84.75%), while the green tea kombucha showed the lowest phenolic content (0.93 ± 0.03 g_{GAE}/L) and highest antioxidant changes (43.73–86.97%). Microbiological safety evaluation revealed that kombucha containing SBL extract possessed stronger antimicrobial efficacy against the tested pathogens compared to conventional green tea kombucha. Moreover, sensory evaluation demonstrated higher consumer acceptability for kombucha beverages enriched with SBL extracts. These results indicate that SBLs, as an underutilised secondary biomass, represent not only a nutritional resource but also a significant source of bioactive compounds. This valorisation approach highlights the potential of using such biomass in the formulation of functional foods aligned with sustainable and circular economy principles.

3.116. The Effects of Wheat Proteins in Non-Coeliac Wheat Sensitivity

Shweta Katrolia [1], Iain Brownlee [2] and Stephen Todryk [2]

[1] Applied Sciences, Health and Life Sciences, Northumbria University, Newcastle upon Tyne, England, UK

[2] Faculty of Health and Life Sciences, Northumbria University, NE1 8ST Newcastle-upon-Tyne, UK

Introduction: Non-coeliac wheat sensitivity (NCWS) is considerably more common than coeliac disease/wheat allergy, affecting ~13% of the population worldwide. It is characterized by gastrointestinal and extraintestinal symptoms due to an immunological pathogenesis, the activation of monocytes/macrophages, and the release of inflammatory cytokines (IL-6, IL-8, IL-1β, TNFα).

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Project aims: To test the impact of cereal proteins on inflammatory responses in a human cell line (THP-1) in vitro. To test whether adherence to a gluten-free diet improved gut symptoms and inflammatory responses in participants in a "before-and-after" dietary intervention.

Methods: We tested wheat proteins such as gluten/ATIs; wheat flour; quinoa, a non-wheat control; and LPS extracted in a PBS buffer, a positive control. We characterised these via SDS gel electrophoresis and HPLC. Protein-stimulated PMA-differentiated THP-1 cell lines were analysed for cytokine release using ELISA, RT-qPCR, and Flow Cytometry.

We conducted a human study [Northumbria University ethics approval registration no. 1723] with the inclusion criteria of pre-existing mild/moderate gastrointestinal symptoms; no dietary restrictions; and no major health issues. Participants (n = 15) were recruited for an ongoing, four-week intervention study of a gluten-free diet. Their gut symptomology was analysed using 24 h dietary recall via *intake24* to assess their dietary inflammatory index and questionnaires.

Results: To date, the ELISA results have shown that gluten and ATI showed a significant increase over the baseline ($p < 0.0001$), except for in regard to TNFα.

The RNA transcripts for the IL-8 cytokines were tested using RT-qPCR. The $\Delta\Delta C_T$ values for ATI showed a significantly different response to that of LPS (ATI, $\Delta\Delta C_T = 1.32$; LPS, $\Delta\Delta C_T = 0.90$), suggesting the expression of RNA for cytokines after protein stimulation.

Flow cytometry data showed the expression of MHC class II molecules on the surface of the stimulated THP-1 cell lines, with the highest mean fluorescence intensity values for ATI compared to those for LPS ($ATI_{mfi} = 7843$; $LPS_{mfi} = 6916$).

Conclusions: Our in vitro findings showed inflammatory responses to specific cereal proteins. These provide a mechanistic insight into NCWS and will inform future human feeding trials.

3.117. The Impact of Spray-Dried Potato Flour on the Techno-Functional, Rheological and Digestibility Traits of White Sorghum Flour-Based Flatbreads

Salman Haider [1], Faiza Shaikh [2], Tahira Mohsin Ali [1], Marium Shaikh [1] and Natasha Abbas Butt [3]

1 Department of Food Science and Technology, University of Karachi, Karachi 75270, Pakistan
2 Department of Human Nutrition and Dietetics, Ziauddin University, Karachi, Pakistan
3 Department of Biomedical Engineering, Ziauddin University, Karachi, Pakistan

The purpose of this study was to develop innovative batter-based flatbreads from a composite flour containing two sources, namely sorghum flour (SF) and spray-dried potato flour (PF). Sorghum flour (S_{100}) was considered as the control, and was partially substituted with spray-dried potato flour at levels of 10% (S_{90}), 20% (S_{80}), 30% (S_{70}), 40% (S_{60}) and 50% (S_{50}), respectively. Proximate composition analysis revealed that substitution with PF caused an increase in carbohydrate and ash contents, whereas a proportional decline was observed in fiber and fat contents. Increasing levels of PF led to a significant reduction in maximum viscosity (MV) and hot paste viscosity (V95). The phase angle (δ) decreased with increased substitution, implying that the batters became more elastic. Regarding texture analysis, the maximum force (Fmax) required to tear apart the flatbread was observed to be the highest for S_{80}, i.e., 1.067 MPa, which decreased significantly for the S_{70}, S_{60} and S_{50} flatbread samples. Higher substitution levels of PF yielded softer flatbreads, owing to the pregelatinized nature of spray-dried PF. The in vitro digestibility of the flatbreads was found to be dependent on viscosity. The lowest glycemic index (pGI) was obtained for S80, i.e., 42.86, due to its maximum viscosity, i.e., 4.33 Pa.s. The flatbreads prepared from composite flours had lower L values (slightly darker) in comparison to the control flour

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flatbread. The sensory profile of the composite flour-based flatbreads was insignificantly different from that of the control (S_{100}), and scored >4 on a hedonic scale of 5.

3.118. The Influence of Fenugreek Oil Addition on the Rheological Properties of Homemade Mayonnaise

Maha Krayem [1], kamar Nassrallah [2], Malak Baydoun [2] and Sanaa Khaled [1]

[1] Department of Biological Sciences, School of Arts and Sciences, Bekaa Campus, Lebanese International University, West Bekaa, Lebanon

[2] Department of Food Sciences and Technology, School of Arts and Sciences, Bekaa Campus, Lebanese International University, West Bekaa, Lebanon

Fenugreek oil has recently been discovered to possess natural antioxidant properties, leading to its increasing use as a natural preservative in some foods. Mayonnaise is a high-oil product prone to oxidation and quality degradation. In this study, we aimed to investigate the effectiveness of adding fenugreek oil as an antioxidant in homemade mayonnaise in terms of sensory evaluation. In order to reach our aim, a structured and ethically approved questionnaire by the LIU Institutional Review Board under the Reference number LIUIRB-221213-KN-218 was distributed to 258 participants across various Lebanese regions. Data were collected on mayonnaise consumption habits, health consciousness, and knowledge of fenugreek's health benefits. Following that, mayonnaise samples were prepared using a standardized formulation comprising 80% vegetable oil, 10% raw whole egg, 7% white vinegar, and 1% salt. Fenugreek oil (FO) was added to the emulsion during the oil phase incorporation as follows: 0% (control), 0.5% FO v/w, and 1% FO v/w. Samples were evaluated fresh (0 days) and after three days of storage in the refrigerator. Sensory analysis was conducted using a nine-member trained panel. Each panelist evaluated the coded samples for appearance, odor, texture, homogeneity, taste, and overall acceptability using a 5-point hedonic scale. The questionnaire findings revealed that participants were generally interested in fenugreek and its potential health advantages, with many willing to try fenugreek-fortified products. Sensory results showed that the addition of 1% FO improved the overall sensory profile without negatively impacting taste or texture, color homogeneity, orspreadability. In addition, sensory degradation over storage time was minimal, suggesting that FO contributes to oxidative stability. As a conclusion, this study may confirm fenugreek oil's role as a natural antioxidant and flavor stabilizer in mayonnaise, supporting its application as a functional additive in food emulsions.

3.119. The Influence of Sorghum–Wheat Composite Flour on the Rheological Properties of Biscuits

Maha Krayem, Rawan Al Majzoub, Sandra Abou Hamdan and Sanaa Khaled

Department of Biological and Chemical Sciences, School of Arts and Sciences, Lebanese International University, Bekaa Campus, Bekaa P.O. Box 146404, Lebanon

Sorghum is the fifth most important cereal worldwide. The production of biscuits from composite flour (wheat/sorghum) has been investigated in many research papers. The use of this composite flour is increasing due to its nutritional properties, which make the product highly desirable and acceptable. The concentration of sorghum flour added to wheat flour is a concern when it comes to producing a high-quality product. In order to better understand the functional properties of sorghum–wheat composite flour, this study was carried out. A questionnaire was designed and distributed among Bekaa participants in Lebanon in order to evaluate people's knowledge of Bekaa's market with regard to sorghum flour and the health benefits of this flour, and to determine their interest in and preferences (production and consumption-wise) towards trying a new product containing sorghum flour. After the answers were collected, a sensory analysis experiment was performed.

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Different concentrations of sorghum flour/wheat flour (*w*/*w*) were tested at day 7 and day 0 at the following percentages (0%, 25%, 50%, and 75%). Biscuits made from 50% sorghum flour had the best average scores for the sensory attributes. The results of the experiments show that the increase in the concentration of sorghum had a significant effect on the appearance and aroma of biscuits. Overall, Sorghum flour has been proven, in our research, to produce biscuits of a better quality when introduced at lower concentrations.

3.120. The Profile of Metabolites of Ellagitannins in the Context of Insomnia Occurrence in Peri- and Postmenopausal Women: A Preliminary Cross-Sectional Study

Beata Stasiewicz

Department of Human Nutrition, The Faculty of Food Science, University of Warmia and Mazury in Olsztyn, Sloneczna 45f, 10-718 Olsztyn, Poland

Introduction: Insomnia is the most common sleep disorder in women. Many metabolic processes are involved in sleep regulation and depend on nutritional status, suggesting a link between diet and sleep [21]. Over the past decade, there has been increased interest in the analysis of ellagitannins—a group of polyphenols whose metabolites involve ellagic acid (EA) and urolithins (Uros). Uros are microbial-derived metabolites with high bioavailability, blood–brain barrier permeability, and documented antioxidant, anti-inflammatory, and neuroprotective properties [22]. However, Uros have not yet been analysed in the context of insomnia. This preliminary study will aim to evaluate the associations between urine metabolites of ellagitannins and insomnia occurrence among peri- and postmenopausal women.

Methods: This preliminary cross-sectional study involved 80 women aged 50–70, including 38 women with insomnia. Due to the direct impact on insomnia, the exclusion criteria for the study included neurological and psychiatric diseases. The occurrence of insomnia was assessed using the five-point WHIIRS scale (Women's Health Initiative Insomnia Rating Scale) [23]. The profile of ellagitannin metabolites in urine was analysed using the LC-MS technique.

Results: Three ellagitannin metabolites were identified in all urine samples (mean concentration): EA (12.6 nM), Uros C (2.8 nM), and Uros D (7.9 nM). Women without insomnia had slightly but significantly higher Uros C concentrations compared to women with insomnia (3.0 vs. 2.5 nM; $p = 0.0470$). Uros A (1.3 nM) and B (1.0 nM) were identified in 80% and 14% women without insomnia and 74% and 8% women with insomnia, respectively.

Conclusions: The obtained findings provide promising preliminary data to design prospective studies involving diet and microbiome analyses to confirm the inverse association between Uros C concentration and insomnia occurrence and explain the mechanisms underlying them.

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3.121. The Role of Insoluble Dietary Fiber from Date Fruit in Structuring Food Matrices

Oni Yuliarti and Sanaa Rasul

Department of Food Science, College of Agriculture and Veterinary Medicine (CAVM) United Arab Emirates University (UAEU), Al Ain, Abu Dhabi P.O. Box No. 15551, United Arab Emirates

Date fruit (*Phoenix dactylifera* L.) pomace is a by-product from the date syrup processing industry, and is an excellent source of insoluble dietary fiber and phenolic compounds. To date, there is limited data on the utilization of the United Arab Emirates date pomace and its application in food systems. Knowledge of its applications, physicochemical characteristics,

and resultant products is crucial to the food industry. The demand for plant-based meat analogues (PBMAs) is currently on the rise in the United Arab Emirates (UAE), with the market size expected to grow annually. Unlike animal meats, PBMAs promote sustainable food production and could offer many health benefits. The incorporation of date fiber into different types of PBMAs has been evaluated, from hybrid (partial replacement) to full replacement of conventional meat in the form of reconstituted meat analogues such as patties, meatballs, ground meats, and high-moisture extrudates (HMEs). Fiber concentration and particle size were evaluated to determine the optimum concentration and particle size for enhancing PBMA textural properties and palatability. The inclusion of date fiber significantly improved the products' degree of texturization, color attributes, juiciness, and nutritional profile. Overall, the addition of date fiber could initiate its potential implementation and commercialization, especially in the UAE, where date processing is a major food industry. The use of fibers from the by-products of date syrup processing, in particular, further promotes food sustainability by supporting a zero-waste approach.

3.122. Toward Efficient Recovery of the Alkaloid Plantagonine from Verbascum sinuatum Flowers: Optimization of Microwave-Assisted and Pressurized Liquid Extraction Methods

Pauline Donn [1], Antia Gonzalez Pereira [1,2], María Carpena Rodríguez [1], Sepidar Seyyedi-Mansour [1], Paula Barciela [1], Ana Olívia Serra Jorge [1,3] and Miguel Angel Prieto Lage [1]

1 Instituto de Agroecoloxía e Alimentación (IAA), Universidade de Vigo, Nutrition and Food Group (NuFoG), Campus Auga, 32004 Ourense, Spain
2 Investigaciones Agroalimentarias Research Group, Galicia Sur Health Research Institute (IIS Galicia Sur). SERGAS-UVIGO, Vigo, Spain
3 REQUIMTE/LAQV, Department of Chemical Sciences, Faculty of Pharmacy, University of Porto, R. Jorge Viterbo Ferreira 228, 4050-313 Porto, Portugal

The increasing scientific interest in *Verbascum sinuatum* L. flowers (VSFs) is due to their potential applications across multiple sectors, including the pharmaceutical, cosmeceutical, and food industries, particularly in the development of functional foods and nutraceuticals. The phytochemical composition of VSFs is predominantly characterized by phenolic compounds, iridoid glycosides, and alkaloids such as plantagonine. This bioactive alkaloid identified in VSFs has been reported to have anticancer, antioxidant, and antimicrobial activities. In the literature, no studies have addressed the optimization of plantagonine extraction from VSFs. Thus, this study aimed to maximize the extraction of plantagonine from VSFs through microwave-assisted extraction (MAE) and pressurized liquid extraction (PLE). For MAE, 2 g of dried VSF powder was placed in a closed vessel and dissolved in 40 mL of a solvent at various concentrations (S) and temperatures (T) and for various periods of time (t). Regarding PLE, the procedure involved placing 1 g of dried VSFs in a 66 mL extraction cell containing diatomaceous earth under 10 bar pressure and applying various S, T and t conditions. Efficient recovery, meaning the maximization of the yield using the lowest possible inputs, was determined using the Response Surface Methodology (RSM) with three independent variables (t/X_1, T/X_2, and the proportion of ethanol in the hydroethanolic solution, S/X_3), employing a five-level circumscribed central composite design (CCCD) comprising 28 experimental runs. The plantagonine content in the VSF extracts obtained under the operational conditions for each point of the experimental design was evaluated through HPLC-ESI-QqQ-MS/MS. The results revealed that under the optimal extraction conditions, the yield obtained using PLE (2312.86 ± 39.69 μg/g extract; 25 min, 200 °C, 59% ethanol) was 1.7-fold higher than that obtained using MAE (1356.20 ± 32.10 μg/g extract; 25 min, 180 °C, 55% ethanol). Therefore, this study proposes, for the first time, the optimal extraction conditions for maximizing the recovery of plantago-

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nine from VSFs using two green extraction techniques, demonstrates the superiority of PLE, and provides a quantitative framework for further industrial extraction and application in the food, cosmeceutical, and pharmaceutical industries.

3.123. Traditional Amlou Spread as a Novel Shelf-Stable Carrier for Probiotics: Microbial Viability and Physicochemical Stability During Storage

Oulayya Essalhi [1], Youssef Ezzaky [1,2], Mariem Zanzan [1], Fadil Bakkali [3] and Fouad Achemchem [1]

[1] Bioprocess and Environment Team, LASIME Laboratory, Agadir Superior School of Technology, University Ibn Zohr, BP 33/S, Agadir 80150, Morocco
[2] FRESH A*STAR, SFA & Nanyang Technological University, 62 Nanyang Drive, Singapore N1.2-01-20, Singapore
[3] Laboratory of Drug Sciences, Faculty of Pharmacy, Mohammed VI University of Health and Sciences (UM6SS), Casablanca 20230, Morocco

The development of shelf-stable functional foods remains a key challenge in probiotic product formulation, particularly for non-dairy alternatives adapted to traditional diets. *Amlou*, a Moroccan low-moisture spread composed of argan oil, almonds, and sugar or honey, offers a promising matrix for probiotic delivery due to its nutrient-rich composition and cultural relevance. This study evaluated the potential of *Amlou* as a carrier for three probiotic strains: *Lactobacillus gasseri* (commercial), *Latilactobacillus sakei* AE126 (locally isolated from fermented fish), and *Enterococcus durans* Y17 (isolated from traditional *Amlou*). Each strain was inoculated separately into six *Amlou* formulations varying in argan oil (5% or 10%) and sugar (0%, 5%, or 10%) content, with an initial probiotic load of approximately 7 log CFU/g. The formulations were stored at ambient temperature (20–25 °C) for 45 days. Probiotic viability was assessed at regular intervals using selective media and standard plate counts. Physicochemical parameters, including pH and water activity (aw), were also measured throughout the storage period. The results showed that probiotic survival was significantly affected by formulation composition (ANOVA, $p < 0.05$). Overall, reductions in viability remained below 1 log CFU/g across all formulations. The best-performing formula for the commercial strain (*L. gasseri*) was Formulation 4 (10% argan oil, 0% sugar), which maintained the highest cell counts over time. For the locally isolated strains, Formulation 5 (10% argan oil, 5% sugar) provided the most favorable conditions for microbial stability. The pH values declined slightly during storage, while water activity decreased with increasing sugar concentration. These findings demonstrate the potential of *Amlou* as a shelf-stable, plant-based matrix for probiotic delivery, contributing to the diversification of functional foods rooted in North African culinary traditions.

3.124. Trypsin Inhibitory Activity and Protein Digestibility in Legume-Based Products Commercially Available in a Southern Brazilian City

Guilherme Soares Lapa Assis Assis, Olga Luisa Tavano, Raissa Leite Coelho, Arthur Amorim de Santana Marques and Lara Campos Borim

Faculty of Nutrition (FANUT), Federal University of Alfenas (UNIFAL-MG), Alfenas Campus, Alfenas 37130-001, MG, Brazil

Plant-based protein diets have been increasingly promoted and adopted. Among the main sources of plant proteins are legumes, which are commonly consumed either as cooked grains or in processed forms. These legumes contain various proteins, including those known as protease inhibitors. Previously considered primarily as antinutritional factors, more recent studies have suggested that these compounds may offer health benefits, such as contributing to the prevention of colon cancer. Their presence at specific levels may, in fact, be desirable. Legume-based foods, even when subjected to thermal process-

ing, retain some level of trypsin inhibitory activity. In this study, various legume-based foods available in markets or restaurants of a municipality in southeastern Brazil were analyzed. Samples were obtained either in ready-to-eat form or were prepared according to the instructions provided on their packaging. Following freeze-drying, protein content was determined, and in vitro protein digestibility was assessed using a sequential pepsin–pancreatin digestion method, followed by quantification of free alpha-amino groups. Trypsin inhibitory activity was evaluated using the BAPNA substrate. The analyzed samples included cooked beans (white, black, and brown varieties), chickpeas, and lentils, as well as aqueous extracts and preparations such as plant-based burgers. Raw seeds of the respective legumes were also analyzed for comparison. Trypsin inhibitory activity was detected in all samples, though with considerable variation (ranging from 447.09 to 15,000 TIU/g). Digestibility also varied substantially, ranging from 53.78% to 128.77% when expressed as a percentage relative to casein. No correlation was observed between trypsin inhibitory activity and digestibility values. The findings suggest that the inclusion of legume-based products in the diet provides a certain intake of protease inhibitors, which may confer health benefits. Furthermore, at the levels detected in this study, these inhibitors do not appear to negatively impact protein digestion in the analyzed samples.

3.125. Unveiling Popularity Shifts in Natural Nootropics: A Time Series Clustering of Reddit Discussions

Christos Gatsios [1], Sofia Vasileiadou [2], Malamatenia Panagiotou [2], Konstantinos Gkatzionis [2] and Efstathios Kaloudis [1]

[1] Computer Simulation, Genomics and Data Analysis Laboratory, Department of Food Science and Nutrition, University of the Aegean, Metropolite Ioakeim 2, 81400 Myrina, Lemnos, Greece

[2] Laboratory of Consumer and Sensory Perception of Food & Drinks, Department of Food Science and Nutrition, University of the Aegean, Metropolite Ioakeim 2, 81400 Myrina, Lemnos, Greece

The increasing popularity of natural nootropics (substances believed to enhance cognitive function) is often reflected in online discussions. Reddit, particularly its r/Nutrition community, offers a rich, time-resolved dataset for exploring these evolving interests. In this study, we analyzed approximately 10 years of posts from r/Nutrition (sourced via academictorrents.com), extracting the 15,000 most frequent words. Using the MiniLM-L6-v2 language model for semantic filtering, we isolated a curated set of 150 food-related nootropic terms. From these, we selected the top 40 most frequent, which collectively account for over 99% of the total nootropic term frequency. For each term, we constructed a monthly time series normalized by the number of active users per month, ensuring that trends reflect genuine relative interest. Each time series was then standardized using mean-variance scaling to allow shape-based comparisons. To identify groups of terms with similar temporal dynamics, we applied the TimeSeriesKMeans algorithm (from the tslearn library), using Dynamic Time Warping (DTW) as the distance metric to accommodate non-linear shifts and misalignments. The results identified four clusters containing 5, 8, 10, and 17 terms, respectively, each with distinct temporal patterns. Cluster 1 showed a broad peak of interest between 2016 and 2018; Cluster 3 peaked around 2017 before declining; Cluster 0 remained stable with minor fluctuations; and Cluster 2 showed a rising trend after 2021, indicating emerging topics. Semantic analysis showed that all clusters were (to some extent) relevant to cognitive performance and food-related enhancers (functional foods, supplements, etc.). Semantic coherence varied. Each cluster had a different temporal usage pattern, but all four in fact depicted what seems to be a general pattern: scientific research focuses on certain foods/substances, which causes an increase in consumers' interest and

an explosion in the market (marketing, availability, and sales), leading to skepticism and critical reassessment and, thus, a drop in interest over time.

3.126. Use of Annurca Apple Peel Flour (Malus domestica) and Cherry Seed Oil in the Formulation of Enriched Crackers

Maria Neve Ombra [1], Florinda Fratianni [1], Beatrice De Giulio [1], Francesca Coppola [1,2] and Filomena Nazzaro [1]

[1] Institute of Food Sciences, National Research Council (CNR), Via Roma 64, 83100 Avellino, Italy
[2] Department of Agricultural Sciences, University of Naples Federico II, Piazza Carlo di Borbone 1, Portici (NA), Italy

The Annurca variety of *Malus domestica* is recognized for its high content of bioactive substances, making it a promising candidate for the production of functional foods. The addition of specific components—such as antioxidants, dietary fibers, and enzyme inhibitors—can offer health-enhancing effects and help mitigate the risk of various diseases. In this research, we made lab-scale cracker prototypes fortified with dried, ground Annurca apple peels at two inclusion levels (5% and 10%, referred to as S1 and S2), as well as cold-pressed cherry seed oil. We investigated their in vitro inhibitory effects on key digestive enzymes and estimated their predicted glycaemic index. Both fortified versions showed inhibition of α-amylase, α-glucosidase, and lipase activities. The IC_{50} values (mg/g dry weight) for S1 and S2 were, respectively: α-amylase 55 and 38; α-glucosidase 118 and 68; lipase 45 and 35. Furthermore, the enriched crackers demonstrated lower predicted glycaemic indices compared to the control samples, without apple peels. We also measured water holding capacity (WHC) and oil holding capacity (OHC), finding no significant variations relative to the control. The aroma profile evolution was monitored using an electronic nose at scheduled intervals, and notable differences were detected in the samples after three months of storage. Overall, our findings indicate that Annurca peel flour and cherry seed oil, due to their valuable functional components, can be successfully used to formulate food products with potential health benefits and stable shelf-life.

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3.127. Use of Fruit and Fruit By-Product Powder for Fortification of Cookies: Antioxidant and Antidiabetic Activity

Ayse Binnur Karatas [1,2] and Yasemin Sahan [3]

[1] Central Research Institute of Food and Feed Control, Osmangazi, Türkiye
[2] Graduate School of Natural and Applied Sciences, Bursa Uludag University, Bursa, Türkiye
[3] Department of Food Engineering, Faculty of Agriculture, Bursa Uludag University, 16059 Bursa, Türkiye

This study aimed to review the literature focusing on the fortification of cookies with fruit and fruit by-product powder, discussing their chemical composition, antioxidant capacity, antidiabetic effect, and sensory acceptability. In this study, we aim to present current findings that can guide industrialists and researchers in healthier cookie production without compromising sensory quality. It is seen that previous studies generally focus on functionality or sensory properties. This study offers a holistic view of the functional cookie development process by evaluating antioxidant and antidiabetic activity, sensory acceptability, and fiber content together. Within the scope of the study, peer-reviewed

publications in the Scopus, Web of Science, and Google Scholar databases between 2015 and 2024 were scanned, and studies in which apple, aronia, grape, papaya, dragon fruit, passion fruit, bergamot, and other fruits were used were analyzed. The total phenolic content of the enriched products ranged up to 622 mg GAE/100 g according to fortified raw materials. Some studies have shown that adding fruit powder to products can make them up to 400 times more effective at inhibiting the α-amylase enzyme compared to non-enriched products. The dietary fiber content in cookies was increased by the addition of fruit pulp and peel powder. Sensory analyses showed that fortification had negative effects on bitterness and texture in some samples, but 5–15% enrichment generally resulted in high consumer acceptance. Cookies fortified with fruit powder additives offer important potential as a functional food with health and sustainability benefits. However, factors such as the additive ratio, particle size, heat treatment process, and food matrix determine the sensory and functional properties of the product. Studies in this field provide insights into the development of new products that have both antidiabetic and antioxidant properties, as well as being well-accepted by consumers in terms of their sensory qualities.

3.128. Valorization of Acidic Whey in Strawberry-Based Functional Beverages

Sana Mukhtar [1], Adnan Mukhtar [1] and Sadaf Shakoor [2]

[1] Constituent College, Depalpur-Okara, University of Agriculture, Faisalabad, Okara 56300, Pakistan

[2] Constituent College, Burewala, University of Agriculture, Faisalabad, Burewala 61010, Pakistan

Acidic whey, a nutrient-rich by-product of cheese production, is naturally high in quality proteins, lactose, vitamins, and minerals, making it a valuable ingredient for human consumption. Despite its nutritional potential, acidic whey poses a significant environmental challenge due to its high volume and limited industrial utilization. This study aimed to valorize acidic whey by incorporating it into a strawberry-based functional beverage, thereby enhancing its nutritional value while contributing to dairy waste management. The beverage, formulated with 70% strawberry juice and 30% acidic whey, was subjected to different preservation treatments and evaluated over 28 days for physicochemical properties, antioxidant capacity, and microbial stability. Four sample groups were studied: an untreated control (T_0), thermal treatment at 80 °C for 10 min (T_1), and ultrasonication at 25 kHz for 5 min (T_2) and 10 min (T_3). Among these, the ultrasonicated sample treated for 10 min (T_3) demonstrated the most favorable results, with minimal pH decline and a 42.88% reduction in sedimentation compared to the control (T_0). T_3 also retained the highest levels of total phenolics (725.08 μg GAE/g) and flavonoids (384.85 μg CE/g) and exhibited a 45.71% increase in antioxidant activity. Microbial analysis for T_3 indicated a 74.10% reduction in total plate count.

These findings highlight the potential of ultrasonication (T_3) in preserving the nutritional and functional attributes of strawberry–acidic whey beverages, particularly in terms of antioxidant activity and bioactive compound retention. The study further supports the application of non-thermal processing techniques for developing shelf-stable and nutritious beverages. This approach aligns with sustainable food processing goals by promoting the circular utilization of dairy by-products in value-added functional products. A detailed study on sensory evaluation and consumer acceptability will be conducted in the future following formal ethical approval.

3.129. Valorizing Agro-Industrial Waste: Enhancement of Bread Nutritional Quality Through Date Seed Fiber Fortification

Seham Al Raish

Department of Biology, College of Science, United Arab Emirates University, Al Ain 15551, United Arab Emirates

The objective of this research was to examine the viability of date seed powder (DSP), a low-value-added agro-industrial by-product, as an eco-friendly and valuable ingredient for bread production. Conducted at the United Arab Emirates University College of Science, this study assessed the effects of partially substituting wheat flour with DSP at concentrations of 1%, 5%, 10%, 15%, and 25% on the physical, sensory, and nutritional attributes of bread.

Visual analysis showed that increased DSP levels progressively darkened the crust and crumb color, primarily due to enhanced Maillard browning reactions linked with higher protein and fiber contents. The bread's physical properties—including weight, volume, and appearance—revealed an optimal balance between structure and nutritional enhancement at 10–15% DSP levels. Sensory evaluation indicated that 10% DSP bread had the highest overall consumer acceptability, offering a favorable texture, pleasant flavor, and appealing crust coloration. In contrast, bread containing 25% DSP had significantly compromised texture and appearance, leading to lower consumer acceptance.

Nutritional analyses revealed a substantial increase in dietary fiber with DSP addition, with the 10% DSP bread containing three times the dietary fiber of the control. Despite these changes, the pH of all DSP bread formulations remained neutral (pH 7.0), confirming that DSP fortification does not adversely impact microbiological safety or freshness.

It was concluded that incorporating up to 10% date seed powder significantly enhances the nutritional value of bread, especially dietary fiber content, without negatively affecting physicochemical quality and consumer acceptability. The findings highlight DSP's potential as an ingredient for healthy, functional bread formulations and sustainable food systems, thus contributing to the ongoing effort toward agro-waste valorization in food processing industries. Further research could explore additional strategies to maximize DSP inclusion levels without compromising sensory or structural properties.

4. Session C: Food Quality and Safety

4.1. "CANTINA 5.0"—Industry 5.0 Enters Winemaking Industry in Italy

Alessandro Bianchi [1], Chiara Sanmartin [2], Isabella Taglieri [2], Alessandro Tonacci [3], Francesco Sansone [3] and Francesca Venturi [2]

[1] Department of Agriculture, Food and Environment, University of Pisa, Via del Borghetto 80, 56124 Pisa, Italy
[2] Department of Agriculture, Food and Environment, University of Pisa, Via del Borghetto 80, 56124 Pisa, Italy
[3] Institute of Clinical Physiology, National Research Council of Italy (IFC-CNR), Via Giuseppe Moruzzi 1, 56124 Pisa, Italy

Industry 5.0, as proposed by the European Commission, marks a paradigm shift from profit-oriented production towards a model that prioritizes human well-being and environmental sustainability. In contrast to Industry 4.0, which emphasized automation and efficiency, Industry 5.0 integrates advanced technologies with a human-centric and eco-conscious approach. The agrifood sector—particularly the winemaking industry—is a strategic application area, given its socio-economic relevance and environmental impact, especially in countries such as Italy. In response, we developed CANTINA 5.0, a research initiative aimed at operationalizing Industry 5.0 principles in Italian wineries through a multidimensional approach centered on sustainability, human factors, and product quality. The research structure is based on four interconnected pillars: (i) quality of life monitoring via wearable sensors and structured questionnaires assessing workers' physical

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and psychological conditions; (ii) environmental monitoring of pollutants within wine cellars using both IoT-based devices and conventional GC-MS analysis; (iii) sustainability assessment through standardized questionnaires addressing environmental practices and social responsibility indicators, with a focus on workforce well-being; and (iv) wine quality evaluation, combining chemical profiling, expert sensory panels, and emotional response tracking of consumers using wearable devices. To date, 20 wineries (12 in Friuli-Venezia Giulia, 8 in Tuscany) have participated. All completed sustainability and well-being surveys; selected facilities underwent environmental monitoring, and workers in some wineries wore smartwatches during harvest and non-harvest periods. Wine samples were analyzed chemically and sensorially, while emotional responses to wine tasting—alone and paired with music—were collected during five public events. Preliminary results show high stakeholder engagement and public interest. Future work will extend data collection and develop targeted dissemination strategies to foster the adoption of Industry 5.0 in national and European R&D frameworks.

4.2. Comparative Study of Natural Vinegars and Sodium Hypochlorite on Microbial Load Reduction, Antioxidant Activity, and Phenolic Content in Fresh Spinach

Hafsa Ben Allal

Department of Nutrition and Bromatology, School of Pharmacy, University of Granada, 18071 Granada, Spain

This study evaluates the effectiveness of four culinary vinegars—white wine vinegar, apple cider vinegar, sherry vinegar, and balsamic vinegar—as natural disinfectants for fresh spinach, compared to sodium hypochlorite. Microbial analysis was performed using standard culturing and plate count techniques to quantify molds, yeasts, and psychrophilic microorganisms and detect *Listeria monocytogenes*. Antioxidant activity was assessed using the DPPH method, while total polyphenolic content was determined using Folin–Ciocalteu reagent.

The results showed a significant reduction in microbial load for all vinegar-treated samples compared to the untreated control ($p < 0.05$), with a reduction in molds and yeasts from 6.45 log CFU/10 g in the untreated sample to below the detection limit (<1.0 log CFU/10 g) at the first vinegar concentration applied. Although differences between the four vinegar types were not statistically significant ($p > 0.05$), vinegar-treated samples consistently showed lower counts of psychrophilic microorganisms and *Listeria monocytogenes* than those treated with sodium hypochlorite ($p < 0.05$).

In terms of antioxidant properties, vinegar treatments led to a significant increase in radical scavenging activity. The highest activity was observed with 50% (v/v) balsamic vinegar (14.60 µM Trolox/10 g sample), compared to 5.51 µM Trolox/10 g in the untreated control and only 2.74 µM Trolox/10 g in sodium hypochlorite-treated samples. Moreover, total polyphenolic content increased significantly following vinegar treatment, with white wine vinegar at 50% (v/v) reaching 10.05 mg GAE, compared to 5.46 mg GAE in the untreated sample and a reduced level of 2.54 mg GAE after sodium hypochlorite treatment. These results indicate an enhancement of nutritional value with vinegar treatments, while sodium hypochlorite led to a marked decrease in both antioxidant activity and phenolic content.

4.3. Ensuring Food Safety Through Comprehensive Pesticide Residue Monitoring and Regulatory Compliance in Infant Nutrition

Miroslava Kuzniarová [1,2], Milena Dömötörová [1] and Martina Michálíková [1]

[1] Public Health Authority of the Slovak Republic, National Reference Center for Pesticide Residues, Trnavská cesta 52, 826 45 Bratislava, Slovak Republic

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[2] Department of Analytical Chemistry, Faculty of Natural Sciences, Comenius University in Bratislava, Ilkovičova 6, 842 15 Bratislava, Slovak Republic

Pesticide residues in baby food are a significant food safety concern due to the heightened vulnerability of infants and young children. The European Union enforces strict regulations, such as Regulation (EC) No. 396/2005 on maximum residue levels (MRLs) and Regulation (EC) No. 178/2002 on general food law. The European Food Safety Authority (EFSA) provides scientific assessments of pesticide toxicity and exposure, supporting risk management decisions.

In Slovakia, the National Reference Center for Pesticide Residues at the Public Health Authority uses validated analytical methods to detect over 200 pesticides in various baby food matrices, including purees, milk formulas, and cereal-based products. Due to infants' higher food intake relative to body weight, it is essential to monitor pesticide residues and metabolites at trace levels (μg/kg).

Sample preparation is based on the QuEChERS method, suitable for complex food matrices. Analytical detection combines LC-MS/MS for thermolabile and polar compounds and GC-MS/MS for volatile and thermally stable substances.

Method validation follows the SANTE/11312/2021 guidelines, addressing parameters such as selectivity, linearity, recovery, precision, and limits of quantification (LOQs). LOQs range from 0.0003 to 0.01 mg/kg. Recoveries generally fall within the acceptable 70–120% range, with some exceptions for organochlorine pesticides in milk. Reproducibility remains below 20%, with rare cases up to 34%.

Around 40 samples are tested annually. Over the past 15 years, no pesticide residue has exceeded the legal limit in baby food. The methods are accredited by the Slovak National Accreditation Service under STN EN ISO/IEC 17025:2018. Their accuracy is regularly confirmed through international proficiency tests and interlaboratory comparisons, with consistently satisfactory results.

These monitoring activities ensure compliance with EU regulations and help protect infant health by minimizing exposure to harmful pesticide residues in baby food.

4.4. Faster and Reliable Quality Control of Encapsulated Coffee

Mariana Ramos [1,2], Joana Costa [1,2], Telma Carapito [2,3] and Ana Maria Aço Monteiro Pintão [1,2]

[1] Egas Moniz Centre for Interdisciplinary Science (CiiEM), Egas Moniz School of Health & Science, Quinta da Granja, Monte de Caparica, 2829-511 Caparica, Portugal
[2] Kaffa, Galvão & Noronha Lda, Rua São Sebastião, lote 6, 2635-448 Rio de Mouro, Portugal
[3] Earth Science Department, Nova School of Science and Technology, Campus da Caparica, 2829-516 Caparica, Portugal

Introduction: The complexity and the time needed to perform analytical standard procedures of coffee quality control can be excessive compared to commercialization needs. A comparative analysis was carried out, using standard and modern methodologies, with new equipment allowing quicker results between blends of encapsulated coffee with different proportions of *C. arabica* L., and *C. canephora* Pierre ex A.Froehner.

Methods: New methodologies were introduced to study the moisture content of green and roasted ground coffee for the determination of water weight loss, with two infrared balances. For the distribution of ground coffee size particles, and its influence on the physicochemical parameters of the drinks, a Fristch laser diffraction analyser was applied and compared with sieve tower results. Other characterization determinations and sensory analyses were performed with internal protocols and a trained panel.

Results: The expedited methods of moisture determination present values very similar to the standard methods. The fragmentation of the particles in the two species and

various origins of coffee was carried out differently, influencing the way the particles were distributed. The blend, consisting mostly of robusta coffee, had the highest percentage of smaller particles, and the one with arabica had the lowest percentage of these particles. The evaluation with a laser particle size analyser allowed the faster and more detailed presentation of results in a diagram for each case. Different organoleptic profiles were obtained, which quantitatively and qualitatively had the most striking characteristics to define each product.

Conclusions: The approach of comparing the two methodologies of weight loss proved to be of interest mainly in the case of ground roasted coffee, while the method of ground particle distribution was more accurate and faster. The sensory and physicochemical characteristics used to evaluate the blends were in accordance with their different compositions, and the results obtained were consistent and reproducible.

4.5. Microbial Quality of Packaged and Unpackaged Cereal Samples Sold in Local Markets in AfrICA

Victor Onyedikachi Etikudike [1], Oluchi J Osuala [2], Constance Chinyere Ezemba [3], Angus N Oli [4], I O Okonkwo [5] and Charlse O Nnadi [6]

1 Pharmaceutical Microbiology, Igbariam Campus, Chukwuemeka Odumegwu Ojukwu University, Igbariam Campus, Igbariam 430101, Anambra State, Nigeria
2 Pharmaceutical Microbiology and Biotechnology, Madonna University, Elele PMB 05, Rivers State, Nigeria
3 Microbiology, Marsha Fuerst School of Nursing, Riverside (Success Education College), Riverside, California, CA 92115, USA
4 Pharmaceutical Microbiology and Biotechnology, Nnamdi Azikiwe University, Awka 420281, Anambra State, Nigeria
5 Virus and Genomics Research Unit, Department of Microbiology, University of Port Harcourt, 500001, Rivers State, Nigeria
6 Pharmaceutical Microbiology and Biotechnology, University of Nigeria, Nsukka, Nsukka 410001, Enugu State, Nigeria

Introduction: Packaged and unpackaged cereals are most commonly consumed food products, and their microbiological quality is important for consumer health. This study examined the isolation and identification of bacterial and fungal pathogens in packaged and unpackaged cereal samples.

Methods: Fresh packaged and unpackaged cereal products were collected from different local markets in Anambra state, Nigeria. A total of 100 samples were analyzed. Each sample (10.0 g) was homogenized with 90.0 mL of sterile normal saline to prepare a stock solution. Then, 0.1 mL of the diluted samples was inoculated on Nutrient Agar (NA), Mannitol Salt Agar (MSA), MacConkey Agar, Salmonella Shigella Agar, Eosine Methylene Blue Agar, Thiocitrate Bile Salt Sucrose Agar, and Potato Dextrose Agar (PDA) (chloramphenicol (40 mg/L) media and incubated at 37 °C for 18–24 hr except for PDA which was incubated at 25 °C for 48–72 hr. The suspected typical colonies of the bacteria and fungi CFU/g of each sample were counted and further identified after various biochemical tests.

Results: All the samples were contaminated with different bacteria and fungus spp. The highest bacterial count was (4.30) logCFU/gm and there was no heterotrophic bacterial count in some samples. The percentage of contamination of the samples is as follows: Total Heterotrophic Bacteria (50%), Total Coliforms (50%), Staphylococcus spp. (70%), Vibrio spp. (60%), Salmonella/Shigella spp. (60%), Fungi (packaged samples) 80%, and Fungi (unpackaged samples) 100%. Fungal pathogens were isolated from all unpackaged cereal samples. The highest fungal (Aspergillus genus) count (4.30 logCFU/g) was found in sample D. The amount of yeast and mold (1.0 × 106 CFU/g) in the unpacked flour sample from

the local market was higher than the recommended limit (105 CFU/g). Therefore, stringent regulatory actions on the microbiological quality control on packaged and unpackaged cereal products, together with the training of salespeople on food spoilage, are necessary for the better management of public health in Nigeria.

4.6. Tracing Strawberry Authenticity Using Isotope and Multielement Analysis

Martina Ivešić, Iva Palac Bešlić and Adela Krivohlavek

Andrija Stampar Teaching Institute of Public Health, Mirogojska Cesta 16, 10000 Zagreb, Croatia

With increasing food demand, ensuring authenticity and traceability is crucial. Advanced analytical methods now reliably verify food origin, production, and composition. For strawberries, which are commonly consumed fresh and processed, techniques like stable isotope ratio analysis (EA-IRMS) and multielement analysis (ICP-MS) provide valuable tools to assess authenticity and geographic origin.

This study aimed to evaluate the potential of isotope and elemental profiling for differentiating strawberry varieties and geographic origins. A total of 40 fresh strawberry samples were analysed: from continental Croatia (Zagreb County), southern Croatia (Opuzen), unspecified domestic sources, and one from Italy. EA-IRMS was applied to determine $^{13}C/^{12}C$ and $^{15}N/^{14}N$ isotope ratios, while ICP-MS was used to quantify 21 elements (B, Na, Mg, Al, K, Ca, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Rb, Sr, Mo, Cd, Ba, and Pb).

The results indicate that $\delta^{13}C$ values were influenced by both variety and region. The Clery variety dominated in both continental ($-25.4‰$ to $-26.6‰$) and southern Croatia ($-25.0‰$ to $-26.7‰$), while less common varieties (Joly, Asia) showed similar values. Unidentified varieties ranged from $-24.2‰$ to $-26.0‰$. The Italian Aprica variety showed a value of $-26.6‰$. The $\delta^{15}N$ values ranged from 2.15‰ to 9.82‰, reflecting different fertilisation regimes, with near-zero values suggesting organic cultivation.

Elemental profiles varied regionally: calcium levels differed across samples; strawberries from southern Croatia showed significantly higher magnesium content; and sodium concentrations were elevated in samples from southern Croatia, other continental areas, and Italy compared to Zagreb County.

These findings represent an initial step toward developing a reference database to support the verification of strawberry origin and strengthen food authenticity and traceability frameworks.

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4.7. A Study on Microplastic Contamination in Medicinal Plants

Vlatka Mikulec [1], Želimira Cvetković [1], Petra Adamović [2] and Martina Ivešić [1]

[1] Andrija Stampar Teaching Institut of Public Health, 10000 Zagreb, Croatia
[2] Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, 10000 Zagreb, Croatia

The microplastic (MP) contamination of food plants is increasingly being recognised as an environmental and public health concern, yet raw medicinal botanicals remain understudied. We surveyed 70 wild-harvested samples (5 g dry weight each) of herbs, flowers, leaves, seeds, roots, and fruits collected in May 2024 from remote meadows and orchards in Herzegovina, Bosnia and Herzegovina. All sample handling—including drying, oxidative digestion (30% H_2O_2, 60 °C, 24 h), and vacuum filtration (0.45 μm)—was performed under clean-air conditions with procedural blanks (n = 3), which showed no background particles.

Retained particles were first inspected by stereomicroscopy (25–100×) and then identified via FTIR spectroscopy. To validate detection capability down to micrometre scales, two positive controls were used: (1) certified traceable polystyrene spheres and (2) in-house ground polystyrene 678E resin, yielding size fractions of ~50 µm, 80 µm and 1.5 mm (MSDS provided). Polymer identity in both controls was confirmed by ATR-FTIR, demonstrating that our qualitative workflow reliably detects and identifies particles $\geq$ 50 µm. No MPs were detected in any of the 70 plant samples, indicating that, when harvested from relatively pristine sites and processed under stringent contamination-control measures, medicinal plants can remain free of detectable microplastic contamination. This qualitative survey provides a validated protocol for direct MP screening in botanicals. Future work should extend to additional regions, commercially processed products, and varied packaging practices to fully assess microplastic exposure across the herbal supply chain.

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4.8. Acoustic Impedance of Some Fruits and Vegetables from the Region of Zacatecas, Mexico: An Approach to the Quality of Agricultural Products

Raúl Alberto Reyes Villagrana

SECIHTI, Universidad Autónoma de Zacatecas, Zacatecas 98000, Mexico

Food quality focuses on specific parameters such as physical, chemical, sensory, and microbiological properties. In the case of physical properties, appearance, texture and condition are the factors that are tested using various technological aids. One of these is low-intensity ultrasound, which is used to examine the internal structure of food by means of acoustic impedance testing, i.e., the resistance of food to the acoustic wave propagating through it in the ultrasound spectrum. This paper presents a study to determine the acoustic impedance of various agricultural products from the Zacatecas region of Mexico. The products were purchased from a local store. The fruit and vegetables analysed were peach (*Prunus persica*), grape (*Vitis vinifiera*), guava (*Psidium guajava*), apple (*Malus domestica*) and quince (*Cydonia oblonda*); onion (*Allium cepa*), prickly pear (*Opuntia ficus-indica*), tomato (*Solanum lycopersicum*), carrot (*Daucus carota*), beans (*Phaseolus vulgaris*), and maize (*Zea mayz*). The acoustic phase velocity of the products was measured using the transmission technique. Bulk density was also determined. The acoustic impedance of the individual products was determined indirectly. This resulted in the following values: peach, Z $\approx$ 1.53 MRayls; grape, Z $\approx$ 1.17 MRayls; guava, Z $\approx$ 0.655 MRayls; apple, Z $\approx$ 0.90 MRayls; and quince, Z $\approx$ 22.54 MRayls; onion, Z $\approx$ 1.062 MRayls; prickly pear, Z $\approx$ 1.311 MRayls; tomato, Z $\approx$ 1.035 MRayls; carrot, Z $\approx$ 0.719 MRayls; bean, Z $\approx$ 4.144 MRayls; and maize, Z $\approx$ 3.6 MRayls. We hope to further explore the acoustic properties of agricultural products in order to correlate them with optical, rheological, and textural properties.

4.9. Advanced Rice Quality Assessment Using Spectral Markers and Machine Learning Based on Near-Infrared Spectroscopy

Pedro Sousa Sampaio [1,2,3], Bruna Carbas [1,4], Andreia Soares [1], Inês Sousa [1,2] and Carla Moita Brites [1,2]

1 Instituto Nacional de Investigação Agrária e Veterinária (INIAV), Av. da República, Quinta do Marquês, 2780-157 Oeiras, Portugal

2 GREEN-IT Bioresources for Sustainability, ITQB NOVA, Av. da República, 2780-157 Oeiras, Portugal

[3] COPELABS–Computação e Cognição Centrada nas Pessoas, Faculty of Engineering, Lusófona University, Campo Grande, 376, 1749-024 Lisbon, Portugal
[4] Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal

Rice (*Oryza sativa* L.) is unique among major cereal crops, as it is primarily consumed as a whole grain after cooking. Evaluating rice quality is crucial for maintaining high standards and meeting consumer expectations. Quality assessment involves multiple parameters, including appearance, texture, aroma, taste, nutritional content, and safety—factors that collectively influence the overall quality and market value of rice products. Near-infrared spectroscopy, combined with machine learning techniques, was employed to link molecular characteristics to quality traits, offering a high-throughput and efficient evaluation method. Partial Least Squares regression models demonstrated strong predictive performance for several key parameters, whiteness (R^2 = 0.94), grain width (R^2 = 0.94), resilience (R^2 = 0.96), and springiness (R^2 = 0.98), identifying important wavelength regions. Principal Component Analysis revealed clear clustering patterns among the rice varieties, while Partial Least Squares Discriminant Analysis achieved a 17% error rate in external validation. The accuracy for the training process was significant, registering a not-assigned value for the samples used for the calibration step (23%). The cross-validation process was characterized by an accuracy of 68%, an error rate of 21%, and a not-assigned value (28%). The cross-validation process was characterized by an accuracy of 68%, an error rate of 21%, and a not-assigned value (28%). Notably, spectral markers at A6032/4457 cm^{-1}, A7004/5241 cm^{-1}, and A7004/4749 cm^{-1} reflected distinct biomolecular differences between varieties. These markers enable accurate quantification, classification, and differentiation of rice types, enhancing quality control, breeding selection, and consumer satisfaction. This study successfully developed a classification model using PLS-DA based on NIR spectroscopy data to distinguish rice varieties by their physicochemical properties. The high classification accuracy underscores the potential of integrating chemometric tools with NIR spectroscopy for advanced grain evaluation. Spectral markers capturing biomolecular traits prove to be powerful tools, improving sensitivity and efficiency, and reducing the time and resources required for comprehensive rice quality assessment.

4.10. Antimicrobial Activity of Belleric Acid Against Pathogenic Microorganisms

Mrudula Guggilla, Ashwini Ravaji Mugale and Vijay Dattarao Kele

Department of Dairy & Food Technology, Parul Institute of Technology, Faculty of Agriculture, Parul University, Vadodara, Gujarat 391760, India

The Belleric acid (BA) found in terminalia species (especially *terminalia chebula*, *terminalia bellirica (TB)*, and *terminalia arjuna*) is a hydrolyzable tannin with antimicrobial activity and is widely used in folk and herbal medicine systems. It shows potent anti-inflammatory effects by inhibiting NFκB activation, antimicrobial effects, and MAPK phosphorylation. In this study, *Terminalia Bellirica* (TB) was used as the source of BA. TB is abundantly found in India's deciduous forests. Studies have shown that extracts of BA exhibit antimicrobial effects against both Gram-positive and Gram-negative bacteria. This study aims to evaluate the antimicrobial activity of BA against *Escherichia coli* and *Bacillus cereus.*

BA was tested against *E. coli* and *B. cereus* using the minimum inhibition concentration (MIC), fluorescence microscopy, diameter of inhibition zone, nucleic acid leakage, membrane potential, and cell structure morphology.

BA exhibited an MIC of 150 μg/mL. The diameter of the inhibition zone for *E. coli* was 24.13 ± 0.004 mm, and for *B. cereus*, it was observed to be 26.12 ± 0.008 mm. BA showed membrane potentials of 308.19 ± 0.013 to 312.23 ± 0.014 AU and also caused physical

deformities in *E. coli* and *B. cereus* such as pitting, adhesion, breakage, and shrivelling, indicating destruction of their membrane and nucleic acid leakage.

From the conducted research, it was observed that BA has good antimicrobial activity against both Gram-negative and Gram-positive foodborne pathogens, indicating its potential use in the food industry as an effective antimicrobial against foodborne pathogens, with the potential for enhancing food safety and quality.

4.11. Application of Powder X-Ray Diffraction (p-XRD) and Chemometrics for the Classification of Cheese Varieties

Maria Tarapoulouzi, Sotiria Kyriacou and Ioannis Pashalidis

Department of Chemistry, University of Cyprus, P.O. Box 20537, Nicosia 1678, Cyprus

This study explores the application of powder X-ray diffraction (p-XRD) combined with chemometric analysis as an innovative approach for the quality assessment and classification of cheese varieties. A total of 64 cheese samples, including Cheddar, Kefalotyri, and Halloumi, were analyzed to investigate differences in their crystalline structures. p-XRD, a non-destructive analytical technique traditionally used in material science, was employed to obtain detailed information on the texture, composition, and internal structure of the samples. Chemometric modeling was then applied to the spectral data to classify the cheeses according to type, highlighting distinct patterns in their crystalline fingerprints. The crystalline fingerprint of each cheese type was investigated, revealing that Cheddar exhibited a low degree of crystallinity, Kefalotyri a medium level, and Halloumi a high degree of crystallinity. These differences were associated with variations in casein structure, calcium salt content, residual lactose, and other inorganic salts present in the cheeses.

The study is particularly novel in its focus on Halloumi, a traditional Cypriot cheese with Protected Designation of Origin (PDO) status. The use of p-XRD in dairy research is limited, and its application to Halloumi is unexplored. The results demonstrate that this technique, when combined with multivariate data analysis, can effectively differentiate cheese types based on subtle structural variations, thereby offering potential for quality control, authenticity verification, and process optimization.

This research paves the way for future studies into the structural characterization of dairy products, especially those produced with emerging ingredients such as milk powder. Although cheese ripening (aging) was not studied in the present work, future research may explore how maturation affects crystalline patterns, further expanding the application of this technique. The methodology developed could serve as a foundation for the design of new analytical workflows in food science and contribute to innovation in the dairy industry through enhanced quality assurance and product traceability.

4.12. Application of Sensory Evaluation in Assessing Fruit Freshness and Shelf Life: A Scientific Approach to Quality and Safety Monitoring

Mian Muhammad Ahmed [1], Muqaddas Muqaddas [2], Saqib Ayyub [3], Muhammad Asim [4], Syeda Maira Hamid [1] and Nimra Hayat [2]

1 College of Life Science and Technology, Tarim University, Alar 843300, China
2 College of Food Science and Engineering, Tarim University, Alar 843300, China
3 Institute of Horticultural Sciences, University of Agriculture, Faisalabad 38000, Pakistan
4 National Key Laboratory for Germplasm Innovation and Utilization of Horticultural Crops, Huazhong Agricultural University, Wuhan 430070, Hubei, China

Fruit freshness and shelf life are critical factors influencing consumer acceptance, marketability, and food safety. Sensory evaluation, an essential tool in postharvest quality assessment, provides a scientific approach to monitoring changes in fruit attributes such as color, texture, aroma, and flavor during storage. This study investigates the relationship

between sensory parameters and objective quality indicators, including firmness, total soluble solids, acidity, moisture content, and microbial load, to develop a predictive model for fruit shelf life. A panel of trained assessors conducted sensory evaluations at regular intervals, while instrumental analyses were performed to validate sensory perceptions. Additionally, advanced technologies such as electronic noses and image analysis were employed to enhance the accuracy and reproducibility of sensory assessments. The impact of different postharvest treatments, storage conditions, and packaging methods on fruit sensory properties and shelf stability was also examined. The results indicate a strong correlation between sensory attributes and physicochemical changes, demonstrating the reliability of sensory evaluation in freshness assessment. The findings emphasize the importance of integrating sensory analysis with instrumental techniques for improved postharvest management, ensuring extended shelf life, reduced food waste, and enhanced consumer satisfaction. This research provides a framework for developing standardized sensory-based quality control protocols in the fruit industry.

4.13. Assessment of Market Potential of Korean Dried Persimmon in Europe: A Qualitative Review

Yasin Ozdemir, Zekiye Goksel, Hasret Altunkanat, Aysun Ozturk and Seda Kayahan

Food Technologies Department, Ataturk Horticultural Central Research Institute, Yalova 77100, Turkey

Dried persimmon is an important agro-food product of South Korea. In recent years, export efforts, especially in Europe, have become critical due to the fact that production has far exceeded domestic demand. This review aims to examine the product characteristics and consumer appeal of Korean dried persimmons and to assess their potential for entry into the European market. A systematic literature review was conducted in accordance with PRISMA guidelines. Academic databases (Google Scholar and Scopus), country export publications and statistics, market reports, and product reviews in the market were used as data sources. Survey-based studies on European consumers' dried fruit taste, frequently consumed dried fruits, and dried fruit consumption habits were also examined. Data after 2020 were used. Sensory and health properties, cultural and brand value, packaging strategies, and market access restrictions were evaluated as main topics. Korean dried persimmons have distinct characteristics such as soft chewability, high nutritional value, and strong cultural identity. They exhibit sensory, textural, and health-beneficial properties that may be attractive to the consumer. However, factors such as cold chain requirements, geographical distance from Europe, use of sulfur preservatives, and low product awareness among European consumers may constitute disadvantages in market entry. The findings indicate that Korean-style dried persimmons may find a response in the European market, especially in the health-oriented consumer segment that is interested in different cultures and different tastes. It has been observed that the consumption of frozen, dried or semi-dried fruit is not a widespread culture in Europe. Therefore, eliminating the need for frozen storage may be advantageous. This product may have significant potential for entry into the European market, especially when positioned as a high-quality healthy snack. For this reason, it is important to abandon the additives used to preserve color.

4.14. Association Between Dietary Profiles and Chronic Disease Patterns

Nabyla, Khaled Khodja [1], Samira Negrichi [2] and Fatiha Brahmi [3]

[1] Faculté des Sciences Biologiques et Sciences Agronomiques, Université Mouloud Mammeri de Tizi Ouzou, Tizi Ouzou, Algeria

[2] Centre de Recherche en Technologies Agro-Alimentaires, Campus Targua Ouzamour, Bejaia 06000, Algeria

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[3] Faculté des Sciences de la Nature et de la Vie, Université de Bejaia, Laboratoire 3BS, Bejaia 06000, Algeria

The global rise of non-communicable diseases necessitates a deeper understanding of the modifiable lifestyle factors involved. While the link between diet and health is established, specific dietary patterns associated with distinct disease categories require further investigation. This study examines the associations between dietary habits, lifestyle choices, and the prevalence of major disease categories, including cardiovascular, nervous system, and inflammatory diseases. This cross-sectional study was conducted in Algeria using an online questionnaire administered to over 300 adults. The questionnaire included items on sociodemographic data, physical activity, food frequency, health status, diseases, and other lifestyle habits.

The results reveal highly significant correlations between dietary profiles and specific pathologies. A strong association was found between cardiovascular diseases and the infrequent consumption of protective foods, including vegetables ($p < 0.0001$), whole grains ($p = 0.002$), and legumes ($p = 0.004$). Conversely, nervous system disorders were significantly linked to the daily consumption of "risky" items, with 50% of this group consuming sweets ($p = 0.005$) and 50% consuming fizzy drinks ($p = 0.006$) on a daily basis. Lifestyle factors also proved influential, as smoking was significantly associated with a higher prevalence of inflammatory diseases ($p = 0.005$).

These findings underscore the existence of distinct dietary signatures for different chronic conditions. They highlight the critical need for targeted public health strategies and personalized nutritional counseling, emphasizing increased plant-based food intake to mitigate cardiovascular risk and reduced sugar consumption to support neurological health.

4.15. Attenuation of Bacterial Biofilms by Passiflora Seed Oil: Insights from Crystal Violet and MTT Microplate Assays

Francesca Coppola [1], Florinda Fratianni [2], Maria Neve Ombra [2], Beatrice De Giulio [2], Gockhan Zengin [3], Raffaele Coppola [4] and Filomena Nazzaro [5]

[1] Department of Agricultural Sciences, University of Naples Federico II, Piazza Carlo di Borbone 1, 80055 Portici, Italy
[2] Institute of Food Science, CNR-ISA, Via Roma 64, 83100 Avellino, Italy
[3] Physiology and Biochemistry Laboratory, Department of Biology, Science Faculty, Selcuk University, Konya 42130, Turkey
[4] Department of Agricultural, Environmental and Food Sciences (DiAAA)-University of Molise, Via de Sanctis snc, 86100 Campobasso, Italy
[5] Institute of Food Sciences, CNR-ISA, Via Roma 64, 83100 Avellino, Italy

Biofilms formed by foodborne pathogens represent a significant threat to food safety and public health. Natural plant-derived oils, such as *Passiflora* seed oil, may offer an effective alternative to conventional antibiofilm agents. The antibiofilm activity of *Passiflora* seed oil (10 and 20 μg/mL) was evaluated against five relevant pathogens (*A. baumannii, E. coli, L. monocytogenes, P. aeruginosa*, and *S. aureus*) using crystal violet (CV) as well as its capacity to affect the metabolism of microbial sessile cells (using the MTT test). Both assays were conducted at time zero (CV0, MTT0) and after 24 h of bacterial growth (CV24 and MTT24) to evaluate their efficacy in inhibiting biofilm formation and disrupting mature biofilms. At 20 μg/mL, the oil strongly inhibited biofilm formation (CV0) caused by *A. baumannii* (61.2%), *E. coli* (44.7%), and *L. monocytogenes* (72.5%). However, activity against pre-formed biofilms (CV24) was limited except for *S. aureus* (64.6%), *E. coli* (19.31%), and *L. monocytogenes*, against which the oil exhibited very weak inhibitory activity (4.85%). MTT0 results only showed a significant reduction in metabolic activity of sessile cells for *E. coli* (84.4%); on the contrary, the effect of the oil was seen against all the strains

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when it was added after 24 h (MTT24), and the sessile cells of *P.aeruginosa*, the biofilm of which was completely resistant to the oil, were very sensitive to the presence of the oil (73.01% of inhibition at MTT24). *Passiflora* seed oil exhibits strain-specific and time-dependent antibiofilm properties, with strong preventive effects and selective action on mature biofilms. These findings support its potential as a natural antimicrobial for food safety applications.

4.16. Authentication of Halal and Kosher Meats by High Performance Liquid Chromatography with Ultraviolet (Hplc-Uv) Fingerprinting and Chemometrics

Alexandra Santomá-Martí and Oscar Nuñez

[1] Department of Chemical Engineering and Analytical Chemistry, University of Barcelona, Martí i Franquès 1-11, E08028 Barcelona, Spain
[2] Research Institute in Food Nutrition and Food Safety, University of Barcelona, Recinte Torribera, Av. Prat de la Riba 171, Edifici de Recerca (Gaudí), Santa Coloma de Gramenet, E08921 Barcelona, Spain
[3] Departament de Recerca i Universitats, Generalitat de Catalunya, Via Laietana 2, E08003 Barcelona, Spain

Fraudulent meat practices regarding product labelling, substitution, and adulteration are common, requiring feasible analytical techniques to address meat authentication issues. Frauds of relevant importance are those involving cultural/religious practices, such as in Muslim countries (Halal products), where the consumption of pork is prohibited, or the case of Kosher products in Jewish communities. Although the substitution of animal species can be easily solved by genetic detection tools based on DNA determination, other Halal and Kosher meat authentication issues, where the way in which animals permitted for consumption are slaughtered, or how the meat products are processed, cannot be solved by genetics. In these cases, metabolomic fingerprinting strategies are emerging as good options to address Halal and Kosher meat authentication issues, not based on animal species.

A simple HPLC-UV fingerprinting strategy was developed to address Halal and Kosher meat authentication. A total of 100 meat samples (lamb, Halal lamb, beef, Halal beef, and Kosher beef), all of them produced in Catalonia (Spain), were employed. Analysis consisted of a sonication (15 min) extraction with water (1 g sample with 10 mL water) followed by reversed-phase C18 HPLC under universal gradient elution conditions. The obtained fingerprints were employed as sample chemical descriptors to address meat classification by partial least squares-discriminant analysis (PLS-DA). PLS-DA classification performance was excellent, with sensitivity and specificity values of 100%, and 100% accuracy on the sample classification ratio. In addition, the potential of HPLC-UV fingerprinting to detect and quantify Halal and Kosher meats adulterated with non-Halal and non-Kosher products (of the same animal species) at different adulteration levels (from 15 to 85% adulteration) was assessed by partial least squares (PLS) regression. PLS calibration, cross-validation, and prediction errors within the ranges of 1.7–6.2%, 3.9–7.9%, and 2.4–6.4%, respectively, were obtained, demonstrating the capability of the proposed HPLC-UV metabolomic fingerprinting strategy to address meat authentication issues that genetic analyses cannot solve.

4.17. Bactericidal Efficacy of Carvacrol Nanocapsules in Chia Mucilage for the Reduction in Salmonella in Spaghetti alla Carbonara

Cátia Morgado [1,2,3], Fabíola Ayres Cacciatore [4], Patrícia Da Silva Malheiros [4], Eduardo Tondo [4] and Carlos Brandão [1,2]

[1] Estoril Higher Institute for Tourism and Hotel Studies, Estoril, 2769-510 Estoril, Portugal
[2] Centre for Tourism Research, Development and Innovation (CiTUR) Estoril, Estoril, 2769-510 Estoril, Portugal
[3] Doctorate Program in Food Science, University of Extremadura, 06071 Badajoz, Spain
[4] Instituto de Ciências e Tecnologia dos Alimentos (ICTA/UFRGS), Universidade Federal do Rio Grande do Sul Campus do Vale-Agronomia (ICTA/UFRGS), Av. Bento Gonçalves 9500, Porto Alegre 91501-970, RS CEP, Brazil

Introduction: The Hazard Analysis and Critical Control Point (HACCP) system for preparations containing raw eggs indicates the need for thermal processing to eliminate the risk of *Salmonella*. Several culinary preparations, such as Spaghetti alla Carbonara, are added with raw eggs after heat treatment, making them hazardous because the temperature and contact time (with the bacterial agent) may not be sufficient to eliminate the biological hazard. For hazard control, studies have shown that some plant essential oils have antimicrobial properties and could replace the use of synthetic preservatives. However, as their application is limited by the lower stability and higher volatility characteristic of this type of compound, their application can be enhanced using nanotechnology.

Objectives: This study aimed to evaluate the bactericidal effect of carvacrol nanocapsules in chia mucilage on the identified hazard when used in the preparation of Spaghetti alla Carbonara.

Methodology: Thirty samples of *Spaghetti alla Carbonara* were prepared and tested at five temperatures: 50, 55, 60, 65 and 70 °C. Six samples were used per temperature, including one control. After reaching the target temperature at the thermal center, eggs inoculated with *Salmonella* and nanocapsules were added. Microbiological analyses were performed to quantify *Salmonella*. Preliminary tests had isolated the thermal effect, allowing evaluation of the nanocapsules' impact.

Results: The nanocapsules were more effective at 50 °C (5.7 log) than at 70 °C (5.3 log). This can be explained by the increasing bactericidal effect of temperature, which reduces the relative contribution of the nanocapsules. At lower temperatures, where thermal inactivation is less pronounced, the nanocapsules' antimicrobial action becomes more evident, enhancing overall bacterial reduction.

Conclusions: Food safety has direct and indirect effects on both economic operators and consumers, and it is becoming increasingly urgent to develop and implement methodologies that reconcile food safety with the interest and gastronomic value of food.

4.18. Changes in the Textural and Pasting Properties and the Microstructure of Two Early Indica Rice Varieties During Storage Using General Linear Model Univariate (GLMU) Analysis

Bing Dai [1,2], Mengya Wang [1,2], Xiaohong Luo [2], Jiangzhang Wu [1] and Xingjun Li [1,2]

[1] College of Grain and Strategic Reserves, Henan University of Technology, Zhengzhou 450001, China
[2] Academy of National Food and Strategic Reserves Administration, National Engineering Research Center for Grain Storage and Transportation, Beijing 102209, China

For solving the problem of feeding the increasing world population, the physicochemical, cooking, textural, pasting, microstructural, and thermal properties of two early indica rice varieties (newly harvested SRN variety and IP46 variety with one-year in-bin storage) were analysed over 12 months of storage at 15 °C and 30 °C, respectively. A General Linear Model Univariate (GLMU) analysis was adopted to show the significant effects of three factors (variety, storage temperature, and time). Compared with 15 °C storage, 30 °C storage resulted in higher free fatty acid (FFA) content, amylose content, conductivity, kernel broken index, chalky kernel percent, and chalkiness degree and a

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reduced taste value. The cooking test showed that 30 °C storage increased the cooking time and the hardness of cooked rice, but decreased the gruel solid loss and the adhesiveness and resilience of cooked rice. Compared with 15 °C storage, 30 °C storage increased the pasting temperature and peak, breakdown, and setback viscosities of the two early indica rice varieties. Moreover, there was an increase in the peak temperature of gelatinization but no change in starch ageing. Infrared spectroscopy analysis confirmed that, in contrast with 15 °C storage, 30 °C storage increased the crystallinity of starch, the interaction between protein and starch, and the β-sheet percent in the early indica rice. Microstructure analysis showed that SRN raw rice exhibited a consistent polygonal shape of starch granules after 12 months of storage at 30 °C, but the edges of the chalky portion of the starch granules were not obvious in IP46 rice. It can be concluded that 30 °C storage can maintain the taste value, paste aging, and cooked rice texture of early indica rice after two years of storage, despite blurring of the edges of the chalky portion of starch granules.

4.19. Comparative Study of Oxidative Stability in Almond and Hazelnut Cultivars Based on Volatile Compound Monitoring

Ines Saouabi [1,2], Leontina Lipan [2], Agustí Romero [2] and Montserrat Mestres [1]

[1] Department of Analytical Chemistry and Organic Chemistry, Chemosens Research Group, Campus Sescelades, Universitat Rovira i Virgili (URV), Edifici N4, C/Marcel·lí Domingo 1, 43007 Tarragona, Spain

[2] Fruit Production Program, IRTA Mas Bové, Ctra. Reus-El Morell Km. 3.8, Constantí, 43120 Tarragona, Spain

Introduction: Oxidative stability is a critical quality parameter in the food lipid-rich products such as nuts. Oxidation not only reduces nutritional value but also alters the organoleptic profile, leading to off-flavors and aromas that are typically rejected by consumers. Since aroma is a key component of sensory perception, this study focuses on the evolution of the volatile profile of raw almonds and hazelnuts under oxidative stress.

Methods: Two almond cultivars and two hazelnut cultivars were selected. Samples were stored for two months under controlled conditions combining different temperatures and light exposure to induce oxidation. Volatile compounds were analyzed weekly using headspace solid-phase microextraction (HS-SPME) followed by gas chromatography–mass spectrometry (GC-MS).

Results: The results showed a time-dependent increase in typical oxidation volatiles. However, the rate and pattern of volatile evolution varied between nut species and among cultivars. Some cultivars demonstrated greater resistance to oxidative changes, with slower accumulation of off-flavor compounds. The data also highlighted the effect of storage conditions in modulating the intensity of oxidation.

Conclusions: This study highlights the importance of considering both nut type and variety when evaluating oxidative stability. Monitoring volatile composition provides valuable insight into sensory deterioration and may guide storage strategies and cultivar selection for improved shelf life and consumer acceptance.

4.20. Curcumin as a Dual-Function Sensor and Active Agent in Sustainable Food Packaging for Spoilage Detection

Kishan Kishor Gupta, Subith Cheeyattil and Madhuresh Dwivedi

Department of Food Process Engineering, National Institute of Technology, Rourkela, Odisha 769008, India

Introduction: Concerns over synthetic additives in packaging, along with the risk of spoilage during storage, caused by pathogens, adulterants, and gases like volatile amines and CO_2, have driven interest in sustainable, biodegradable, and intelligent food packaging.

These issues highlight the need for effective monitoring and detection strategies. Curcumin, a natural polyphenolic compound from *Curcuma longa*, exhibits antimicrobial and pH-responsive colorimetric properties, making it a promising dual-function component in eco-friendly food packaging systems.

Methods: Curcumin was incorporated into biodegradable polymer matrices (cross-linked potato starch and citric acid) using the solvent casting method. This is attached to the packaging films, and performance analysis was conducted, including color responsiveness, antimicrobial efficacy, mechanical strength, and biodegradability. This curcumin-based film is employed to monitor and detect the spoilage of paneer and extend its shelf life.

Results and Conclusions: The curcumin-based starch-citric acid film exhibited clear pH-sensitive color changes from yellow to reddish-brown in response to volatile amines released during paneer spoilage, enabling effective visual detection. Antimicrobial testing showed notable inhibition zones against *E. coli*, confirming curcumin's bioactivity. The film maintained good tensile strength and flexibility and was suitable for packaging applications. Biodegradability tests demonstrated rapid degradation under composting conditions. When applied to paneer, the film extended shelf life by a week under refrigerated conditions compared to the unpackaged control, validating its dual role as an active and intelligent packaging material for dairy product preservation.

4.21. Determination and Risk Assessment of Phosphate Additives in Processed Meat Products in Albania Using UV-Vis Spectrophotometry

Qëndresa Istrefi, Loreta Vallja and Drita Guraj

Department of Chemistry, University of Tirana, 1023 Tirana, Albania

Phosphates are widely used as additives in processed meat foods to maintain their structure, water-holding capacity, and quality. They pose risks to human health if overdosed, resulting in mineral disturbances, cardiovascular disease, and osteoporosis. This study aimed to determine the total phosphorus content, used as an indirect measure of phosphate additives, in processed meat products on sale in Albania and analyze consumers' exposure to them. As total phosphorus includes both natural and added sources, this method does not specifically isolate phosphate additives. A total of 30 samples were randomly selected from various supermarkets of Tirana, including 13 salami, 12 ham, and 5 sausage products representing different commercial brands. The samples were analyzed using a spectrophotometric method based on the reaction between ammonium molybdate and phosphate ions (PO_4^{3-}), which, after reduction with ascorbic acid, forms a blue complex that can be measured at 880 nm. The findings showed that the average content of total phosphorus in the products under investigation was 4715 mg P_2O_5/kg, with the highest value found in beef ham (6075.2 mg P_2O_5/kg). About 33.3% of the sausage samples and 41.6% of the ham samples had phosphate levels above the permitted limit of 5000 mg P_2O_5/kg, with ham thus being the product with the highest phosphorus content among the three products, i.e., sausages, salami, and ham. Consumer exposure to phosphates was assessed by the estimated daily intake (EDI) of phosphorus and the risk index (%MTDI) in age groups of 3–4 and 5–9 years. In some products, the %MTDI value was above the safety level, which means that excessive consumption of processed meat could have a harmful effect on children. These findings highlight the need for improved regulation of phosphate additives in the food industry and suggest further monitoring to reduce dietary exposure, particularly in vulnerable populations such as children.

4.22. Development and Characterization of Fermented Seaweed-Based Meat Analogs Using Two Different Seaweed Types

Izalin Zahari and Shaiful Adzni Bin Sharifudin

Food Science & Technology Research Centre, Malaysian Agricultural Research & Development Institute (MARDI), Selangor, Malaysia

The rising interest in sustainable and health-focused diets has led to a growing demand for meat alternatives made from novel plant-based sources. Seaweed is an abundant marine resource rich in fiber, bioactive compounds, and functional nutrients, making it a promising candidate for alternative protein development. This study aimed to develop a functional meat analog using fermented seaweed as the core ingredient. Two types of edible red seaweeds, *Kappaphycus alvarezii* and *Gracilaria sp.*, were subjected to solid-state fermentation with *Rhizopus oligosporus* to improve their nutritional quality and reduce undesirable marine odors. The fermented biomass was incorporated into meatball prototypes using different proportions of seaweed and binding agents. The resulting products were analyzed for their physicochemical properties, texture profile (TPA), microbiological stability, and sensory attributes. Comparative analysis revealed that *Kappaphycus*-based formulations produced a firmer, more cohesive texture, while *Gracilaria*-based formulations yielded a softer texture with enhanced umami perception. Importantly, the optimized seaweed meatball achieved a protein content of approximately 18%, closely matching that of conventional meat products. Fermentation was found to significantly improve palatability by enhancing flavor and masking off-notes. Overall, this study demonstrates the feasibility of using fermented seaweed as a sustainable, protein-rich base for meat analog products, supporting the development of clean-label, minimally processed foods that align with current consumer trends.

4.23. Development and Validation of a Novel GC–MS Method for the Determination of Flavonoids in Mallorcan Carob (Ceratonia siliqua) Honey

Daniela Lupu Andrei [1,2], Mohamad Subhi Sammani [2], Gabriel Hancu [1] and Laura Ferrer [2]

[1] Department of Pharmaceutical and Therapeutic Chemistry, Faculty of Pharmacy, "George Emil Palade" University of Medicine, Pharmacy, Science and Technology of Târgu Mures, Gh. Marinescu 38, 540139 Târgu Mures, Romania

[2] Environmental Analytical Chemistry Group, University of the Balearic Islands, Cra. Valldemossa km. 7.5, 07122 Palma, Spain

Carob (*Ceratonia siliqua*) honey from the Balearic Islands is a unique monofloral product recognized for its sensory properties and rich content in bioactive compounds. Despite its growing economic and nutraceutical importance, the compositional profile of this honey—especially its flavonoid content—remains largely unexplored. In the present study, we report the development and validation of a novel gas chromatography–mass spectrometry (GC–MS) method specifically optimized for the sensitive and selective quantification of flavonoid compounds in Mallorcan carob honey.

The analytical workflow includes liquid–liquid extraction with ethyl acetate, derivatization with *N*,*O*-bis(trimethylsilyl)trifluoroacetamide (BSTFA) in the presence of pyridine as a catalyst, and subsequent chromatographic separation coupled with mass spectrometric detection. Derivatization conditions—particularly the volume ratio of BSTFA to pyridine, reaction temperature, and time—were optimized using a multivariate experimental design to maximize the yield and stability of trimethylsilyl derivatives. This chemometric approach enabled efficient silylation of structurally diverse flavonoids while minimizing thermal degradation and byproduct formation.

A total of 22 analytes, including quercetin, kaempferol, luteolin, apigenin, and pinocembrin, were successfully separated within a 17 min analytical window. Method validation demonstrated excellent linearity ($R^2 > 0.995$), low detection limits (LODs: 5–30 ng/mL), and high repeatability (RSD 5%).

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The optimized GC–MS protocol was complemented by total polyphenol content (TPC) and total flavonoid content (TFC) spectrophotometric assays, alongside three antioxidant activity assays—FRAP, CUPRAC, and ABTS—providing a comprehensive evaluation of the honey's polyphenolic and antioxidant profile. This is the first comprehensive application of GC–MS for flavonoid profiling in Mallorcan carob honey, offering a strong analytical basis for compositional authentication and valorization of this regional product.

4.24. Development of a Functional Plant-Based Energy Drink Produced from Baru Almonds: Innovation Using the Biodiversity of the Brazilian Cerrado

João Renato de Jesus Junqueira, Julia Barros Gomes de Souza, Christopher Leandro Rodrigues dos Santos, Luisa Freire Colombo, Luciana Miyagusku and Raquel Pires Campos

Faculty of Pharmaceutical Sciences, Food and Nutrition, Federal University of Mato Grosso do Sul (UFMS), Campo Grande, Mato Grosso do Sul 79070-900, Brazil

Sustainable development has driven the advancement of the bioeconomy by promoting the responsible use of natural resources. In this context, the Brazilian Cerrado, a biome rich in biodiversity, stands out as a source of innovative ingredients, such as baru (*Dipteryx alata* Vogel). This study aimed to develop and evaluate a protein energy drink, including characterization of its physicochemical and microbiological properties, as well as conduct a market survey. The product was formulated using a water-soluble extract of baru combined with functional ingredients—caffeine and taurine—in accordance with the current Brazilian legislation. Physicochemical analyses demonstrated appropriate levels of protein (15.24 ± 1.3 g/100 g) and soluble solids (3.0 ± 0.1 °Brix) and a suitable pH (6.30 ± 0.1), in compliance with national standards. Microbiological assessments (of the presence of *Salmonella* spp., *Bacillus cereus*, Enterobacteriaceae, molds and yeasts, mesophilic bacteria, coliforms, and *Escherichia coli*) confirmed the product's safety for consumption, meeting food quality and safety regulations. The market research revealed significant consumer acceptance, particularly among individuals with busy lifestyles and an interest in natural alternatives. The packaging design highlights sustainability and regional identity, reinforcing the connection with the local biodiversity. Overall, the beverage demonstrates strong competitive potential in the functional beverage market, driven by growing consumer interest in affordable, natural, and protein-enriched energy products. Its development integrated innovation, environmental responsibility, and the valorization of native resources from the Brazilian Cerrado.

4.25. Development of a Predictive Model for the Effects of Product and Process Parameters on Thermal Inactivation of Heat-Resistant Spoilage Yeast in Simulated Fruit Juice

Gerieka Ramos Anapi

Laboratory of Food Microbiology and Hygiene, Department of Food Science and Nutrition, University of the Philippines Diliman, Quezon City 1101, Philippines

A predictive model for the thermal inactivation kinetic parameter decimal reduction time (D_T) of spoilage yeast in simulated fruit juice (SFJ) is being reported for the first time in this study. The target microorganism was a previously identified heat-resistant strain of *Pichia anomala* (BIOTECH 2205), which was cultured to its mid-stationary phase (MSP) to reflect a more resilient physiological state. The spoilage yeast spp. was artificially inoculated into SFJs formulated with varying combinations of pH, processing temperature (°C), and natamycin concentration (ppm) to simulate diverse juice environments. These intrinsic (pH and natamycin) and extrinsic (temperature) variables were systematically varied based on a Rotatable Central Composite Design (RCCD) to generate a statistically sound range of treatment conditions. Response Surface Methodology (RSM) was employed to model and

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interpret the effects of these factors and their interactions on the thermal inactivation of the yeast. Heat treatment experiments showed that microbial inactivation followed a log-linear reduction pattern, with high coefficients of determination (R^2 = 0.90–0.99) indicating good model fit across all treatment combinations. Observed D_T values ranged from 5.70 ± 1.19 to 39.44 ± 4.91 s, highlighting substantial variation in thermal resistance depending on treatment conditions. Significantly, the D_T values were found to fit a quadratic model ($p < 0.002$), demonstrating the appropriateness of RSM in modeling the response. Among the tested factors, the individual linear effects of pH, temperature, and natamycin concentration, the quadratic effect of temperature (T^2), and the interaction between pH and temperature (pH × T) significantly influenced the D_T values. These findings provide critical insights into the complex interplay between juice composition and processing parameters on the thermal resistance of spoilage yeasts. The developed model, subject to a validation procedure, may be useful in optimizing juice pasteurization schedules. This is the first study to assess the interaction between natamycin and heat treatment for simulated fruit juices.

4.26. Dielectric Measurements for Monitoring the Storage of Vegetable Oils

Sándor Beszédes [1], Zoltán Jákói [1] and Balázs Lemmer [2]

[1] Department of Biosystems Engineering, Faculty of Engineering, University of Szeged, HU-6725 Szeged, Hungary

[2] Department of Food Engineering, Faculty of Engineering, University of Szeged, HU-6725 Szeged, Hungary

During the storage of vegetable oils, various chemical and physicochemical changes occur that can significantly affect oil quality and safety. These include autoxidation, the breakdown of triglycerides, and increased acidity. Several indicators and methods are known for monitoring these changes, such as measurements of viscosity and colour, and the determination of peroxide value and free fatty acid (FFA) concentration. Depending on the applied measuring frequency, dielectric parameters are considered sensitive to chemical, physical, and structural changes. Changes in the concentration of polar compounds (e.g., FFAs, aldehydes, peroxides, and water) also influence dielectric behavior. Dielectric measurements are non-destructive methods suitable for real-time detection, and therefore have great potential for application in vegetable oil quality monitoring.

In our research, the 16-month storage of olive, palm, sunflower, rapeseed, and pumpkin seed oils was investigated through the determination of peroxide value (using a Hanna HI83730 PV photometer), dielectric constant, and loss factor (using a Speag DAK 3.5 open-ended coaxial sensor in the 200–2400 MHz frequency range).

Our results show that the processing technology influences the dielectric behavior of oils, with certain processes (e.g., cold pressing and degumming) resulting in significant differences. Over the 16-month storage period, both the dielectric constant and the loss factor increased with time. The variation in dielectric parameters was most consistent in the frequency range of 200–700 MHz, while differences became non-significant at measuring frequencies above 2200 MHz. Based on our findings, a strong linear correlation ($R > 0.9$) was observed between the peroxide value and the dielectric constant in the 300–500 MHz range. In summary, the changes occurring in edible oils during storage can be effectively monitored by measuring dielectric parameters if the measurement frequency is appropriately selected.

4.27. Efecto de la Nisina Sobre la Estabilidad Microbiológica Y Sensorial de la Masa de Sopa Paraguaya

Liz Carolina Ríos Duarte [1], Cristhian Esteban Fernandez [2] and Juliana Moura Mendes [3]

[1] Departamento de Investigación en Ingenieria y Tecnología de Alimentos, Facultad de Ciencias Químicas, Universidad Nacional de Asunción, San Lorenzo 16601, Paraguay
[2] Facultad de Ciencias Administrativas, Universidad Tecnica de Comercialización y Desarrollo, Asunción 00101, Paraguay
[3] Centro Multidisciplinario de Investigaciones Tecnológicas, Universidad Nacional de Asunción, San Lorenzo 16601, Paraguay

Paraguayan soup is a traditional and emblematic dish widely consumed in Paraguay. Its valorization and potential for industrial-scale production highlight the need to improve preservation methods. This study aimed to evaluate the effect of nisin on microbial growth of mesophilic aerobes, total coliforms, Escherichia coli, Staphylococcus aureus, and Salmonella spp. at intervals of 7 days, culminating on day 40. Sensory attributes such as texture, appearance, color, and consistency were also assessed, comparing nisin-treated samples (which showed the lowest microbial counts) with a control. Microbiological evaluations followed AOAC specifications, and sensory analysis adhered to the Spanish standard UNE-ISO 6658 [24]. Nisin exhibited a biopreservative effect on mesophilic aerobes and Staphylococcus aureus in refrigerated soup dough. Significant differences were found in total coliforms between the treated and control groups, although E. coli counts did not vary significantly. Salmonella spp. were not detected in any samples, so nisin's inhibitory effect could not be determined in this case. Sensory evaluation revealed a preference for the nisin-treated soup in terms of flavor, color, and aroma—but not in consistency. These findings suggest that nisin has strong potential as a biopreservative in the industrial production of refrigerated Paraguayan soup dough ready for baking, contributing to improved microbial safety and sensory appeal. Moreover, incorporating nisin could significantly enhance the preservation and valorization of Paraguay's traditional culinary products.

4.28. Effect of Functionalised Pure Aloe Vera Gel/Essential Oil Coating on the Postharvest Storage of White Button Mushroom (Agaricus bisporus)

Divyashree Jangam Seshagiri [1,2], Abhishek Biswal Rajendra [2], Periyar Selvam Sellamuthu [2], Ramalakshmi Kulathooran [1] and Emmanuel Rotimi Sadiku [3]

[1] Department of Food Technology, Rajalakshmi Engineering College, Thandalam 602105, Tamil Nadu, India
[2] Department of Food Process Engineering, Postharvest Research Lab, School of Bioengineering, SRM Institute of Science and Technology, Potheri, Kattankulathur 603203, Chengalpattu District, Tamil Nadu, India
[3] Institute of Nanoengineering Research (INER) and Department of Chemical, Metallurgical and Materials Engineering, Tshwane University of Technology, Pretoria West Campus, Staatsartillerie Rd, Pretoria 0183, South Africa

The white button mushroom (*Agaricus bisporus*), a widely consumed vegan food, typically has a short shelf-life of 1–3 days under ambient storage conditions due to its high moisture content and susceptibility to microbial spoilage. This study aims to enhance its postharvest longevity through a natural, functionalized coating technique utilizing aloe vera gel in combination with essential oils, selected based on optimized in vitro antifungal efficacy. The essential oils of neroli and palmarosa demonstrated significant antifungal activity at a concentration of 9 µL per Petri plate by effectively inhibiting the radial mycelial growth of isolated postharvest fungal pathogens *Trichoderma lentinulae* and *Rhizopus arrhizus*. Among various tested formulations, a coating composed of pure aloe vera gel blended with palmarosa essential oil at 600 µL/L concentration yielded the most favorable results. This treatment significantly preserved physiochemical parameters, including controlled weight loss, firmness, and higher total phenolic content, all indicative of delayed senescence and better retention of quality. Furthermore, sensory evaluations and antioxidant activity

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assays confirmed the acceptability and functional benefits of the treated white button mushrooms. The shelf-life of the white button mushrooms increased to a period of 16 days under the storage conditions of 4 ± 1 °C and 85–90% RH. Overall, this eco-friendly and bioactive coating system offers a promising alternative to synthetic preservatives, providing a natural means of extending the shelf-life and maintaining the postharvest quality of white button mushrooms.

4.29. Effect of High Hydrostatic Pressure on Physicochemical Properties and Polyphenol Content of Strawberry Nectars

Bartosz Kruszewski, Stanisław Kalisz and Natalia Polak

Department of Food Technology and Assessment, Institute of Food Sciences, Warsaw University of Life Sciences—SGGW, 02-776 Warsaw, Poland

In strawberries, anthocyanins are the most problematic compounds due to instability during the processing and storage of the product. Therefore, new methods of processing and preserving strawberry products have been investigated.

The aim of this study was to determine the effect of high hydrostatic pressure (HHP) on the physicochemical properties and pigment stability of strawberry nectar. For this purpose, an evaluation of the pH, total acidity, color parameters, turbidity, and content of anthocyanins and total polyphenols was performed. The samples were treated with HHP at 300 and 500 MPa (20 °C, 15 min), and then stored for 9 weeks at 4 °C.

HHP processing with 300 and 500 MPa did not affect the pH, extract, or total acidity of the nectar; they were 3.20, 10.0 °Brix, and 0.32%, respectively. HHP did not affect the color, turbidity (90 NTU), or anthocyanin content (16.3 mg/100 mL), but the polyphenol content increased significantly. This was most noticeable for the 500 MPa sample—an increase from a basic level, at 106, to 143 mg GAE/100 mL was observed. Cold storage of pressurized nectars gradually increased turbidity to twice its initial value. The color parameter a* significantly decreased after 9 weeks of storage, while the b* parameter decreased already after 3 weeks. This was associated with a decrease in the anthocyanin content during storage to 9.28 and 9.32 mg/100 mL for 300 and 500 MPa, respectively. Also, the content of total polyphenols significantly decreased to 47 and 56 mg GAE/100 mL (300 and 500 MPa) at the end of storage. After 9 weeks, no changes were observed in the pH, extract, or acidity of nectars.

This study showed that nectars just after HPP treatment showed no changes in physicochemical and bioactive compound values. This innovative processing method did not ensure the stability of anthocyanins and thus color during cold storage for longer than 3 weeks. For long-term storage, pressures higher than 500 MPa are required to maintain the nectar quality.

4.30. Evaluation of Bulk Flours: Storage Conditions of Bulk-Sold Flours in the City of Macaé-RJ

Gabriela Barbosa Iat and Jéssica Chaves Rivas

Instituto de Ciências Farmacêuticas, Universidade Federal do Rio de Janeiro, Macaé, Rio de Janeiro 27965-045, Brasil

Introduction: Flaxseed and oats are recognized for offering numerous health benefits, being sources of minerals, vitamins, and dietary fiber. According to Brazilian legislation, bulk food is defined as any food that is measured and packaged in the presence of the consumer. Proper storage of these products is of vital importance, as they are perishable and subject to quality variations due to chemical, enzymatic, or microbiological deterioration.

Objective: This study aimed to analyze the moisture content and titratable acidity of oat and flaxseed flours sold in bulk in the city of Macaé-RJ, Brazil.

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Methodology: Oat and flaxseed flour samples sold in bulk were collected from the main natural product stores in Macaé-RJ (Stores A, B, and C). Moisture analysis was performed using an infrared moisture analyzer, and titratable acidity was determined according to the methodology described by the Adolfo Lutz Institute (1985).

Results: None of the samples showed moisture values above 15%, as established by Brazilian legislation (RDC No. 711, July 2022). The oat flour samples from Stores A, B, and C presented moisture contents of 10.27%, 11.54%, and 11.29%, respectively. The flaxseed flour samples showed lower moisture values compared to the oat flour: 5.57%, 6.08%, and 6.47% for Stores A, B, and C, respectively.

Regarding acidity, there is no specific Brazilian regulation for this parameter; however, it was observed that the samples showed low titratable acidity. The flaxseed flour from Store A had the highest acidity (5.79%), followed by Stores B (2.615%) and C (0.845%). For oat flour, Store C showed the highest acidity (1.71%), followed by Stores B (0.745%) and A (0.375%).

Conclusions: It can be concluded that both oat and flaxseed flours exhibited results indicating good preservation conditions.

4.31. Evaluation of Exposiure and Bioaccessibility of Polycyclic Aromatic Hydrocarbons in Wild and Farmed Oyster

Pamella Talita da Silva Melo [1], João Paulo Machado Torres [2], Carlos German Massone [3], Renato da Silva Carreira [3], Leonardo Rocha Vidal Ramos [1] and Fabiola Helena Dos Santos Fogaça [4]

1 Department of Animal Science, Animal Science Faculty, Campus of Seropedica, Federal Rural University of Rio de Janeiro, Seropédica 23897-000, RJ, Brazil
2 Department of Biophysics, Carlos Chagas Filho Institute of Biophysics, The Health Sciences Center (CCS), Federal University of Rio de Janeiro, Rio de Janeiro 21941-902, RJ, Brazil
3 Department of Chemistry, Technological Institute, Pontifical Catholic University of Rio de Janeiro, Rio de Janeiro 22451-900, RJ, Brazil
4 Department of Food Chemistry, Embrapa Food Technology, Brazilian Agricultural Research Corporation, Rio de Janeiro 23020-470, RJ, Brazil

Seafood is a source of proteins, healthy fats, vitamins, and minerals in the human diet. Notwithstanding these nutritional advantages, seafood may acquire organic lipophilic nonpolar contaminants, including polycyclic aromatic hydrocarbons (PAHs) and heavy metals, from the aquatic environment, hence presenting potential dangers to consumers. In 2019, the most significant oil spill incident occurred on the Brazilian coast, resulting in the poisoning of marine ecosystems and their inhabitants. Consequently, officials and academics worked to evaluate the contamination levels and associated dangers in seafood from the impacted region. This study sought to assess the contamination levels and bioaccessibility of polycyclic aromatic hydrocarbons in oysters from both natural environments and marine farms situated in the Delta of the Parnaiba River, Piauí state. PAH extraction adhered to the EPA-3545A standard, while bioaccessible fractions were obtained utilizing the liquid–liquid extraction method of the EPA-3510C protocol. The identification and quantification of PAHs adhered to the EPA-8270D procedure. The in vitro digestion simulation was conducted using the INFOGEST 2.0 standard protocol. The average concentration of the 39 assessed PAHs was consistent among the samples. The average quantities of PAHs ranged from 0.26 to 47.22 μg kg−1, with the most significant level detected in oysters from the natural environment. Naphthalene, acenaphthene, anthracene, fluorene, chrysene, benzo (b) fluoranthene, and benzo (a) pyrene were identified in the bioaccessible fraction, with respective bioaccessibility values of 11.53%, 19.33%, 7.78%, 48.2%, 11.95%, and 14.41%.

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Naphthalene was the most prevalent of the measured PAHs. The bioaccessible percentage of the cultivated oyster samples exhibited the lowest potency equivalent amounts of BaP (1.39 μg kg^{-1}) in contrast to oysters from the wild environment (4.0 μg kg^{-1}). The samples did not exceed the maximum limit of 18.0 μg kg^{-1} set by the National Agency for Sanitary Vigilance and Safety for mollusks, as per the BaP. The oyster from regions impacted by the oil spill is deemed safe for consumption.

4.32. Evaluation of Microbiological and Sensory Analysis of Stored and Processed Ginger Sauce

Adebayo Olawande Osesusi, Victoria Oluwakemi Adeleke, Helen Oluwaseun Adeloye and Gloria Temitope Matthew

Department of Science Laboratory and Technology, Ekiti State University, Ado-Ekiti 360212, Nigeria

Tomato sauce is made primarily from tomatoes. Sauces are versatile food products that can be used to enhance the flavour and appearance of a variety of dishes. However, sauces can also be a source of foodborne illness if they are not properly processed and stored. This study evaluated the microbiological and organoleptic properties of processed and stored tomato sauce. The aim was focused primarily on assessing the relationship/effect of storage for up to three months on the organoleptic and microbial characteristics of processed tomato sauce with and without ginger. The tomato sauce was prepared in varying portions/concentrations using different methods, including heat treatment, freezing, and drying. They were then stored at different temperatures, including refrigeration and room temperature, and both the organoleptic and microbiological properties were determined using standard methods. Various biochemical analyses were employed in identifying different tentative bacteria present in the samples. A range of bacteria was isolated with a range of frequency distributions: *Bacillus subtilis* (15%), *B. licheniformis* (15%), *Bacillus* sp (5%), *Staphylococcus aureus* (22%), *Proteus vulgaris* (22%), *Enterobacter aerogenes* (11%), *Bacillus cereus* (5%), and *Escherichia coli* (5%). The findings showed a varied microbial load in fresh sauce garnished with ginger (too few to count) for the first month, while for the second month, this reached 92CFU/mL, and after three months, and stored over time, this was attributed to the antimicrobial properties of ginger. The coliform count ranged from 0 to 6 CFU/mL. There was also a remarkable change in the sensory attributes of the sauce. The sensory appeal and texture were better with sauce samples containing ginger than those without ginger.

4.33. Evaluation of the In Vitro Combinatory Growth-Inhibitory Effects of Thymol and Thymoquinone Against Foodborne Pathogens Using the Broth Volatilization Chequerboard Method in the Vapour Phase

Adrish Dutta, Marketa Houdkova and Ladislav Kokoska

Department of Crop Sciences and Agroforestry, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamycka 129, 165 21 Prague, Czech Republic

Foodborne pathogens are the cause of a huge number of illnesses, hospitalizations, and deaths per year, causing losses related to human health and the economy. Plant-derived volatile agents offer a safe and environmentally friendly alternative, with their vapours protecting food through atmospheric distribution and lowering the risk of preservative residues in food products. Their combinations can exhibit synergistic antimicrobial effects against foodborne pathogens, enhancing their efficacy and lowering the risk of microbial resistance and toxicity, by releasing vapours of the compounds from a solid volatilization matrix inside the packaging, thereby protecting food by creating a protective antimicrobial atmosphere around the food without direct contact. Therefore, there is a need to test their combinatory effects against food pathogens in the vapour phase for food preservation.

Herein, the growth-inhibitory effects of plant volatiles, namely, thymol and thymoquinone in combination, were tested against various food pathogens such as *Bacillus cereus*, *Enterococcus faecalis*, *Escherichia coli*, *Listeria monocytogenes*, *Salmonella enterica Typhimurium*, *Shigella flexneri*, *Vibrio parahaemolyticus*, and *Yersinia enterocolitica* using the broth volatilization chequerboard method. The results obtained showed ΣFIC values in the range of 0.375–0.039 for the liquid phase and 0.281–0.031 for the vapour phase, indicating synergistic interactions of the compound for *E. coli*, *E. faecalis*, and *L. monocytogenes*. They also exhibited several additive effects with ΣFIC 1-0.53 and 1-0.515 for liquid and vapour phases, respectively, for *S. e. Typhimurium*, *S. flexneri*, and *V. parahaemolyticus*. These results indicated greater effects of lower concentrations of the compounds in inhibiting the growth of pathogens when used in combination, unlike lesser effects when used alone. Therefore, this combination shows promise as food preservatives producing a synergistic antibacterial effect against food pathogens, e.g., in the form of aerosolized sanitizers. However, further research on their safety, organoleptic properties and efficacy in food models is very much needed before their incorporation into practical applications.

4.34. Exploring University Students' Awareness, Perceptions, and Use of Nonnutritive Sweeteners

Erika Patricia Caicedo and Elena Alexa

School of Food Science and Environmental Health City Campus, Technological University Dublin, Central Quad, Grangegorman, D07 ADY7 Dublin, Ireland

Noncommunicable diseases are the cause of many deaths around the world. Heart disease is the leading cause of death, as well as kidney disease caused by diabetes. These illnesses depend on their sufferers' dietary patterns, which are usually characterised by high sugar consumption. Consequently, some alternatives, such as nonnutritive sweeteners, have been developed. This food additive has no caloric input and mimics the sweet taste of food, helping consumers to reduce their sugar consumption or avoid consuming sugar. However, there is ambiguity regarding the effects on human health that nonnutritive sweeteners can cause. The literature and research findings regarding this topic are diverse and controversial. This study aimed to explore the awareness, perceptions and knowledge of university students regarding NNSs. An online and in-person survey was distributed among students, and it was completed by 720 participants aged 18 to 65 years. The results showed a moderately positive perception of NNSs; this was explained by a significantly positive perception of their potential in reducing the risk of diabetes, as indicated by 30% of respondents. However, 38% of respondents perceived the use of NNSs and their potential undesirable health effects as more risky than beneficial. Additionally, a strong trust in government agencies and health professionals was identified, with 30% of respondents agreeing and 29% of respondents strongly agreeing that they trusted them. Hence, partial consistency was observed, with similar research highlighting the need for more initiatives to raise awareness regarding health topics, such as NNSs, specifically concerning health risk perceptions and awareness. The results provide an opportunity for further investigation to identify the public's understanding and perceptions of NNSs, which will contribute to the development of more effective targeted public health campaigns.

4.35. Fish-Based Pureed Baby Foods: A Scientific Literature Review on Metal(Oid) Levels and Limited Availability in the Spanish Market

Ana Micaela Solivella Poveda, Marta Rodríguez Soriano, Marcos Rodríguez Estrada, Marina Cano Lamadrid and Esther Sendra Nadal

Instituto de Investigación e Innovación Agroalimentario y Agroambiental (CIAGRO-UMH), Universidad Miguel Hernández de Elche, Ctra Beniel km. 3.2, 03312 Orihuela, Alicante, Spain

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Fish is a recommended food in early childhood due to its high content of essential nutrients, particularly omega-3 fatty acids, which are positively associated with cognitive development. However, fish may also be a source of exposure to toxic metal(loid)s, such as Hg and As, which can pose health risks. This study had two main objectives: (i) to conduct a literature review on the levels of metal(loid)s in commercial pureed baby foods (PBFs); and (ii) to assess the availability and labelling information of fish-based PBFs in the Spanish market. This study followed the methodology of a scoping review, conducted in accordance with the PRISMA Extension for Scoping Reviews (PRISMA-ScR). The PRISMA 2020 guidelines and checklist were followed throughout the process. On the other hand, the supply of fish-based PBFs in the Spanish market was compiled, as well as information on their labelling. The examined studies (n = 11) showed that fish-based PBFs had the highest mean concentrations of As and Hg, while meat- and vegetable-based PBFs showed higher levels of Cd and Pb, sometimes exceeding legal limits. Fish-based PBFs represented only 12.04–13.13% of the total Spanish market supply, with a fish content frequently around 8%. Most of these products also included potato (≈ 80%), carrot (≈ 70%), and rice (≈ 65%). Despite the well-documented neurodevelopmental benefits of fish consumption during childhood, the limited availability of fish-based PBFs suggests a nutritional gap. While legislation establishes maximum permissible limits for metal(oid)s in baby foods, efforts should focus on minimizing their presence to ensure infant health, following the strategy "Closer to Zero".

4.36. Formation Mechanism and Regulation of Volatile Flavors of Dried Oyster: Critical Review

Feiyu Luo [1], Nan Pan [2], Yihui Chen [3], Xiaoting Chen [2], Jingna Wu [4], Shuji Liu [2], Yongchang Su [2] and Zhiyu Liu [5]

1 College of Food Science, Fujian Agriculture and Forestry University, Fuzhou 350002, China
2 Fisheries Research Institute of Fujian, Xiamen 361013, China
3 College of Food Science, Fujian Agriculture and Forestry University, Fuzhou 350002, China
4 Xiamen Medical College, Xiamen 361023, China
5 Key Laboratory of Cultivation and High-Value Utilization of Marine Organisms in Fujian Province, National Research and Development Center for Marine Fish Processing, Xiamen 361013, China

Dried oyster, a highly sought-after traditional dried aquatic product in East Asia, is valued by consumers for its distinctive aroma. However, during processing and storage, this is easily affected by factors like light, temperature, oxygen, moisture, and microorganisms, leading to quality deterioration and the formation of fishy and rancid odors. Therefore, it is critical to elucidate the formation mechanism of a fishy off-flavor in dried oyster, clarify the influencing factors, and establish regulatory measures. In this paper, the characteristic flavors of and key volatile organic compounds in dried oyster during processing and storage are summarized, and the formation mechanism of volatile flavors is analyzed from multiple perspectives, including lipid oxidation, the Maillard reaction, and the interaction between the reaction products of the Maillard reaction and lipid oxidation, as well as degradation of thiamine, carbohydrates, amino acids, and peptides. Factors affecting the flavor quality of dried oyster, such as the raw material properties (variety, growth cycle, breeding area, etc.), shucking process, drying process, and storage methods, were also examined. Furthermore, strategies for effectively regulating fishy off-flavors in dried oyster and maintaining its original aroma are proposed, which involve selecting superior raw materials, adopting innovative shucking and drying technologies, and applying novel storage–preservation techniques. This comprehensive review aims to provide a theoretical basis and technical

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support for controlling fishy–rancid odors and improving the flavor quality of dried oysters, thereby meeting consumers' demand for high-quality aquatic products.

4.37. Hygiene and Sanitary Conditions in an Organic Layer Farm from Piraquara-PR, Brazil

Bárbara Kornin Gabardo [1], Giovana Scuissiatto de Souza [1,2], Elisana Julek [1,2], Maria Rosa Aparecida Nunes de Oliveira [1,2], Julia Unicki Philipp [1], Guilherme Souza Cavalcanti de Albuquerque [3] and Julia Arantes Galvão [1,4]

1 Department of Veterinary Medicine, Agrarian Sciences Sector, Universidade Federal do Paraná (UFPR), Curitiba 82520-690, Brazil
2 Post-Graduation Program in Veterinary Sciences, Veterinary Department, Campus Cabral, Federal University of Parana, Curitiba 80035-050, PR, Brazil
3 Federal University of Parana, Curitiba/Paraná 80035-050, PR, Brazil
4 Department of Veterinary Medicine, Federal University of Paraná (UFPR), Curitiba 82520-690, Brazil

Many health and food safety concerns surround egg production, especially with respect to microorganism contamination of the final product; thus, the management of hygiene and sanitary maintenance of laying hens in production is essential. The present work aimed to accomplish hygiene indicator microorganism counts and investigate the presence of *Salmonella* sp. in an organic layer farm in the city of Piraquara, PR, Brazil. Samples of stored feed (A), animal drinking water (B), drag swab (C) and egg content (D) from the three coops present on the property were collected twice, with a one-year interval. The samples were assessed for *Salmonella* sp. detection (Samples A, C and D), total and thermotolerant coliform counts (Samples A, B and D), noting that samples A and D were initially analyzed through the most probable number (MPN) and, on the second occasion, through the total plate count (TPC). Additionally, mesophilic bacteria (Sample B) and yeast and mold counts (Sample A) were also performed. No strains of *Salmonella* sp. were present in any sample. Water and eggs did not present coliform growth (3 MPN/mL or g). Mesophilic bacteria investigation showed 10 CFU/mL. Feed samples initially presented 460 MPN/g of total coliform growth, and in the second analysis, averaged 2.8×10^3 CFU/g between all coops; the yeast and mold count resulted in 9.00×10^4 CFU/g in the first analysis and 7.0×10^4 CFU/g on the second analysis. Analysis of compiled results showed that the storage of the feed must be improved, since coliforms, mold spores and toxins can pose a health risk to animals that consume highly contaminated feed. The absence of *Salmonella* sp. and all other samples presenting a low to complete absence of contamination demonstrated the accomplishment of a hygienic and sanitary production flow.

4.38. Improving the Microbiological Safety of Traditional Goat Merguez Sausage from Morocco's Argan Region Using Indigenous Lactic Acid Bacteria

Lobna Jilal [1], Hamza Tami [1], Youssef Ezzaky [1,2], Mariem Zanzan [1], Said El Hizazi [1] and Fouad Achemchem [1]

1 Bioprocess and Environment Team, LASIME Laboratory, Agadir Superior School of Technology, University Ibn Zohr, BP 33/S, Agadir 80150, Morocco
2 FRESH A*STAR, SFA & Nanyang Technological University, 62 Nanyang Drive, Singapore N1.2-01-20, Singapore

Morocco's gastronomic heritage includes a diverse array of traditional foods, notably fermented sausages prepared from goat meat sourced from the argan-growing regions. These products are emblematic of local culture and contribute significantly to rural livelihoods. However, their artisanal production under non-standardized hygienic conditions increases the risk of contamination by foodborne pathogens, including *Staphylococcus aureus*.

This study aimed to enhance the microbiological safety of artisanal merguez-type goat sausages by integrating selected lactic acid bacteria (LAB) as protective starter cultures. Three sausage batches were formulated: a control batch inoculated with *S. aureus*, a batch supplemented with a commercial starter (*Lactobacillus sakei* + *Staphylococcus carnosus*), and a third batch enriched with indigenous LAB strains previously isolated and characterized in the laboratory (*L. sakei* Y241 and *Enterococcus faecium* F58). Samples were monitored over 18 days of fermentation and drying for physicochemical parameters (pH, water activity) and microbial dynamics (mesophilic flora, LAB counts, *S. aureus* levels).

The results revealed that the indigenous LAB culture achieved a significant reduction in *S. aureus* (>3 log CFU/g), while supporting robust LAB growth and acidification. Although the commercial culture maintained better stability of pH and water activity, its antimicrobial effect was less pronounced. These findings highlight the potential of using adapted autochthonous strains to improve the safety of fermented meat products while preserving their artisanal identity. This approach supports the sustainable valorization of traditional meat products and local biodiversity in the argan-producing regions of Morocco.

4.39. Meat Species Identification and Classification by MALDI-TOF Mass Spectrometry

Newton Valerio Verbisck [1], Larissa Bortoli de Souza [2], Marita Vedovelli Cardozo [3], Nilton Gabriel Paiva Guimarães [1] and Gelson Luis Dias Feijó [1]

1 EMBRAPA Beef Cattle, Campo Grande 79106-550, Brazil
2 Institute of Biosciences, Federal University of Mato Grosso do Sul (UFMS), Campo Grande 79070-900, Brazil
3 Department of Pathology, Reproduction and One Health, School of Agricultural and Veterinarian Sciences, São Paulo State University (UNESP), Jaboticabal 14884-900, Brazil

Introduction: MALDI-TOF protein profiling and machine learning were developed to distinguish and classify meat from different species of livestock animals, with the aim of establishing a methodology useful for certifying meat species.

Methods: The samples were beef (filet mignon and sirloin), pork (loin), chicken (breast fillet) and tilapia fish (fillet). Approximately 3 cubic mm were excised, without apparent fat. After maceration with a sterile plastic pestle, proteins were extracted with a mixture of acetonitrile/water/trifluoroacetic acid, 50:49.9:0.1 v/v, followed by centrifugation at 13,000$\times$ g for 2 min. Supernatants were mixed with alpha-cyano-4-hydroxycinnamic acid, and mass spectra were acquired in a MALDI Biotyper Sirius One (Bruker Daltonics), with external calibration. Peak identification and meat classification were carried out with MALDI Biotyper Compass Explorer 4.1 and ClinProTools 3.0 (Bruker Daltonics) software.

Results: Meat protein extraction methodology successfully produced nice spectra for fresh and frozen/cooked meat. Fresh samples of beef (n = 6), pork (n = 6), chicken (n = 4) and tilapia (n = 2) were analyzed, and clearly distinct peaks were observed for all types of meat. Considering peaks with signal/noise equal to or greater than 5, the mean numbers of peaks obtained were 30, 26, 17 and 41, respectively, for beef, pork, chicken and tilapia. Analysis with the Biotyper algorithm allowed correct identification with an average score equal to or greater than 2000 for beef after freezing or cooking. The mass spectra obtained also allowed the distinction between Nelore and Angus breeds, but so far, they have not differentiated between the filet mignon and sirloin cuts. PCA classification revealed possible biomarkers for meat types.

Conclusions: Different meat species can be correctly classified with the MALDI-TOF mass spectrometry and may be used in the future for meat certification. The new aspect presented here comes from the possibility of distinguishing cattle breeds.

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4.40. Metal—Antibiotic Combinations as a One Health Strategy Against Multidrug-Resistant Pathogens: In Vitro and Milk Matrix Evaluation

Muskaan Garg, Adrija R, Shilpa Vij, Diwas Pradhan, Rashmi H.M and Raghu H.V.

ICAR-National Dairy Research Institute, Karnal 132001, Haryana, India

Introduction: The rise of antimicrobial resistance (AMR) poses a major threat to food safety, public health, and sustainable agriculture. This study investigates the potential of metal-based antimicrobials as innovative agents to combat multidrug-resistant (MDR) foodborne pathogens within the One Health framework.

Material and methods: We evaluated five metal salts—silver nitrate ($AgNO_3$), zinc sulfate ($ZnSO_4$), gold chloride ($AuCl_3$), copper sulfate ($CuSO_4$), and aluminum sulfate ($Al_2(SO_4)_3$) for their antibacterial activity against ESBL-producing *Escherichia coli*, methicillin-resistant *Staphylococcus aureus* (MRSA), and vancomycin-resistant *Enterococcus* (VRE). Using a suite of microbiological and physicochemical assays, including Zone of Inhibition (ZOI), MIC, MBC, time-kill kinetics, and propidium iodide (PI) membrane integrity analysis, and analysing the toxicity of metals, we observed strong concentration-dependent antibacterial effects.

Results: $AgNO_3$ showed the highest efficacy, with MIC values as low as 0.318 mM and >3-log reduction in bacterial counts within 4–8 h. PI uptake assays indicated substantial membrane damage, supporting disruption-based mechanisms of action. Checkerboard assays revealed synergistic interactions (FICI ≤ 0.5) between metals and antibiotics. Importantly, all metals retained antibacterial activity in raw milk without causing precipitation or discoloration, demonstrating compatibility with complex food matrices. While metal toxicity is still under evaluation, the heatmaps and radar plots were used to visualize strain-specific responses and rank antimicrobial performance, with $AgNO_3 > AuCl_3 > ZnSO_4$.

Conclusions: These findings highlight the promise of metal-based antimicrobials as functional, broad-spectrum agents for use in dairy systems and food biotechnology. Their potential to enhance food safety, reduce AMR, and support sustainable food systems makes them valuable candidates for integration into next-generation food engineering and "foods as medicine" strategies.

4.41. Monitoring of Persistent and Emergent Pollutants in Black Scabbard Fish Aphanopus carbo By-Products and Protein Hydrolysates

Sara Sousa [1], Virgínia Cruz Fernandes [1,2], Carolina Camacho [3,4], Maria Sapatinha [4,5], Carla Pires [4], António Marques [3,4], Ana Rita A. Ribeiro [6], Maria Leonor Nunes [3], Valentina Fernandes Domingues [1] and Cristina Delerue-Matos [1]

1 REQUIMTE/LAQV, ISEP, Polytechnic of Porto, 4249-015 Porto, Portugal
2 RISE-Health, Center for Translational Health and Medical Biotechnology Research (TBIO), ESS, Polytechnic of Porto, 4200-072 Porto, Portugal
3 CIIMAR/CIMAR-LA—Interdisciplinary Centre of Marine and Environmental Research, 4450-208 Matosinhos, Portugal
4 IPMA, I.P.—Portuguese Institute for the Sea and Atmosphere, 1495-165 Algés, Portugal
5 Department of Chemistry, Nova School of Science and Technology, Campus da Caparica, Nova University Lisbon, 2829-516 Caparica, Portugal
6 B2E—Blue Bioeconomy Co., LAB, 4450-718 Leça da Palmeira, Portugal

The Portuguese population consumes approximately 2.5 times more fish than the EU average. Black scabbardfish (Aphanopus carbo, BS) is a popular fish species, commercially available as whole/gutted or in portions/fillets. During processing, approximately 30–40% of by-products are generated (heads, bones, skins). These by-products are often discarded or undervalued, although they can be a valuable source of bioactive ingredients with

many applications. The production of protein hydrolysates (PHs) is of great interest as they exhibit a variety of important bioactive and technological properties, making them potential ingredients for new functional foods and supplements. Their incorporation into food and animal feeds offers multiple benefits, yet these by-products can also carry environmental pollutants (EPs).

In this study, 40 EPs were analysed in BS by-products and their freeze-dried PHs. A single QuEChERS extraction followed by dispersive solid-phase extraction clean-up was employed, coupled with gas chromatography using either flame photometric detection or electron capture detection. This approach enabled the determination of organochlorine pesticides, polychlorinated biphenyls, brominated flame retardants, organophosphorus pesticides, organophosphate esters, and dioxins.

Trace amounts of EPs were detected in all by-products and PHs analysed. However, most concentrations remained below the EC's maximum residue limits, except for DDE in the PH one-stage enzymatic hydrolysis with ProtanaPrime® (PH_P). These findings suggest that PHs from BS by-products can be safely incorporated into food products and animal feed (PH_P up to 30% due to DDE). Continued surveillance and regulatory action of EPs are crucial to promote a blue circular economy aligned with *OneHealth* principles.

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4.42. Nickel Profiling in Wild Edible and Poisonous Mushrooms from Leicester, UK

Gurminderjeet S Jagdev, Mark D. Evans, Tiziana Sgamma and Antonio Peña-Fernández

[1] Leicester School of Allied Health Sciences, De Montfort University, LE1 9BH Leicester, UK

[2] Department of Surgery, Medical and Social Sciences, Faculty of Medicine and Health Sciences, University of Alcalá, Ctra. Madrid-Barcelona, 28871 Alcalá de Henares, Madrid, Spain

Nickel (Ni) contamination in wild mushrooms represents a potential, yet underexplored, route of human exposure to this metal. This study investigates Ni concentrations in wild mushrooms foraged across Leicester (England) and evaluates the associated oral exposure risks from consuming edible species. In total, 106 mushrooms were collected, including 95 from urban areas and 11 from the nearby Bradgate Park. Species identification was confirmed through DNA barcoding, using DNA extracted from 100 mg of homogenised mushroom material with the DNeasy Plant Mini Kit©. Nickel concentrations were determined via ICP-MS, following sample preparation involving cleaning, drying, and homogenisation, with a detection limit of 3.40 mg/kg dry weight. Due to a high proportion of censored data (56.8%), the NADA package in R was employed for data analysis.

The findings revealed considerable variability in Ni concentrations among mushroom species, with levels ranging from below detection to 90.50 mg/kg (mean 7.67 $\pm$ 13.94 mg/kg). Spatial differences were also observed within the urban sampling zones, with the lowest Ni levels detected in the North West quadrant and the highest in the South East ($p < 0.05$). Notably, Ni was undetectable in key edible species such as *Agaricus bitorquis* and *Marasmius oreades*. In contrast, elevated levels were found in toxic species like *Panaeolus foenisecii* (up to 26.42 mg/kg), *Coprinus atramentarius* (up to 90.50 mg/kg), and *Mycena citrinomarginata* (up to 76.43 mg/kg). Previous studies reporting trace Ni levels in *Agaricus* species from other regions, such as Croatia, align with these observations and suggest limited contamination in

Leicester. Moreover, the calculated bioconcentration factor was below unity (0.2), indicating minimal accumulation relative to local topsoil concentrations.

Overall, these results indicate that the risk of nickel exposure through the consumption of wild edible mushrooms collected in Leicester is negligible. However, continued monitoring is recommended to ensure consumer safety and to better understand the environmental dynamics influencing metal uptake in wild fungi.

4.43. NMR-Based Descriptors for the Detection of Dairy Product Adulteration

Nicoleta-Aurelia Chira [1], Mihaela Tociu [1], Aurelia Bratu [1] and Cristina Stavarache [2,3]

1 "C. Nenitescu" Department of Organic Chemistry, Faculty of Chemical Engineering and Biotechnologies, National University of Science and Technology POLITEHNICA Bucharest, Bucharest, Romania
2 Advance Polymer Materials Group, Faculty of Chemical Engineering and Biotechnologies, National University of Science and Technology POLITEHNICA Bucharest, Bucharest, Romania
3 "C.D. Nenitescu" Centre of Organic Chemistry of the Romanian Academy, 202B Spl. Independentei, 060023 Bucharest, Romania

Milk fat is characterized by its unique composition, particularly its high content of short- and medium-chain fatty acids (FAs), which sets it apart from other fats and oils. The standard method for accurately determining the fatty acid profile (FAP) of milk and dairy products—gas chromatography (GC)—is both time-consuming and involves the use of hazardous chemicals, typically requiring nearly two hours per sample even with a skilled operator. As a result, there is a growing interest in faster, alternative techniques. In recent years, spectroscopic methods, such as NMR, combined with multivariate data analysis, have gained attention due to their significantly quicker turnaround and more user-friendly procedures.

This study examined the limitations of the current method used to determine the fatty acid profile of oils and fats using nuclear magnetic resonance (^{1}H- and ^{13}C- NMR) spectroscopy. According to the literature, in the case of dairy fats, the signal at 0.96 ppm originates both from the butyric acid moiety and n-3 fatty acids like linolenic acid (C18:3). As a result, the widely accepted NMR-based method for profiling fatty acids in fats is unreliable for detecting adulterationin dairy products. It risks misidentifying linolenic acid as butyric acid, which can lead to adulterated samples being incorrectly classified as genuine milk fats. As an alternative, we propose new descriptors based on the integral ratios of signals corresponding to CH_2 groups relative to those associated with butyric and n-3 fatty acids. These new markers offer a more reliable approach for identifying adulterated dairy products.

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4.44. Optimization of Fatty Acid Extraction and Derivatization for GC-MS: An Application on Chicken Liver Tissue

Jakub Šťastný [1], Aya Igaki Meader [1], Michaela Dohnalová [1], Irena Marková [2], Martina Hüttl [2], Hana Malínská [2], Vladimír Hönig [1], Petr Kačer [1] and Tereza Kačerová [3]

1 Chemistry Department, Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences Prague, 165 00 Prague, Czech Republic
2 Centre for Experimental Medicine, Institute for Clinical and Experimental Medicine, 140 21 Prague, Czech Republic

[3] Chemistry Research Laboratory, Department of Chemistry, University of Oxford, 12 Mansfield Road, OX1 3TA Oxford, UK

In lipidomic research, the accurate quantification and identification of fatty acids in biological samples present methodological and analytical difficulties. From extraction to analysis, the choice of reagents, precision of derivatization, and analytical parameters all influence researchers' proper understanding of the lipid profile. This is particularly relevant in studies of modern Western diets, where robust analytical methods are critical for assessing human nutritional health. This study aims to optimize key steps in fatty acid extraction, derivatization, and chromatographic analysis. Initial testing was conducted on chicken liver samples, with the intention of applying the optimized method to human samples in subsequent work. By testing different reagent concentrations, we demonstrated that a 46.5% solution of H_2SO_4 in methanol resulted in the most efficient methylation of fatty acids into fatty acid methyl esters (FAMEs), which was measured as higher peak intensities. In contrast, chromatographic separation was primarily influenced by column temperature gradients and injection parameters. The results indicate that a GC oven program starting at 100 °C, with a ramp of 7 °C/min to 240 °C, most effectively separated FAME peaks. Additionally, the use of a phosphate buffer at pH 5.8 during extraction was found to marginally improve peak resolution and amplitude compared to pH 7.0. All results were validated by assessing repeatability through repeated injections, inter-rater reliability, and variation in injection volumes. The novelty of our method lies in its application to soft tissue samples and in the systematic optimization and integration of multiple parameters, such as buffer composition, acid concentration for methylation, and GC/MS settings, which result in a robust, reproducible protocol suitable for high-quality analysis of fatty acids in complex biological matrices.

4.45. Potential of Cyclic Voltammetry Fingerprinting Using Screen-Printed Electrodes to Assess Spanish Honey Botanical Varieties

Andrea Obelleiro [1], Clara Pérez-Ràfols [1,2], Núria Serrano [1,2], José Manuel Díaz-Cruz [1,2] and Oscar Nuñez [1,3,4]

[1] Department of Chemical Engineering and Analytical Chemistry, University of Barcelona, 08028 Barcelona, Spain
[2] Water Research Institute (IdRA), University of Barcelona, 08028 Barcelona, Spain
[3] Research Institute in Food Nutrition and Food Safety, University of Barcelona, Santa Coloma de Gramenet, 08028 Barcelona, Spain
[4] Generalitat de Catalunya, 08028 Barcelona, Spain

Honey is a natural product that is highly appreciated for its nutritional and therapeutic properties, but it is very susceptible to fraudulent practices. Its high economic value and complex composition make honey an attractive product for fraud. Fraudulent practices may involve adding adulterants, artificial feeding of the bees, or incorrect labelling of the botanical variety and geographical origin. In this context, there is a need for simple, fast, and reliable analytical methods for honey characterization and authentication.

A non-targeted cyclic voltammetry (CV) fingerprinting method using screen-printed (SPCE) electrodes and chemometric analysis to discriminate Spanish honey samples according to their principal typology (blossom or honeydew honey) and their specific botanical variety was developed and validated. One hundred and ten blossom and honeydew honey samples of different botanical varieties (blossom, eucalyptus, heather, lavender, rosemary, thyme, almond, chestnut, forest, holm oak, and mountain) were analyzed after a simple dissolution of 2 g of honey in 20 mL of water. CV measurements were initiated by immersing an SPCE into the honey extract solution while scanning the potential from −1.8 to 1.0 V for three consecutive cycles using a scan rate of 0.05 V/s. The second voltammetric

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cycle was selected as a sample chemical descriptor for chemometrics. Exploratory principal component analysis showed clear discrimination among blossom and honeydew honey samples, except for blossom heather samples, which were grouped with the honeydew ones because of their similar physicochemical properties. Partial least squares discriminant analysis provided in general calibration and cross-validation sensitivity and specificity values higher than 0.9, and percentages of correct classification (PCC) ranging 80–92%. Good results were also achieved when addressing blossom and honeydew groups independently, with PCC values ranging from 70 to 100% and 73 to 93% for blossom and honeydew varieties, respectively, demonstrating the suitability of CV fingerprints as sample chemical descriptors to assess honey botanical variety.

4.46. Prevalence of Staphylococcus aureus in Meat-Based Food Collected from Restaurants Around Serdang, Malaysia

Noor Azira Abdul Mutalib and Shi Hui Lau

Department of Foodservice and Management, Faculty of Food Science and Technology, Universiti Putra Malaysia, Serdang 43400 UPM, Selangor, Malaysia

Staphylococcus aureus is a common foodborne pathogen associated with a wide range of illnesses, including food poisoning, skin infections, and systemic diseases. Foodborne illness caused by *S. aureus* typically results from the consumption of contaminated foods, particularly meat-based products. Despite the existence of food safety regulations and guidelines, data on the prevalence of *S. aureus* in meat-based foods from restaurants in Serdang remain limited. This study aimed to determine the prevalence of *S. aureus* in meat-based dishes collected from various restaurants in Serdang and to evaluate the association between extrinsic factors (such as food temperature, cooking methods, and restaurant hygiene grade) and *S. aureus* contamination. A total of 35 meat-based food samples were collected, comprising 13 chicken, 12 beef, and 10 lamb samples. Microbiological analysis was conducted using Total Plate Count and Mannitol Salt Agar to estimate the total aerobic bacteria and identify the presumptive *S. aureus*, respectively. The findings revealed that *S. aureus* was present in 7.69% of chicken samples (mean count: 1.7×10^2 CFU/g) and 40% of lamb samples (mean count: 1.55×10^2 CFU/g). Additionally, 88.57% of all food samples were contaminated with aerobic bacteria. Among the samples exceeding 10^2 CFU/g of *S. aureus*, one was classified as hot food, and four as warm; one sample came from a Grade B restaurant and four from Grade C restaurants; three were prepared using dry cooking methods and two using moist methods. Although no significant relationship was found between *S. aureus* contamination and food temperature or cooking method, a significant correlation (p value = 0.001) was observed with restaurant hygiene grade. These findings highlight the need to strengthen food safety awareness and practices, particularly in lower-grade establishments, to reduce the risk of *S. aureus*-related foodborne illnesses in the community.

4.47. Quality and Safety Evaluation of a Novel Avocado-Based (Persea americana) Beverage During Refrigerated Storage

Tharindi Malisha Wehella, Sakuni Senarath and Madhura Jayasinghe

Department of Food Science and Technology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda 10250, Sri Lanka

Due to the rising interest in functional and plant-based beverages, the market demand for innovative juice products with enhanced nutritional and sensory attributes has increased. This study aimed to develop and evaluate the quality and safety of a fresh avocado-based (*Persea americana*) beverage prepared with avocado pulp, bee honey, and water. Pre-experimental trials were conducted to optimize ingredient ratios based on sensory texture

and consumer appeal. Using the ingredient levels selected by this trial-and-error method, the Taguchi L9 orthogonal array was employed for systematic formulation development. Sensory evaluation, using a ranking test followed by a 9-point hedonic scale and Just-About-Right (JAR) scale, enabled the selection of optimal formulations and identified areas for improvement in attributes such as color, fruity aroma, sweetness, and overall acceptability. Storage stability was investigated under refrigerated conditions (4 ± 1 °C) for 14 days. Samples treated with sodium metabisulphite and potassium sorbate (30:300 ppm) demonstrated superior stability in terms of pH (5.86), total soluble solids [TSSs] (11.7 °Brix), and color [L value] (54.597 ± 0.015), while also effectively suppressing browning and microbial growth (microbial count: $3.9 * 10^4$ CFU ml^{-1}). Comparatively, a combination of low preservative levels (10:150 ppm) and mild thermal treatment of avocado pulp at 70 °C improved the storage stability marginally over low preservative levels alone. Oxidative stability was confirmed by low thiobarbituric acid (TBA) and peroxide values [PV] (TBA value: 0.0297 ± 0.0004 mg MDA kg^{-1}; PV value: 2.492 ± 0.003 O_2 kg^{-1}) throughout storage. These results highlight the feasibility of producing a safe, sensorially acceptable avocado beverage with potential for short-term storage, offering a valuable solution for post-harvest losses of avocado while developing a value-added beverage.

4.48. Quality Evaluation of Essential Oils from Fennel Achenes Grown in Morocco for Industrial Use

Nahla Chakroun [1], Ahmed Lamarti [1], Alain Badoc [2], Patrick Martin [3], Alexis Spalletta [3], Nicolas Joly [3], Ahmed Chelouan [1], Abdenbi Ben Driss [4] and Ali Aghmiz [1]

1 Laboratory of Chemistry, Applied Microbiology & Biotechnology, Department of Chemistry, Faculty of Science, Abdelmalek Essaadi University, Mhannech II, Sebta Avenue, Box 2121, Tetouan 93002, Morocco
2 Oenology Research Unit (UMR1366), Department of Life Sciences & Health, Institute of Vine & Wine Sciences, Bordeaux University, F-33140 Villenave d'Ornon, France
3 Transformation & Agro-Resources Unit (UTA, ULR7519), University Institute of Technology, Artois University-UniLaSalle Polytechnic Institute F-62408, 62400 Bethune, France
4 Laboratory of Biology, Ecology & Health, Department of Biology, Faculty of Science, Abdelmalek Essaadi University, Mhannech II, Sebta Avenue, Box 2121, Tetouan 93002, Morocco

The fennel plant is an aromatic *Apiaceae*, widely cultivated in the Mediterranean basin to serve as a vegetable (azoricum variety, bulbous) and condiment (dulce variety, sweet) and for the production of EO rich in (E)-anethole (vulgare variety, bitter). Our previous work has shown that the EOs of the dulce and azoricum varieties contain more limonene and less α-pinene and fenchone compared to the vulgare variety. The latter is a more productive EO than the dulce variety, as it provides more fruit but is less rich in (E)-anethole and limonene and contains a large quantity of bitter-flavored substances such as α-pinene and fenchone.

The aim of our investigations was to formulate standards that must be met before fennel fruit can be marketed.

We carried out a study on the EO composition of 14 batches of cultivated fennel fruits marketed in Morocco. The compounds detected were determined by means of GC-MS and 25 compounds are identified (16 monoterpenes and 9 arylpropenes). We report the unusual presence of sabinene hydrate, p-butylanisole, elemicin, and two isomers, methyleugenol and methylisoeugenol.

Among the 14 batches analyzed, six samples of sweet fennel and just one batch of bulbous fennel were suitable for consumption. The consumer has the right to expect a product with an aniseed taste, with more than 50% (E)-anethole, less than 20% fenchone, and less than 20% (E)-anethole oxidation compounds, under the names "sweet fennel",

"bulbous fennel", and "bitter fennel". We propose that fennel containing more than 10% estragole, or highly oxidized arylpropenes (20%) with a less aniseed taste, should be marked fennel rich in estragole or rich in elemicin. This latter molecule is structurally close to mescaline and is psychoactive at high doses. The gradual accumulation of this substance in the body following repeated consumption over a long period leads to serious adverse effects (cumulative toxicity).

4.49. Rapid and Sensitive Detection of Mycotoxins in Agricultural Products Using Surface-Enhanced Raman Spectroscopy

Wenlei Zhai and Meng Wang

Institute of Quality Standard and Testing Technology, Beijing Academy of Agriculture and Forestry Sciences, Beijing 100097, China

Mycotoxins are toxic secondary metabolites generated during the infection of agricultural products by fungi. The contamination of mycotoxins presents a major risk to the health of humans and livestock. Thus, rapid and sensitive detection of mycotoxins in agricultural products is an urgent task. In this work, a new method for mycotoxin detection was established by combining a molecularly imprinted polymer (MIP) with surface-enhanced Raman spectroscopy (SERS). Direct detection of aflatoxin B1 (AFB1) in corn and peanuts was accomplished according to the characteristic signals of the target molecules. In brief, Au nanoparticles (AuNPs) were encapsulated with an MIP layer for specific capture of AFB1. After optimization, the AuNPs@MIP hybrid nanomaterials enabled effective and selective adsorption of AFB1, following with qualitative and quantitative SERS detection according to the characteristic bands in the obtained spectra. The limit of detection for AFB1 was as low as 0.1 ng/mL, which was significantly lower than the maximum residue levels set by the Chinese government. Spiking experiments were carried out to examine the performance by employing corn and peanuts as the real sample, and the recovery rates were in the range of 89.6~107.3%. Thus, this method can be used for rapid and sensitive screening of AFB1 contamination in grains and nuts. The proposed study demonstrated the major advantages of combining MIP and SERS for the detection of food contaminants, including high sensitivity, selective recognition and enrichment of the target, rapid assay, ease of operation, and low cost. Therefore, it should be considered as a promising platform for rapid screening and early warning of various contaminants in agricultural products.

4.50. Recombinant Listeria Adhesion Protein (LAP)-Based Lateral Flow Assay for Detection of Listeria Monocytogenes in Milk

Raghu VishweswaraiaH [1], Pradeep Jaybhaye [1], Jitesh Tarak [1], Namita Narwal [1], Shreya Saha [1], Rashmi Hogarehalli Mallappa [1], Diwas Pradhan [1], Sachinandan De [1], Arun Bhunia [2] and Shivendra Tenguria [2]

[1] Dairy Microbiology Division, ICAR-National Dairy Research Institute, Karnal 132001, India

[2] Department of Food Science, Department of Comparative Pathobiology (Courtesy), Purdue University, West Lafayette, IN 47907, USA

This study reports the development and validation of recombinant *Listeria* adhesion protein (rLAP) as a bio-recognition molecule for the rapid and specific detection of *Listeria monocytogenes*. The LAP gene was cloned into a pET vector, expressed in *E. coli* BL21 (DE3) under IPTG induction, and purified as a 104 kDa His-tagged protein via Ni-NTA affinity chromatography (yield: 2.88 mg/mL). Protein identity and purity were confirmed by SDS-PAGE and Western blotting. A LAP-based sandwich ELISA using anti-Internalin A antibodies demonstrated high specificity for *L. monocytogenes* serovars 4b and 4e, with a detection limit of 10^4 CFU/100 µL, and no cross-reactivity with *L. innocua* or other non-

target bacteria. Additionally, a lateral flow immunoassay (LFA) was developed using rLAP as the test line antigen and gold nanoparticles (GNPs) conjugated with specific antibodies. GNPs synthesized via citrate reduction were characterized by DLS (31.11 nm, −37.5 mV) and UV-Vis spectroscopy. Optimized antibody-GNP conjugates (33.46 nm, −16 mV) and LAP-coated 8 µm nitrocellulose membranes enabled sensitive detection. The assay specifically detected *L. monocytogenes* strains (ATCC 19115, 19118, MTCC 1143) with no cross-reactivity to *L. ivanovii*, *L. innocua*, or other Gram-positive/negative bacteria. In spiked milk, after 24 h enrichment in LESM, the LFA achieved detection limits of 3.34 ± 0.01 log CFU/mL (broth) and 3.3 ± 0.02 log CFU/mL (milk), with results available in 20 ± 2 min. These findings establish LAP as a robust and biologically relevant capture molecule for developing rapid, cost-effective, and field-deployable immunodiagnostic platforms for food safety surveillance.

4.51. Relationships Between Physicochemical Properties and Image Texture Features of Yellow Sweet Bell Pepper After Selected Periods of Spontaneous Lacto-Fermentation

Ewa Ropelewska, Justyna Szwejda-Grzybowska and Anna Wrzodak

Fruit and Vegetable Storage and Processing Department, The National Institute of Horticultural Research, Konstytucji 3 Maja 1/3, 96-100 Skierniewice, Poland

Lacto-fermentation is an effective method for preserving sweet bell peppers after harvest. In addition to extending their shelf life, this process enhances the peppers with beneficial health properties. The objectives of this study were as follows: (1) To determine the physicochemical properties, such as pH, acidity, total soluble solids, sugars, L-ascorbic acid, and carotenoids, and 2172 texture parameters from images in color channels *R*, *G*, *B*, *S*, *U*, *V*, *X*, *Y*, *Z*, *L*, *a*, and *b*, of yellow sweet bell pepper 'Yellow California' before lacto-fermentation and after 7, 14, 28, and 56 days of the process. (2) To determine the linear correlations between physicochemical properties and image texture features. Finally, (3) to set linear regression equations for estimating the changes in the physicochemical properties of yellow sweet bell pepper during lacto-fermentation based on image parameters. The correlation and regression were performed using STATISTICA 13.3 (StatSoft Polska Sp. z o.o., Kraków, Poland, TIBCO Software Inc., Palo Alto, CA, USA). Significantly strong relationships among the analyzed parameters were found. The values of correlation coefficient (R) reached 0.99 between glucose and image texture bS5SN3SumVarnc, and pH and VS5SV1Correlat; −0.99 between fructose and RHPerc99, total sugars and RHPerc99, L-ascorbic acid and RHPerc99, and total soluble solids and RHPerc99; 0.98 between ß-carotene and US5SH1Entropy, and sucrose and US5SH3Entropy; and −0.98 between ß-carotene and aHMaxm10. The developed regression equations allowed for predicting physicochemical parameters based on image textures with high coefficients of determination (R^2) of up to 0.98. The models were validated and tested using independent data, which confirmed their effectiveness.

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4.52. Short Food Supply Chains and Food Safety Issues: HACCP Utilization, Opportunities and Limits

Benoît Grossiord

Bordeaux Sciences Agro, 1 Cours du Général de Gaulle, CS 40201, 33175 Gradignan, France

In order to maintain their farming activities and to appropriately respond to the expectations of consumers and society, farmers are developing new ways to valorize their

products. One of these ways consists of shortening the distance between producers and consumers by developing new strategies that allow for a direct producer–consumer relation, like the so-called short food supply chains (SFSCs).

When developing SFSCs, producers have to use new skills to manage and control all the steps involved in the processing, storing, marketing or transport of the end products they put on the market. Through the whole process, from rearing animals or growing crops to end products, the producer has to face many risks related to those new activities. One of the main stakes is the management and control of food safety. Like all other food business operators, producers involved in SFSCs must respect the EU regulation on food safety (Food Law). Here, we focus on Article 6 of the Food Law and its application in SFSCs.

Article 6 deals with risk analysis, which consists of three successive actions: risk assessment, risk management, and risk communication. The HACCP method (Hazard Analysis and Critical Control Point) is universal, and this report explores its utilization in SFSCs. The HACCP allows for a full analysis of the steps involved in the elaboration of end products, from the production of raw materials to commercialization. It is therefore a powerful tool for raising operators' awareness of the many hazards (physical, chemical, biological) that must be managed along the food chain, while also helping them to identify and apply proper good hygiene practices (GHPs). A better understanding and utilization of the HACCP will contribute to the improvement of the food safety culture (FSC), as is expected along the food chain.

4.53. Smart Bio-Packaging Powered by Bacteriocins

Natalia Hejda [1], Paulina Brzęcka [1], Marcela Pejchalová [2], Maria Swiontek Brzezinska [3] and Agnieszka Richert [1]

1 Department of Genetics, Faculty of Biology and Veterinary Science, Nicolaus Copernicus University, Gagarina 11, 87-100 Toruń, Poland
2 Department of Biological and Biochemical Sciences, Faculty of Chemical Technology, University of Pardubice, Studentská 95, 532 10 Pardubice II, Czech Republic
3 Department of Environmental Microbiology and Biotechnology, Nicolaus Copernicus University, Gagarina 11, 87-100 Toruń, Poland

Introduction: Bacteriocins are ribosomally synthesized peptides with selective antimicrobial activity, produced by various bacteria and archaea. Due to their specificity, low cytotoxicity, and ability to inhibit pathogens without disturbing beneficial microflora, they are considered promising natural alternatives to conventional antibiotics and chemical preservatives. Their potential application in food packaging aligns with current trends promoting clean-label, sustainable, and biodegradable solutions.

Methods: In this study, biodegradable polymer-based films and hydrogels were developed using polycaprolactone (PCL) and sodium alginate, enriched with two model bacteriocins: nisin and pimaricin. Antibacterial properties were evaluated against three reference strains: *Escherichia coli*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa*. Antifungal efficacy was assessed using a mixed culture of four common fungal strains. Additional assays included spectrophotometric quantification of bacterial biofilm formation, Ames test for mutagenicity, and soil biodegradation analysis over 28 days.

Results: All bacteriocin-enriched materials demonstrated strong antimicrobial activity. Nisin showed pronounced antibacterial effects with clear inhibition zones >1 mm. Pimaricin exhibited notable antifungal action, especially against *A. niger* and *C. globosum*. Both compounds significantly reduced biofilm formation on material surfaces. No mutagenic effects were detected, and the materials, particularly alginate-based hydrogels, showed high biodegradability.

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Conclusions: The material exhibits antimicrobial properties due to the controlled release of the active substance to the food surface. PCL, as a hydrophobic polymer, ensures the relative stability of the material in an aqueous environment, allowing for the gradual and prolonged action of bacteriocin, especially against Gram-positive bacteria. The material can be used for packaging perishable products such as meat, fish, cheese or ready-made chilled meals.

4.54. Study on the Effects of Thermal Treatments on Polyphenol Retention, Enzyme Activity and Browning of Apple Puree

Shichao Li, Alessandro Zanchin and Lorenzo Guerrini

Department TESAF—Department of Land, Environment, Agriculture and Forestry, University of Padova, 35020 Legnaro, Italy

Apple (*Malus domestica*) puree is widely used as a substitute for sucrose to improve the health properties of foods due to its natural sweetness and nutritional advantages. Thermal treatment has become a critical part of quality control in the processing of apple puree in order to extend the shelf life and improve quality. Polyphenol degradation and enzymatic browning during thermal treatments of apple puree are key factors leading to nutrient loss and color deterioration. This study investigated the effects of a temperature–time combination on the quality of cooked apple puree in this systematic study.

Golden Delicious apples were used as raw material and were peeled, ground and processed at different temperatures (87–102 °C) and times (6–17 min). Total polyphenols, peroxidase, polyphenol oxidase and total antioxidant capacity were evaluated for fresh apples and purees based on chemical analysis. Moreover, puree viscosity was measured with a rheometer, while syneresis was evaluated by quantifying the liquid release.

The results showed that browning of apple puree increased when the temperature was higher than 100 °C and the heating time was less than 12 min. The lowest polyphenol concentrations were found in uncooked purees (control), as polyphenols may have been released with warming. Moreover, the highest temperature significantly increased the puree consistency by increasing viscosity and limiting syneresis. No enzymatic activity was found in cooked puree, indicating that the lowest temperature was suitable for color and polyphenol preservation. This study provides a basis for process optimization for balancing nutrient retention and browning control in apple puree processing.

4.55. Survival Dynamics of Salmonella and Microbial Changes During Home-Brewed Kombucha Fermentation

Philip Junior Yeboah, Boce Zhang and Katherine Witrick

Department of Food Science and Human Nutrition, University of Florida, Gainesville, FL 32611, USA

Kombucha is a fermented tea known for its health benefits, including antimicrobial properties and immune-boosting effects. However, improper home brewing practices can lead to contamination by harmful bacteria, raising concerns about food safety and health. This study evaluated the survival levels of *Salmonella* and its interactions with microbial dynamics and assessed changes in the natural microbial environment during fermentation. It also investigated the physicochemical properties and changes in indigenous microbial analysis during fermentation. The kombucha was prepared using black tea and SCOBY cultures under controlled conditions at 25 °C for 14 days (0, 1, 2, 3, 5, 7, 10, and 14 days). Microbial and physicochemical analyses were conducted at various time points over 14 days, measuring pH, acidity, antioxidant activity, organic acids, and polyphenols. Microbial analyses (aerobic plate counts, lactic acid bacteria LAB, total yeast and mold, and *Salmonella* enumerations) were performed in triplicate, using Petrifilm, MRS, PDA and XLT4

media, respectively. Genomic analysis of the SCOBY (pre- and post-fermentation) via 16S rRNA sequencing was used to characterize microbial changes and assess their inhibitory effects on *Salmonella.* The significance ($p \leq 0.05$) of differences between mean values was determined using a two-way analysis of variance (ANOVA). The initial *Salmonella* population of 7.30 log CFU/mL significantly ($p \leq 0.05$) decreased to below detectable limits (1 log CFU/mL) by day 10 in the kombucha. The LAB also increased from 4.95 to 6.91 log CFU/mL within 10 days; the reductions in *Salmonella* and the increase in LAB, respectively, correlate with decreases in pH and increases in organic acid concentrations. Total yeast and mold and APC recorded increased (4.2 to 5.95 log CFU/mL) and (4 log CFU/mL), respectively, over the 14 days. After fermentation, total polyphenols and antioxidant activity increased, which may be a potential indication of antimicrobial effects. Meanwhile, the sugar content decreased, indicating active fermentation. This study illustrated the microbiological safety of home-brewed kombucha, identifying critical factors that influence pathogen survival.

4.56. Systematic Review of Food Safety Training Outcomes Among Food Handlers Across Diverse Food Service Settings

Andrea Insfran-Rivarola [1], Ana Pamela Arévalos [2], Airi Maehara [3], Jose Luis Vazquez Noguera [1], Sebastian Grillo [3], Laura Gonzalez-Cespedes [4], Pastor Enmanuel Pérez-Estigarribia [3], Ulises Sanabria-Villamayor [1] and Yamila Velazquez [1]

1 Universidad Americana, 001409 Asunción, Paraguay
2 Departament of Industrial Engineering, Facultad de Ingeniería, Universidad Nacional de Asunción, San Lorenzo 2160, Paraguay
3 Facultad Politécnica, Universidad Nacional de Asunción, San Lorenzo 2160, Paraguay
4 Departamento de Nutrición, Dirección de Investigación, Facultad de Ciencias Químicas, Universidad Nacional de Asunción, San Lorenzo 2160, Paraguay

Food safety is a growing global public health concern, with millions of people becoming ill and thousands dying annually because of the consumption of contaminated food. These incidents also lead to significant economic losses in food-related industries, including tourism and catering. This systematic review aimed to identify key risk factors associated with food contamination and assess the effectiveness of training and educational interventions targeting food handlers in various settings, such as restaurants, hospitals, universities, hotels, households, street food stalls, and food production facilities. This review analyzed 31 peer-reviewed studies published between 2019 and 2024 that evaluated changes in food handlers' knowledge, attitudes, and practices (KAPs) following food safety interventions. The findings revealed that while most interventions resulted in improved knowledge, positive changes in attitudes and practices were not always guaranteed. Common risk factors include limited food safety knowledge, poor hygiene practices, lack of handwashing, improper use of uniforms and accessories, and inadequate thawing techniques. These findings underscore the importance of ongoing monitoring and supervision to ensure sustained improvements in food safety behavior. This review contributes to the field by offering evidence-based insights for designing future training programs and practical guidelines to enhance food safety compliance in both industrial food production and small- to medium-sized enterprises.

4.57. The Effect of Selected Antioxidants on the Stability of Pomegranate Seed Oil

Diana Mańko-Jurkowska [1], Adrianna Domińska [2] and Marta Siol [1]

1 Department of Chemistry, Institute of Food Sciences, Warsaw University of Life Sciences, 02-776 Warsaw, Poland

[2] Faculty of Food Technology, Warsaw University of Life Sciences, Nowoursynowska St. 166, 02-787 Warsaw, Poland

Pomegranate seed oil (PSO) is a valuable source of bioactive compounds with health-promoting properties, but it is particularly susceptible to oxidation due to its high content of polyunsaturated fatty acids (PUFAs). Oxidative stability is one of the most important indicators of the quality and shelf life of edible oils. A common strategy to enhance oil stability is the application of antioxidants, which can effectively inhibit or slow down oxidative degradation.

In this study, the effects of a plant-derived antioxidant-rich extract (rosemary extract) and a synthetic antioxidant (butylhydroxytoluene, BHT) on the stability of PSO were investigated. The oxidation process was monitored to assess oil quality and stability using parameters such as peroxide value (PV), oxidation induction time (τ_0), and the time corresponding to the maximum oxidative changes (τ_{max}). The samples were stored for two months at room temperature, in the absence of light, and under refrigerated conditions.

In the first stage of the study, the fatty acid (FA) composition of PSO was determined via gas chromatography. During storage, changes in the oxidative stability of all prepared samples were monitored via pressure differential scanning calorimetry (PDSC), and changes in PV were measured via potentiometric titration.

PSO was characterized by a high content of polyunsaturated FAs (~82%), particularly punicic acid (~74.6%), and exhibited very low oxidative stability, as evidenced by its short τ_0 at 120 °C (3.90 min). The addition of both antioxidants had a beneficial effect on PSO stability, which was reflected in the values of τ_0, τ_{max}, and PV. The natural antioxidant proved to be more effective in this regard, particularly at room temperature.

4.58. The Influence of the Ikejime Technique on Sea Bass (Dicentrarchus labrax) Quality

Martina Čagalj [1], Matko Šimleša [1], Barbara Soldo [2], Judita Grzunov Letinić [3] and Vida Šimat [1]

[1] University Department of Marine Studies, University of Split, R. Boškovića 37, 21000 Split, Croatia
[2] Department of Chemistry, Faculty of Science, University of Split, Ruđera Boškovića 33, 21000 Split, Croatia
[3] Institute of Public Health Zadar, Ljudevita Posavskog 7a, Zadar, Croatia

Ikejime is a technique used to kill fish by inserting a spike into the brain, which can be performed manually or mechanically. This technique originated in Japan and aims to reduce stress and prevent uncontrolled muscle contractions after the catch, thereby preserving the quality of the meat and prolonging its freshness. This not only preserves the original flavour and texture of the fish, but also creates a rich "umami" taste. In this study, the proximate composition, amino acid profile and fatty acid composition with the degree of their oxidation were compared in farmed sea bass (*Dicentrarchus labrax*) killed by cold water asphyxiation after capture and the samples bled during capture using the Ikejime technique. No significant difference was found between the samples in proximate and fatty acid composition. Lipid oxidation, measured by the tiobarbituric acid test, showed similar results with no significant difference: 0.62 ± 0.01 μmol malondialdehyde (MA)/100 g in the sea bass killed by cold water asphyxiation, and 0.76 ± 0.01 μmol MA/100 g in the sea bass killed by Ikejime. The lower levels of ASP, HIS, GABA, MET and LYS found in Ikejime-treated sea bass indicate lower stress and delayed proteolysis, which enhances the oxidative and microbial stability of fish killed by this technique. While the immediate umami flavour can be milder, the flavour improves with a short period of maturation, making Ikejime fish ideal for high-quality, well-matured seafood products.

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4.59. Traditional vs. Innovative Rice Cakes: The Contribution of Alcobaça Apple and Spirulina

Joaquina Pinheiro [1], Cíntia Silva [2], Margarida Silva [2] and Rui Ganhão [1]

[1] MARE—Marine and Environmental Sciences Centre/ARNET—Aquatic Research Network, ESTM—School of Tourism and Maritime Technology, Polytechnic of Leiria, 2520-614 Peniche, Portugal

[2] ESTM—School of Tourism and Maritime Technology, Polytechnic of Leiria, 2520-614 Peniche, Portugal

Food innovation is essential to address consumers' growing concerns about health, nutrition, and sustainability. This innovation encourages the research of diverse raw materials and the development of food products featuring powerful ingredients, such as the microalgae *Spirulina*, known for its high protein content, vitamins, and antioxidants. Advanced technologies and streamlined processes have been adapted to meet market demand, resulting in healthier and more sustainable food solutions. Our commitment is to enhance nutritional and functional quality while prioritizing environmental stewardship, aiming to address today's dietary needs and ensure the preservation of essential resources for future generations.

The main goal of this study was to develop innovative food products inspired by traditional Portuguese pastries, namely the rice cake (*bolo de arroz*). To achieve this, the formulation was modified through the incorporation of the following regional ingredients: *Alcobaça* apples, representing fruit from the Western Region of Portugal, and *Spirulina* as a marine resource. Three cake formulations (CTR: wheat and rice flour, AL: rice and almond flour, AL.AS: rice and almond flour with apple and microalgae) were tested in triplicate for comparative analysis. The colour (CIE Lab parameters and TCD), texture (texture profile analysis), and water activity (a_W) of traditional and innovative rice cake samples were determined. The enriched rice cake samples (AL.AS) exhibited a significantly greener and darker colour ($p < 0.05$, Tukey's test) compared to the CTR and AL samples. In terms of texture, the AL.AS samples showed a 40% increase in hardness and less water activity (0.88) than that observed in the CTR samples (0.91).

The enriched rice cake features an improved nutritional profile, particularly with lower calorie and sugar content compared to the standard formulation. This enhancement may encourage healthier dietary choices and promote the consumer's well-being. Additionally, the product aligns with two Sustainable Development Goals: promoting sustainability and supporting the zero-waste concept.

4.60. Tropane Alkaloid Contamination of Gluten-Free Cereal Food

Ljilja Torovic [1], Mina Jankovic [2] and Gorica Vukovic [3]

[1] Department of Pharmacy, Faculty of Medicine, University of Novi Sad, 21000 Novi Sad, Serbia

[2] Department of General Education Subjects, Faculty of Medicine, University of Novi Sad, 21000 Novi Sad, Serbia

[3] Field Test Laboratory, 11000 Belgrade, Serbia

Cereal crops are susceptible to contamination with tropane alkaloids from the seeds of certain weeds growing in the same fields. The low gluten content of crops like corn, rice, buckwheat, and millet makes them essential ingredients in gluten-free foods, which serve as nutritional therapy for people with gluten intolerance or celiac disease. The current study aimed to address the lack of data on the presence of the main tropane alkaloids, atropine and scopolamine, in such foods.

The atropine and scopolamine content of 71 prepacked gluten-free cereal foods collected on the Serbian market were determined by liquid chromatography with tandem

mass spectrometry (LC-MS/MS; limit of quantification of 0.4 μg/kg for each analyte) and further used for regulatory compliance assessment (maximum level for millet, sorghum, and maize products: 5 μg/kg; maximum level for buckwheat: 10 μg/kg).

Overall, atropine was found in 42.3% of the samples and scopolamine in 35.2%. Regarding the contamination frequency, the distribution across the food groups was as follows: flour (66.7%) > biscuits (53.3%) > pasta (41.7%) > crackers (35.0%) > bread (25.0%) > breakfast cereals (0%). The total concentrations of atropine and scopolamine varied widely among the food groups, with a maximum of 60.8 μg/kg in flour and 32.4 μg/kg in pasta. Notably, two flour samples (16.7%; made from corn/corn, rice, and millet) and one pasta sample (8.3%; made from corn and rice) exceeded the permissible limit. The overall mean ratio of atropine to scopolamine in the same pasta sample was 2.4 ± 1.1, suggesting contamination with *Datura stramonium* seeds.

The recorded non-compliance rate of 4.2% in the gluten-free food samples, with contamination greatly exceeding the regulatory limit, is of public health importance. Although processing of samples such as flour and pasta can modify the composition and concentration of tropane alkaloids in ready-to-eat food, solid information on the degree of degradability and toxicity of the products formed is still unavailable.

4.61. Tropane Alkaloid-Associated Health Risks in People on Gluten-Free Diet

Ljilja Torovic [1], Mina Jankovic [2] and Gorica Vukovic [3]

[1] Department of Pharmacy, Faculty of Medicine, University of Novi Sad, 21000 Novi Sad, Serbia
[2] Department of General Education Subjects, Faculty of Medicine, University of Novi Sad, 21000 Novi Sad, Serbia
[3] Field Test Laboratory, 11000 Belgrade, Serbia

Gluten-free food, a nutritional therapy for people with gluten intolerance/celiac disease, is produced from crops (corn, rice, buckwheat and millet) which are highly prone to contamination with the seeds of plants producing tropane alkaloids. The current study was undertaken to determine the health risks associated with atropine and scopolamine, the toxicologically most important tropane alkaloids.

A total of 71 cereal foods labelled as gluten-free were collected on the Serbian market. Atropine and scopolamine were quantified using liquid chromatography with tandem mass spectrometry. For the purpose of consumer health risk assessment, the upper-bound concentrations were considered alongside national acute food consumption data, and the resulting acute exposure was compared with the group acute reference dose (ARfD) of 16 ng/kg bw, as well as the clinically significant minimal acute dose (1.54 μg/kg bw; for calculation of the margin of exposure (MOE)).

The exposure to the combination of atropine and scopolamine exceeded the group ARfD in the case of two flour samples and one pasta sample when they were consumed by toddlers and children, one flour and one pasta sample when they were consumed by adolescents and adults, and one pasta sample when they were consumed by pregnant and lactating women and vegetarians. In cases of high food consumption, in addition to two flour samples and one pasta sample posing a risk of acute adverse effects in all the population groups, bread and biscuit samples exceeding 50% of the group ARfD in the case of consumption by toddlers (2 + 2) and children (1 + 1) also attracted attention. Regarding the MOE results, the lowest MOE of 9 was observed for one pasta sample if it was consumed in high amounts by toddlers, rising to 22 in cases of mean food consumption, which can be considered sufficiently protective.

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Adverse acute health effects of tropane alkaloids cannot be ruled out even in the case of single-source dietary exposure, while aggregate exposure from multiple food sources consumed in the relevant time-frame increases concerns.

4.62. Uncovering Novel Antimicrobial-Producing Microorganisms in Soil Environments

Estelle Le Squin [1,2], Taofiqat Kasali [1] and Elena Alexandra Alexa [1,3]

[1] School of Food Science and Environmental Health, Technological University Dublin, D07 H6K8 Dublin, Ireland
[2] Ecole Supérieure d'Ingénieurs en Agroalimentaire de Bretagne Atlantique, 29280 Plouzané, France
[3] Centre for AMR and One-Health Research, Technological University Dublin, Dublin, Ireland

The microbial diversity of soil environments offers a promising source of potential solutions in the face of antimicrobial resistance, which, nowadays, is viewed as a significant threat to global health. This research centres on isolating and screening lactic acid bacteria (LAB) from diverse soil samples (n = 5), a promising reservoir of beneficial traits for food and medical industry applications. Furthermore, soil samples were serially diluted and 0.1 and 1 mL of inoculum were plated in duplicate onto de Man Rogosa Sharpe (MRS), Plate Count Agar (PCA), Violet Red Bile Glucose Agar (VRBGA), and Sabouraud Dextrose Agar (SDA) for the identification and enumeration of LAB, total viable counts, Enterobacterales, and yeasts and molds, respectively. Plates were incubated at their corresponding temperature in aerobiosis and anaerobiosis conditions. Colony counts indicated total bacterial loads exceeding 10^5 CFU/g, while lactic acid bacteria (LAB) ranged between 10^2 and 10^3 CFU/g. All samples except P3 exhibited elevated levels of Enterobacterales at approximately 10^2 CFU/g.

Functional screening of 79 LAB isolates was conducted to evaluate their antagonistic activity against pathogenic strains, including *S. aureus* ATCC25923, *Klebsiella oxytoca* ATCC49131, and *Escherichia coli* ATCC25922, using the spot-on-lawn method, showing inhibition rates of 50.63%, 40.50%, and 45.56%, respectively. *Lactococcus lactis* ATCC11454 and *Lactobacillus reuteri* DSM17938 were included in each assay to assess the bacteriogenic potential of LAB isolates with standard controls. This research highlights soil environments as promising sources of potential antimicrobials, with applications in food science and the potential to address antimicrobial resistance in future medical practices.

4.63. Valorisation of Agri-Food Waste Through the Use of Colorimetry

Adriana Rodrigues Machado [1,2], Gonçalo Sá [1], João Nunes [1] and Manuela Pintado [2]

[1] Associação CECOLAB, Collaborative Laboratory Towards Circular Economy, Business Centre, Rua Nossa Senhora da Conceição, 2, Oliveira do Hospital, 3405-155 Coimbra, Portugal
[2] Centro de Biotecnologia e Química Fina (CBQF), Universidade Católica Portuguesa, 4169-005 Porto, Portugal

The valorisation of agri-food waste as food ingredients has gained attention due to their nutritional and functional importance, as well as their role in sustainability and the circular economy. Pigmented residues like grape pomace, prunings, stems and brewing by-products can enhance visual appeal and attract consumers. This study aimed to characterise the colourimetric properties of flours produced from such waste. Samples were dried at 60 °C, then at 40 °C for 24 h with forced air, milled using a Retsch SR 300 and analysed with the CIELAB colour space. Significant differences were found in luminosity (L*), red–green (a*) and yellow–blue (b*). Grape pomace had the lowest lightness (L* = 21.18 ± 0.45) and the most intense red colour (a* = 12.11 ± 0.13), possibly associated with the presence of an-

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thocyanins and tannins. On the other hand, grape pruning showed the greatest luminosity (L* = 54.55 ± 0.22) and the greatest yellowing (b* = 13.29 ± 0.26), which may be related to the content of lignin and other non-pigmented phenols. The stalks showed intermediate luminosity with reddish and yellowish tones, while the brewery waste showed high luminosity and the highest b* value (14.67 ± 0.13), potentially influenced by the presence of melanoidins, resulting from the Maillard reaction. The differences observed between the waste may reflect variations in their composition of phenolic compounds, lignin and natural pigments such as anthocyanins, flavonoids and betalains, as reported in the literature. Although the quantification of these compounds was not carried out in this study, the colorimetric profiles obtained allow for a useful preliminary characterisation to differentiate the materials based on their visual properties. These data provide initial subsidies for future research into the use of these residues as natural ingredients in foods, supporting strategies for utilising by-products in the context of sustainability and innovation in the food chain.

4.64. Web Monitoring of Italians' Home Food Safety Interest and Perception: A Preliminary Study

Antonella Maugliani [1], Monica Valli [2], Cinzia Civitareale [1], Francesca Baldi [1], Manuela Luzi [3], Manlio Mammoli [3] and Francesca Maialetti [1]

1 Istituto Superiore di Sanità—Department Food Safety, Nutrition and Veterinary Public Health—Viale Regina Elena, 299-00161 Rome, Italy
2 Istituto Superiore di Sanità—National Centre for Disease Prevention and Health Promotion—Viale Regina Elena, 299-00161 Rome, Italy
3 Istituto Superiore di Sanità—Organization of the central directorate for general affairs—Viale Regina Elena, 299-00161 Rome, Italy

Global health organisations acknowledge that household habits significantly affect food safety. Foodborne illness have become a major public health concern worldwide, often resulting from improper food handling by consumers at home. These issues are underestimated due to under-reporting of domestic outbreaks.

Consumers often neglect proper food handling practices, increasing their exposure to food-related risks. Changing consumer attitudes and practices regarding food safety is crucial to mitigating these risks.

Nowadays, the internet is the main source of general information, including topics related to home food safety (HFS). However, as highlighted during the COVID-19 pandemic, online information is not always reliable. Public health institutions play a crucial role in disseminating accurate and trustworthy messages. Assessing knowledge, awareness and practices (KAP) regarding HFS, along with analysing online information, can support the development of effective communication strategies.

This study aims to identify and analyse the Italian online landscape concerning HFS, to gain insights into the topics and issues to which consumers are exposed.

A web-monitoring tool was employed to systematically collect and analyse online content, identify trends, and assess public interest in HFS. The methodology involved developing web-monitoring profiles, optimised through a three-step process (keyword refinement, validation, calibration) and refined during a pilot phase. Over eight months, 46,184 items of online content were gathered; 37,763 were reviewed and 4881 were deemed relevant according to specific eligibility criteria.

Relevant content, sourced from websites, blogs and social media platforms, was categorised using five "ad hoc" analytical features: Context, Content, Source, Type of Information, and Type of Issue. Each feature comprised defined values, enabling the creation of a 'content fingerprint' that characterises the nature and focus of online information. These findings will inform the design of a forthcoming KAP survey on HFS among Italian web users, to be distributed via our institutional web channels.

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5. Session D: Food Microbiology

5.1. Evaluation of a Natural Extract as a Preservative in a Banana Filling for Pastry: A Clean Label Alternative

Elisabetta Tomé [1], Teresa Bento de Carvalho [1], Beatriz Nunes [1], Beatriz Silva [2], Isabel Oliveira [2], Miguel Azevedo [2] and Paula Teixeira [1]

[1] CBQF-Centro de Biotecnologia e Química Fina, Laboratório Associado, Escola Superior de Biotecnologia, Universidade Católica Portuguesa, Rua de Diogo Botelho 1327, 4169-005 Porto, Portugal

[2] Decorgel–Produtos Alimentares S.A., Rua do Progresso, 363-Lantemil, 4785-647 Trofa, Portugal

The growing consumer demand for more natural food products has driven the development of clean-label alternatives that exclude synthetic preservatives. In this context, natural preservatives have gained attention as potential substitutes for synthetic preservatives traditionally used in the food industry. Fruit fillings, widely used in bakery and pastry products, are characterized by low acidity, low water activity, and high sugar content, making them particularly susceptible to fungal contamination. Among the most used synthetic preservatives are sorbic acid and its salt, potassium sorbate, whose replacement represents both a technological and safety challenge.

The objective of this study was to evaluate the efficacy of a group of berry extracts and tapioca starch rich in sorbic acid, applied at two concentrations (0.5% and 1%), as a preservative in an industrially produced banana filling. The product's stability was assessed over 70 days of storage at 22 °C and 62% relative humidity and compared with a control sample preserved with potassium sorbate.

Microbiological analyses (total viable counts, molds and yeasts, aerobic and anaerobic spore-forming bacilli) were performed, along with physicochemical and rheological tests.

Results showed that both concentrations of the natural extract effectively controlled microbial growth while maintaining the physicochemical and rheological properties of the product throughout the storage period. These findings suggest that natural preservatives could be a viable alternative to synthetic preservatives in bakery products, contributing to the development of more sustainable foods aligned with current consumer expectations.

5.2. Conjugates of Polyethylenimine with Protoporphyrin IX and Zinc Protoporphyrin IX as Novel Photosensitizers for Raw Food Surface Decontamination

Giuliana Antonela Larrea, Natalia Soledad Gsponer and Edgardo Néstor Durantini

[1] Institute for Agroindustrial and Health Development, National Council for Scientific and Technical Research (CONICET), Río Cuarto, Córdoba, Argentina

[2] Department of Chemistry, Faculty of Exact, Physical-Chemical and Natural Science, National University of Río Cuarto (UNRC), Río Cuarto, Córdoba, Argentina

Ensuring microbiological safety is a growing concern in modern food technology, especially in response to consumer demand for minimally processed fruits and vegetables. In this study, two novel photosensitizer conjugates were synthesized by covalently linking protoporphyrin IX (PPIX) and its Zn (II) complex (ZnPPIX) to polyethyleneimine (PEI). The aim was to develop naturally derived polymeric materials capable of reducing microbial contamination on food surfaces through photodynamic inactivation (PDI) of pathogens. The conjugates were characterized by means of FT-IR spectroscopy, confirming successful covalent binding. Spectroscopic analysis indicated that the porphyrin chromophores retained their optical properties upon conjugation with PEI. Both PEI–PPIX and PEI–ZnPPIX were able to generate singlet oxygen (Φ_Δ = 0.20 and 0.47, respectively) and superoxide anion radicals in the presence of NADH. In addition, the conjugates efficiently photooxidized

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the amino acid L-tryptophan, a commonly used substrate in biological photochemistry. PDI assays demonstrated strong antimicrobial activity against *Staphylococcus aureus*, with both conjugates achieving >7 log reductions in bacterial viability. Furthermore, cucumber surfaces were used as a representative raw food commonly found in salads. After microbial contamination, both photosensitizers showed effective pathogen eradication at low concentrations (0.1–2.5 nmol). These results indicate that PEI–PPIX and PEI–ZnPPIX are promising antimicrobial materials with potential applications in the preservation of fresh food and extending shelf life.

5.3. Optimizing Wet Fermentation Time with Lactic Acid Bacteria to Improve the Cupping Quality of Coffea arabica-Coffea canephora Blends

Nadiah Nur, Abu Bakar Tawali and Amran Laga

Department of Agricultural Technology, Hasanuddin University, Makassar 90245, Indonesia

Coffee fermentation is a crucial step that significantly influences the final taste and quality of the product. This study investigates the effect of varying wet fermentation durations (0, 12, 24, 36, and 48 h) on blends of *Coffea canephora* and *Coffea arabica* beans. A starter culture of lactic acid bacteria (LAB) was used to enhance fermentation, consisting 2% of *Lactiplantibacillus plantarum*, *Leuconostoc pseudomesenteroides*, and *Weisella* sp., with a consistent Arabica-to-Robusta ratio applied across treatments. Fermentation was carried out at room temperature in a controlled wet environment. After each fermentation period, the beans were dried, roasted, and ground before sensory evaluation. The experiment was conducted in two replicates, and two panelists were involved in the sensory evaluation using the Specialty Coffee Association of America (SCAA) cupping protocol. Panelists assessed aroma, flavor, aftertaste, acidity, body, balance, sweetness, clean cup, overall quality, and final score. Based on the results of the analysis of variance (ANOVA) with a significance value of 0.00, there was a statistically significant effect between treatments ($p < 0.05$), indicating differences in fermentation and blending times. Fermentation duration had a noticeable impact on sensory attributes. The 48 h fermentation yielded the highest cupping score, marked by improved acidity, sweetness, and balance, resulting in a cleaner and more complex cup. In contrast, the 12 h fermentation period showed less flavor development and acidity. In conclusion, controlled wet fermentation with LAB inoculation can enhance the sensory quality of Arabica-Robusta coffee blends. A 48 h fermentation period was determined to be optimal for producing a balanced, high-quality cup. These findings highlight the potential of microbial starter cultures in improving consistency and flavor development in blended coffee products.

5.4. The Microbiology of Cheeses Produced in the Metropolitan Region of Curitiba

Milena Gabrielle de Jesus [1], Lorena Lima Ludovico [1], Kauã Colaço Schier [1], Elisana Julek [1,2], Bárbara Kornin Gabardo [1], Vitória Furquim Nascimento [1], Maria Rosa Aparecida Nunes de Oliveira [1,2], Isabela Cristina Batista Martins [1], Luana Siqueira de Souza [1,2], Gizelli Nascimento Santos [3], Vinicius de Assis Moscatelli [1], Bruno Ariel Furtado de Miranda [1,2], Andreia Bueno da Silva [1] and Julia Arantes Galvão [1,2]

1 Quality Control and Food Safety Laboratory—Federal University of Paraná, Curitiba/Paraná 80035-050, Brazil
2 Post-Graduation Program in Veterinary Sciences—Federal University of Paraná, Curitiba/Paraná 80035-050, Brazil
3 Santa Cruz State University—UESC, Ilhéus 45662-900, Brazil

Cheese is a popular food in Brazil, but its microbiological safety can be compromised by the presence of potentially pathogenic microorganisms, such as coagulase-positive

Staphylococcus (CPS) and *Listeria monocytogenes*. However, there is a lack of published data on the microbiological quality of cheeses produced in the Metropolitan Region of Curitiba (MRC), which limits the understanding of regional risks to public health and the development of specific food safety strategies. This study seeks to fill this gap by providing unpublished data on microbial counts and fermentation quality in locally produced cheeses. Lactic acid bacteria (LAB) are important for fermentation, helping to develop flavor and inhibit the growth of pathogens. However, the lack of sanitary control in production can result in contamination. There are no reports on the microbiological conditions of cheeses produced in the MRC, so this study aimed to quantify LAB and CPS, as well as to investigate the presence of *L. monocytogenes* in cheeses from the MRC, in addition to evaluating pH, an important parameter for product safety and quality. Five cheese samples were collected from two cheese factories in the MRC, totaling 10 samples. In the microbiological analysis, CPS were detected at levels above those permitted in the samples from cheese factory 1, indicating shortcomings in the hygiene and health conditions. No CPS ($\leq 1.0 \times 10^2$ CFU/g) were detected in cheese factory 2. *L. monocytogenes* was not detected in any of the samples evaluated. On the other hand, the LAB count was satisfactory in both cheesemakers, suggesting good fermentation. The pH of the samples varied between 4.8 and 5.1 atCheese Factory 1, indicating efficient fermentation, while at Cheese Factory 2, the higher pH (6.57–6.67) suggests problems in the fermentation process. These results highlight the importance of hygienic control and fermentation for the safety and quality of the cheeses.

5.5. Valorization of Milk Thistle Oilcakes in the Culture of Yarroiwa Lipolytica Yeast

Jolanta Małajowicz [1], Karolina Chaberska [2], Adam Kraśniewski [3], Sina Makouie [1] and Joanna Bryś [1]

[1] Department of Chemistry, Institute of Food Sciences, Warsaw University of Life Sciences, 02-776 Warsaw, Poland
[2] Department of Human Nutrition, Warsaw University of Life Sciences, 02-776 Warsaw, Poland
[3] Institute of Food Sciences, Warsaw University of Life Sciences, 02-776 Warsaw, Poland

Milk thistle (*Silybum marianum*) is a plant from the Asteraceae family, originally native to the Mediterranean region, but now also found in other parts of Europe, North America, and Australia. Large, spiny leaves with white spots and purple flowers characterize it. Milk thistle is valued mainly for its silymarin content, which has strong liver-protective properties. The seeds are rich in protein, fiber, healthy fats, and micronutrients, making them a valuable dietary ingredient.

Milk thistle oil cakes, or residues from pressing oil from seeds, can also be a valuable source of many nutrients. This work aimed at analyzing the composition of milk thistle cakes and attempted to valorize them by using them as components of a microbiological medium in cultivating Yarrowia yeast. The main components of the cakes were determined in the work, including the content of dry matter, protein, and fat. The results of the analyses confirmed that milk thistle cakes are a valuable source of fat, in which polyunsaturated fatty acids dominate. Such an oilcake introduced into microbiological media is a valuable carbon and nitrogen source for growing microorganisms. Yarroiwa lipolytica grown on media with 10% addition of oilcake showed high biomass yield and lipolytic activity twice as high as in the control medium (YPG).

5.6. A Newly Isolated Kluyveromyces Marxianus Strain Capable of Producing Oleic Acid-Rich Oil for Human Consumption from Whey

Alejandro Pérez-Rodríguez [1,2], Carlos Alberto Montenegro-Herrera [1], César Mateo Flores-Ortíz [3], Liliana Morales-Barrera [1] and Eliseo Cristiani-Urbina [1]

[1] Departamento de Ingeniería Bioquímica, Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacional, Ciudad de México 07738, Mexico
[2] Departamento de Ciencias Básicas, Unidad Profesional Interdisciplinaria de Biotecnología, Instituto Politécnico Nacional, Ciudad de México 07340, Mexico
[3] Unidad de Biotecnología y Prototipos, Facultad de Estudios Superiores-Iztacala, Universidad Nacional Autónoma de México, Estado de México 54090, Mexico

Microbial oils have been extensively considered valuable bioactive compounds due to their favorable effects on human health and, therefore, hold promising prospects for use in producing food additives and multifunctional fat replacers. The microbial conversion of whey into oils has garnered enormous attention because whey is a by-product of the dairy industry, generated in significant quantities during cheese and casein manufacture. This represents a significant challenge for the dairy industry because its disposal can be costly and environmentally problematic due to its high biological oxygen demand and potential to pollute water sources.

We sought to isolate oleaginous microorganisms that are safe for human health and exhibit high levels of oil production from whey. The best-performing microorganism was then molecularly identified, and both its oil production and fatty acid composition were characterized.

Fifteen microbial strains were isolated from whey that were capable of accumulating triglycerides. Batch fermentation studies conducted with the 15 microbial isolates revealed that a yeast strain, designated as CM9b, produced the highest oil production (2.68 g/L) and oil yield (49%) from whey. Isolate CM9b was molecularly identified as *Kluyveromyces marxianus*, a type of yeast that is generally regarded as safe (GRAS) and widely used in the food industry. The main fatty acids in the oil derived from *K. marxianus* were oleic, palmitic, stearic, and linoleic acid. The fatty acid composition of the oil from *K. marxianus* was very similar to that of avocado oil. The advantages of cultivating *K. marxianus* on whey include its high percentage of oleic acid (53%) and the balance of other fatty acids (68% monounsaturated fatty acids, 32% saturated fatty acids), its capacity to generate oils in a short time, the controlled environment of production, and the relatively limited surface area required. Thus, *K. marxianus* shows potential as an alternative and economical source of oleic acid for the food industry.

5.7. Antimicrobial Potential of Olive Mill Wastewater Phenolic Extracts Against Bacillus cereus

Luca Fasolato [1], Barbara Di Franco [1], Stefania Balzan [1], Federico Fontana [1], Laura Dadalt [1], Agnese Taticchi [2] and Enrico Novelli [1]

[1] Department of Comparative Biomedicine and Food Science, University of Padua, Viale dell'Università, 16, 35020 Legnaro (PD), Italy
[2] Department of Agricultural, Food and Environmental Sciences, University of Perugia, Perugia, Italy

Phenolic compounds recovered from olive mill wastewater (OMWW) represent a promising resource for sustainable antimicrobial applications. While their antioxidant properties are well documented, limited data are available on their antimicrobial activity against spore-forming bacteria such as *Bacillus cereus*. This study assessed the antimicrobial efficacy of a purified extract of OMWW submitted to a spray-dry process on a support of maltodextrin DE-19 against three *B. cereus* strains (one field and two reference). Microtiter-based assays were used to evaluate bacteriostatic and bactericidal effects on vegetative cells and spores at 20 °C and 30 °C. Minimum Inhibitory Concentration (MIC), Minimum Bactericidal Concentration (MBC), and Killing Quotient (KQ) were determined. At 20 °C, vegetative cells were inhibited at 0.095–0.187 mg/mL, with one strain highly susceptible. At 30 °C, MICs ranged from 0.187 to 1.5 mg/mL. Bactericidal activity was observed at

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0.75–3 mg/mL. Spore germination was inhibited above 0.75 mg/mL, though no sporicidal effect was detected. In general, the experimental setup using phenolic extracts can present significant challenges due to their chemical complexity and variability. Nonetheless, this phase is essential to define appropriate dosages and mechanisms of action prior to any application in food matrices. Here, the stability of the spray-dry extract allowed for the proper build-up of in vitro tests. The results highlight the potential of OMWW phenolics as natural antimicrobials, particularly effective against vegetative forms of *B. cereus*.

5.8. Antimicrobial Properties of Lactic Acid Bacteria Isolated from Moroccan Camels' Meat for Natural Food Preservation

Hamza TAMI, Youssef Ezzaky, Ahmed Elidrissi, Mariem Zanzan, Mohamed Amellal and Fouad Achemchem

Bioprocess & Environment Team, LASIME Research Laboratory, Agadir Superior School of Technology, Ibnou Zohr University, Agadir 80150, Morocco

Lactic Acid Bacteria (LAB) play a critical role in food bio-preservation due to their ability to produce antimicrobial compounds such as lactic acid, bacteriocins, and hydrogen peroxide. This study focuses on the isolation and characterization of LAB from camels' meat sourced from the Argan region, an area known for its unique ecological and microbial diversity. Being highly perishable, this meat provides an ideal substrate for the growth of both beneficial and spoilage microorganisms, making it a suitable candidate for investigating the potential of LAB in extending food shelf life.

LAB strains were isolated using MRS agar and GM17 agar under anaerobic conditions. Morphological and biochemical tests were employed to identify the dominant LAB species. Among 2304 isolated strains, 115 exhibited significant antimicrobial activity against at least one of the tested foodborne pathogens: *Salmonella* enterica Enteritidis CECT4396, *Staphylococcus aureus* ArFMSA019, and *Listeria monocytogenes* CECT935. The inhibition zones ranged from 12 to 25 mm in diameter, with 15% of the active strains showing broad-spectrum antimicrobial activity against all three pathogens. Key metabolites—including lactic acid and bacteriocins, which were extracted using centrifugation—were tested, confirming their activity against the aforementioned pathogenic microorganisms.

The findings suggest that LAB strains isolated from camels' meat in the Souss Massa region possess unique adaptive traits, likely influenced by the area's distinct environmental conditions. These LAB strains hold promise as natural biopreservatives in meat products, contributing to improving shelf life, food safety, and reducing reliance on synthetic preservatives. Further studies are recommended to evaluate their application in real-world food systems and assess their compatibility with traditional preservation methods.

5.9. Application of Particle Film Influences Yeast Communities on the Surface of Touriga Nacional and Touriga Franca Grape Berries in the Douro Region

Isabel Rodrigues [1], Fernanda Cosme [2,3], Virgílio Falco [4,5] and António Inês [2,3]

1 Centro de Investigação de Montanha (CIMO), ESA, Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal
2 Centro de Química—Vila Real (CQ-VR), Universidade de Trás-os-Montes e Alto Douro (UTAD), 5000-801 Vila Real, Portugal
3 Departamento de Biologia e Ambiente (DEBA), Escola de Ciências da Vida e do Ambiente (ECVA) Universidade de Trás-os-Montes e Alto Douro, 5000-801 Vila Real, Portugal
4 Centre for the Research and Technology of Agro-Environmental and Biological Sciences (CITAB), Universidade de Trás-os-Montes e Alto Douro (UTAD), 5000-801 Vila Real, Portugal

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[5] Laboratory for Green Chemistry (LAQV) of the Network of Chemistry and Technology (REQUIMTE), Universidade do Porto (UP), 4099-002 Porto, Portugal

The microbial community present on the surface of grape berries plays a key role in the initial stages of wine fermentation, affecting both the microbiological stability and sensory characteristics of the final product. This study investigated the effects of particle film applications, specifically kaolin and potassium silicate, on the indigenous yeast communities associated with two key grape varieties, "Touriga Nacional" and "Touriga Franca", cultivated in Portugal's Douro region. Grape bunches were harvested from a commercial vineyard, where selected rows of "Touriga Nacional" and "Touriga Franca" had been treated at veraison with kaolin (5%) or potassium silicate (at 0.05% or 0.1%). Untreated vines served as controls. To assess the yeast populations, berry samples were washed in isotonic peptone water, and the resulting suspensions were plated on YPD agar. Yeast colonies were isolated, quantified, and identified through molecular analysis of the D1/D2 domain of the 26S rRNA gene. Total yeast count ranged from 10^3 to 10^4 CFU/berry. Overall, the "Touriga Franca" variety presented significantly higher populations of both *Saccharomyces* and non-*Saccharomyces* yeasts. However, within this variety, grape samples treated with potassium silicate (at both concentrations) presented the lowest yeast counts. Thirteen yeast species were identified, belonging to the phyla Ascomycota and Basidiomycota. Untreated grapes exhibited significantly higher species richness and diversity compared to treated grapes. *Aureobasidium pullulans* was the dominant species across all treatments, although its relative frequency varied according to treatment type and grape variety. Multivariate analyses revealed distinct yeast community structures shaped by grape variety, treatment, and their interaction. These findings suggest that particle film applications can change the indigenous yeast community on grape surfaces, potentially affecting fermentation dynamics and wine quality.

5.10. Bifidobacterial Occurrence and Species Variability in Raw Milk

Vera Neuzil-Bunesova, Nikol Modrackova, Blanka Krausova and Tereza Brousilova

Department of Microbiology, Nutrition and Dietetics, Czech University of Life Sciences Prague, Kamycka 129, 165 00 Prague 6, Czech Republic

Introduction: Bifidobacteria are typical commensals in the gut of various hosts. Raw milk and its products are also sources of bifidobacteria, which is attributable to secondary contamination. The aims of our work were to quantify and identify bifidobacteria in raw milk from various farms and ruminant hosts to detect their species variability, and based on their typical occurrence and taxonomy, to evaluate the possible origin.

Methods: Bifidobacteria were quantified and isolated using bifidobacterial mupirocin media under anaerobic/microaerobic conditions, at 37 °C/room temperature. Colony identification was performed using MALDI-TOF MS and 16S rRNA gene sequencing. TBX medium was used to detect *Escherichia coli* and other coliforms (aerobically, at 37 °C), which was intended to serve as a control for fecal contamination.

Results:*Bifidobacterium crudilactis* and *B. animalis* subsp. *lactis* were repeatedly detected in raw milk using anaerobic cultivation at 37 °C. Other cultivation conditions reduced bifidobacterial capture and allowed the growth of a larger number of other microorganisms. Also, other bifidobacterial species typical of ruminants were detected in some samples. The detection of β-glucuronidase-positive *E. coli* on TBX agar was quite frequent; however, it did not fully correspond with the occurrence of bifidobacteria.

Conclusions:*B. animalis* subsp. *lactis* is a well-known probiotic species used in dairy production, as well as a multi-host species typical of the gut microbiota. By contrast, the occurrence of *B. crudilactis* has not yet been confirmed in the gut microbiota, which,

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together with our results, indicates its environmental characteristic. However, future strain physiological characterization is needed.

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5.11. Biopreservation and Control of Staphylococcus aureus in Traditional Goat's Cheese Using Essential Oil of Lavandula mairei

Mariem Zanzan [1], Hanane Oublid [2], Kaoutar Boussif [1], Youssef Ezzaky [1], Fouad Msanda [2] and Fouad Achemchem [1]

[1] Bioprocess and Environment Team, LASIME Laboratory, Agadir Superior School of Technology, University Ibnou Zohr, Agadir 80150, Morocco

[2] Laboratory of Biotechnologies and Valorization of Natural Resources, Biology Department, Sciences Faculty, Ibn Zohr University, 80000 Agadir, Morocco

Traditional goat's cheese is highly perishable due to its high moisture content and near-neutral pH, making it susceptible to microbial contamination, particularly by *Staphylococcus aureus*. This study aimed to enhance the microbiological and nutritional quality of traditional goat's *jebn* cheese through the application of essential oil (EO) extracted from *Lavandula mairei* Humbert. EO was extracted from the aerial parts of *L. mairei* via hydrodistillation using a Clevenger apparatus. Antimicrobial activity against *S. aureus* CECT 976 was evaluated in vitro using disc diffusion and broth microdilution methods to determine the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC). EO was then incorporated into the freshly prepared goat's cheese inoculated with *S. aureus*, and microbiological and physicochemical analyses were performed over the storage period. The MIC and MBC of *L. mairei* EO against *S. aureus* were determined to be 1.25 mg/mL and 2.5 mg/mL, respectively, indicating a bactericidal effect, with an MBC/MIC ratio of 2 based on values in mg/mL. In treated cheese samples, EO at 0.6% significantly reduced *S. aureus* counts compared to untreated controls. Furthermore, physicochemical analysis showed a gradual decline in acidity during storage, without compromising the sensory or nutritional properties of the cheese. *L. mairei* EO exhibits strong antimicrobial properties and holds promise as a natural preservative for enhancing the safety and shelf life of traditional goat's cheese. This plant-based biopreservation method aligns with consumer demand for additive-free, microbiologically safe dairy products.

5.12. Biotechnological Potential of Apple Pomace as a Source of Pectin for Formulating Functional Juices

Jazmín Berenice Hurtado and María Clara Tarifa

[1] Centro de Investigaciones y Transferencia (CIT) de Río Negro, Universidad Nacional de Río Negro (UNRN), 446 9 de Julio St, Villa Regina 8336, Argentina

[2] CIT RÍO NEGRO (CONICET-UNRN), Universidad Nacional de Río Negro, 446 9 de Julio St, Villa Regina 8336, Argentina

Apple pomace (AP), a by-product of apple processing, constitutes 20–35% of the fruit's fresh weight. Its disposal poses considerable environmental and logistical challenges for the industry. However, AP is a rich source of compounds with biotechnological potential, particularly pectin, a major dietary fiber known for its gel-forming and prebiotic properties.

This study aimed to evaluate the impact of adding pectin to Not-From-Concentrate (NFC) apple juice on the viability of two probiotic bacteria: *Lactiplantibacillus plantarum* ATCC 8014 (LP) and *Lacticaseibacillus casei* ATCC 393 (LC). Comparisons between apple pomace-derived and commercial pectin were performed.

Pectin was extracted from AP powders using a 1:30 acidified water (pH 2)-to-AP ratio, using citric acid. The extraction process involved a sonication step (40 °C, 25 min) followed

by heat treatment (90 °C, 70 min). The extracted pectin was characterized according to the following: equivalent weight (Peq), methoxyl content (MeO%), degree of esterification (DE%), and galacturonic acid content (AUG%), besides the yield of the process. Pectin was then added to commercial NFC apple juices at 1% *w*/*v*. Probiotic strains (107 CFU/mL) were incorporated into the pectin-enriched juices, and their viability was monitored weekly over four weeks under refrigeration.

The pectin extraction yield was 11%, and its characterization showed values of Peq 115 g/eq, MeO% 12%, DE% 46%, and AUG% 153%. Probiotic survival with pectin enrichment was higher compared to the controls without pectin. Notably, AP pectin yielded equal or higher survival rates than commercial pectin: 87% for LC and 100% for LP, compared to 82% and 100%, respectively, for commercial pectin. These findings are highly promising, particularly given the vast volumes of by-products generated by the apple industry. This approach offers a straightforward implementation strategy, simultaneously mitigating waste and enhancing the dietary fiber content of functional juices.

5.13. Cell-Free Supernatant from a Foodborne Enterococcus faecium Strain Inhibits the Sessile Growth of Salmonella Typhimurium in Single- and Mixed-Species Biofilms

Alexia Maria Giorgi, Persefoni-Pinelopi Vourvoulia, Dimitra Kostoglou and Efstathios Giaouris

Laboratory of Food Microbiology and Hygiene, Department of Food Science and Nutrition, School of the Environment, University of the Aegean, 81400 Myrina, Lemnos, Greece

Biofilms that contain foodborne pathogens and form on food contact surfaces pose a persistent challenge to food safety and public health. This study evaluated the biofilm inhibitory potential of sterile and neutralized cell-free supernatants (CFSs) derived from two foodborne lactic acid bacteria (LAB) strains (*Enterococcus faecium* LFMH-B79b and *Pediococcus acidilactici* LFMH_B10) against both single- and mixed-species biofilms of four target bacterial species that negatively affect food quality: *Pseudomonas fluorescens*, *Staphylococcus aureus*, *Salmonella enterica* serovar Typhimurium, and *Listeria monocytogenes*. Bacteria in saline suspensions (8 log CFU/mL) of the target species were allowed to attach for three hours at 20 °C on model stainless steel surfaces, under either single- or mixed-species conditions, and then incubated in tryptic soy broth (TSB), with or without the addition of each LAB CFS (at 50% *v*/*v*), for up to 48 h at 20 °C. At 24 and 48 h of incubation, both planktonic and biofilm bacteria on surfaces were counted using selective plate counting. Our results indicated that in single-species biofilms, *S*. Typhimurium sessile cell counts were reduced by approximately 90% (1 log) after 48 h of incubation with the CFS of the *E. faecium* strain. A similar trend was observed in mixed-species biofilms, where co-incubation with CFS again led to a ~1 log reduction in *S*. Typhimurium biofilm cell numbers. It should be noted that the observed inhibition of biofilm formation was not due to the inhibition of planktonic growth or nutrient dilution, indicating a targeted inhibitory effect of *E*. faecium-derived metabolites on *S*. Typhimurium biofilm formation. No significant biofilm inhibition was observed for the other three target bacterial species. These findings provide a strong rationale for further exploring LAB-derived metabolites for biofilm-targeted interventions in food systems, highlighting the complex nature of intercellular microbial interactions.

5.14. Characterization of Exopolysaccharides from Lactic Acid Bacteria Using Edible Growth Medium

Banasree Bhowmik, Afsana Habib Jui, Sadia Afrin, Farhana Boby, Monzur Morshed Ahmed and Md Nur Hossain

Institute of Food Science and Technology, Bangladesh Council of Scientific and Industrial Research, Dhaka 1205, Bangladesh

Exopolysaccharides (EPSs) are naturally occurring carbohydrates with various biological properties, including antimicrobial, antioxidant, anticancer, immunomodulatory, and gut microbiota-modulating properties, which have been extensively studied. Lactic Acid Bacteria (LAB) are constantly generating interest as a safe source of EPSs while posing no health risks. The present study aims to identify EPS-producing LAB isolates, determining the GRAS capability and EPS-producing potential; it also aims to assess the industrial applications of EPSs.

In this work, initially, EPS-producing LAB strains, including *Lactiplantibacillus plantarum* and *Enteroccoccus faecium*, were identified by a series of cultural, morphological, and molecular identification techniques. A comparative study of the bacterial growth conditions revealed a higher growth rate of these LAB strains in the vegetable-based edible medium than in the MRS medium. In a GRAS capability study focused on probiotic characteristics, the LAB strains were able to tolerate simulated human gastrointestinal (GI) tract conditions (a high temperature, low pH, and bile salt) and exhibited significant cell-surface hydrophobicity. The ethanol precipitation method was used for the extraction of EPSs, followed by the purification of the EPSs by column chromatography and thin-layer chromatography (TLC). Maximum EPS yields of approximately 135–175 mg/500 mL were achieved after the anaerobic incubation of the LAB strains for 48 h at 37 °C under static conditions. UV-vis, FTIR, XRD, and NMR spectroscopy were subsequently performed on the purified EPSs to determine the purity, key functional groups, and the structure of the polysaccharides, respectively. The antimicrobial, antioxidant, and emulsification properties of the purified EPSs were assessed to evaluate their biological properties. The EPSs possessed antimicrobial activity along with stronger antioxidant and emulsification activity. Therefore, the biological and functional characteristics of the LAB EPSs support the potential use of EPSs in the food and pharmaceutical industries.

5.15. Development of a Predictive Model for the Growth of Listeria monocytogenes in Fresh Goat Cheese "Jben" Under Varying Temperature Conditions

Kaoutar Boussif [1], Youssef Ezzaky [1], Mariem Zanzan [1], Antonio Valero [2] and Fouad Achemchem [1]

[1] Bioprocess and Environment Team, LASIME Laboratory, Agadir Superior School of Technology, University Ibnou Zohr, Agadir 80150, Morocco

[2] Department of Food Science and Technology, UIC Zoonosis y Enfermedades Emergentes (ENZOEM), CeiA3, Campus Rabanales, Universidad de Córdoba, 14014 Córdoba, Spain

Listeriosis outbreaks have been linked to cheese consumption, prompting this study to focus on goat's *jben*, a traditional Moroccan dairy product, to assess and model the growth of *Listeria monocytogenes* at various storage temperatures (4–30 °C). Lab-scale *jben* samples were prepared following a traditional Moroccan recipe and inoculated with a three-strain cocktail of *L. monocytogenes* at approximately 2–3 log CFU/g. These inoculated samples, with a pH = 6.701 ± 0.09 and aw = 0.915 ± 0.006, were stored under different isothermal conditions (4, 10, 20, 25, and 30 °C) and analyzed microbiologically using plate count methodology to quantify pathogen levels. Predictive microbiology models, utilizing mathematical equations, were employed to estimate microbial behavior in the product. The Baranyi model was used to describe the growth kinetics of cheeses stored under different temperature levels and was integrated with the Ratkowsky model through global regression analysis. This approach linked *L. monocytogenes* concentrations with storage temperature and time. Results showed that the pathogen's growth potential increased with higher storage temperatures. Analysis conducted using MATLAB provided estimated Ratkowsky model parameters: b = 0.0154 log CFU/h °C, = 1.5 °C. Growth rates, modeled with the

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extended Ratkowsky square root model, ranged from 0.0118 to 0.1804 log CFU/h across the temperature range of 4 to 30 °C. The proposed model aims to predict *L. monocytogenes* growth over a wide range of storage temperatures, offering a foundation for making informed decisions about the microbiological safety of *jben*.

5.16. Development of Red Flour from Amaranthus caudatus Grains by Solid-State Fermentation by Monascus Ruber

Evelyn Quispe-Rivera [1], Franz Tucta-Huillca [1], Vasco Cadavez [2], Ursula Gonzales-Barron [2] and Marcial Silva-Jaimes [1]

[1] Universidad Nacional Agraria La Molina (UNALM), Av. La Molina s/n La Molina, Lima 15024, Peru

[2] Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal

Amaranthus caudatus, known as amaranth or *kiwicha*, is a pseudocereal that does not contain gluten; it is a rich source of high-quality nutrients, with a good amount of proteins, lipids and fiber; it also contains twice as much calcium as milk, all of which makes it an excellent input for the food industry. Within the research related to the development of products for this industry, many sustainable processes are being carried out using microorganisms, including filamentous fungi that produce red biopigments such as *Monascus ruber*, which provide added value to the substrates metabolized by fermentation. The objective of this study was to produce *kiwicha* flour fermented by *M. ruber* through solid-state fermentation. For this purpose, an optimization of factors such as the sodium chloride g/g–glucose g/g ratio (water–sample ratio) was carried out through a Box–Behnken experimental design because it comprises a specific set of 3k factorial combinations and is widely used in food processes due to its economic design. The fermented flour was analyzed in CIELAB color space (L*, a*, b*) and statistical analysis was performed using R software. The results of the optimized dependent variables were L* = 51.93, a* = 20.91 and b* = 21.89 with R^2 values of 0.89, 0.87 and 0.88, respectively. The present study could provide a new and good source of flour with high added value in the food industry.

5.17. Evaluation of Antimicrobial Activity of Pine Natural Extracts Against Agri- and Food-Related Pathogenic Bacteria

Paschalitsa Tryfinopoulou [1], Eirini Evaggelia Kallianioti [2] and Efstathios Panagiotis Pavlakos [3]

[1] Laboratory of Microbiology and Biotechnology of Foods, Department of Food Science and Human Nutrition, School of Food and Nutritional Sciences, Agricultural University of Athens, Iera Odos 75, 11855 Athens, Greece

[2] Laboratory of Microbiology and Biotechnology of Foods, Department of Food Science and Human Nutrition, Agricultural University of Athens, Iera Odos 75, GR-11855 Athens, Greece

[3] Independent Researcher, Odos 46H No 38, GR-19016 Artemis, Greece

The natural extracts derived from Pine (*Pinus halepensis*, region Attica, Greece) needles, male cones, and pollen mixed with male cones were prepared following a green procedure at all stages, using environmentally friendly methods and safe solvents. Seventeen bacterial strains, relevant to agriculture and food, were cultured under optimal conditions. Antibacterial activity was assessed using agar well diffusion to determine inhibition zones, followed by the broth microdilution method to determine the minimum inhibitory concentrations (MICs) and minimum bactericidal concentrations (MBCs). The highest inhibition zones were observed for pollen mixed with male cones extract against

Listeria monocytogenes, while the lowest MIC values were recorded for pine needles extract against *Staphylococcus aureus* (7.50 ng/mL). The lowest MBC values were observed from the pollen mixed with male cones extract (0.35 mg/mL) against *Bacillus cereus*. Notably, the pine needles extract showed antibacterial activity with MIC and MBC values ranging from 7.50 ng/mL–7.69 mg/mL and 0.48–30.75 mg/mL, respectively, against *Escherichia coli*, *Vibrio harveyii*, *Staphylococcus epidermidis*, *S. aureus*, *L. monocytogenes*, *B. cereus*, and *Agrobacterium tumefaciens*. Significant antibacterial activity was recorded for the pine male cones with pollen extract with MIC and MBC values ranging from 0.02–22.4 mg/mL and 0.35–22.4 mg/mL, respectively against *S. aureus, L. monocytogenes, and B. cereus*. The pine male cones extract inhibited *B. cereus, L. monocytogenes*, and *S. aureus with MIC values ranging from 3.6–14 mg/mL, though MBC values were not detected*. The extracts show minimal antimicrobial activity against *Pseudomonas aeruginosa*, *Serratia marcescens*, *Yersinia enterocolitica*, *Klebsiella aerogenes*, *Salmonella enterica*, and *Salmonella typhimurium*. Notably, *Citrobacter freundii*, *Klebsiella oxytoca*, *Serratia liquefaciens*, and *Citrobacter sakazakii* exhibited resistance to all tested extracts. These findings suggest the potential of natural extracts, especially those from pine needles, as antimicrobial agents in the agricultural and food sectors.

5.18. Evaluation of Culture Media for the Growth of Flavobacterium covae: Toward Standardization for Inoculation Studies

Jhennys P Becerra, Larry Hanson, Juan L Silva and Angelica Abdallah

Department of Food Science, Nutrition, and Health Promotion, Mississippi State University, Mississippi State, MS 39762, USA

Flavobacterium covae is the predominant species responsible for columnaris disease in Channel Catfish, posing significant challenges to the aquaculture industry. Despite its importance, there is a lack of consistency in the culture media used for the optimal growth of *F. covae*, delaying in vitro and in vivo studies due to the bacterium's fastidious nature. The objective of this study was to evaluate and compare the efficacy of various culture media to support the growth of *F. covae* during initial resuscitation, preparation of a stationary-phase inoculum, and throughout the bacterial growth curve. Initial resuscitation was conducted at 28 °C and evaluated at 24, 48, and 72 h using various agar and broth media, including Nutrient Agar, Tryptic Soy Agar, Tryptic Soy Agar with Blood, Brain Heart Infusion Agar and Broth, Reasoner's 2A (R2A) Agar and Broth, and Shieh Broth. Consistent growth was observed with R2A (Agar and Broth) and Shieh Broth, observing small, yellow-pigmented colonies in agar and turbidity in broth after 48 h of incubation at 28 °C. Subsequent inoculation to obtain a stationary-phase inoculum and generate growth curves was conducted in R2A broth and Shieh broth at 28 °C for 48 h with constant agitation. A microplate reader was used to measure optical density (OD600) hourly. Bacterial growth was consistently observed in R2A broth across all replicates, whereas Shieh Broth showed either no growth or minimal growth, likely due to its sensitivity to pH and complex preparation requirements. The bacterial growth curve results reported a final population of 7.6 log CFU/mL for R2A and 6.3 log CFU/mL for Shieh. The viability of the bacterial stock and the freshness of the media were also found to significantly influence outcomes. In conclusion, R2A could be a reliable option for the cultivation of *F. covae*, being a promising candidate for standardization in laboratory protocols.

5.19. Evaluation of the Antimicrobial Activity of Melipona Quadrifasciata Geopropolis Against Foodborne Pathogens

Bruno Ariel Furtado De Miranda [1,2], Elisana Julek [1,2], Luana Siqueira de Souza [1,2], Juliana Chiesse da Silva Zatta [1], Bárbara Kornin Gabardo [1], Kauã Colaço Schier [1] and Julia Arantes Galvão [1,2]

[1] Quality Control and Food Safety Laboratory—Federal University of Paraná, Curitiba/Paraná 80035-050, Brazil
[2] Post-Graduation Program in Veterinary Sciences—Federal University of Paraná, Curitiba/Paraná 80035-050, Brazil

Food safety is a constant concern in the food industry, especially regarding the control of pathogens responsible for foodborne diseases (FBDs). The geopropolis produced by Melipona stingless bees has gained interest due to its natural antimicrobial potential. This study aimed to evaluate the antimicrobial activity of the geopropolis from the stingless bee *Melipona quadrifasciata* against seven bacterial strains: *Staphylococcus aureus* ATCC 25923, *S. aureus* (field strains S4 and S31), *Salmonella* Typhimurium ATCC 14028 and the field strain L14A, *Salmonella* Heidelberg (field strain), and *Listeria monocytogenes* ATCC 19111. The raw geopropolis was selected to remove impurities, frozen, ground, and homogenized. Two grams of the material were weighed and mixed with 25 mL of 80% cereal alcohol, followed by extraction in a water bath at 70 °C for 30 min under intermittent agitation. The extract was filtered and incorporated into Mueller–Hinton agar at final concentrations of 10% and 5%. Each Petri dish was perforated with seven wells, into which 10 µL of bacterial suspension standardized at 0.5 on the McFarland scale was inoculated. The plates were incubated at 37 °C for 24 h. *Staphylococcus aureus* (ATCC and field strains) was completely inhibited at both concentrations tested. *Salmonella* Typhimurium (ATCC 14028 and L14A) and *Salmonella* Heidelberg were inhibited only at 10% concentration. *Listeria monocytogenes* ATCC 19111 was eliminated at both concentrations. The geopropolis of *Melipona quadrifasciata* demonstrated relevant antimicrobial activity against bacteria of importance in FBDs, particularly *S. aureus* and *L. monocytogenes*. The results suggest the potential use of geopropolis as an auxiliary agent in microbiological control, contributing to food safety and the fight against bacterial resistance.

5.20. Evaluation of the Neuroprotective Activities in Gaba-Producing Potential Probiotic Strains from Indigenous Fermented Foods

Souparno Paul [1], Sayani Banerjee [2], Sugato Banerjee [2] and Gunjan Goel [1]

[1] Department of Microbiology, Central University of Haryana, Jant-Pali, Mahendragarh, Haryana 123031, India
[2] Department of Pharmacology and Toxicology, National Institute of Pharmaceutical Education and Research, Kolkata, West Bengal 700054, India

Recent research focuses on developing GABA (γ-aminobutyric acid)-producing psychobiotic strains that can positively influence mental health by modulating the gut–brain axis (GBA) through restoration of stress-induced gut dysbiosis and inflammation. This study evaluated the GABA-producing strain *Limosilactobacillus fermentum* PB02, isolated from traditional Indian fermented foods, for its activity against lipopolysaccharide (LPS)- and glucose-induced oxidative stress, as well as glutamate-induced toxicity in SH-SY5Y neuronal cell lines. The de Man, Rogosa, and Sharpe (MRS) medium supplemented with 2% monosodium glutamate (MSG) at 37 °C for 72 h was identified as the optimal condition for GABA production, confirmed using ^{1}H Nuclear Magnetic Resonance (NMR) and mass spectrometric analyses. The metabolites produced included GABA, along with other important precursors of neurotransmitters such as phenylalanine and L-tyrosine. The strain exhibited key desirable probiotic properties, including non-haemolytic activity, acidic pH tolerance, high bile tolerance (up to 1% bile salts), adhesion to hydrocarbons, and 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging activity. The cell-free supernatant (CFS) of the isolate provided 79.2 ± 4.87% protection against LPS, 70.1 ± 2.77% protection against glucose-induced stress, and 84.47 ± 3.86% protection against glutamate-induced toxicity in the SH-SY5Y neural cell line model, validated by means of Live/Dead cell imaging. The

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IC_{50} values for LPS and high glucose were 200 mM and 1.5 µg/mL, respectively. The strain *Limosilactobacillus fermentum* PB02 (GenBank accession number PQ555695) has the potential to reduce glutamate toxicity by increasing GABA levels, modulating GABAergic signalling, and influencing the GBA. Our findings suggest that this strain offers moderate-to-high neuroprotection and could be explored further as a potential psychobiotic after evaluation in a depression-induced animal model.

5.21. Genome-Guided Valorization of Soy Sauce Cake Using a Novel Halophilic Mesobacillus sp. Strain LC4

Ivan Kai Jie Lim [1], Esther Zhe Hui Chong [2], Chun Shiong Chong [3], Ming Quan Lam [4,5] and Kah Yaw Ee [1,5]

1 Department of Agricultural and Food Science, Faculty of Science, Universiti Tunku Abdul Rahman, Jalan Universiti, Bandar Barat, Kampar 31900, Perak, Malaysia
2 Bidor Kwong Heng Sdn. Bhd., Plot 1919, Kawasan Perusahaan Bidor, Bidor 35500, Perak, Malaysia
3 Department of Biosciences, Faculty of Science, Universiti Teknologi Malaysia, Skudai 81310, Johor, Malaysia
4 Department of Biological Science, Faculty of Science, Universiti Tunku Abdul Rahman, Jalan Universiti, Bandar Barat, Kampar 31900, Perak, Malaysia
5 Centre for Agriculture and Food Research, Universiti Tunku Abdul Rahman, Jalan Universiti, Bandar Barat, Kampar 31900, Perak, Malaysia

Introduction: Soy sauce cake (SSC), a protein-rich by-product of soy sauce production, represents a largely underutilized resource, despite its significant potential for sustainable food valorization. Harnessing halophilic bacteria capable of degrading salty food waste offers a promising biotechnological route for upcycling SSC into functional ingredients.

Methods: A halophilic protease-producing bacterium, strain LC4, was isolated from mangrove sediments of Matang Mangrove Forest Reserve, Perak, Malaysia. Taxonomy analysis was conducted with phylogenetic, whole-genome analysis and in silico analyses (ANIb and dDDH) to accurately identify strain LC4. In addition, protease-encoding genes were mined from the whole-genome data of strain LC4 with InterProScan. Crude protease extracts were characterized for activity across various conditions and tested for stability. Strain LC4 was then applied in submerged fermentation of SSC, with protein hydrolysis and peptide production measured over time.

Results: Phylogenetic and whole-genome analyses identified strain LC4 as a novel species within the *Mesobacillus* genus, with ANIb (95%) and dDDH (70%) values. Genome mining revealed 25 extracellular protease-encoding genes, comprising serine and metallo-proteases. The identified proteases displayed halophilic and thermotolerant characteristics, with optimal performance at 40–60 °C, pH 8, and 4–8% (*w*/*v*) NaCl. Enzymes maintained stability in the presence of $Ca^{2+}$and Al^{3+} ions, highlighting their industrial potential. Strain LC4 was subsequently applied for SSC biodegradation. Submerged fermentation of SSC resulted in significant protein hydrolysis (5.16 mg/g dry SSC) within 24 h and peptide production (0.63 mg/g dry SSC) after 72 h. The results demonstrate the potential of strain LC4 to convert protein-rich high-salt food waste into functional peptides.

Conclusions: *Mesobacillus* sp. strain LC4 offers a sustainable approach to upcycling SSC into bioactive peptides. The integration of genomic analysis and wet-lab validation highlights its potential as an efficient biocatalyst, contributing to circular economy efforts and advancing food waste bioprocessing for nutraceutical applications.

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5.22. Genomic Surveillance of Listeria monocytogenes in Argentina: Analysis of Cases and Isolates, 2023–2024

Ariel Gianecini, Lucila Cipolla, Tomás Poklepovich, Paula Etcheverry, Florencia Rocca and Mónica Prieto

Special Bacteriology Laboratory, Bacteriology Department, National Institute of Infectious Diseases, Ciudad Autónoma de Buenos Aires C1282AFF, Argentina

In vulnerable individuals, *Listeria monocytogenes* can cause invasive listeriosis, a severe foodborne infection with 20–30% mortality. Case notification to the National Health Surveillance System (SNVS) combined with whole-genome sequencing (WGS) enhances surveillance and source identification. This study evaluated listeriosis cases and the genomic relationships of isolates in Argentina identified from 2023 to 2024.

All twenty-five consecutive cases of listeriosis, a nationally notifiable disease, along with their corresponding isolates referred to the National Reference Laboratory between 2023 and 2024, were analyzed. The patients' demographic data, medical history, and outcomes were obtained from the SNVS. The sequence types (STs), clonal complexes (CCs), and relationships between the isolates were determined through WGS using the Nextera XT DNA library preparation kit and the Illumina MiSeq Platform.

Women comprised 60% of the cases and men comprisedd 40%. The patient's medical history was documented in 56% of cases, including whether they were pregnant (n = 9), non-HIV-immunocompromised (n = 4), or transplant recipients (n = 1). Fetal loss occurred in 33.3% of pregnancies. The isolation sites included the blood (n = 13), cerebrospinal fluid (n = 6), and placenta (n = 6). The outcomes were unknown in 60% of cases, while patients were cured/improved in 24% and died in 16%. Four genomic clusters were identified: three associated with hypervirulent CC1 (ST1) and one with CC59 (ST59). Two clusters, CC1 (n = 5) and CC59 (n = 3), were identified in three provinces. No food sources were identified.

The low amount of documented outcomes (40%) and missing medical history (44%) highlight the need for strengthened SNVS notification to better understand the disease burden and identify key populations at risk. Genomic clusters were detected without food source identification. Incorporating food surveys and systematic isolate referral will improve our consumption pattern knowledge and allow for epidemiological investigations for source identification.

5.23. GenoPheno4Trait Project—Genomic and Phenotypic Traits Contributing to Persistence of Listeria monocytogenes in Food Processing Environment

Rui Magalhães [1], Lucia Noronha [2], Ana Sousa [2] and Paula Teixeira [1]

[1] CBQF—Centro de Biotecnologia e Química Fina—Laboratório Associado, Escola Superior de Biotecnologia, Universidade Católica Portuguesa, Rua de Diogo Botelho 1327, 4169-005 Porto, Portugal

[2] Associação Colab4Food—Laboratório Colaborativo para Inovação da Indústria Alimentar, Rua dos Lagidos, 4485-655 Vairão, Portugal

Listeria monocytogenes is a major foodborne pathogen, responsible for the highest mortality rates due to contaminated food and for frequent product recalls, contributing to significant economic losses and food waste. Persistent Listeria strains, which can survive for extended periods in food processing environments (FPEs), are particularly challenging to control. However, the specific traits that enable this persistence remain poorly understood. The GenoPhenoTraits4Persistence project aims to reduce food contamination with Listeria by identifying the genetic and phenotypic traits associated with persistence. A unique collection of 1000 *L. monocytogenes* isolates, already sequenced through Whole Genome

Sequencing (WGS), will serve as the basis for comparing persistent and sporadic strains. These comparisons will include tolerance to environmental stresses commonly found in FPEs (low temperatures, acidity, salt, disinfectants, phages, and desiccation), as well as the formation of persister cells—a potential mechanism for survival under stress. Importantly, this project introduces metabolomic profiling as a novel strategy to discover biomarkers for persistence, an approach not previously applied in this context. The integration of genomics, stress phenotyping, and metabolomics represents a disruptive and innovative methodology in Listeria research. Led by a multidisciplinary team, this project will significantly advance our understanding of *Listeria* persistence and support the development of targeted control strategies. The outcomes will contribute to improving food safety and reducing food waste, aligning with national and international priorities in food quality and safety and with the United Nations Sustainable Development Goals.

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5.24. Identification and Characterization of Phage-Susceptible Bacillus subtilis Strains Isolated from Thua Nao

Ekachai Chukeatirote and Poosanisa Chia

School of Science, Mae Fah Luang University, Chiang Rai 57100, Thailand

Bacillus subtilis bacteria have been described as an important starter culture in fermented soybean foods. An earlier study isolated a lytic BasuTN3 bacteriophage effective against the *B. subtilis* strain TN3 isolated from Thua Nao, a Thai fermented soybean product. The bacteriophage infection is a persistent threat that can cause delayed or failed fermentations. In the present study, four bacterial strains (TN3, DM1-2, and FM2-3 isolated from Thua Nao, and ASA from Natto)—which could be considered as potential inocula for Thua Nao fermentation based on their relative index values of protease activity—are vulnerable to the BasuTN3 phage, as demonstrated by the double layer assay. These four strains were then phenotypically and genotypically characterized; these included morphology, biochemical assays (e.g., IMViC test), fermentation of carbohydrates using API 50 CHB, and 16S rRNA gene sequence. These four bacterial isolates were rod-shaped, endospore-forming, Gram-positive bacteria. Based on the biochemical assays, all isolates exhibited similar profiles (not identical). Further molecular analysis using the 16S rRNA gene sequence revealed that they belonged to a distinct group of *B. subtilis*. It should be noted, however, that these four strains were distinct based on their overall characteristics, which could be considered as 'strain-dependent'. The results of the present work are expected to be useful for comparative purposes of the key characteristics (both phenotypic and genotypic) among the closely related Bacillus strains. These data would be useful for future screening and isolation of the bacterial inocula.

5.25. In Silico Characterization of Bacillus Protease Enzymes

Nuttachat Wisittipanit, Chutipon Joralee and Ekachai Chukeatirote

School of Science, Mae Fah Luang University, Chiang Rai 57100, Thailand

Proteases from Bacillus species are of significant industrial and biotechnological interest due to their diverse applications. This study focused on the in silico characterization of Bacillus protease enzymes to elucidate their physicochemical properties and to establish a classification framework based on computational analyses. Initially, a comprehensive dataset of 100 Bacillus protease sequences, categorized into 6 groups—(1) metalloprotease, (2) serine protease, (3) cysteine protease, (4) glutamic protease, (5) aspartic protease, and (6) threonine protease—were retrieved from the GenBank database and were then subjected to analysis using various bioinformatics tools (e.g., ProtParam, Pfam, and MEME) to

characterize their key features, including their number of amino acid residues, amino acid composition, number of positive/negative charges, molecular weight, theoretical isoelectric point (pI), extinction coefficient, instability index, aliphatic index, and grand average of hydropathicity (GRAVY). Moreover, phylogenetic analysis and comparative sequence analysis were employed to investigate evolutionary relationships and identify conserved motifs, facilitating the categorization of these proteases into distinct groups. The in silico approach enabled the rapid prediction of diverse physicochemical characteristics, revealing significant variations among different Bacillus proteases. The resulting classification provided a systematic understanding of their potential functionalities and optimal operational conditions. These findings offer valuable insights for selecting or engineering Bacillus proteases with desired traits for specific industrial or research applications, streamlining the traditional experimental characterization process. In particular, understanding these enzymes' properties can aid in identifying candidates suitable for food microbiology applications, such as fermentation, protein hydrolysis, and food preservation, where tailored protease activity is critical.

5.26. Innovative Technological Potential of Lachancea thermotolerans in the Fermentation of Table Olives

Patricia Gil-Flores and Joaquín Bautista-Gallego

Department of Biomedical Sciences, Faculty of Science, University of Extremadura, 06006 Badajoz, Spain

Table olives are one of the most widely consumed fermented vegetables, with strong consumer acceptance. While their global production is widespread, cultivation is mainly concentrated in Mediterranean countries such as Spain, Italy, and Greece. However, the industry faces persistent challenges, particularly the low survival rate of commercial starter cultures during early fermentation. This has prompted a search for novel microorganisms with high biotechnological potential. Among them, *Lachancea thermotolerans* (*Lt*) stands out for its acidification capacity and beneficial interactions with lactic acid bacteria (LAB).

In this context, this study evaluated the technological potential of a collection of *Lt* strains. Initially, their acidification capacity was assessed in different culture media. Additional traits such as salt and low pH tolerance were also measured. The best-performing strains were then selected for co-culture studies with *Lactiplantibacillus plantarum* (Lp) strains. To evaluate the microbial interactions, biofilm formation was assessed on abiotic surfaces. Several *Lt–Lp* consortia significantly improved biofilm development compared to monocultures. These enhanced biofilms were further examined using scanning electron microscopy to understand structural interactions.

Selected *Lt* strains were then used in fermentations of Spanish-style green table olives, followed by inoculation with a reference *Lp* strain. In all fermenters, *Lt* successfully dominated the early stages, accelerating acidification and enabling rapid LAB growth. Final packaged olives fermented with two selected *Lt* strains received the highest sensory scores, confirming their positive impact on product quality.

In summary, *Lt* shows strong potential as a table olive starter culture, capable of forming stable, efficient microbial consortia and improving the sensory and microbiological quality of table olives.

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5.27. Integrated Metabolic Profiling Uncovers the Stress Adaptation Network of Saccharomyces boulardii Under Gastrointestinal Stress

Dingkang Wang

School of Public Health, Xi'an Jiaotong University, Xi'an 710061, China

The probiotic yeast Saccharomyces boulardii exhibits remarkable tolerance to gastrointestinal stress conditions, yet the specific metabolic adaptations enabling this resilience remain incompletely characterized. In the present study, we employed comprehensive LC-MS-based metabolomic profiling to investigate S. boulardii's dynamic metabolic responses to simulated gastric fluid (SGF), intestinal fluid (SIF), and sequential SGF-SIF exposure. Our systematic analysis revealed that organic acids, lipids, and organoheterocyclic compounds constituted the predominant metabolic classes affected by gastrointestinal stress, with carboxylic acids and their derivatives representing the most significantly altered subclass. Notably, intestinal fluid exposure induced the most profound metabolic perturbations, resulting in quantitative changes to 2029 distinct metabolites, including 1008 upregulated and 1021 downregulated species. A detailed pathway analysis (KEGG) demonstrated significant activation of purine/pyrimidine metabolism and amino sugar/nucleotide sugar biosynthesis pathways, which are fundamentally important for maintaining cellular energy status and cell wall integrity during stress exposure. Conversely, tyrosine metabolism and taurine-related pathways showed marked downregulation, suggesting potential metabolic trade-offs during stress adaptation. Through an advanced correlation network analysis, we identified Parisvanioside A and specific glyceryl phosphatides as key metabolites positively associated with stress tolerance, while valorphin and D-glucosamine exhibited substantial depletion under stress conditions. These findings provide compelling evidence for S. boulardii's metabolic flexibility during gastrointestinal transit and reveal specific molecular targets for probiotic optimization. The identified metabolic signatures suggest promising strategies for enhancing probiotic viability, including targeted metabolite stabilization or nutritional supplementation approaches during gastrointestinal passage.

5.28. Microalgae Oils Mitigate Inflammation and Oxidative Stress Triggered by Helicobacter pylori Infection

Laura Alonso Pintre, Pilar Gómez-Cortés, Blanca Hernández-Ledesma, Jose Manuel Silvan and Adolfo Jose Martinez-Rodriguez

Institute of Food Science Research (CIAL, CSIC-UAM, CEI UAM + CSIC), Nicolás Cabrera 9, 28049 Madrid, Spain

Helicobacter pylori (*H. pylori*) is one of the most prevalent pathogenic bacteria worldwide, infecting over 50% of the global population. Its infection is linked to oxidative stress and chronic inflammation. Although antibiotic-based eradication therapy is the standard treatment, rising antibiotic resistance and the adverse effects associated with these drugs underscore the need for alternative therapeutic approaches.

Microalgae have gained attention due to their adaptability, sustainability, and high nutritional value, as well as their potential health benefits. This study aimed to evaluate the antioxidant, anti-inflammatory, and antibacterial properties of lipid extracts from various microalgae species (*Chlorella vulgaris*, *Nannochloropsis gaditana*, *Arthrospira platensis* and *Tetraselmis chuii*) against *H. pylori* infection. Oils were obtained from pretreated microalgal biomass, using freeze–thaw cycles and ultrasounds. The protective effects against *H. pylori*-induced oxidative stress and inflammation were evaluated in an infected human gastric cell model by measuring reactive oxygen species (ROS) and interleukin-8 (IL-8) levels. Additionally, antioxidant activity was assessed using DPPH and ABTS assays. Antibacterial effects were determined by quantifying *H. pylori* colony-forming units (CFU).

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The lipid extracts demonstrated protective effects against *H. pylori*-induced oxidative stress and cellular inflammation. Furthermore, the microalgae oils exhibited direct antibacterial activity against *H. pylori*, with *Nannochloropsis gaditana* having the greatest effect. The lipid extracts also exhibited strong in vitro radical-scavenging activity and *Chlorella vulgaris* showed the highest potency. These findings suggest that microalgae oils could serve as a promising therapeutic strategy to combat *H. pylori* infection and its associated symptoms.

5.29. Microbiological Evaluation of Stingless Bee Honey from Four Different Species

Elisana Julek [1,2], Artur Silva Ruschel [2], Vitória Furquim Nascimento [2], Barbara Kornin Gabardo [2], Bruno Ariel Furtado Miranda [1,2], Milena Gabrielle de Jesus [2], Lorena Lima Ludovico [2], Kauã Colaço Schier [2], Andreia Bueno da Silva [2], Fabio Sossai Possebon [3], Tomaz Longhi Santos [4] and Julia Arantes Galvão [1,2]

1 Post-Graduation Program in Veterinary Sciences, Federal University of Paraná, Curitiba/Paraná 80035-050, Brazil
2 Quality Control and Food Safety Laboratory, Federal University of Paraná, Curitiba/Paraná 81531-970, Brazil
3 Instituto de Biotecnologia, Universidade Estadual Paulista Júlio de Mesquita Filho, Saint Paul 01049-010, Brazil
4 Post-Graduation Program in Environment, the Federal University of Paraná, Curitiba/Paraná 80035-050, Brazil

Stingless bee honey (SB) is naturally more fluid and has higher water activity than *Apis mellifera* honey, which favors the presence of microorganisms. Studies on honey from different SB species are essential, as behavioral variability among Brazil's more than 300 species can directly influence the microorganisms present in the product. This study evaluated the microbiological profile of ten honey samples from different stingless bee species collected in rural areas: *Tetragonisca angustula* (A), *Melipona bicolor* (B and C), *Melipona marginata marginata* (D, E, and F), and *Melipona quadrifasciata quadrifasciata* (G, H, I, and J), testing for coliforms, *Salmonella* spp., lactic acid bacteria (LAB), mesophilic microorganisms (MM), yeasts, and fungi. All samples showed 3 MPN/mL for coliforms, were negative for *Salmonella* spp., and demonstrated $\leq$1 log CFU/mL of fungi. MM colony counts ranged from 3.40 to 5.28 log CFU/mL, reflecting contamination or the product's own microbiota, potentially characterized by LAB (counts from 3 to 4.40). The lowest count (absence of cells) occurred in the only sample refrigerated by the producer. The highest microorganism count corresponded to the lowest yeast concentration, which ranged from 3.28 to 6.31 log CFU/mL. Values above 10^4 CFU/g, the limit set by Paraná state legislation, may indicate issues in hive management or the natural microbiota accompanying the product. Yeasts can be considered intrinsic to the product, as they are introduced through the bees' natural foraging behavior and may be used to feed larvae. Accurate identification of these yeasts may be valuable for assessing whether their presence poses real risks to consumers, thus ensuring product safety. The observed microbiological diversity may be linked to variations in bees' foraging behaviors and the physicochemical characteristics of the honeys. A higher acidity, a feature of this type of honey, may create an unfavorable environment for the survival of certain pathogenic microorganisms.

5.30. Microbiological Quality of Dehydrated Pig and Cattle Ears Commercialized as Dog Treats in Curitiba, Brazil

Maria Rosa Aparecida Nunes de Oliveira, Elisana Julek and Julia Arantes Galvão

Quality Control and Food Safety Laboratory, Veterinary Department, Campus Cabral, Federal University of Parana, Curitiba 80035-050, PR, Brazil

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The growing canine population in urban centers, such as Curitiba, Brazil—where there is approximately one dog for every three residents—has led to an increased demand for pet treats, including dehydrated animal by-products. While these products are widely accepted by pet owners, their microbiological quality remains underexplored, posing potential health risks to both animals and humans. This study aimed to evaluate the microbiological safety of dehydrated pig and cattle ears sold as dog treats. Twenty samples (10 bovine and 10 porcine ears) were collected from four commercial brands, grouped into four sets of five samples each from the same production batch. All samples were within the expiration date, with intact packaging and no visible alterations. Microbiological analyses were performed at the Quality Control and Food Safety Laboratory of the Federal University of Paraná, focusing on the enumeration of Total Coliforms, Thermotolerant Coliforms, yeasts, and molds. In 50% of the samples, none of the targeted microorganisms were detected. However, Total Coliforms were present in 25% (5/20), Thermotolerant Coliforms in 10% (2/20), and Molds and Yeasts in 35% (7/20) of the products. Contamination levels varied across brands but were found in both bovine and porcine samples. The presence of indicator microorganisms highlights the need for improved hygienic practices in the production and handling of these products. Such contamination poses not only a risk to animal health but also to human health through potential cross-contamination. The findings emphasize the importance of microbiological monitoring of pet treats to ensure food safety within a One Health framework.

5.31. Postharvest Mycotoxin Contamination in Maize: Microbiological Insights from Ghana

Lydia Bemah

Graduate School of Education, Nazarbayev University, Astana 001000, Kazakhstan

Maize is a key staple crop in Ghana, essential for household food security. However, postharvest handling and storage practices make maize highly susceptible to fungal infestation and subsequent mycotoxin contamination. Mycotoxins, particularly aflatoxins and fumonisins, pose significant health risks, including liver cancer, immune suppression, and stunted growth. This study investigates the microbial causes and contributing factors of mycotoxin contamination in stored maize, with the aim of identifying food safety risks in typical Ghanaian storage environments.

The study involved the collection of maize samples from 60 farmers across five rural communities in the Eastern and Ashanti regions of Ghana. Fungal species were isolated and identified using standard pour plate and serial dilution methods on Potato Dextrose Agar (PDA), incubated at 25–28 °C for 5–7 days.

Moisture content, temperature, and storage conditions were also recorded and analysed to assess their correlation with fungal presence and mycotoxin production.

Preliminary results revealed a high incidence of *Aspergillus flavus* and *Fusarium verticillioides*, with aflatoxin B1 and fumonisin B1 as the most common toxins detected.

Poor ventilation, high humidity, and traditional storage methods were strongly associated with higher fungal loads and mycotoxin levels. These findings confirm that postharvest practices significantly influence microbial contamination and toxin accumulation.

In conclusion, this study highlights the urgent need for improved postharvest management and mycotoxin monitoring in Ghana. By applying a food microbiology approach, the research provides valuable insight into the fungal ecology of stored maize and offers practical recommendations for farmers and policymakers. The results support national and regional efforts to enhance food safety, reduce postharvest losses, and protect public health in maize-dependent communities.

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5.32. Proteolytic Activity of Geotrichum candidum Isolated from Natural Bloomy Rind Artisanal Minas Cheese

Miriam Aparecida de Aguilar Santos [1], Kelly Aparecida da Cunha Pereira [2] and Luís Roberto Batista [2]

[1] Department of Food Science, University of Lavras (UFLA), Lavras 37203-646, Brazil
[2] Department of Agricultural Microbiology, University of Lavras (UFLA), Lavras 37203-646, Brazil

Geotrichum candidum is a fungus that is commonly associated with dairy products and plays an important role in the ripening of Natural Bloomy Rind Artisanal Minas Cheese (NBRAMC), where it is naturally predominant. *G. candidum* is linked to proteolysis and is responsible for the production of many compounds that are essential for flavor and aroma. Thus, this study aimed to evaluate the proteolytic capacity of *G. candidum* strains exhibiting distinct phenotypic characteristics and isolated from NBRAMC and the environment. Five strains were isolated from Artisanal Minas Cheese, and one was obtained from the wild environment. Qualitative evaluation of protease activity in the different *G. candidum* strains was performed using skim milk agar tubes. A volume of 6 µL of spore suspension at a concentration of 10^5 spores/mL was inoculated into the agar, followed by incubation at 25 °C for 22 days. Proteolytic activity was assessed by measuring the length of the transparent region beneath the colony, resulting from the hydrolysis of milk proteins. *Penicillium roqueforti* and a non-identified bacterium isolated from milk were used as positive controls. Analysis of variance and Tukey's test ($p < 0.05$) were performed using Sisvar software. Protease activity was found to vary among the *G. candidum* strains. Five out of six strains produced clear zones of different lengths, although all were smaller than those observed for the positive controls, *P. roqueforti* and the bacterium, at 48.7 mm and 52.7 mm, respectively. Notably, the *G. candidum* strain isolated from the environment was among those with the highest proteolytic activity, with lengths ranging from 17.7 mm to 23.3 mm. These findings highlight the intraspecific variability of *G. candidum*. This variability may explain the diversity of sensory profiles observed in NBRAMC, a cheese whose production relies on the natural, uninoculated development of *G. candidum*, which is not controlled during the process.

5.33. Spontaneously Fermented Foods as Reservoirs of Probiotic Microorganisms: Tradition Meets Functionality

Natalija Atanasova-Pancevska and Sofija Kostandinovska

Department of Microbiology and Microbial Biotechnology, Institute of Biology, Faculty of Natural Sciences and Mathematics–Skopje, Ss. Cyril and Methodius University in Skopje, Lazar Pop-Trajkov 5–7, 1000 Skopje, North Macedonia

Spontaneous fermentation, a traditional preservation method rooted in cultural heritage, is increasingly recognized as a valuable source of probiotic microorganisms with functional health benefits. Unlike industrial fermentations that rely on standardized starter cultures, spontaneous processes rely on the native microbial consortia naturally present in raw materials, processing environments, and artisanal practices. These dynamic ecosystems often harbor strains of *Lactobacillus* spp., *Leuconostoc* spp., *Pediococcus* spp., *Bifidobacterium* spp., and yeasts with potential probiotic functions.

This paper explores the microbial diversity and probiotic potential of spontaneously fermented foods, with a focus on lactic acid bacteria and yeasts capable of surviving gastrointestinal transit, exerting antimicrobial activity, and modulating gut health.

As a source of microorganisms, we use sauerkraut and pickled vegetables because these products act not only as nutritious staples but also as functional carriers of benefi-

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cial microbes, many of which demonstrate resilience to gastrointestinal conditions and possess antimicrobial, enzymatic, and bioactive properties. The interactions among microbial populations generate bioactive compounds (e.g., organic acids, bacteriocins, and exopolysaccharides) that enhance food safety, shelf life, sensory profiles, and, most importantly, confer potential health effects such as gut microbiota modulation, immune support, and inhibition of pathogens.

Furthermore, we discuss the ecological dynamics of spontaneous fermentation, including microbial succession, interspecies interactions, and metabolite production, that enhance sensory and health-related traits. Emphasis is placed on recent research that characterizes and isolates novel probiotic strains from traditional ferments, offering new avenues for functional food development and microbiome-targeted interventions.

Spontaneously fermented foods thus represent not only gastronomic and cultural treasures, but also untapped microbial reservoirs that align with the global demand for sustainable, health-promoting nutrition. Their integration into functional food development may unlock new pathways for microbiome-friendly diets rooted in time-tested practices. This paper aims to bridge traditional knowledge with modern science, emphasizing the need for preserving microbial biodiversity while embracing innovation.

5.34. Spontaneously Fermented Products—Microbial Reservoir for Isolating New Potential Probiotic Yeast Strains

Viorica Maria Corbu and Ortansa Csutak

1 Department of Genetics, Faculty of Biology, University of Bucharest, 060101 Bucharest, Romania
2 Center for Research, Training and Consultancy in Microbiology, Genetics and Biotechnology MICROGEN, no1-3, 060101 Bucharest, Romania
3 Research Institute, University of Bucharest (ICUB), B.P Hasdeu 7, 050568 Bucharest, Romania

The growing interest of consumers in minimally processed and health-promoting foods prompts researchers to find alternative probiotics, especially yeast strains, that are able to withstand industrial and gastrointestinal stress, are not associated with horizontal gene transfer of antibiotic resistance and display broad environmental tolerance.

Our study aims at determining the probiotic potential of nine newly identified yeast strains isolated from household spontaneously fermented food products (pickled cucumbers, homemade borscht, wine wort and pickled cabbage in brine) from the Bucharest-Ilfov region, Romania. The taxonomic identification using PCR-RFLP and ITS1-5.8S-ITS2 rDNA sequencing showed that the yeast isolates belong to *Saccharomyces*, *Torulaspora*, *Debaryomyces* and *Metschinikowia* genera. The safety profiling was performed by screening for the production of extracellular enzymes known to damage human cells, including hemolysins, gelatinases, caseinases, DNases, amylases and phospholipases. None of the strains produced all the tested enzymes, suggesting an acceptable safety profile. Functional characterization revealed promising probiotic traits: wine wort isolates showed strong auto-aggregation (up to 75%) and hydrophobicity (up to 80%), which indicates good adhesion potential. The strains from brine-based products exhibited high tolerance to bile salts, while those from borscht and wine wort tolerated low pH (pH 2) and showed increased biomass production in the presence of pancreatic enzymes. Antimicrobial activity was observed for the strains *Debaryomyces hansenii* V I and *Torulaspora delbrueckii* III 2 based on the production of killer toxins which were effective against common foodborne pathogens and clinically relevant *Candida* strains. Additionally, *Metschinikowia pulcherrima* M3 showed high antimicrobial potential via iron competition, inhibiting food spoilage microorganisms.

The results highlight the untapped potential of naturally fermented foods as an isolation source for potential probiotic yeasts. The nine newly characterized yeast strains exhibit

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key probiotic traits, recommending them as promising candidates for further testing for the development of functional food products.

5.35. The In Vitro Bioactive Properties of Fermented Brewer's Spent Grain with Lactiplantibacillus plantarum: Aerobic vs. Anaerobic Processes

Quoc Minh Ha [1,2], Victor Rimbault [1], Phuc Hanh Nguyen [1], Mathilde Berthevas [1], Maryam Ghamsary [1], Eileen Kitundu [1], Rothman Kam [1,2], Brent Seale [1,2], Claus Henier Bang-Berthelsen [3] and Thao Le [1,2]

1 AUT Centre for Future Foods, Auckland University of Technology, Auckland 1010, New Zealand
2 School of Science, Auckland University of Technology, Auckland 1010, New Zealand
3 National Institute for Food, Technical University of Denmark, 2800 Kongens Lyngby, Denmark

Introduction: Fermentation offers a sustainable method to convert food by-products into valuable resources. This study explored the *Lactiplantibacillus plantarum (L. plantarum)* fermentation of brewer's spent grain (BSG), a major by-product from blonde wheat (WB) and stout beer (SB) production. This study compared aerobic and anaerobic fermentation conditions to enhance BSG's bioactive properties.

Methods: BSG from WB and SB was fermented with L. plantarum under aerobic and anaerobic conditions for 10 days, with non-fermented BSG as a control. Extracts, collected every two days, were evaluated for in vitro bioactivities: antioxidant capacity (ferric ion reducing antioxidant power (FRAP) and DPPH assays), antimicrobial effects (against *Staphylococcus aureus*, *Escherichia coli*, and *Bacillus cereus*), anti-obesity potential (anti-lipase activity), and cytotoxicity on RAW 264.7 macrophages. Ex vivo antibacterial activity was assessed on wheat- and milk-based food products.

Results: Fermentation significantly enhanced BSG bioactivities compared to non-fermented controls, with distinct outcomes varying by condition. Anaerobic fermentation doubled antioxidant activity in WB and SB extracts by Day 6 compared to aerobic conditions. Aerobic fermentation showed superior antimicrobial activity, fully inhibiting *Bacillus cereus* at 83.3 mg/mL (vs. 166.6 mg/mL under anaerobic conditions, Day 6), and stronger anti-obesity effects, with IC_{50} values of 8.6 mg orlistat equivalents (OE)/g (WB) and 6.6 mg OE/g (SB) on Day 8. Ex vivo assays confirmed antimicrobial effects, with wheat-based media requiring lower concentrations (0.042 mg/mL) than milk-based media (333.3 mg/mL). Cytotoxicity assays indicated no toxicity, with both conditions promoting macrophage proliferation.

Conclusions: Fermentation with L. plantarum significantly enhances BSG's bioactivity. Anaerobic conditions optimise antioxidant properties, while aerobic conditions favour antimicrobial and anti-obesity effects. These findings suggest fermented BSG's potential for food preservation and health-promoting applications.

6. Session E: Chemistry and Physicochemical Properties

6.1. Comparative Analysis of Nutritional and Sensory Quality of Gluten-Free Doughnuts Prepared from Corn, Millet, and Sorghum Flours

Jerry Ampofo-Asiama [1], Nazir Kizzie-Hayford [1], Rosemond Godbless Dadzie [2], Vivianne Geraldo [1], Bernice Hayford [1] and Godfred Inkoom [2]

1 Department of Biochemistry, School of Biological Sciences, University of Cape Coast, Cape Coast 0331, Ghana
2 Department of Agricultural Engineering, School of Agriculture, University of Cape Coast, Cape Coast 0331, Ghana

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The demand for gluten-free products has increased globally, necessitating research into available gluten-free flours for the preparation of pastries and other baked foods that meet the nutritional, health, and sensory needs of consumers. In this study, we investigated the tropical cereals, corn, millet and sorghum, as viable alternatives for the preparation of gluten-free foods by comparing the nutritional and functional properties of their flours and the sensory acceptability of the resulting doughnuts. Proximate composition analysis revealed the highest values of ash and fibre for corn flour, while millet had the highest protein and fat. Additionally, no differences were observed in the pH and total soluble solids content, although the highest and lowest whiteness index was observed for corn and sorghum flours, respectively. Further, corn flour had the highest water absorption capacity, while millet had the highest swelling power. Analysis of textural properties of doughnuts prepared from the flours showed that the sorghum doughnut had the highest hardness, gumminess, and chewiness. Among the attributes that were used to describe the doughnut by the sensory panelists included *firm* and *brown* for sorghum doughnuts; *golden*, *creamy*, and *grainy* for corn doughnuts; and *fluffy*, *sweet*, and *dense* for millet doughnuts. Overall, millet doughnuts had the highest acceptability score, showing the potential of this flour for use in the preparation of gluten-free doughnuts and other pastries.

6.2. Proximate Composition and Physicochemical Properties of Matoa (Pometia pinnata) Seed and Seed Oil

Yanty Noorzianna Abdul Manaf [1], Haryani Ariesta [2], Yunika Mayangsari [2], Chusnul Hidayat [2] and Bangun Prajanto Nusantoro [2]

[1] Halal Research Group, Faculty of Food Science and Nutrition, Universiti Malaysia Sabah Jalan UMS, Kota Kinabalu 88400, Sabah, Malaysia

[2] Faculty of Agricultural Technology, Gadjah Mada University, Yogyakarta 55281, Indonesia

Matoa (*Pometia pinnata*) trees can be found in many Asian countries. The flesh of the matoa fruit is sweet and resembles the taste of other tropical fruits (longan, lychee and rambutan). This fruit is native to Indonesia; however, the seeds are considered waste. This study aims to determine the proximate composition of Indonesian matoa seeds and the physicochemical properties of matoa seed oil. The main composition of matoa seeds was moisture, carbohydrates, fiber and fat. The oil of dried matoa seeds was obtained through maceration extraction using n-hexane as a solvent. The oil extraction process was performed in a water bath shaker at 28 °C for 24 h. The oil yield of matoa seeds was 22.43%, with a yellowish-green colour and a liquid state at ambient temperature. The physicochemical propertiesof oil, such as the refractive index (1.46), unsaponifiable matter (3.52%), slip melting point (26 °C), smoke point (149.50 °C), iodine (46.09 g iodine/100 g oil) and saponification (144.41 mg KOH/g) values of the oil, were investigated. The acid (1.68 mg KOH/g), peroxide (0.97 mEq/kg), p-anisidine (0.78 mEq/kg), and totox (3.60 mEq/kg) values were also investigated to determine oil quality. Differential scanning calorimetry (DSC) thermograms of the oil displayed thermal transitions at low-temperature regions in crystallisation (below 0 °C) and melting (below 26 °C) profiles. Matoa could be a potential source of edible seeds and oil; however, intensive studies on the composition, antioxidant activity and toxicology are needed to explore the potential applications of these seeds and oil.

6.3. Intra-Species Variation in Regiospecific Distribution of Fatty Acids in Triacylglycerol (TAG), and Nutritional Indices of Cow (Bos indicus), Buffalo (Bubalus bubalis) Milk Fat

Pavel Rout

Department of Dairy Chemistry, College of Dairy Science and Food Technology, Raipur 492006, Chhattisgarh, India

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The composition and regiospecific distribution of fatty acids in TAG molecules are species-specific and vary within species. These are very important in determining milk fat's nutritional properties, impact on tissue metabolism, and functional properties affecting human health. TAG was hydrolysed by pancreatic lipase, and fatty acids were isolated by TLC separation and finally analysed using GC. Different trends were observed for the saturated and unsaturated fatty acid profiles among different species and within species, and the nutritional indices also showed significant differences between cow and buffalo milk fat. Strong species-wise variation in the sn-2 and sn-1(3) fatty acid distribution was often observed by analyzing data from across the whole year (intra-positional distribution). The mol % of saturated fatty acids at sn-2 positions was significantly ($p \leq 0.05$) higher in cow milk fat (73.49 $\pm$ 0.53), while it was significantly ($p \leq 0.05$) higher in the sn-1(3) position in buffalo milk fat (71.23 $\pm$ 1.61). On the contrary, the mol% of unsaturated fatty acids (UFAs) was significantly ($p \leq 0.05$) higher in the sn-2 position in buffalo milk fat (33.17 $\pm$ 1.16) than in cow milk fat (26.51 $\pm$ 0.84); the mol% of UFAs was significantly ($p \leq 0.05$) higher in the sn-1(3) position in cow milk fat (31.14 $\pm$ 0.1) than in buffalo milk fat (25.33 $\pm$ 0.59). A PCA analysis indicated that the sn-2-positional fatty acids were unique to each species. The MUFA and conjugated linoleic acid content were highest in the sn-2 position in buffalo milk. In buffalo milk fat, a higher amount of SFAs was converted to MUFA and PUFA, representing a higher Δ-9 desaturase index at the sn-2 position in TAG. PCA analysis also revealed differences in the sn-2- and sn-1(3)-positional distribution of TAG fatty acids in milk fat among different species. The Euclidean distance matrix of the quantitative data was also employed to group and categorize the fatty acids using heatmaps. The observed variations among various species revealed the significance of positional analysis in the characterization of milk fat from multiple species.

6.4. Chemical Composition, Antioxidant Capacity, and Volatile Profile of Laser trilobum (Kefe Cumin) Seeds Grown in Turkey

Belkis Tekguler [1], İlkay Koca [1], Hojjat Pashazadeh [2], Ali Ali Redha [3,4] and Bulent Karadeniz [5]

[1] Food Engineering Department, Engineering Faculty, Ondokuz Mayıs University, Samsun 55139, Turkey
[2] Department of Gastronomy and Culinary Arts, Art and Design Faculty, Istanbul Nisantası University, Istanbul 34398, Turkey
[3] Department of Public Health and Sport Sciences, Faculty of Health and Life Sciences, University of Exeter Medical School, University of Exeter, EX1 2LU Exeter, UK
[4] Centre for Nutrition and Food Sciences, Queensland Alliance for Agriculture and Food Innovation (QAAFI), The University of Queensland, Brisbane, QLD 4072, Australia
[5] Food Institute, TUBITAK MAM, Gebze Campus, Kocaeli 41470, Turkey

Laser trilobum (L.) Borkh., locally known as "Kefe kimyonu," is a perennial herb of the Umbelliferae family that is traditionally used in Turkey as a cumin substitute in culinary and folk medicinal applications. This study aimed to evaluate the chemical composition, antioxidant activity, and volatile compounds of ripe fruits (seeds) from *L. trilobum* plants grown in the Mersin/Adana region of the Taurus Mountains. Seven different seed samples were analyzed for their physicochemical and bioactive properties. The color values (L*, a*, b*) averaged 38.60 $\pm$ 2.65, 13.65 $\pm$ 3.47, and 1.34 $\pm$ 1.02, respectively. The seeds had a moisture content of 10.41 $\pm$ 1.16%, ash content of 10.00 $\pm$ 0.83%, crude fat content of 15.02 $\pm$ 2.55%, and crude protein content of 18.77 $\pm$ 1.32%. The total phenolic content was 7.91 $\pm$ 1.70 mg GAE/g, while the iron-reducing antioxidant power (FRAP) and DPPH radical scavenging capacity (IC_{50}) were 38.89 $\pm$ 20.97 mmol Fe^{2+}/g and 298.24 $\pm$ 88.05 µg/mL, respectively. Volatile compound profiling via solid-phase microextraction (SPME) coupled

with GC-MS revealed 20 major components, with limonene (47.99 ± 15.46%), α-pinene (19.19 ± 4.87%), and 1-cyclohexen-1-carboxaldehyde, 4-(1-methylhethenyl) (5.88 ± 2.46%) being the most abundant. This study represents one of the first comprehensive evaluations of *L. trilobum* seeds in terms of both chemical and aromatic composition. These findings suggest that *L. trilobum* seeds possess promising antioxidant properties and a rich volatile profile, supporting their potential use as a functional spice and as a natural ingredient in the cosmetic, fragrance, and pharmaceutical industries.

6.5. Physicochemical and Techno-Functional Properties of Pumpkin Seed (Cucurbita pepo Var styrica) Flour

Manuel Rojas, Marina Fernández Bravo, Juan José Burbano and María Jimena Correa

Centro de Investigación y Desarrollo en Ciencia y Tecnología de los Alimentos (CIDCA), Facultad de Ciencias Exactas, Universidad Nacional de La Plata, CIC, CONICET, 47 y 116, La Plata 1900, Argentina

The global food industry annually generates large amounts of by-products, many of which are underutilized or used only for animal feed. Recently, the circular economy approach has gained importance, focusing on transforming waste into value-added products by repurposing them as raw materials. Pumpkin seed flour (PSF) is obtained as a by-product from the milling of the press cake produced during industrial pumpkin seed oil extraction. PSF is notable for its high protein (41%) and lipid (35%) content and a moderate amount of dietary fiber (4.3%). The objective of this work was to characterize the techno-functional, physicochemical, nutritional, and microstructural properties of pumpkin seed flour. PSF showed low moisture content (5.1%) and water activity (aw = 0.523) and an intense green color with L*, a*, and b* values of 47.6, 1.1, and 21.6, respectively. Regarding the techno-functional properties, PSF presented good emulsion activity (55%), high thermal emulsion stability (51%) and good water and oil retention. On the other hand, ATR-FTIR spectra showed signals at 1744 cm^{-1}, 2923 cm^{-1}, and 2854 cm^{-1} consistent with the presence of triglycerides and phospholipids. Moreover, chromatographic analysis revealed that around 82% of the fatty acids in PSF were unsaturated; despite this, PSF showed high oxidative stability by rancimat. Finally, confocal scanning laser microscopy showed that the main components of PSF were highly interrelated and, as expected, no intact structures were observed. These results demonstrate the potential of pumpkin seed flour to be included as an ingredient in more complex matrices, which could improve its nutritional and technological properties. This, in turn, will contribute to the circular economy approach by valorizing this industrial by-product in the development of new food products.

6.6. A Comparison of the Health-Promoting Index (HPI), the Atherogenic Index (AI), and the Thrombogenic Index (TI) in Sheep's Butter Oil and Cow's Butter Oil

Badrieh Sahargahi [1], Majid Mahmoudi [1], Sattar Jamshidpour [1] and Rojan Shokoohizadeh [2]

[1] Administration of Food and Drug, Kermanshah University of Medical Sciences, Kermanshah, Iran

[2] Medicine Faculty, Shiraz University of Medical Sciences, Shiraz, Iran

Introduction: Milk-based oil is a bioactive and nutrient-rich food item, containing fat-soluble vitamins, essential fatty acids, and Rumenic Acid (RA). However, high cholesterol and saturated fatty acid levels make it challenging to consume. Some indices based on fatty acid composition have been defined to address this issue:

$HPI = (\sum(USFAs))/(\sum C12:0 + C16:0 + (4 \times C14:0))$

AI = (∑C12:0 + C16:0 + (4 × C14:0))/(∑(MUFAs + PUFAs))
TI = (∑C14:0 + C16:0 + C18:0)/(0.5∑MUFAs + 0.5∑PUFAs(n6) + 3∑PUFAs(n3) + n3/n6)

Method and materials: In this cross-sectional study, the nutritional indices of 12 sheep and 12 cows' butter oil were assessed and compared. The fatty acid composition of the oils was determined using gas chromatography after direct trans-esterification. The calculations of the HPI, AI, and TI were carried out using statistical tests in SPSS software.

Results: The study revealed that cow's butter oil had a higher HPI mean of 0.40 ± 0.03 than sheep's butter oil, which had a mean of 0.35 ± 0.28 ($p < 0.001$). Additionally, the cow's butter oil had a lower AI mean of 1.96 ± 0.26 compared to the sheep's butter oil, which had a mean of 2.42 ± 0.33 ($p < 0.001$). Lastly, the TI was 2.78 ± 0.26 in cow's butter oil vs. 2.96 ± 0.25 in sheep's butter oil ($p < 0.064$).

Conclusions: It appears that, based on the indices for assessing the nutritional value and consumer health benefits of animal fat, cow's butter oil may be better than sheep's butter oil for human nutrition. However, further clinical trial studies are recommended to investigate the effects of butter oil on the Partial Thromboplastin Time (PTT) test and Atherogenic Indices of Plasma in both animal and human models.

6.7. Characterising the Nutritional and Physicochemical Properties and Lipase and Lipoxygenase Activity of Fermented KABULI Chickpea (Cicer arietinum L.) Flours and the Sensory Properties of Plant Cheese Formulated from These Ingredients

Sophia Antoniello and Marcia English

Department of Human Nutrition, St. Francis Xavier University, Antigonish B2G2W5, NS, Canada

Pulses are key sources of protein that are linked to sustainable food systems; however, the presence of anti-nutrients and off-flavors limits their widespread applications. Here, we used *Lactiplantibacillus plantarum* (ATCC 533) and *Lactobacillus acidophilus* (ATCC 356) to ferment whole chickpeas (*Cicer arietinum* L.) over a 9 h period and assessed the impact of this pre-treatment on the nutritional and physicochemical properties and flavour profiles of the flour samples generated. The impact of lipoxygenase (LOX) and lipase activities on their 'beany' off-flavour profiles was also evaluated. Fermented samples registered significantly ($p < 0.05$) higher water holding capacities and water absorption indices, but no differences in protein and fat contents or lipase activity were observed. In terms of the amino acid composition, compared to the unfermented samples, there was also a significant reduction ($p < 0.05$) in the relative abundance of all of the beany flavour markers; however, this varied across different fermentation times. In three of the five markers (2,4-Decadienal (~42%), 2,4-Nonadienal (~36.4%) and 2-Pentylfuran (~40%), the greatest reduction in the relative abundance values was observed after fermenting for 5 h. Conversely, the greatest decreases in the relative abundance of 1-hexanol and hexanal were observed at T0 and T30 min, respectively. The decrease in beany off-flavours was attributed to the positive correlation with LOX activity, and the strongest association was with 2,4-Decadienal (0.7). A panel of thirty panelists also rated their overall liking of the plant-based cheese formulations made with the fermented chickpea flours, and the appearance and flavour received average scores of 7.0 and 6.5, respectively, on a 9-point scale. Overall, fermentation can be used to modify the nutritional and functional properties and beany off-flavours of chickpea flours, which in turn can improve the quality and consumer acceptability of these ingredients and the plant-based cheese formulations developed.

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6.8. Characterization of Magarine Derived from Pili (Canarium ovatum) Nuts: Analyzing Its Composition, Viscosity, and Thermal Properties

Danielle Ashley Sobremonte [1], Christian Gabriel Seagan [1], Maria Carmen Tan [1], Melfei Bungihan [2], Raymond Malabed [1], Janesky Esplana [3] and Aldrin Porcioncula Bonto [1]

[1] Department of Chemistry, College of Science, De La Salle University, 2401 Taft Avenue, Manila 1004, Philippines
[2] Department of Chemistry, College of Science, University of Santo Tomas, España Blvd, Manila 1008, Philippines
[3] Department of Science and Technology, Industrial Technology Development Institute, National Metrology Laboratory of the Philippines, Taguig City 1631, Philippines

This study characterizes magarine derived from the pili nut (*Canarium ovatum*), a tree native to the Philippines, focusing on its potential as a plant-based milk alternative. Pili nut margarine was prepared using protocols adapted from established nut-based milk methodologies. Proximate analysis revealed high lipid and protein content, supporting its nutritional viability. Gas chromatography–mass spectrometry (GC-MS) analysis of the lipid fraction identified major fatty acid methyl esters, including oleic acid (C18:1, 48.2%), palmitic acid (C16:0, 27.5%), linoleic acid (C18:2, 13.7%), and stearic acid (C18:0, 6.8%), along with minor components such as lauric and myristic acids. These results indicate a lipid profile rich in monounsaturated and polyunsaturated fatty acids associated with positive health effects. Fourier-transform infrared (FT-IR) spectroscopy further confirmed the presence of key functional groups: strong absorption bands corresponding to O–H stretching (~3400 cm^{-1}), C–H stretching (~2920 cm^{-1}), C=O stretching (~1740 cm^{-1}), and C–O stretching (~1050 cm^{-1}), consistent with triglycerides and other lipid esters. Differential scanning calorimetry (DSC) revealed thermal transitions characteristic of margarine matrices, with endothermic peaks between 24–30 °C and 90–110 °C, indicating stable emulsified fat structures. Viscosity measurements demonstrated favorable rheological properties across various temperatures, while total acidity values supported the product's stability and palatability. The combined compositional, structural, and functional analyses underscore the potential of pili magarine as a nutritious, locally sourced, plant-based milk alternative, supporting dietary diversity and sustainable food innovation in the Philippines.

6.9. Comparative Evaluation of Physical Properties of Starches from MABONDO and MUGANDE Varieties for Food Applications: Insights from Rwanda's Locally Cultivated Potato and Sweet Potato

Christophe Nteziryayo

Community Engagement for Food and Agriculture Development in Rwanda (CEFAD-RWANDA), Kigali 00000, Rwanda

This study investigates the physical properties of starches extracted from two Rwandan cultivars: the MABONDO variety of potato and the MUGANDE variety of sweet potato. Emphasis was placed on assessing their functional performance in food applications and comparing them with starches from common sources such as corn, cassava, and wheat. Key physical parameters evaluated included viscosity, water absorption capacity, wettability, and gelatinization behavior. Standardized extraction techniques and analytical procedures were followed using equipment such as viscometers, centrifuges, and drying ovens. The results revealed that both MABONDO and MUGANDE starches demonstrated desirable physical characteristics suitable for food processing. Notably, potato starch from the MABONDO variety exhibited superior binding properties due to its larger molecular structure, while sweet potato starch also performed competitively in terms of gelatinization and water absorption.

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Comparative analysis showed that the studied starches outperformed conventional starches in several properties relevant to culinary use. The findings support the viability of locally sourced potato and sweet potato starches as alternatives to imported or conventional starches in food preparation. Promoting these underutilized starches can contribute to Rwanda's efforts in enhancing food system resilience, value addition, and agricultural sustainability.

The study recommends further confirmatory research and stakeholder engagement to encourage the integration of these starches into commercial food production and distribution channels.

6.10. Comparison of Various Assays of Antioxidant Activity/Capacity: Limited Significance of the Redox Potential of Oxidants/Indicators

Izabela Sadowska-Bartosz [1], Paulina Furdak [1,2], Kacper Kut [1] and Grzegorz Bartosz [1]

[1] Laboratory of Analytical Biochemistry, Institute of Food Technology and Nutrition, College of Natural Sciences, University of Rzeszow, 4 Zelwerowicza Street, 35-601 Rzeszow, Poland

[2] Doctoral School, University of Rzeszow, 16C Rejtana Street, 35-959 Rzeszow, Poland

Introduction: A common challenge in estimating the antioxidant activity (AA) of various compounds or the total antioxidant capacity (TAC) of complex materials such as food products is the differences between results obtained from different assays. Moreover, such assays do not provide information on the composition of antioxidants present in a sample. As the thermodynamic condition for a redox reaction is that the redox potential of the oxidant must be higher than that of a reductant (antioxidant), it is of interest to check whether it is possible to estimate the content of antioxidants in various ranges of redox potentials using a set of assays employing oxidants/indicators of different values of redox potentials.

Methods: In the study, the AA of eight antioxidants (Trolox, ascorbic acid, glutathione, gallic acid, allicin, and three nitroxides) and the TAC of an aqueous garlic extract were estimated using Fe(III)phenanthroline reduction, ORAC, FRAP, ABTS$^{\bullet}$ decolorization, CUPRAC, DPPH$^{\bullet}$ decolorization, ferricyanide reduction, and 2,6-dichlorophenolindophenol (DCIP) reduction assays (E_o' of 1.14, about 1, 0.70, 0.68, 0.59, 0.53, 0.36, and 0.23 V, respectively). The antioxidant activities were related to Trolox and expressed in Trolox equivalents (TEs).

Results: The thermodynamic condition made some antioxidants unreactive with indicators of sufficiently low E_o', but otherwise, no dependence between the AA and redox potentials of oxidants/indicators and antioxidants was observed. Some antioxidants exhibited low reactivity in certain assays (e.g., glutathione in assays based on Fe(III) reduction). The TAC of the garlic extract did not show any regular dependence on the redox potential of the oxidant/indicator, being the highest in the test of ABTS$^{\bullet}$ decolorization assay (1.06 ± 0.16 mol TE/L) and the lowest for the Fe(III)phenanthroline reduction assay (0.11 ± 0.02 mol TE/L).

Conclusions: These results indicate that kinetic factors play a primary role in determining the AA and TAC in various assays.

6.11. Crystalline Phase Identification of Cocoa Fat Triacylglycerol Using X-Ray Diffraction and Rietveld Refinement

Sruti Chandra, R. Paranthaman and Jeyan Arthur Moses

Computational Modeling and Nanoscale Processing Unit, National Institute of Food Technology, Entrepreneurship and Management—Thanjavur, Ministry of Food Processing Industries, Government of India, Thanjavur 613005, Tamil Nadu, India

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Introduction: Cocoa butter exhibits polymorphism, a crystallographic property that strongly influences its physicochemical behavior. This feature is crucial for the quality, stability, and sensory characteristics of chocolate, where cocoa butter is a primary component. Polymorphism stems from the molecular packing of specific fatty acids and triacylglycerols (TAGs). Understanding these crystalline forms provides deeper insight into the structural behavior of cocoa fat.

Methods: This study characterizes the crystalline phases of cocoa fat in three samples using X-ray diffraction (XRD) combined with Rietveld refinement. Analyses were performed on a PANalytical X'Pert^3 Powder XRD system with CuK-α radiation (λ = 1.5418 Å), a step time of 5 s per step, 30 mA of current, and 40 kV of voltage. Diffraction patterns were compared against reference data from the Crystallography Open Database (COD) for phase identification.

Results and Conclusions: The diffraction patterns matched two TAGs and one fatty acid—1,3-distearoyl-2-oleoyl-glycerol ($C_{57}H_{108}O_6$), 1-palmitoyl-2-oleoyl-3-stearoyl-glycerol ($C_{53}H_{102}O_6$), and cis-9-octadecenoic acid ($C_{18}H_{34}O_2$)—with match scores of 48, 59, and 44, respectively. These compounds crystallized in monoclinic, triclinic, and orthorhombic systems, respectively, as determined by Rietveld refinement. The XRD results confirm the coexistence of multiple polymorphic forms, underscoring the molecular heterogeneity of cocoa fat. This study demonstrates the utility of Rietveld refinement in structural food chemistry as an effective tool for phase analysis and compositional assessment.

6.12. Decoding Wine's Identity: The Impact of Winemaking Treatments on Elemental and Isotopic Profiles

Marco Consumi, Alessandro Cavaglioni, Raffaello Nardin, Duccio Tatini, Simone Pepi and Mariagrazia Lettieri

Department of Biotechnology, Chemistry and Pharmacy, University of Siena, Via A. Moro 2, 53100 Siena, Italy

Winemaking treatments significantly influence the micro/trace-element composition and stable isotopic ratios ($\delta^{18}O$, $\delta^{13}C$, $\delta^{15}N$) of wine, affecting the determination of geographic traceability, authenticity, and quality. Fining agents—including bentonite, polysaccharides, tannins, and protein-based additives—alter trace-element profiles through the introduction or removal of metals.

The interaction between wine and metallic/rare earth elements (REEs) has gained increasing research attention due to implications for wine quality, safety, and traceability. As a complex acidic matrix, wine affects the leaching, adsorption, and precipitation of metals (e.g., Fe, Cu, and Pb) and REEs during fermentation, aging, and storage. Organic wine acids (tartaric and malic) and polyphenols actively chelate metals, modifying their bioavailability and potential toxicity. While REEs serve as valuable geochemical fingerprints in terroir studies, their stability under varying pH and redox conditions during winemaking remains insufficiently characterized.

Winemaking fining agents (bentonite, proteins, etc.) can subtly alter wine's stable isotope ratios ($\delta^{13}C$, $\delta^{15}N$, $\delta^{18}O$) by introducing exogenous elements, adsorbing metal-complexing compounds, or modifying fermentation dynamics. While effects are generally minor compared to terroir-driven isotopic signatures, unstandardized fining may impact traceability studies. Protein-based agents influence $\delta^{15}N$; bentonite affects $\delta^{13}C$ via metal removal; and silica gels may shift $\delta^{18}O$. These processing-induced variations require careful calibration in isotopic authentication.

In our study, we replicated fining treatments at the laboratory scale using both artificial and commercial red/white wines to examine treatment effects on metal, REE, and stable isotopic profiles. Through combined ICP-MS and IRMS analyses as well as multivariate

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statistics, we demonstrated significant fining-induced compositional changes. Although multi-instruments, multi-element, and multi-isotope profiling coupled with chemometric analysis can distinguish wines by their origin despite processing effects, careful standardization and procedures are essential to account for treatment-induced variability.

6.13. Determination of Total Free Amino Acids (FAAS) Released During Proteolysis of Cheeses Made with Artichoke Flower Extracts as a Substitute for Rennet

Cecilia Verónica Cimino [1], Diego Vallés [2], Paula Conforti [3,4], Constanza Liggieri [1] and Sandra Vairo Cavalli [4,5]

1 CIProVe, Centro Asociado CIC, Universidad Nacional de La Plata, La Plata 1900, Argentina
2 Laboratorio de Biocatalizadores y sus Aplicaciones, IQB, Facultad de Ciencias Universidad de la República, Montevideo 11400, Uruguay
3 Centro de Investigación y Desarrollo en Ciencia y Tecnología de los Alimentos (CIDCA), Consejo de Investigaciones Científicas y Técnicas (CONICET)–UNLP–CIC, La Plata, Argentina
4 Centro Científico Tecnológico CONICET, CCT-La Plata, La Plata 1900, Argentina
5 CIPROVE-Centro Asociado CIC, Departamento de Ciencias Biológicas, Facultad de Ciencias Exactas, Universidad Nacional de La Plata, La Plata, Argentina

Artichoke from the horticultural belt of La Plata, Argentina, has been granted a Geographical Indication status under the name "Alcachofas platenses". If allowed to bloom, artichoke flowers are an excellent raw material for vegetable rennet preparation due to their protease content. Proteolysis, the key biochemical event that occurs during cheese ripening, impacts texture, flavour, aroma, and physicochemical parameters. This work aims to study the total free amino acids (FAAs) released during the ripening of mini-cheeses made with artichoke flower extracts as the rennet.

Mini-cheeses were made using an enzymatic extract of *C. scolymus* flowers (Cs-cheeses) or recombinant chymosin (Q-cheeses, control) and cow's milk, with the addition of $CaCl_2$ and a mesophilic starter. Mini-cheeses were salted, vacuum-packed, and aged at 4 °C for 1 month. Physicochemical parameters were evaluated. Soluble subfractions were prepared via the precipitation of cheese soluble extracts at pH 4.6 with 70% ethanol (FS70). FAAs were determined and quantified using HILIC on FS70 in a UHPLC coupled to a Quadrupole mass detector.

A higher moisture content and a higher wet matter/dry weight ratio were observed in Cs- cheese compared to the control, possibly due to the greater proteolytic activity of the vegetable rennet. The Cs-cheese FS70 showed higher FAA than the control. Gly, the most abundant amino acid in the Cs-cheese FS70, was not found in Q-cheese FS70. Other amino acids well represented in both FS70 cheeses were essential amino acids Leu and non-essential amino acids Tyr and Ser.

The higher proteolysis observed in Cs-cheese could explain the changes previously reported by us in microstructure, texture, and functional properties. The presence of Gly in Cs-cheese may contribute to its flavour profile, as glycine imparts a sweet taste and can attenuate perceptions of saltiness and bitterness. Using extracts obtained from artichoke flowers that were not harvested due to their visual appearance enabled the production of a semi-hard cheese exhibiting distinctive characteristics.

6.14. Development and Validation of a UAE and GC-MS Method to Analyze Monosaccharides from Algae

Inmaculada Moscoso Ruiz, Miriam Conforto, Inés Alejandra Cea Pavez and Vito Verardo

1 Centro de Investigación y Desarrollo del Alimento Funcional (CIDAF), Avda. Del Conocimiento, 37, 18016 Granada, Spain

https://doi.org/10.3390/blsf2026056015

[2] Department of Nutrition and Food Science, Institute of Nutrition and Food Technology "José Mataix Verdú", Biomedical Research Centre, University of Granada, 18071 Granada, Spain

Algae are an interesting source of bioactive compounds, and their polymeric carbohydrate fraction can be broken down to their monomers. In addition, Rugulopteryx okamurae is an invasive alga that it is difficult to remove from coasts. The objective of this work is to validate an analytical method and develop an environmentally friendly technique to quantify algal monosaccharides. Gas chromatography coupled with tandem mass spectrometry (QTOF) has been used to identify monosaccharides, using derivatization with oximes and silylation. The internal standard was inositol. Pretreatment consisted of milling the algae and making a pretreatment using ethanol to eliminate pigments and phenolic compounds. The solvent used in this green extraction was water, and the extraction technique was ultrasound-assisted extraction (UAE). The first optimization concerned the mass–solvent ratio, testing between 1:15 and 1:30; 1:15 was selected as optimum. UAE has been optimized by experimental design, evaluating power and time in ranges of 20–70% power and 30–120 min by a factorial design. The maximum was established at 70% power and 30 min. The method is selective, sensitive and accurate. Rugulopteryx okamurae has mainly mannitol, and other monosaccharides are galactose and glucose. Ulva ohnoi possesses xylose, rhamnose, galactose and glucose. A green and GRAS method was developed to extract monosaccharides from invasive algae.

6.15. Effect of Flour Fractionation on Functional Properties, Antioxidant Capacity, and Phenolic Acids in Wheat Flour

Samson Adeoye Oyeyinka [1], Oluseyi Moses Ajayi [1], Jill Ellis [1] and Oluwafemi Ayodeji Adebo [2]

[1] School of Agri-Food Technology and Manufacturing, University of Lincoln, PE12 7PT Holbeach, UK

[2] Centre for Innovative Food Research (CIFR), Department of Biotechnology and Food Technology, University of Johannesburg, Doornfontein Campus, Johannesburg 2028, South Africa

Whole grain wheat flour is valued for its nutritional and antioxidant properties due to its high levels of phenolic compounds. However, its high bran content can negatively impact dough handling, bread texture, and colour, posing a challenge for developing healthier baked products with desirable sensory qualities. While sieving is commonly used to separate bran from endosperm, little is known about how controlled flour fractionation at specific particle sizes (250 μm and 500 μm) affects the distribution of bioactive compounds and flour functionality. Hence, this study investigated the impact of flour fractionation by sieving (250 μm and 500 μm) on colour, water absorption capacity, total phenolic content (TPC), total flavonoid content (TFC), antioxidant activity (2,2-diphenyl-1-picrylhydrazyl [DPPH] and 2,2′-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) [ABTS]), and selected phenolic compound composition. Whole white wheat flour (WWF) and whole brown wheat flour (BWF) were included for comparison. BWF showed the highest water absorption (0.84 mL/g), while fractionated flours (0.65–0.69 mL/g), particularly the 250 μm fraction, demonstrated improved lightness and higher TPC (approx. 3.2 mg QE/g) compared to BWF (1.39 mg QE/g) and WWF (1.97 mg QE/g). Although BWF retained higher antioxidant activity, fractionation significantly influenced phenolic compound profiles. Trans-ferulic acid was the predominant compound, and quercetin levels remained consistent across all samples. Principal component analysis (PCA) of TPC, TFC, phenolic acids, and antioxidant activities (ABTS and DPPH) explained over 75% of the total variance in the first two components, revealing distinct clustering by flour type and fraction. These

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findings highlight the potential of targeted flour fractionation as a novel strategy to enhance both the functional and nutritional properties of whole grain flours, offering a balanced solution for improving whole grain bread making without the need for full bran removal. Future studies should apply the flour in baked goods, including bread, muffins, and cakes.

6.16. Effect of Roasting Conditions on the Chemical and Functional Properties of Oat Oil

Bharani Kumar Palani [1], Joanna Bryś [1], Piotr Koczoń [1] and Marko Obranović [2]

[1] Department of Chemistry, Institute of Food Sciences, Warsaw University of Life Sciences, 159c, Nowoursynowska St., 02-776 Warsaw, Poland

[2] Department of Food Engineering, Faculty of Food Technology and Biotechnology, University of Zagreb, Pierottijeva 6, 10000 Zagreb, Croatia

Oats (Avena sativa) are a nutritionally dense cereal crop. They are appreciated for their characteristic flavour and high levels of essential nutrients, particularly high-quality oil enriched with unsaturated fatty acids and antioxidants. This study evaluates the influence of various roasting conditions on oat oil's chemical composition and functional quality. Roasting, a widely used food processing method, enhances flavour and digestibility while inducing structural and compositional modifications in cereal grains.

Oat grains were roasted at different temperatures, and the oil was extracted using Soxhlet and supercritical carbon dioxide methods. Gas Chromatography (GC) was used to analyse the fatty acid composition, and oxidative stability was measured using Pressure Differential Scanning Calorimetry (PDSC). The peroxide and acid values were analysed using standard titrimetric methods. Molecular-level changes in the oil were examined using Fourier Transform Infrared (FTIR) spectroscopy within the 4000–400 cm^{-1} range, followed by chemometric analysis.

The results demonstrate that roasting significantly affects the yield and quality of oat oil. Roasting at slightly higher temperatures, specifically between 160 °C and 190 °C for 20 to 50 min, enhances the oil's ability to resist oxidation. FTIR spectroscopy and multivariate statistical tools effectively distinguished roasted from unroasted samples, revealing distinct thermal-induced alterations in the oil's chemical profile. These findings contribute to a deeper understanding of how thermal processing impacts oat oil's nutritional and functional properties, offering valuable implications for developing health-oriented food products.

6.17. Evaluation of Proximate, Mineral and Protein Digestibility of Germinated Pearl Millet (Pennisetum glaucum) and Amaranth GraiN (Amaranthus cruentus) Flour Blends

Samuel Olufemi Owolade and Olaide Ruth Aderibigbe

National Horticultural Research Institute, Product Development Programme, P.M.B. 5432, Idi- Ishin, Jericho GRA, Ibadan, Oyo State, Nigeria

The study aimed to improve traditional complementary food by incorporating germinated amaranth grain flour into germinated millet flour. Millet is low in quality protein, being limited in essential amino acids, particularly lysine and tryptophan. Germination of millet and amaranth grains was performed by wrapping soaked grains in cheesecloth and keeping them for 24 h, and washing, drying and milling them. Design expert was used to achieve ten runs of millet and amaranth flour blends, analyzing proximate, mineral and protein digestibility. In vitro protein digestibility was determined with the common method of using a pepsin–pancreatin enzyme system with other chemicals such as NaoH and HCl. The results show significant differences ($p < 0.05$) among the blends and the control sample. The protein content among blends ranged between 9.20% and 12.86%. The sample consisting of 60% millet and 40% amaranth mixture had the highest protein

(12.86%), and the control sample, mainly 100% millet, had the lowest protein content (8.7%). The energy content of the blends was between 357.65 kcal/100 g and 361.82 kcal/100 g. Also, 60% millet and 40% amaranth flours had the highest energy (361.82 kcal/100 g). The minerals analyzed include Fe, Ca, Zn, Mg and Mn, and their concentrations ranged between (6.19 mg/100 g–9.96 mg/100 g), (13.72–38.11 mg/100 g), (14.39 mg/100 g–33.41) mg/100 g), (22.20 mg–67.31 mg/100 g) and (0.24 mg/100 g–0.66 mg/100 g), respectively. The blend with 60% millet and 40% amaranth had the highest concentration of Ca (38.11 mg/100 g) and Zn (33.41 mg/100 g). The protein digestibility of blends was between 65%–85%. The control sample, which was 100% millet, had the lowest protein digestibility, at 65%, while the 60% millet and 40% amaranth blend had the highest protein digestibility, at 85%. The study shows that incorporating germinated amaranth into germinated millet flour results in better nutritional composition than unsupplemented millet, often used in rural communities as infant food. Thus, the blend of millet and amaranth at a suitable mixing proportion could serve as an improved alternative for rural nursing mothers who cannot afford commercially formulated infant foods.

6.18. FTIR-ATR Characterization of By-Products from Canola Oil Processing

Mariana Robalo Santos [1,2], Veronica Capdevila [1], Carolina Iraporda [1,2] and Maria Belen Fernandez [1,2,3]

1 Seeds and Foods Technology (TECSE), Department of Chemical Engineering and Food Technology, Faculty of Engineering, National University of the Center of the Province of Buenos Aires (UNCPBA), Olavarría B7400JWI, Argentina
2 National Scientific and Technical Research Council (CONICET), Olavarría B7400JWI, Argentina
3 Research Center in Physics and Engineering of the Center of the Province of Buenos Aires (CIFICEN), UNCPBA–CICPBA–CONICET, Olavarría B7400JWI, Argentina

Currently, the meals resulting from the processing of canola seeds are mainly used as animal feed. However, the high global production of canola oil generates considerable amounts of this by-product, which has driven research aimed at finding alternative uses for its valorization. This work proposes the analysis, via FTIR, of two by-products: press cake and press cake subjected to ethanol extraction assisted by ultrasound. Canola seeds were provided by Al High Tech (Argentina). These seeds were hydrothermally pretreated in a VZ autoclave (Argentina) for 5 min at 130 °C, dried in a BGH QuickChef microwave oven to 7% moisture (dry basis), and pressed in an IMEGEN screw press (Argentina). The resulting press cake was subjected to ultrasound-assisted extraction (absolute ethanol, 57% amplitude, 60 min, 38 °C, solid–solvent ratio 1:28, VCX 500 ultrasonic probe, USA). Press cake samples with and without subsequent extraction were analyzed by means of FTIR-ATR (IRXross, Shimadzu, Japan). The analysis of the spectra allowed for the identification of various bands corresponding to relevant functional groups in both samples. Bands were observed at 1031 cm^{-1}, which were attributed to C–O stretching vibrations, characteristic of polysaccharides. The signals in the region from 2920 to 2930 cm^{-1} correspond to C–H stretching vibrations, indicative of the presence of polysaccharides. Similarly, the band registered at 1741 cm^{-1} is related to the presence of carbonyl bonds (C=O) found in lipids, indicating the presence of residual oil. Absorptions near 1230 cm^{-1} can be attributed to C–H bending vibrations. Finally, peaks were recorded at 3003 cm^{-1}, assigned to C=CH stretching, which may indicate the presence of proteins in the meals. These results suggest that both by-products retain relevant structural components of polysaccharides and proteins, encouraging further analysis aimed at their separation, structural characterization, study of functional properties, and promotion of their valorization in technological applications.

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6.19. Gummy Innovation: Development and Characterization of Plant-Based Gummies as Healthier Alternatives

Cláudia Campos Pessoa [1,2], Elisandra Lopes [3], Diana Daccak [1,2], Inês Carmo Luís [1,2], Ana Coelho Marques [1,2], Ana Rita F. Coelho [1,2], Paulo Legoinha [1,2], Fernando H. Reboredo [1,2], Manuela Simões [1,2], Maria Manuela Silva [1,2] and Fernando C. Lidon [1,2]

1 Departamento de Ciências da Terra, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal
2 Centro de Investigação de Geobiociências, Geoengenharias e Geotecnologias (GeoBioTec), Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal
3 FCT-NOVA, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal

Faced with the global rise in sugar consumption linked to pathologies such as type 2 diabetes and obesity, there is an urgent need to develop healthier alternatives to standard sweets. This study aimed to develop plant-based gummies and evaluate their physical–chemical and sensory properties. A total of six gummy formulations were prepared using agar–agar (a gelling, thickening, and stabilizing agent of plant origin, derived from red algae), mixed with different beverage flavors: 100% vegetable-based beverage (coconut), or 100% fruit/vegetable juices (apple, grape, orange, tomato, carrot). The average transmittance in the visible spectra (450–650 nm) (assessed with a scanning spectrophotometric colorimeter in the visible region) demonstrated that coconut presented the highest values, which is a characteristic of its white color. A binocular magnifier was used to attain gummy images. The pH values (measured with a portable pH meter) varied between 3.42 and 7.09, with coconut flavored beverage presenting the highest value in comparison to the other formulations. The total soluble solids (assessed with a portable refractometer) show variations between 5 and 21 °Brix, with coconut and grape flavored beverages presenting the lowest and highest values, respectively. A sensory analysis with a hedonic scale was used to assess parameters such as color, aroma, firmness, texture, taste and sweetness. Color-wise, coconut and orange formulations presented the highest acceptance, and for aroma, coconut- and apple-flavored gummies received higher evaluations. On flavor and sweetness, grape and apple formulations were the most appreciated (to which total soluble solids may have contributed). Similar values in texture and firmness can be due to a homogeneous process in gummy formulations with agar. In conclusion, the use of 100% fruit and vegetable beverages in gummies provides a basis for innovation in plant-based product development.

6.20. Influence of Raising Method and Dietary Olive Cake Supplementation on the Physicochemical Composition of Bísaro Pork Loins: A Comparative Analysis

Sandra Rodrigues, Ana Leite, Lia Vasconcelos and Alfredo Teixeira

Centro de Investigação de Montanha, LA SusTEC, Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal

The present study was designed with two primary objectives: (1) to investigate and compare the effects of different rearing systems—specifically intensive versus extensive production—on the quality characteristics of loins obtained from Bísaro pigs, a traditional Portuguese breed, and (2) to assess the potential influence of dietary supplementation with olive cake, a by-product of olive oil production, on the physicochemical composition of pork loins derived from these animals. To achieve these aims, muscle samples from the *Longissimus thoracis et lumborum* region were collected from Bísaro pigs reared on farms located in the Trás-os-Montes region of northern Portugal. The slaughter and

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carcass cutting procedures were standardized and conducted at the Bragança municipal slaughterhouse, ensuring consistency in sample handling and preparation for laboratory analyses. Comprehensive evaluation of physicochemical parameters revealed that, among the various components analyzed, only the ash content showed a statistically significant difference ($p = 0.007$) between the two rearing systems, suggesting that farming conditions may influence mineral content in the meat. However, no statistically significant differences ($p > 0.05$) were observed between rearing systems concerning other key quality indicators, including moisture content, protein concentration, total fat, collagen content, and pigment levels. Furthermore, the inclusion of olive cake in the animals' diet, regardless of the rearing system employed, did not result in any significant alterations in the levels of these physicochemical traits. The same lack of statistical significance ($p > 0.05$) was observed in the analysis of the meat's fatty acid composition, including the proportions of saturated fatty acids (SFAs), monounsaturated fatty acids (MUFAs), and polyunsaturated fatty acids (PUFAs).

6.21. Machine Learning-Based Classification of Cherry Tomato (Solanum lycopersicum var. cerasiforme) Genotypes for Open Field and Polyhouse Cultivation

Chandni [1] and Abhinav Dubey [2]

[1] Indian Council of Agricultural Research, Central Institute of Temperate Horticulture, RS Mukteshwar, Uttarakhand, India

[2] Indian Council of Agricultural Research, Central Institute of Postharvest Engineering & Technology, Ludhiana, Punjab, India

The selection of suitable cherry tomato (*Solanum lycopersicum* var. *Cerasiforme*) genotypes for Indian agro-climatic conditions is vital for maximizing profitability and achieving sustainable cultivation. Traditional genotype selection through field trials is time-consuming and resource-intensive. This study leverages machine learning (ML) models to classify cherry tomato genotypes based on yield and quality traits under both open-field and polyhouse conditions. A comprehensive dataset, comprising morphological, physiological, and biochemical parameters such as plant height, days to flowering, fruit morphology, lycopene, β-carotene, total soluble solids (TSS), sugars, and acidity, was used for model training and evaluation.

Protected cultivation significantly enhanced fruit quality, with polyhouse-grown tomatoes exhibiting up to 51.88% higher TSS (4.2–7.9 °Brix) and superior lycopene content (1.07–7.48 mg/100 g) compared to open-field conditions. Five ML classifiers—Decision Tree, Random Forest, Support Vector Machine (SVM), K-Nearest Neighbours (KNN), and Neural Network—were evaluated using an 80:20 train–test split to ensure external validation. The Neural Network model achieved the best performance with an accuracy of 75%, F1-score of 0.66, and ROC-AUC of 0.88. The Decision Tree model showed comparable accuracy (75%) but a lower ROC-AUC (0.77). Random Forest and SVM achieved 50% accuracy with ROC-AUC values of 0.77 and 0.16, respectively, while KNN performed poorly (accuracy: 25%, ROC-AUC: 0.50).

These results highlight the potential of ML-based classification in enhancing the efficiency of genotype selection, minimizing dependency on exhaustive field evaluations, and promoting precision agriculture. The findings serve as a decision-support tool for breeders and cultivators aiming to optimize genotype deployment under diverse cultivation environments.

6.22. Octenyl Succinic Anhydride (OSA)-Modified Starches: From Molecular State to Granular State

Songnan Li

Joint International Research Laboratory of Agriculture and Agri-Product Safety of the Ministry of Education of China, Institutes of Agricultural Science and Technology Development, Yangzhou University, Yangzhou 225009, Jiangsu, China

Starch is the second most abundant renewable biopolymer on Earth after cellulose, and is widely distributed in plant tissues such as leaves, stems, seeds, roots, and tubers. However, native starch has limited industrial applicability due to its poor water solubility and low process tolerance. To address these limitations, starch esterification with octenyl succinic anhydride (OSA) is conducted, which introduces hydrophobic substituents by partially substituting hydroxyl groups, resulting in OSA-modified starch (or OSA starch). OSA starch finds applications in both food and non-food products, including functional beverages, salad dressings, and biodegradable films, where it serves as an emulsifier, encapsulating agent, or fat replacer.

Most commercial OSA starches are derived from waxy or normal maize starches through OSA modification followed by enzymatic hydrolysis, rendering them water-soluble and amphiphilic at the molecular level. Interestingly, recent studies have proposed that OSA starch in its intact granular state—prior to enzymatic hydrolysis—can function as an effective Pickering stabilizer. This work will investigate the effect of modification parameters (degree of substitution, particle size and oil volume fraction) on the multi-scale characterization, combined with the formation rules of Pickering emulsions, and then introduce a "Green" hydrophobic modification using zein for novel lutein delivery. This study will promote the development and applications of the multi-scale characterization combined with functional features of starch-based Pickering emulsions.

6.23. Physicochemical Evaluation of Alternative and Conventional Flours: Toward Nutritional Diversification in the Flour-Based Industry

Diana Daccak [1,2], Bárbara Barra [3], Cláudia Campos Pessoa [1,2], Inês Carmo Luís [1,2], Ana Coelho Marques [1,2], Ana Rita F. Coelho [1,2], Paulo Legoinha [1,2], Manuela Simões [1,2], Maria Manuela Silva [1,2], Fernando C. Lidon [1,2] and Fernando H. Reboredo [1,2]

1 Departamento de Ciências da Terra, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal
2 Centro de Investigação de Geobiociências, Geoengenharias e Geotecnologias (GeoBioTec), Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal
3 FCT-NOVA, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal

The flour-based industry constitutes the second most valued food sector in Portugal. As consumers seek healthier and functional food options, the industry has invested in the development of new products linked to health benefits. In recent years, the incorporation of alternative raw materials beyond conventional wheat flour has expanded the number of flours available to consumers.

This study aimed to characterize a range of commercially available flours in Portuguese hypermarkets, comprising seven refined flours (wheat, rice, oat, carob, almond, maize, and amaranth) and four wholemeal flours (oat, wheat, rye, and spelt). Each sample was analyzed for its colorimetric parameters (L*, a*, b*), moisture content, ash content, and concentrations of selected mineral elements (Ca, S, Fe, Mn, Mo, Zn, and Se). Mineral composition was assessed using X-ray fluorescence spectroscopy, with it being found that most of the mineral element concentrations did not significantly differ across flour samples. However, some exceptions were noted: manganese (Mn) was detected only in rice, almond, and wholewheat flour; selenium (Se) was only detected in wheat flour; and zinc (Zn) presented the highest value in oat flour (although this was not significant). Colorimetric

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values were obtained using visible-range scanning spectrophotometry. Carob flour showed distinct coloration, with the lowest L* value and the only positive a* value, indicating a darker reddish hue. Also, almond flour showed a particularly low moisture content and the highest ash level compared to that in the other alternative flours.

These differences highlight the potential of alternative flours to promote innovation in the food sector through healthy products based on their nutritional and physicochemical attributes.

6.24. Structural Characterization and Moisture Sorption Analysis of Encapsulated DPP-IV-Inhibitory Peptides

Ashritha B [1], Guruparan K [1], Sathish Kumar M H [1], Manoj Kumar C T [1], Priyanka Singh Rao [1] and Suman Kapila [2]

[1] Dairy Processing Section, SRS of ICAR-National Dairy Research Institute (NDRI), Karnal 132001, India

[2] Principal Scientist, Animal Biochemistry Section, National Dairy Research Institute (NDRI), Karnal 132001, India

Introduction: Dipeptidyl peptidase IV (DPP-IV) inhibitors constitute a novel approach for the management of type 2 diabetes mellitus (T2DM). A major obstacle to the commercialization of these milk-derived bioactive peptides is their susceptibility to breakdown within the gastrointestinal tract. Consequently, encapsulation has become a vital strategy for enhancing the utilization of bioactive peptides. Therefore, this study was conducted to encapsulate DPP-IV-inhibitory hydrolysates derived from milk proteins and evaluate their structural and moisture sorption properties.

Methods: A milk protein hydrolysate rich in DPP-IV-inhibitory peptides was prepared. This hydrolysate was encapsulated in a matrix of gum arabic and resistant maltodextrin through spray drying. The obtained encapsulated DPP-IV-inhibitory peptides were analysed in terms of their structural characteristics (SEM), FTIR and moisture sorption isotherm.

Results: SEM analysis confirmed the achievement of matrix-type encapsulation with a smooth, wrinkled surface and aggregated particles. The FTIR results indicated the uniform distribution of peptides within the matrix. The glass transition, crystallization and melting temperatures of the encapsulated peptides were 57.11, 181.37 and 283.49 °C, respectively. The moisture sorption isotherm (MSI) behaviour was investigated at 25, 35 and 45 °C using an isopiestic method. The isotherm obtained for the encapsulated peptides was J-shaped, close to a type-III isotherm. Various mathematical models were used for the analysis of the experimental equilibrium moisture content. The Kuhn, Halsey and GAB mathematical models showed the best fit, whereas the BET, Caurie and Modified Mizrahi models did not fit at all the temperatures based on their RMS% and P values. The surface area of sorption decreased from 26.31 at 25 °C to 17.70 and 17.22 m^2g^{-1} at 35 and 45 °C, respectively, indicating increased sorption and an increased surface area at lower temperatures. The isosteric heat of sorption showed the independence of the product to varying temperatures. Overall, the present study shows the successful encapsulation of milk protein hydrolysates. The characterization studies showed that encapsulated hydrolysates have a hygroscopic nature and can be improved with different bulking agents.

6.25. Sustainable Extraction of Pectin from Peach Fruit Using Natural Deep Eutectic Solvents (NADESs)

Sara Elorabi [1], Hojjat Pashazadeh [2,3], Ali Ali Redha [4,5] and Ilkay Koca [1]

[1] Department of Food Engineering, Faculty of Engineering, Ondokuz Mayis University, Samsun 55139, Turkey

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[2] Department of Gastronomy and Culinary Arts, Art and Design Faculty, Istanbul Nisantası University, Istanbul 34398, Turkey
[3] Hafızbaba Bitkisel ve Kozmetik Ürünler Pazarlama Gıda Sanayi Tic. Ltd. Şti, Istanbul 34398, Turkey
[4] Department of Public Health and Sport Sciences, Faculty of Health and Life Sciences, University of Exeter Medical School, University of Exeter, EX1 2LU Exeter, UK
[5] Centre for Nutrition and Food Sciences, Queensland Alliance for Agriculture and Food Innovation (QAAFI), The University of Queensland, Brisbane, QLD 4072, Australia

Pectin is a widely used biopolymer in the food, pharmaceutical, and environmental industries. Traditionally extracted from citrus and apple peels using harsh acids and high energy inputs, conventional methods raise environmental and sustainability concerns. Recent research has turned toward greener extraction technologies, including the use of Natural Deep Eutectic Solvents (NADESs) as environmentally friendly alternatives to conventional solvents. In this study, pectin was extracted from peach fruit using six different NADES formulations. Each solvent was prepared with choline chloride (ChCl) as a hydrogen bond acceptor (HBA) and one of six organic acids, lactic acid (LA), acetic acid (AA), malic acid (MA), malonic acid (MalA), oxalic acid (OA), or citric acid (CA), as the hydrogen bond donor (HBD), in a 1:1 (w/w) molar ratio. Extractions were performed at 80 °C for 2 h with ultrasonic assistance, and the NADES solutions were diluted with 3.5% ultrapure water. Yields were compared to those from conventional solvents (0.2 N citric acid and HCl, pH 1.5). The highest pectin yield (5.27 ± 0.08%) was obtained using ChCl:LA. The extracted pectins were characterized via Fourier-transform infrared spectroscopy (FTIR) and scanning electron microscopy (SEM). FTIR analysis revealed the highest degree of esterification (DE) in pectin extracted with ChCl:CA (52.92%). Pectins were classified as high methoxyl (HM, DE > 50%) or low methoxyl (LM, DE 50%). Conventional methods produced HM pectins with DE values of 51.35% (HCl) and 53.46% (citric acid). Among NADES extractions, ChCl:AA (50.6%), ChCl:CA (52.92%), and ChCl:MA (55.77%) also yielded HM pectins, while ChCl:LA (34.19%), ChCl:MalA (45.65%), and ChCl:OA (16.81%) resulted in LM pectins. In conclusion, ChCl:LA was the most effective solvent for maximizing pectin yield from peach fruit, while ChCl:MA was optimal for producing high methoxyl pectin. These findings support the potential of NADES as a green, sustainable approach for biopolymer extraction from fruit matrices.

6.26. The Cholesterol Content and Fatty Acid Composition of Sheep Butter Oil in Comparison to Cow Butter Oil

Badrieh Sahargahi [1], Majid Mahmoudi [1], Sattar Jamshidpour [1] and Rojan Shokoohizadeh [2]

[1] Administration of Food and Drug, Kermanshah University of Medical Sciences, Kermanshah, Iran
[2] Medicine Faculty, Shiraz University of Medical Sciences, Shiraz, Iran

Introduction: On the one hand, the cholesterol content and fatty acid composition of milk-based fats pose a nutritional challenge. On the other hand, these parameters can be considered as physicochemical specifications based on animal origin.

The aim of this study was to assess and compare the cholesterol content and fatty acid composition of sheep butter oil and cow butter oil.

Method and materials: In total, 10 samples of cow butter oil and 27 samples of sheep butter oil were selected randomly by a trained expert in 20 villages of Kermanshah province in Iran.

Cholesterol content was measured using the high-performance liquid chromatography (HPLC) system (Knauer Model, Germany) equipped with a UV detector at 205 nm.

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Fatty acid composition was determined by direct trans-esterification, also via the gas chromatography technique.

Results: The cholesterol content of sheep butter oil was significantly higher than that of cow butter oil, at 247.08 ± 25.57 (mg/100 g) vs. 187.07 ± 37.93 (mg/100 g). ($p < 0.001$).

Also, this study showed that the saturated fatty acid (SFA) content of sheep butter oil was slightly higher than that of cow butter oil (64.64 ± 3.10 vs. 62.94 ± 3.03, $p = 0.088$). The polyunsaturated fatty acid (PUFA) content in cow butter oil was significantly higher than that of sheep butter oil (3.55 ± 0.193 vs. 2.89 ± 0.55, $p < 0.001$). Based on the length of fatty acids, we found that the medium-chain fatty acid (MCFA) content of sheep butter oil was significantly higher than that of cow butter oil, at 19.48 ± 2.60 vs. 14.47 ± 1.

Conclusions: It is concluded that cow butter oil is better than sheep butter oil for human nutrition in terms of cholesterol content and fatty acid composition.

Regarding dietary guidelines, there is no serious worry about the cholesterol content and fatty acid composition of butter oil in moderate consumption, but it seems cow butter oil is more optimal than that of sheep.

6.27. The Influence of Oat Milk on the Rheological Properties and Compositional Properties of Basil-Enriched Functional Ice Cream

Deepika Shrestha, V. Sai Sharanya Palletti, Swethapriya R.B., Alisha Pradhan and Srijaya Mupparapu

Food and Nutritional Sciences Department, Sri Sathya Sai Institute of Higher Learning, Anantapur Campus, Andhra Pradesh 515001, India

Background: The high water-binding capacity of oat milk develops viscosity and subsequently results in smoother and creamier textures, qualities that are valued in traditional ice cream. The rheological properties of oat milk impact its texture, overrun, melting behavior, and overall consumer acceptability. This study aimed to evaluate the impact of oat milk substitution on the rheological and compositional characteristics of basil-enriched functional ice cream.

Methods: Dairy milk was substituted with oat milk at two levels—partially (50%) and completely (100%)—for the development of a functional ice cream. The experimental samples were flavoured with 10% basil leaf extract. These experimental samples were compared with the control sample of 100% full-cream dairy milk ice cream for its physicochemical properties (pH, titratable acidity, fat, protein, carbohydrate, ash, and total solids) using standard AOAC methods, rheological properties (viscosity measurements), overrun, melting properties, and antioxidant potential (Total Polyphenol and DPPH inhibition activity).

Results: Oat milk substitution led to significant rheological and compositional changes. Viscosity increased markedly in oat-based ice cream samples (ranging from 35.13 to 146 cP), attributed to the presence of β-glucans and soluble fibers, which enhanced the structural thickness and water-binding capacity of the mix. The increased viscosity contributed to improved melting properties, structural integrity, and a denser and smoother texture. Compositional analysis showed higher total solids, carbohydrates, and ash, comparatively, which supported the observed textural improvements. Total phenolic content increased substantially in the oat milk samples, with the 100% oat milk-substituted ice cream sample recording the highest antioxidant activity (Polyphenoli −45.44 to 46.68 mg GAE/100 g and DPPH inhibition activity −89.85 to 92.81%).

Conclusions: Oat milk significantly enhances the rheological properties and functional quality of basil-enriched ice cream formulations. Its inclusion improves viscosity, structural stability, and antioxidant capacity, making it a promising dairy substitute for developing plant-based frozen desserts tailored to health-conscious and lactose-intolerant consumers.

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6.28. Transforming Waste into Value: The Impact of Grape Pomace Variety and Extraction Parameters on Grape Seed Oil Yield and Physicochemical Properties

Alice Feng

Granite Ridge Intermediate School, Chino, CA 91710, USA

California's Central Valley produces 75% of the state's wine grapes, generating large amounts of pomace waste that create environmental concerns. With rising demand for healthier oils, cold-pressed grape seed oil offers a sustainable solution. However, limite-drelated research has focused on this wine region. This project aimed to (1) identify factors influencing extraction efficiency and oil quality, and (2) assess profitability for small-scale and low-income farmers.

In total, 500 g of seeds were separated, cleaned, and dried. Seed size was measured in 10 replicates with a caliper, and seed weight was the mean of 50 seeds in triplicate. Oil extraction was performed using a Luzrise 1800 W Oil Press under varied conditions: temperatures of 0–200 °C and seed moisture of 0–10%. Oil color was measured by a spectrophotometer at 420, 520, and 620 nm. Density was determined by dividing the oil's weight by its volume. Viscosity was measured with a Rotary Viscometer. Odor was evaluated manually.

The results showed that Pinot Noir seeds were the largest, and Ruby Cabernet seeds were the smallest. Red grape seeds ranged from medium to dark brown, whereas white varieties exhibited a greenish-brown hue. Oil yield was strongly influenced by seed water content and extraction temperature, with an extraction rate of 7.2% observed at 6% water content and 49 °C. Seed separation rates were higher for red grapes (45% for Pinot Noir and 40% for Tempranillo) than for white varieties. Oil density ranged from 0.905 to 0.930 g/mL, with Pinot Noir demonstrating the highest density. Viscosity differences were negligible. Red seed oils showed greater yellow absorbance, while white seed oils were greener. Sensory evaluation found Syrah and Pinot Noir oils nutty and fruity, Chardonnay grassy, and others acceptable. Estimated revenue per ton of pomace reached USD 1450 for Pinot Noir, USD 678 for Tempranillo, and USD 457 for Syrah, suggesting grape seed oil can provide supplementary income for low-income farmers.

6.29. Valorization of Red Onion Skin: Thermal Stability and Potential of a Natural Dye for Industrial Applications

Nayana Hayss Araújo da Silva, Mariana Lopes Geraldo, Gabryelle Araújo Coutinho, Anielle Gomes Rabelo and Camila Argenta Fante

Laboratório de Tecnologia de Alimentos, Universidade Federal de Minas Gerais, Belo Horizonte 31270-901, Brazil

The red onion skin (CB), which accumulates more than 550 thousand tons per year, stands out for its high content of bioactive compounds such as phenolics, flavonoids, and anthocyanins, as well as for its potential application in the food industry, combining innovation and sustainability. In this context, the objective of this study was to obtain a natural dye from CB and characterize it in terms of its thermogravimetric properties (TGA). To obtain the natural dye, CB donated by the Zé Miúdos Cooperative, located in Macacos, MG, was used. The CB samples were washed with potable water to remove dirt, sanitized with sodium hypochlorite (200 mg/L), then frozen at −20 °C and freeze-dried at −46 °C for 72 h. The samples were ground and standardized using 80-mesh sieves, and the resulting natural dye (CNCB) was stored in glass jars protected from light until analysis. For TGA, 20–30 mg of CNCB was placed in an aluminum crucible under a nitrogen atmosphere, with a flow rate of 50 mL/min and a heating rate of 10 °C/min up to 600 °C. The TGA indicated an initial weight loss between 21 °C and 123 °C, corresponding to water evaporation. The

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range from 123 °C to 170 °C reflected the degradation of volatile compounds and the breakdown of hydroxyl side groups present in the anthocyanin structures. At around 273 °C, the decomposition of remaining compounds, such as phenolics and sugars, began. Above this temperature, the weight loss continued, likely due to ash decomposition. CNCB demonstrated thermal stability up to approximately 300 °C, highlighting its potential as a promising natural colorant for industrial applications. Utilizing red onion skin as a source of this dye presents a sustainable and innovative alternative to reduce agricultural waste, replace synthetic additives, and meet the growing demand for healthier and more environmentally friendly products.

6.30. Yield and Physicochemical Properties of Pili (Canarium ovatum) Pulp Oil

Nur Ainani Zuyyin Jinin [1], Jain Linton [2], Noor Atiqah Aizan Abdul Kadir [3], Bangun Prajanto Nusantoro [4] and Yanty Noorzianna Abdul Manaf [5]

1 Faculty of Food Science and Nutrition, University Malaysia Sabah, Jalan UMS, Kota Kinabalu 88400, Sabah, Malaysia
2 Sabah Agriculture Department, Lagud Sebrang Agriculture Research Centre, Peti Surat No. 197, Tenom 89908, Sabah, Malaysia
3 Nutrition in Community Engagement (NICE) Living Laboratory, Faculty of Food Science and Nutrition, Universiti Malaysia Sabah, Jalan UMS, Kota Kinabalu 88400, Sabah, Malaysia
4 Faculty of Agricultural Technology, Gadjah Mada University, Yogyakarta 55281, Indonesia
5 Halal Research Group, Faculty of Food Science and Nutrition, Universiti Malaysia Sabah, Jalan UMS, Kota Kinabalu 88400, Sabah, Malaysia

This research investigated the yield and physicochemical properties of pili (*Canarium ovatum*) pulp oil from Sabah, Malaysia. The oil was obtained through Soxhlet extraction. The oil extraction was performed at 60 °C for 8 h, using petroleum ether as a solvent. Although pili pulp oil has been studied in the Philippines, there are currently no available research reports on pili pulp oil originating from Malaysia. The yield of the extracted oil was 40.97%. The oil was green in colour and existed in liquid form at ambient temperature. The pili pulp oil had an iodine value, refractive index, and cloud point of 84.6 g I_2/100 g, 1.47 and 19 °C, respectively. The carotene content was 158.53 ppm and was measured through the spectrophotometric method. Gas chromatography combined with flame ionization detection (GC-FID) identified oleic (69.56%) and palmitic (19.80%) acids as the dominant fatty acids. These findings showed that this oil resembles edible, oleic-rich oils. The predominant triacylglycerols in pili pulp oil were triolein (OOO), palmitoyl diolein (POO), dioleoyl linolein (OOL), and dipalmitoyl olein (PPO). The quality indicators of the oil were evaluated, including free fatty acid (0.96 mg/g oil), peroxide (17.45 meq/kg), p-anisidine (14.45 meq/kg), and TOTOX (49.23 meq/kg) values. This study aims to provide basic information about Malaysian pili pulp oil, and an intensive investigation of the functional properties, toxicology, and potential product applications could be conducted in the future.

7. Session F: Sustainable Food Security and Food Systems

7.1. Apple Pomace as a Functional Ingredient for Sustainable Snack Innovation

Jahanvi Goswami

Department of Food Science and Technology, GB Pant University of Agriculture and Technology, Pantnagar 263145, India

Apple pomace, the fibrous by-product of juice extraction, is rich in dietary fiber, polyphenols, and other bioactive compounds. Despite its nutritional potential, over 4 mil-

lion tons of pomace are discarded annually, contributing to environmental degradation and resource wastage. In the context of growing demand for clean-label, sustainable foods, utilizing such agro-industrial residues offers a promising avenue for both nutritional enhancement and waste reduction.

This study explores the incorporation of dried and ground apple pomace into cereal-based flour for the development of extruded snacks. At the laboratory scale, formulations containing 15%, 20%, and 30% pomace were prepared. While constrained by basic processing tools, the product design drew on established findings. Previous research supports the feasibility of such incorporation: Reis et al. [25] demonstrated improved phenolic and fiber content in extruded products with up to 20% pomace, while Usman et al. [26] reported high sensory acceptability in bakery goods fortified with 10–25% pomace. Kawecka and Galus [27] highlighted that a 20–30% apple pomace addition contributes antioxidant properties without compromising product integrity.

Result: Our formulation trials reflected similar outcomes, with the 20% level offering an optimal balance of nutritional enrichment and product quality. The use of apple pomace as a functional ingredient aligns with the principles of circular economy and zero-waste food innovation. Its safety, biodegradability, and compatibility with food systems Kawecka and Galus [27] support its application in sustainable snack development.

By valorizing apple pomace, this study contributes to reducing food industry waste and advancing eco-conscious product design. As consumers increasingly seek functional, ethical, and clean-label products, incorporating fruit residues like pomace represents a vital step toward a more resilient and sustainable food system.

7.2. Adsorption of Natural Pigments of Mushroom Wastes Using a Heavy Metal—Nickel

Gamze Özçakır

Department of Chemical Engineering, Faculty of Engineering, Bilecik Seyh Edebali University, Bilecik TR 11100, Turkey

Edible mushroom wastes can be utilized in animal feed, fertilizer, wastewater treatment, and renewable energy, such as bioethanol and biohydrogen [28]. In addition, mushrooms naturally have pigments, and the adsorption of these pigments can allow them to be effectively used in the pharmaceutical, cosmetic, food, and textile industries [29]. Nickel, as one of the most studied heavy metals, has been utilized for water cleaning in the literature [30,31]. Hence, this study aimed to collect these pigments from edible mushroom wastes (stalk and cap) via adsorption. For this purpose, the wastes were first dried at 100 °C. Then, they were processed in a muffle furnace in stable air at 800 °C for 1 h. Then, adsorption was conducted in Ni(II) solutions (0.4–0.8 g/L) with 0.1 g dried mushroom waste at a 200 rpm shaking rate and at room temperature. Another sample was prepared that included only dried mushrooms and water and was subjected to the same adsorption process to observe the effect of nickel on natural pigment removal. At 45 min of adsorption, the sample concentrations were recorded as initial levels (t = 0 min). Then, concentrations over time were noted (t = 10, 20, 45 min). A UV-vis spectrophotometer was used to obtain absorbance values at a 400 nm wavelength. Based on these values, removal efficiency (RE, %) and adsorption capacity (AC, mg/g) were calculated. In addition, the most appropriate kinetic model was determined from the experimental values. Maximum RE and AC values were obtained at a 0.4 g/L Ni(II) solution concentration and a 45 min adsorption time, equaling 61% and 3783 mg dried mushroom pigment/g Ni(II). Furthermore, the most suitable kinetic model for all the studied Ni(II) solution concentrations was determined to be pseudo-second-order ($R^2 \geq 0.9$).

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7.3. Advancing Sustainable Food Systems Through Short Food Supply Chains: Insights from Slovenia

Špela Strnad [1], Mojca Jevšnik Podlesnik [1] and Urška Jamnikar Ciglenečki [2]

[1] Department of Sanitary Engineering, Faculty of Health Sciences, University of Ljubljana, 1000 Ljubljana, Slovenia

[2] Institute of Food safety, Feed and Environment, Veterinary Faculty, University of Ljubljana, Gerbičeva 60, 1000 Ljubljana, Slovenia

Short food supply chains are an innovative, sustainable approach emerging to address global food supply challenges by promoting closer relationships between producers and consumers, minimizing environmental impacts, and enhancing rural resilience. This is the first study to systematically examine the implementation of short food supply chains in Slovenia, investigating good practices, stakeholder challenges, and specific educational needs relevant to developing targeted capacity-building initiatives. Conducted within the framework of the Erasmus+ project Food Improviders, the research applies a quantitative cross-sectional design based on an online survey of Slovenian food producers.

The findings indicate that short food supply chains in Slovenia are predominantly characterized by direct sales, participation in local farmers' markets, and increasing use of national and European-level quality assurance schemes. However, significant barriers persist, including limited regulatory support, inconsistent enforcement of food hygiene regulations, and infrastructural constraints such as poor digital connectivity. Producers expressed a strong interest in further training, especially in food safety, marketing, and knowledge-sharing on best practices, with a preference for blended learning approaches, combining occasional in-person workshops with digital modules, and identified one to two trainings per year as optimal.

To our knowledge, this is the first empirical study of its kind conducted in Slovenia. It identifies priority areas for future development, including policy alignment, infrastructural investment, and the design of inclusive educational programs. The findings have broader implications for advancing sustainable food systems across Europe.

7.4. Cooking for Change: Evaluating the Impact of Sustainable Food Education on Eating Behavior

Yen-Cheng Chen [1], Pei-Ling Tsui [2] and Bo-Kai Lan [3]

[1] Department of Applied Science of Living, Chinese Culture University, Taipei 11114, Taiwan

[2] Department of Hospitality Management, National Taitung Junior College, Taitung 95045, Taiwan

[3] Program in Nutrition and Food Science, Fu Jen Catholic University, New Taipei City 242062, Taiwan

This study investigates the effects of a sustainability-oriented food education program on participants' dietary behavior and ecological awareness. The instructional framework integrates key principles of global food security, environmental sustainability, and responsible consumption, in alignment with the United Nations Sustainable Development Goals (SDGs), specifically SDG 2 (Zero Hunger) and SDG 12 (Responsible Consumption and Production). The curriculum combines theoretical instruction with experiential culinary activities, emphasizing the use of locally sourced ingredients, plant-based protein alternatives, food waste reduction, and energy-efficient cooking practices. A quasi-experimental design was employed, involving an experimental group and a control group, both receiving equivalent sustainability-focused content. Data were collected through validated instruments assessing sustainability knowledge and health-oriented eating behaviors. Analytical procedures using partial least squares structural equation modeling (PLS-SEM) were

conducted to evaluate the mediating role of sustainability education in the relationship between pedagogical intervention and behavioral outcomes. Results indicate that participants exposed to the full intervention demonstrated significantly greater improvements in dietary attitudes, awareness of sustainable practices, and behavioral engagement. Furthermore, sustainability education was found to fully mediate the pathway from instruction to behavior change. These findings highlight the value of integrating sustainability pedagogy into food education, offering empirical support for the development of transformative, behaviorally anchored curricula that foster responsible eating habits in response to global food and environmental challenges.

7.5. Determining Environmental Sustainability of Polyphenol and Cellulose Recovery from Olive Leaves via Life Cycle Assessment

Roberta Palmieri, Hamid Mushtaq, Simona Piccolella and Severina Pacifico

Department Environmental, Biological and Pharmaceutical Sciences and Technologies, University of Campania "Luigi Vanvitelli", Via Vivaldi 43, 81100 Caserta, Italy

The increasing focus on sustainable agricultural practices and the circular bioeconomy has driven interest in the valorization of agro-industrial residues. Olive leaves (OLs), a by-product of pruning operations, represent a rich source of bioactive compounds such as polyphenols, as well as structural materials like cellulose. This study aims to assess the environmental sustainability of a novel biorefinery process developed to extract polyphenols and cellulose from Olea europaea L. cv. Caiazzana leaves using a Life Cycle Assessment (LCA) approach. The LCA was conducted in accordance with international standards, adopting a cradle-to-gate system boundary. The functional unit was defined as 1 kg of OLs processed. Primary data were collected from laboratory-scale experiments, while secondary data were sourced from the Ecoinvent database. The process flow included mechanical pretreatment, polyphenol extraction, separation and purification steps, and cellulose recovery from the residual biomass. The environmental impacts were assessed using the ReCiPe 2016 Midpoint and Endpoint method. The LCA revealed that the main environmental hotspots were energy consumption during the drying and extraction phases and the use of chemical reagents. The most affected impact categories included climate change, freshwater eutrophication, and human toxicity. However, the co-extraction of high-value polyphenols and cellulose significantly improved the process's eco-efficiency. A sensitivity analysis indicated that replacing fossil-based electricity with renewable sources could reduce the total GHG emissions by over 40%. The valorization of OL pruning residues into bioactive compounds and cellulose presents a promising strategy to reduce agro-industrial waste and promote resource efficiency. Integrating LCA in early-stage process development highlights potential environmental trade-offs and improvement opportunities, supporting the transition toward sustainable and circular agricultural systems.

7.6. Public Territorial Promotion Tools to Strengthen Local Agri-Food Systems: The "Torino Doc" Case in Support of Gi Wines

Giovanni Peira [1] and Sergio Arnoldi [2]

[1] Department of Management "Valter Cantino", University of Turin, 10134 Torino, Italy
[2] Torino Chamber of Commerce, Turin, 10121 Piedmont, Italy

Across Europe, Geographical Indications (GIs) are crucial for enhancing food quality and fostering rural development, particularly in the wine industry. Official certifications like PDOs (DOCG and DOC in Italy) provide a legal framework that safeguards the connection between a product and its geographical origin. However, there has been a growing interest in alternative quality labels—those developed and promoted by various institutions—that can help local producers gain visibility and recognition.

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This paper delves into the Torino DOC initiative, spearheaded by the Chamber of Commerce of Turin. The program focuses on selecting and promoting wines from provinces that already hold a DOCG or DOC status, intending to showcase their unique identity and help them tap into broader markets.

This research, conducted from January to May 2025, relies on a desk analysis that draws from three primary sources: regulatory and policy documents; communication materials from Torino DOC (including the website, social media, and printed guides); and a dataset collected via an online questionnaire, including information about the winery, wine production, prices, certifications (such as organic and SQNPI), distribution channels, and sustainability practices. An updated guide is expected by the end of 2025.

Initial findings indicate that Torino DOC enhances existing GIs by reinforcing values such as authenticity and a strong connection to the land. It also supports smaller wineries by providing curated promotions, tastings, and opportunities to participate in events and fairs.

Over time, some of the data will be utilised to track wine characteristics and their evolution, creating historical records that can aid research on climate change in viticulture. More broadly, this case illustrates how voluntary, transparent, and independent programs can bolster sustainable food systems and inspire similar initiatives in other regions.

7.7. A Study of Regression Analysis on Food Price Fluctuation in Developing Countries—A Case Study of Kenya

Collins Oduor Ondiek

United States International University Africa, Nairobi P.O. Box 14634-0800, Kenya

Discussions on the state of food price fluctuations come hand in hand with the challenge of food insecurity. Food insecurity is a systemic problem all over the world. Data provided by the Food and Agriculture Organization, according to the Global Report on Food Crises (GRFC) 2025, show that an estimated number of 295 million people worldwide experienced some form of food insecurity in 2024. The report highlights that acute food insecurity and malnutrition are worsening, with a rise in the number of people experiencing severe hunger. The Government of Kenya has in the past deployed some interventions to solve food insecurity through efforts mainly on supply-side food production issues, such as subsidized farm inputs, affordable farm machinery, pesticides, and fertilizers. There is scarce empirical research conducted on food price instability, especially in the developing world. Furthermore, there is also an urgent need to develop a system that tracks and catalogs efforts made to tackle food price fluctuations. Other factors affecting food inflation are still unresolved, such as fuel costs, currency exchange rates, climate change, low investments in R&D, high cost of agricultural inputs, high cost of fuel, punitive export policies, increased capacity of food banks for relief efforts, etc. This study investigated these factors contributing to food price fluctuations in Kenya. This paper expounds on the use of regression analysis to analyze food price movements in Kenya with the intention of predicting and implementing policies beforehand to avoid food price shocks. Food prices are at the heart of food security, which is a challenge in the developing world. Progress in food price fluctuations can only be realized by comparing how the situation has changed over time, and statistical techniques such as regression analysis provide a good starting point for the data-driven decision-making processes required in carefully evaluating food price volatility to solve this systematic problem.

7.8. Alternative Proteins in Pet Food: A Sustainable, Nutritious Future or Just a Trend?

Antonia Charalampos Mataragka

Laboratory of Anatomy and Physiology of Farm Animals, Department of Animal Science, School of Animal Biosciences, Agricultural University of Athens, 11855 Athens, Greece

The pet food industry is undergoing a significant transformation as sustainability concerns, ethical considerations, and nutritional advancements necessitate the transition to alternative protein sources. Traditional protein ingredients such as beef, poultry, and fish contribute to environmental degradation and resource depletion, necessitating the exploration of novel, eco-friendly alternatives. The potential of alternative protein sources in pet nutrition as a response to the dual challenge of meeting high dietary protein requirements and reducing the environmental impact of traditional pet feeds seems promising. Protein is a critical component in pet diets, with requirements ranging from 18% to 22% for dogs and 26% to 30% for cats on a dry basis. However, conventional dry pet food production contributes 56–151 Mt of CO_2-equivalent emissions annually, utilizes 41–58 Mha of agricultural land, and consumes 5–11 km^3 of freshwater, accounting for up to 2.9%, 1.2%, and 0.4% of global agricultural resource use, respectively.

Insect-based proteins offer high protein (25–70%) and lipid (10–50%) contents with a lower water, land, and carbon footprint. Single-cell proteins derived from yeast, fungi, or algae can be cultivated using a variety of substrates, including agricultural waste and industrial by-products. The potential of these alternative protein sources is promising in terms of resource-efficient solutions. While these alternatives offer comparable nutritional value and digestibility to conventional protein sources, safety and regulatory challenges remain, particularly concerning allergenicity and anti-nutritional factors, potential contaminants, and strict standards imposed on single-cell proteins. Future research should focus on mitigating potential risks while establishing robust regulatory frameworks to facilitate widespread adoption of sustainable protein alternatives in pet nutrition.

7.9. Application of Agro-Industrial Biomasses as a Strategy to Increase the Sustainable Bioeconomy in the Amazon

Orquidea Vasconcelos Santos [1], Mayara Galvão Martins [2], Helen Cristina Oliveira Palheta [3], Jade Vitória Duarte de Carvalho [3], Railanni dos Santos Cantão [4], Andrei de Oliveira Ramos [4] and Amanda Ramos Soares [4]

1 Federal University of Pará, Belém 66075-110, Brazil
2 Instituto Mamirauá de Desenvolvimento Sustentável—IMDS-CNPQ, Tefé 69553-225, Brazil
3 Graduate Program in Food Science and Technology (PPGCTA), Federal University of Pará (UFPA), Belém 66075-110, Brazil
4 Institute of Health Sciences, Faculty of Nutrition, Federal University of Pará, Belém 66075-110, Brazil

Biomasses from agro-industrial practices in the Amazon have generated significant inputs in the last decade for the development of projects and the extension of more sustainable production chains, based on the results of research, on a laboratory scale, pilot scales and in rapid expansion in industrial scaling. The rise in the use of biomass from raw materials of the so-called superfruits are notable examples: açaí (Euterpe oleracea Mart.), Brazil nut (Bertholletia excelsa HBK), pupunha (Bactris gasipaes Kunth), tucumã (Astrocaryum aculeatum) and buriti (Mauritia flexuosa) are examples of great prominence in the region's trade balance, contributing significantly to the import of products and by-products from Brazil. In view of the above, this research aims to present the nutritional, functional and technological properties of these biomasses as an element of industrial innovation in the use of isolated constituents in various segments of the food, pharmaceutical, dermocosmetic and packaging industries. The data show that research has been guided and deepened in protein, fibrous and starch-based biopolymers contained in these biomasses,

with greater emphasis on investigations in isolation and applications of bioactive compounds and starches and fibers in the development of films and packaging with good resistance properties and high environmental biodegradability, being economically viable as food coatings, acting in synergy with the application of technologies and the increase in the sustainable circular bioeconomy in the Amazon, combining techno-economic and environmental development in the most diverse industrial segments.

7.10. Bell Pepper (Capsicum annuum) Production in Protected Environments in the Dominican Republic: Optimization of Fertigation and Substrate

Ángel Radhamés Pimentel Pujols [1], Fernando Borrás [2], Juana Fernández López [3] and José Miguel García [4]

[1] Faculty of Agronomic and Veterinary Sciences, School of Agronomic Engineering, Universidad Autónoma de Santo Domingo, Santo Domingo 11005s, Dominican Republic
[2] Department of Statistics and Operational Research, Miguel Hernández University of Elche, 03202-Elche, Alicante, Spain
[3] Institute of Agri-Food and Agro-Environmental Research and Innovation, Miguel Hernández University of Elche (CIAGRO-UMH), 03312-Orihuela, Alicante, Spain
[4] Dominican Institute of Agricultural and Forestry Research (IDIAF), Dominican Republic

In 2022, global vegetable production exceeded 1.2 billion tons, with bell peppers accounting for 37 million tons. This crop is essential due to its versatility and nutritional value. In the Dominican Republic, greenhouse vegetable production has grown over the past 23 years, exceeding 10 million m^2. Specifically, bell pepper production increased from 9122 to 32,000 tons over two decades. However, there is limited documented information on the influence of various management factors (fertigation and type of substrate, among others) on fruit yield and nutritional quality.

This study evaluated the effects of three fertigation programs (EC in the ranges of 1.2 to 1.9, 1.2 to 2, and 1.4 to 2.2 dS/m, respectively) and substrate types (rice husk biochar, coconut fiber, and a 50/50 mix of both) on bell pepper productivity and quality under protected conditions. The experiment followed a split-plot design with four replications. Evaluated variables included plant height, first internode diameter, canopy width, chlorophyll and nitrogen levels, leaf temperature, fruit size, yield, and Brix degree.

The rice charcoal substrate and its mixture with coconut fiber significantly outperformed coconut fiber alone in terms of fruit weight, diameter, and length. No significant interaction effects were observed ($p > 0.05$). Brix values ranged from 5.20 to 7.9, averaging 6.50. Fruit size in the rice charcoal substrate increased by 28% compared to coconut fiber; program three significantly outperformed program one by 27% in yields. The biochar substrate, combined with the highest nutrient dose, produced the best results.

In conclusion, bell pepper responds significantly to high nutrient doses and shows better adaptation to rice husk biochar as a substrate. The optimization of pepper crop management in a protected environment through the control of fertigation and substrate would increase the productivity of this crop in the Dominican Republic and improve the quality of the fruit obtained.

7.11. Bioaccumulation of Microplastics in Wheat and Maize

Slaveya Petrova [1,2], Bogdan Nikolov [1], Petar Mandaliev [3], Georgi Stanchev [4], Ekaterina Valcheva [5], Tatyana Bileva [5], Veska Kashorova [1], Plamen Marinov-Serafimov [6], Irena Golubinova [7] and Nadezhda Petkova [8]

[1] Department of Ecology and Environmental Conservation, Faculty of Biology, University of Plovdiv "Paisii Hilendarski", 4000 Plovdiv, Bulgaria

[2] Department of Microbiology and Ecological Biotechnologies, Faculty of Plant Protection and Agroecology, Agricultural University, 4000 Plovdiv, Bulgaria
[3] Institute of Bioenergy and Resource Efficiency, University of Applied Sciences Northwestern Switzerland (FHNW), Klosterzelgstrasse 2, 5210 Windisch, Switzerland
[4] Agricultural University, 12 Mendeleev Blvd, 4000 Plovdiv, Bulgaria
[5] Department of Agroecology, Faculty of Plant Protection and Agroecology, Agricultural University, 12 Mendeleev Blvd, 4000 Plovdiv, Bulgaria
[6] Institute on Decorative Plants, Negovan, Bulgaria
[7] Agricultural Academy, Institute of Decorative and Medicinal Plants, Negovan, 1222 Sofia, Bulgaria
[8] Department of Organic and Inorganic Chemistry, University of Food Technologies, 4002 Plovdiv, Bulgaria

Microplastics can not only enter agricultural lands through direct application of plastic materials (for mulching, etc.) but also by means of sewage sludge, composts, etc. From the soil, they easily pass into living organisms, where they can cause disruptions of biological functions, physiological processes, and reproduction, as well as lead to the accumulation of pollutants in biomass and along food chains, inevitably increasing the risk to human health. In this context, it is of great importance to clarify the potentially toxic effects of microplastics on plants, as well possibility of them entering and accumulating in different tissues and organs. The aim of the present study was to assess the potential of wheat and maize to absorb microplastics from the soil through their root systems and the transfer and accumulation of microplastics in underground and aboveground plant organs. Two types of fluorescent plastic particles were used in experiments conducted under controlled conditions, and the different plant organs were observed using a fluorescent microscope. The penetration and accumulation of microplastics from the two studied fractions (27–32 μm and 75–90 μm) were detected in all the organs of the test plants—the roots, stem, and leaves. We established a statistically significant impact of microplastics on the growth and synthesis of biomass in both underground and aboveground organs, with the degree of their impact depending on the type of plant and the size of the plastic particles. Polyethylene microplastics have an effect on the biosynthesis of photosynthetic pigments, and hence on the intensity of the photosynthesis process, with this effect being positive in corn and negative in wheat.

7.12. Bioeconomy in the Dairy Industry: Application of Buttermilk in Kefir Production

Herlândia Cotrim Santos [1], Valéria Silva de Lana [2], Eliara Acipreste Hudson [1], Izabela Maria Montezano de Carvalho [2], Maria do Carmo Gouveia Peluzio [2] and Ana Clarissa dos Santos Pires [1]

[1] Departamento de Tecnologia de Alimentos, Universidade Federal de Viçosa, Viçosa 36570-900, MG, Brazil
[2] Departamento de Nutrição, Universidade Federal de Viçosa, Viçosa 36570-900, MG, Brazil

Buttermilk, a co-product generated during butter production, has high nutritional value; however, it is often underutilized by small- and medium-sized dairy industries in developing countries. This study aimed to evaluate the use of different proportions of whole milk and buttermilk (100:0; 80:20; 60:40; 40:60; 20:80; and 0:100) for kefir production, with the goal of adding value to this co-product and promoting bioeconomy principles in the dairy sector. A 100% milk formulation was used as the control. The proximate composition, kefir grain biomass growth over 21 days, syneresis, and water retention capacity (WRC) were evaluated. The results showed that increasing the proportion of buttermilk led to a linear increase in moisture content (from 89.70% to 96.57%) and a significant decrease in fat

(from 3.05% to 0.55%), protein (from 3.43% to 1.89%), and carbohydrate content (from 3.34% to 0.63%). Regarding kefir grain growth, formulations with higher milk content (100%, 80%, and 60%) showed the greatest increases in biomass (150.00 g, 105.50 g, and 107.60 g), respectively. Conversely, kefir produced exclusively with buttermilk (100%) reached only 16.62 g, indicating that whole milk provides more favorable nutritional conditions for grain development. WRC decreased with increasing amounts of buttermilk: 100% milk (52.42%), 80% (42.42%), 60% (33.91%), 40% (29.55%), 20% (23.01%), and 0% milk (18.58%). This is likely due to buttermilk's lower protein content (1.76%) compared to milk (3.00%). On the other hand, syneresis increased proportionally with the buttermilk content, ranging from 31.92% (100% milk) to 73.92% (100% buttermilk), suggesting weaker and less stable gel structures favoring greater phase separation. Therefore, partial replacement of milk by buttermilk in kefir production proved viable up to the 40% level, maintaining acceptable physicochemical and technological characteristics. The inclusion of buttermilk contributes to the valorization of an underutilized co-product, promoting sustainable alternatives aligned with bioeconomy principles in the dairy industry.

7.13. Bioremediation of Bacteria, Histamine, and Animal DNA by Black Soldier Fly Larvae for Safe Food Waste Valorisation

Joana Oliveira [1], Carolina Ligeiro [1,2], Carina Carvalho [1], Clarice Souza [1,2], Miguel L. Grilo [1,3], Rafaela Fantatto [1,2], Alexandre Trindade [1], Daniel Murta [1,2] and Ricardo Assunção [1,4]

1 Egas Moniz Center for Interdisciplinary Research (CiiEM), Egas Moniz School of Health & Science, Caparica, 2829-511 Almada, Portugal
2 Ingredient Odyssey S.A.—EntoGreen, Rua Cidade de Santarém 140, 2005-079 Santarém, Portugal
3 MARE–Marine and Environmental Sciences Centre/ARNET–Aquatic Research Network, Ispa–Instituto Universitário de Ciências Psicológicas, Sociais e da Vida, Rua Jardim do Tabaco 34, 1149-041 Lisbon, Portugal
4 National Institute of Health Dr. Ricardo Jorge, Food and Nutrition Department, Av. Padre Cruz, 1649-016 Lisboa, Portugal

By 2050, the global population is expected to reach 9.8 billion, increasing pressure on agri-food systems and worsening food waste. In the EU, around 59 million tonnes of food is wasted annually, enough to feed 42 million people per year. This waste has major public health impacts. Managing it through safe, sustainable strategies is essential. Black soldier fly larvae (BSFL; *Hermetia illucens*) offer a promising solution by converting food waste into high-value products: protein, fat, and organic fertiliser. However, EU legislation currently prohibits using food waste as insect feed due to possible contamination with prions and other foodborne hazards such as bacteria and histamine. This study evaluates the food safety potential of BSFL by assessing their ability to reduce pathogenic bacteria and histamine, and to determine whether they bioaccumulate animal DNA (pork, beef, chicken). To test this, 2 tonnes of heterogeneous food waste was transformed into BSFL substrate and used as the test group in a bioconversion assay. Larvae in the test group showed improved performance, with higher bioconversion, growth rates, and a lower feed conversion ratio compared to the control group. Analyses were conducted on food waste substrate, larvae, BSFL meal, and frass, including controls. Bacterial enumeration followed ISO protocols; histamine was quantified using an ELISA kit; DNA was extracted and then analysed via PCR and agarose gel electrophoresis. BSFL significantly reduced *Salmonella* spp. and *Vibrio* spp. in the test group ($p = 0.002$), and *Bacillus cereus* and *Vibrio* spp. in the control ($p = 0.015$). Histamine levels decreased significantly ($p = 0.029$). No animal DNA was detected in larvae ($p = 0.029$), though traces persisted in frass, indicating excretion

rather than bioaccumulation. These findings support the safe use of BSFL in food waste valorisation and their integration into circular, One Health food systems focused on safety and sustainability.

7.14. Biostimulant Effects of Brown Macroalgae and Arbuscular Mycorrhizal Fungi on the Yield and Quality of a Yellow Tomato Landrace

Soumaya Abidi [1], Alessio Vincenzo Tallarita [2], Eugenio Cozzolino [3], Vasile Stoleru [4], Otilia Cristina Murariu [5], Amina Abidi [6], Roberto Maiello [2], Vincenzo Cenvinzo [2], Pasquale Lombardi [7], Antonio Cuciniello [3], Lamia Hamrouni [6], Gianluca Caruso [2] and Rafik Balti [8]

1 Laboratory of Functional Physiology and Valorization of Bioresources, Higher Institute of Biotechnology of Beja, University of Jendouba, Avenue Habib Bourguiba, Beja BP 382 9000, Tunisia
2 Department of Agricultural Sciences, University of Naples Federico II, Portici, 80055 Naples, Italy
3 Council for Agricultural Research and Economics (CREA)-Research Center for Cereal and Industrial Crops, 12 81100 Caserta, Italy
4 Department of Horticultural Technologies, 'Ion Ionescu de la Brad' University of Life Sciences, Iasi, Romania
5 Department of Food Technologies, 'Ion Ionescu de la Brad' University of Life Sciences, Iasi, Romania
6 Institut National de Recherche en Génie Rural, Eaux et Forêts, BP 10, Ariana 2080, Tunisia
7 Research Center for Vegetable and Ornamental Crops, 84098 Pontecagnano Faiano, Italy
8 CentraleSupélec, Laboratoire de Génie des Procédés et Matériaux, Centre Européen de Biotechnologie et de Bioéconomie (CEBB), Université Paris-Saclay, 3 rue des Rouges Terres, 51110 Pomacle, France

Improving crop productivity while minimizing reliance on chemical fertilizers and pesticides is a central challenge in sustainable agriculture. In this context, plant biostimulants such as brown macroalgae and arbuscular mycorrhizal fungi (AMF) have emerged as effective tools to enhance crop performance by stimulating physiological processes, increasing nutrient use efficiency, and improving stress resilience. This study investigated the effects of three brown macroalgae species (*Padina pavonica*, *Fucus vesiculosus*, and *Cystoseira tamariscifolia*) and AMF, applied individually or in combination, on the growth, yield, fruit quality, and antioxidant activity of a traditional yellow tomato (*Solanum lycopersicum* L.) landrace. A two-year field experiment was conducted using a randomized complete block design, with eight treatments, including a non-treated control. Biostimulants were applied at transplanting and subsequently via root application. Among the treatments, *P. pavonica*—particularly when combined with AMF—showed the most promising results. This treatment led to the highest fruit yield (57.3 t ha^{-1}), an increase in the fruit number per plant (20.4 fruits/plant), and a greater total biomass (1.21 kg/plant). Fruit quality was also improved, with significant increases in soluble solids content (4.6 °Brix), firmness (1.42 kg/m^2), and brightness (L^* value of 61.2). Moreover, the *P. pavonica* + AMF treatment induced the strongest antioxidant response, with elevated levels of CAT (2.45 µmol min^{-1} mg^{-1} protein) and GPOX (23.71 µmol min^{-1} mg^{-1} protein) activities. These findings underline the synergistic potential of combining macroalgal extracts with mycorrhizal fungi to sustainably enhance both the yield and nutritional value of tomatoes. This approach offers a viable and environmentally friendly alternative for improving horticultural performance in reduced-input systems.

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7.15. Buriti Oil as an Additive in Biodegradable Polysaccharide- and Protein-Based Films: Towards Sustainable Food Packaging Systems

Barbara Luiza Da Silva Freitas, Noemi de Paula Almeida, Gabriela Santos Costa, Adriana Silva Franca and Leandro Soares Oliveira

Ciência de Alimentos da Faculdade de Farmácia do Campus Pampulha, Universidade Federal de Minas Gerais, Belo Horizonte 31275-025, Brazil

The escalating environmental concerns associated with conventional plastics drive an urgent search for more sustainable food packaging solutions, with particular emphasis on biodegradable films derived from biopolymers. In this context, the valorization of agro-industrial waste, often rich in polysaccharides and proteins, represents a promising strategy. This study investigated the development and characterization of biodegradable films based on citrus pectin and isolated sunflower seed protein (PISG), both individually and in blends (Pectin/PISG 25:75). Buriti oil was evaluated as a potential plasticizing agent, partially (50%) and totally (100%) replacing glycerol. Films were produced via the casting method and characterized in terms of moisture content, water solubility, optical, barrier, mechanical, and thermogravimetric properties, as well as their biodegradability. The results demonstrated that the substitution of glycerol with buriti oil significantly altered the films' properties. A general trend of reduced moisture content and water solubility was observed with increasing oil content, particularly evident in protein-based films. Regarding optical properties, oil incorporation intensified the color in all formulations, with a more pronounced effect in protein matrices. The barrier properties were positively influenced by adding oil, showing a reduction in both water vapor and oxygen permeability. However, the complete replacement of glycerol led to a marked loss of flexibility and increased brittleness in the films, particularly for protein-based formulations. Thermogravimetric analysis indicated that buriti oil generally enhanced the thermal stability of the films. Biodegradability was modulated, with oil-containing films exhibiting a longer degradation time, suggesting improved durability without compromising their inherent biodegradability. In conclusion, buriti oil is a promising additive for enhancing the hydrophobicity and barrier properties of pectin and sunflower seed protein films. Nevertheless, optimizing its mechanical properties, potentially through its combination with other plasticizers or by improving incorporation techniques, is crucial for its successful application in sustainable food packaging systems.

7.16. Buriti Oil as an Additive in Carbohydrate-Based Biodegradable Films: Towards Sustainable Food Packaging Systems

Barbara Luiza Da Silva Freitas, Noemi de Paula Almeida, Layla Talita de Oliveira Alves, Adriana Silva Franca and Leandro Soares Oliveira

Ciência de Alimentos da Faculdade de Farmácia do Campus Pampulha, Universidade Federal de Minas Gerais, Belo Horizonte 31275-025, Brazil

In response to the growing environmental challenges posed by the improper disposal of plastic food packaging and the urgency to valorize natural resources and agri-food waste, science relentlessly seeks more sustainable approaches, and the use of food waste-based biopolymers represents a promising alternative. Therefore, this work evaluated the use of buriti oil as a potential plasticizing agent in biopolymeric films from different carbohydrate-based matrices, namely, locust bean gum (LBG) and starch (extracted from cassava peel and inner bark), both individually and blended. The films were prepared via casting and characterized in terms of their optical (color and opacity), barrier, and mechanical properties, as well as their biodegradability. The main findings indicated that the incorporation of buriti oil significantly influenced the film characteristics, with different effects depending

on the polymeric material's composition. Replacement of glycerol by buriti oil led to increases in luminosity for all films, while color saturation only increased for the pure LGB and blended films. Film opacity increased for the LBG film but decreased for the films containing starch. There was a significant reduction in oxygen and water permeability for the LGB-based film. The materials' biodegradability was positively affected, allowing for prolonged shelf life without compromising their natural decomposition. However, this substitution also led to non-uniformity in LBG/starch films. Furthermore, the complete replacement of glycerol with buriti oil, particularly for films prepared with cassava starch, resulted in a drastic reduction in flexibility and increased fragility, indicating that the oil cannot be employed as the only plasticizer. Nevertheless, the use of buriti oil as an additive or as a partial substitute for glycerol led to interesting results in terms of barrier properties without compromising the film's desired resistance and flexibility, indicating buriti oil as a promising additive for the development of biodegradable films.

7.17. Can Bees Be Considered as Proactive Microplastic Samplers?

Vlatka Mikulec [1], Želimira Cvetković [1], Petra Adamović [2] and Martina Ivešić [1]

[1] Andrija Stampar Teaching Institute of Public Health, 10 000 Zagreb, Croatia
[2] Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, 10000 Zagreb, Croatia

Microplastics (MPs), pervasive pollutants found in various environmental matrices, pose growing ecological and health concerns. Honeybees (Apis mellifera carnica), owing to their broad foraging behavior and environmental sensitivity, have been proposed as potential bioindicators for environmental pollution, including microplastics. This study investigates whether honeybees can act as proactive samplers of MPs in urban environments. Over a one-year period, 1215 honeybee specimens were systematically collected from nine distinct urban locations in Croatia, with standardized protocols ensuring consistency in hive sampling, processing, and analysis. The collected bees underwent a multi-step laboratory protocol involving physical separation, chemical digestion, and stereomicroscopic examination for the presence of MPs, categorized by size, shape, and color. Despite the comprehensive and rigorous sampling and analytical procedures, no microplastic particles were detected on or within the bee specimens. The absence of MPs may reflect the relatively low environmental contamination at the selected sampling sites, which were intentionally chosen to avoid heavy industrial or traffic-related sources. Additionally, reduced human activity during the COVID-19 pandemic may have further contributed to lower microplastic presence. These findings emphasize the need for broader and more diverse sampling efforts across different environmental contexts and beekeeping practices to validate the initial results. Future studies involving private apiaries and expanded geographical coverage could offer deeper insights into the feasibility of using honeybees as sentinel organisms for microplastic monitoring.

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7.18. Claiming Food Ethics as a Pillar of Food Security—Insights from the Romanian Context

Ioana Mihaela Balan and Teodor Ioan Trasca

[1] University of Life Sciences "King Mihai I" from Timisoara, 300645 Timisoara, Romania
[2] University of Agronomic Sciences and Veterinary Medicine of Bucharest, 011464 Bucharest, Romania

Introduction: While food security is classically defined by four pillars—availability, access, utilization, and stability—emerging evidence suggests that these categories are insufficient to address the moral contradictions within modern food systems. In the European Union, over 20% of all food is lost or wasted, while 42 million people are unable to afford a healthy daily meal. Romania mirrors this paradox: high levels of food waste coexist with persistent food insecurity.

Methods: This study adopts a qualitative approach grounded in secondary data analysis from Eurostat, FAO, and Romanian national authorities, along with a conceptual inquiry into food ethics as a missing dimension of food security. It examines the broader legislative and behavioral context in Romania, including national policies and recent regulatory measures aimed at reducing food waste and promoting responsible consumption.

Results: Romania generates over 2.2 million tonnes of food waste per year, with 70% originating from households, retail, and food services. Simultaneously, 14.7% of the population reports being unable to afford a protein-based meal every other day. Only 12% of consumers take ethical considerations into account when discarding food. Romania's legislation now requires food operators to prioritize donation and reuse, indicating a shift toward institutionalized ethical responsibility.

Conclusions: The current food security framework must be expanded to include ethical responsibility as a core dimension. This includes recognizing the role of food citizenship: the active engagement of individuals and communities in shaping just, sustainable, and inclusive food systems. An "ethical pillar" would enable the assessment of food systems not only by quantity and access but also by fairness, responsibility, and sustainability of use. Romania represents a relevant case study where legal and civic mechanisms converge, pointing to scalable pathways for integrating food ethics and food citizenship into national and European food policies.

7.19. Combining Pectin and Sunflower Seed Protein for the Development of Biodegradable Films with Potential Application in Food Packaging

Noemi de Paula Almeida [1], Bárbara L. S. Freitas [1], Layla T. O Alves [1], Leandro S. Oliveira [2] and Adriana S. Franca [2]

[1] PPGCA, Universidade Federal de Minas Gerais, Belo Horizonte 31270-901, MG, Brazil
[2] DEMEC, Universidade Federal de Minas Gerais, Belo Horizonte 31270-901, MG, Brazil

The packaging used for food products is mostly made of synthetic polymeric materials, especially plastics, which contribute significantly to greenhouse gas emissions and the contamination of terrestrial and aquatic environments. Given the growing demand for environmentally responsible solutions, biopolymers from renewable sources, such as carbohydrates and proteins extracted from agro-industrial wastes, are emerging as promising alternatives for the development of sustainable packaging materials. In this context, this study aimed to develop and characterize biopolymeric films formulated from isolated sunflower seed protein combined with commercial citrus pectin in different proportions. The films were prepared by casting and characterized in terms of their optical, barrier, and mechanical properties and thermal stability. Increases in the amount of pectin added led to increases in film luminosity. All the prepared films showed complete soil degradation after 10 days of exposure, except those with higher amounts of pectin (80 and 100%). The main results showed that there was no linear correlation between the pectin/protein ratio and barrier, mechanical or thermal properties. Nonetheless, the addition of pectin led to films that were more rigid and less flexible. Regarding oxygen and water vapor barrier properties, the film containing 80% protein and 20% pectin exhibited the lowest permeability values. It was concluded that it is feasible to produce films based on pectin

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combined with protein isolated from sunflower seeds, representing a sustainable alternative to conventional plastic packaging.

7.20. Consumers' Evaluation and Perception of the Threatened with Abandonment Orino of Epirus (Oe) Sheep of Greece

Dimitris Skalkos and Ioanna. Kosma

Laboratory of Food Chemistry, Department of Chemistry, University of Ioannina, 45110 Ioannina, Greece

Introduction: The loss of local sheep breeds, such as the *Orino of Epirus* (Mpoutsiko) [OE] sheep, poses a threat to the nutritional and livelihood security of present and future generations. The objective of this study is to assess consumers' evaluations and perceptions of the OE sheep in the Epirus region of Greece.

Method: During the Eastern period in April 2025, OE sheep were sold by selected local butcher shops to consumers for the traditional Eastern meal, which is based on roasted lamb on Eastern day. Afterwards, consumers' evaluations and perceptions of the meat they ate were assessed via a survey conducted in person in May 2025 among 30 consumers who had eaten OE sheep. The consumers evaluated the 10 quality criteria for consuming OE sheep compared to the conventional sheep they usually eat. These criteria were "appearance", "smell", "taste", "aroma", "tenderness", "juiciness", "less fat", "named meat", "value for money", and "willingness to pay more." The scale used for the answers for each criterion was expanded from "partly not preferred" to "highly preferred".

Results: Consumers indicated a significant preference for the OE meat as compared with the conventional, no-name meat they had used so far. Most answers for the use of OE sheep were between "moderately" to "highly preferred" while most answers for the use of the conventional sheep were between "slightly preferred" to "a little more preferred". The results for each of the criteria will be presented at the conference.

7.21. Development of Gluten-Free, Vegan, and Protein-Rich Bread Using Response Surface Methodology

Jaspreet Kaur

Dr. ssb Uicet Panjab University Chandigarh, Chandigarh 160014, India

The demand for gluten-free and vegan bakery products has increased due to rising health concerns and dietary restrictions. Celiac disease is affecting a larger number of people nowadays, which is making people switch from wheat products to gluten-free ones that are gluten-free. This study aimed to develop a nutritionally enhanced, gluten-free, and vegan bread using alternative flours such as brown rice flour, chickpea flour, flaxseed flour, gram flour, and psyllium husk to improve texture, structure, and sensory properties. Response surface methodology (RSM) was applied to optimize ingredient proportions and formulation. The final optimized bread formulation consisted of 3% flaxseed flour, 16% brown rice flour, 8% gram flour, 8% chickpea flour, 10% olive oil, and 3% psyllium husk. A total of 33 experimental trials were conducted to assess the effects of these ingredients on specific volume, loaf height, moisture loss, and overall acceptability. The model's suitability was validated using analysis of variance (ANOVA) and residual plots, ensuring statistical reliability. The proximate analysis of the developed bread showed protein, fat, carbohydrate, sugar, and energy content of 6.74%, 5.0%, 45.35%, 5.29%, and 253 kcal/100 g, respectively, making it a nutritionally balanced option. The study demonstrates that optimizing gluten-free and vegan bread formulations can lead to a product with desirable sensory and structural attributes. The findings of this study contribute valuable insights into the development of plant-based, gluten-free bakery products that meet consumer

expectations. Future research may explore the role of additional hydrocolloids, enzymes, or fermentation techniques to further enhance bread quality, shelf life, and market viability.

7.22. Edible Insects—A Pilot Study on How Knowledge and Information Can Inspire Change

Sofia G. Florença and Raquel P. F. Guiné

CERNAS-IPV Research Centre, Polytechnic Institute of Viseu, 3504-510 Viseu, Portugal

Introduction: Entomophagy is a traditional practice from time immemorial in many areas where eating insects is part of people's cultures and dietary patterns. However, in other regions, consumers are not used to eating insects. The aim of this pilot study was to investigate the perceptions, attitudes, and knowledge of a small group of individuals regarding edible insects via a longitudinal approach, i.e., before and after listening to an educational talk about edible insects.

Methods: Two short surveys were prepared and applied to a case study sample of adults, one to be applied before the talk and the other to be applied after. The participants were mainly female (76%) and aged between 20 and 30 years, with a few aged above 20 years (12%). The talk lasted 60 min and addressed various topics related to edible insects, including tradition, neophobia, sustainability, nutrition, and health effects.

Results: Participants expressed a very positive view of the talk, finding it informative, interesting, and useful. Additionally, they considered that the talk contributed to improving their knowledge about insect-based foods. When asked if they recognized the term entomophagy, most responded that they had not heard of it, and only 24% responded positively. Some of the participants had consumed insects before, but most of the participants stated that they would not previously have considered consuming edible insects on a regular basis, although none demonstrated neophobia towards eating insects, considering them disgusting. In fact, the respondents demonstrated an open attitude to consuming products containing insects, as long as they were disguised as ingredients in foods, such as, for example, in the form of flour or cookies.

Conclusions: This pilot study showed the usefulness of targeted interventions as a way to increase knowledge and diminish misconceptions or prejudices related to edible insects, contributing to the shift to more sustainable diets.

7.23. Ensuring Access to Food Security Through Waste-to-Food Practices in Calabar Municipality, Cross River State, Nigeria

Etim Omini Eteng [1] and Joseph Etim Amah [2]

[1] Department of Geography and Environmental Sciences, Faculty of Environmental Sciences, University of Calabar, Cross River State, Calabar 540242, Nigeria

[2] Department of Environment Management, Faculty of Environmental Sciences, University of Calabar, Cross River State, Calabar 540242, Nigeria

The challenge of food insecurity in rapidly urbanizing regions of Nigeria is compounded by poor waste management, deprived livelihood opportunities, environmental degradation, and unsustainable production and consumption patterns. This study investigates the options and potential of integrating waste-to-food systems—such as urban composting, household biogas, and organic waste reuse—to enhance access to food system sustainability in Calabar Municipality. Through mixed methods, including household surveys, field observations, and stakeholder interviews, the research uses feedback from public engagements and focus group options, policy gaps, and the environmental benefits of adopting circular food-waste strategies. Preliminary findings reveal that over 60% of household waste in Calabar is organic and could be redirected to sustainable urban agriculture and renewable energy, creating avenues for livelihood creation, yet institutional

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frameworks remain weak. Concepts regarding basic needs, as policy inputs of the Food and Agricultural Organization, should be examined as theyrelate to food availability and the issue of post harvest food losses, and this is relevant to developing countries in the face of climate change challenges. This paper advocates for diverse partnerships from other sectors of the urban space, community-based composting initiatives, and educational campaigns to drive behavioral change. By linking waste management with food production and flexible and green consumption patterns, in line with environmental sustainability imperatives, this study contributes practical insights into achieving Sustainable Development Goals (SDGs) 2, 11, and 12 in urban Africa.

7.24. Evaluating Nutritional and Antinutritional Traits in Faba Beans for Sustainable Food Systems

Madhvi Singh [1], Maria Balota [2], Haibo Huang [1], Renata Carneiro [1] and Sean F. O'Keefe [1]

[1] Department of Food Science and Technology, Virginia Tech, Blacksburg, 24061, USA
[2] Tidewater Agricultural Research and Extension Center, Virginia Tech, Suffolk, 23437, USA

Introduction: Faba bean (Vicia faba L.) is a protein-rich and stress-tolerant legume gaining prominence in North America as a sustainable source of plant-based protein. Its cultivation addresses the growing demand for eco-friendly diets and reduced food production footprints. However, anti-nutritional factors such as vicine and convicine limit the utility of certain varieties. This study aimed to evaluate nutritional and anti-nutritional components in 22 faba bean genotypes to support current breeding efforts for Mid-Atlantic U.S. production.

Methods: Fifteen genotypes from the USDA-ARS mini-core (492 accessions), five commercially purchased cultivars (Felix, Vroma, Microgreen, Sprouting), and two Crop Development Centre cultivars (Snowdrop, CDC 219-16) were evaluated. Vicine and convicine were quantified using HPLC-DAD. Total nitrogen was measured using the Dumas method and converted to protein (N × 6.25). Seed length, breadth, and width were measured with a Vernier caliper. All measurements were performed on a dry-weight basis in triplicate. Correlations among traits were visualized with a heatmap, and PCA with hierarchical clustering identified factors driving genotype segregation. Analyses were conducted in RStudio.

Results: The protein content ranged from 19 to 33%. Vicine and convicine were in the ranges of 4.29–15.73 mg/g and 1.76–11.00 mg/g, respectively. ANOVA showed significant genotype effects ($p < 0.05$) for protein, vicine, convicine, and seed dimensions. Vicine correlated negatively with length (−0.6117), breadth (−0.6044), and width (−0.6852), and positively correlated with protein (0.3069). Convicine showed similar but weaker correlations. PCA and clustering identified seed dimensions, vicine, convicine, and protein as key contributors to genotype differentiation.

Significance: This study identifies PI 469151, Vroma, and PI 469123 as optimal genotypes, combining high protein content with acceptable vicine and convicine levels. Felix, Microgreen seeds, and PI 655348 are secondary options, offering higher protein but elevated anti-nutritional factors. These findings support breeding efforts promoting faba beans as nutrient-rich, sustainable protein sources for global food security.

7.25. Evaluation and Optimization of Extraction Conditions for Protein Isolates from Underutilized Ethiopian Lupinus spp.: Chemical Characterization and Yield Assessment

Ejigayehu Teshome [1,2], Yetenayet Bekele Tola [1], Habtamu Admassu [3,4] and Tilahun Abera Teka [1]

[1] Department of Post-Harvest Management, College of Agriculture and Veterinary Medicine, Jimma University, Jimma P.O Box 307, Ethiopia
[2] Department of Food Science and Postharvest Technology, College of Agricultural Sciences, Wachemo University, Hosanna P.O Box 667, Ethiopia
[3] Department of Chemical Engineering, College of Engineering, Addis Ababa Science & Technology University, Addis Ababa P.O Box 16417, Ethiopia
[4] Biotechnology and Bioprocess Centre of Excellence, Addis Ababa Science & Technology University, Addis Ababa P.O Box 16417, Ethiopia

The rapidly growing global population and socioeconomic shifts increased the demand for plant proteins. Notably, lupine is an underutilized legume crop that is nutritious and recognized for its high crude protein (CP). Therefore, this study was conducted to optimize the pH of protein isolate extraction (EpH) and isoelectric precipitation (IEPpH) in lupine genotypes using a central composite design (CCD). The results indicate significant variations in the chemical composition of lupine genotypes, including moisture content (6.01–7.97 g/100 g), CP (39.9–46.1 g/100 g), ether extract (6.26–13.3 g/100 g), essential amino acid index (EAAI) (62.61–70.7%), and total alkaloid (TA) (1.76–11.1%). Vitabor exhibited its maximum protein isolate purity (PIP) of 92.1% at an EpH of 8.5 and an IEPpH of 4.5. Vitabor achieved a superior protein isolate yield (PIY) of 29.0%, while the local maximum recovery (PIR) was 57.5%. All genotypes show the lowest TA at an EpH of 10 and an IEPpH of 5. The optimized extraction conditions for achieving high yield and desirable chemical compositions were as follows: EpH and IEPpH values of (10, 5) for the local, (9.86, 4.66) for Vitabor, (10, 4.69) for Sanabor, and (9.58, 4.64) for Probor. Under optimized conditions, Vitabor can serve as a sustainable source of protein isolate for low-income countries, offering high CP, EAAI, PIP, PIY, PIR, and the safest limit of TA. Meanwhile, the local and Probor are suitable for food formulations and therapeutics. Further work on the characterization of techno-functional and molecular properties is required.

7.26. Evolving Breakfast Culture: Balancing Tradition, Convenience, and Impact on Health

Amarnath V [1] and Akruti Singh [2]

[1] Department of Food Technology, School of Allied Sciences, Dev Bhoomi Uttarakhand University, Dehradun 248007, Uttarakhand, India
[2] School of Health Sciences and Technology, UPES, Dehradun 248007, Uttarakhand, India

Breakfast is often referred to as the most important meal of the day because it triggers metabolism, enhances brain function, and maintains energy. Traditional Indian breakfasts, including dishes like idli, dosa, pearl millet porridge, fermented rice, ragi porridge, poha, paratha, and upma, are rich in regional diversity, nutritional value, and cultural significance. These meals are typically prepared fresh and include a balance of carbohydrates, proteins, fibers, and essential micronutrients. Due to changing lifestyles, urbanization, and the global influence of Western food habits, modern Ready-to-Eat (RTE) cereals, such as corn flakes, muesli, masala oats, and granola, offer convenience, standardized nutrition, and longer shelf life, making them increasingly popular among urban populations. According to a recent market survey, India reached a Compound Annual Growth Rate (CAGR) of 8% in the last five years. The global RTE breakfast market CAGR from 2024 to 2030 is estimated to range from 5.8% to 7.2%, varying by source and region. The Indian RTE breakfast market CAGR from 2024 to 2030 is projected to rise between 12% and 17%, driven by rapid urbanization and an increasing working population. Among different age groups, children consume 18% traditional and 48% RTE breakfasts. Adolescents as well as young adults show a higher preference for RTE foods and often skip breakfast. In contrast, older adults still rely heavily on traditional breakfasts, with around 85% adhering to such dietary habits. However, concerns over glycemic index, sugar spikes, maltodextrins, processing

levels, and the loss of traditional food habits are often raised. This study aims at exploring the nutritional, cultural, and socioeconomic dimensions of traditional Indian breakfasts versus modern RTE cereals, emphasizing the need for a balanced approach that preserves cultural heritage while embracing modern convenience.

7.27. Food Innovation for the Underserved: Biotechnological Strategies for Sustainable Agriculture in African LMICs

Oluchi Judith Osuala [1], Chinyere Constance Ezemba [2], Victor Onydikachi Etikudke [3], Charles Nnadi Okeke [4], Angus Nnamdi Oli [5] and Iheanyi Okonko [6]

1 Department of Pharmaceutical Microbiology and Biotechnology, Faculty of Pharmacy, Madonna University, Elele 511101, Rivers State, Nigeria
2 Success Education Colleges, Marsha Fuerst School of Nursing, Riverside, CA 92115, USA
3 Department of Pharmaceutical Microbiology and Biotechnology, Faculty of Pharmacy, Chukwuemeka Odumegwu Ojukwu University, Uli 431117, Anambra State, Nigeria
4 Department of Pharmaceutical and Medicinal Chemistry, Faculty of Pharmacy, University of Nigeria, Nsukka 410001, Enugu State, Nigeria
5 Department of Pharmaceutical Microbiology and Biotechnology, Faculty of Pharmacy, Nnamdi Azikiwe University, Awka 420007, Anambra State, Nigeria
6 Virus and Genomics Research Unit, Department of Microbiology, University of Port Harcourt, Port Harcourt 500102, Rivers State, Nigeria

African low- and middle-income countries (LMICs) need flexible and innovative technologies to address chronic problems such as food insecurity, poor crop yields, post-harvest loss, and malnutrition. Microbial and genetic biotechnologies now serve as major technologies for transforming food production, preservation, and quality nutrition in LMICs. Still, their use in African LMICs is presently hampered by infrastructural limitations, regulatory challenges, and socio-cultural opposition.

This report addresses the sustainability potential of microbial and genetic biotechnology to improve African LMICs' food security. It highlights the use of genetically modified (GM) crops with increased stress tolerance and nutritional content and microbial fermentation technology enhancing food preservation, safety, and functional properties. Drawing on Ugandan (bioengineered banana), Nigerian (Bt cowpea), and Kenyan (use of starter cultures in fermented foods) case studies, we examine how these biotechnologies are being adopted at the local level to enhance food production and reduce chemical input dependence.

The paper emphasises the need for stronger biosafety policy measures, strengthened local research and development facilities, and culture-sensitive public outreach to establish trust and long-term adoption. Additional investment in microbial genomics, synthetic biology, and open-access biotech platforms is also proposed as a step towards capacity building among African scientists and food producers.

In short, genetic and microbial biotechnologies hold immense promise for sustainable food innovation in African LMICs. Developing them for equitable use and deployment for equitable benefits can drive resilience, enhance food quality, and take the continent's overall vision for food sovereignty and sustainable development forward.

7.28. How a Risk-Based Strategy Could Contribute to a More Sustainable Agri-Food System

Benoît Grossiord

Department Feed & Food, Bordeaux Sciences Agro, 33170 Gradignan, France

Members of the agri-food system are the target of much criticism, but they are also the bearers of much hope with regard to the challenges facing our society in terms of

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sustainable development. Their contribution to achieving the Sustainable Development Goals is a key element of this challenge. In order to achieve these goals, they must improve the quality of their products, practices, and organisation. Their responsibility is greater than ever, and they must lead the change by understanding stakeholder expectations and managing the risks associated with their activities. Here, we show that many issues related to governance, social benefits, environmental impacts, animal welfare, and health and nutrition dimensions can be integrated into a global approach to the food chain. To this end, the simultaneous use of already available tools, methods, guidelines, and standards is recommended. The use of management system requirements, taking into account intrinsic and extrinsic quality attributes, allows the development of an integrated approach with the aim of continuous improvement. This approach is based on risk management tools that are applied to multiple stakeholders, such as product quality, occupational health and safety, and environmental impact, thus enabling better global performance. Among food business operators, small producers, due to harder working conditions and lack of time and opportunities, are not familiar with such approaches, despite being useful for improving their overall performance and long-term viability. In relation to the growing expectations of consumers and society, they must consider diversifying their activity, proposing new products, following different quality schemes, or changing their modes of production. The aim of this paper is to show that the mobilisation of risk management tools by agri-food members is a solution that could allow better management of their activities and significantly improve the resilience of their systems.

7.29. Incorporating Portuguese Chestnut Shells into Chestnut Flour: Nutritional Benefits and Effects of Thermal Processes on Protein and Functional Profile

Ana Cristina Gonçalves [1,2], André Lemos [3,4] and Maria José Alves [4,5,6]

1 Ourense Campus, Vigo University, Faculty of Law, 32004 Ourense, Spain
2 Research Centre for Active Living and Wellbeing (LiveWell), Instituto Politécnico de Bragança, 5300-253 Bragança, Portugal
3 AquaValor—Centro de Valorização e Transferência de Tecnologia da Água, Rua Dr. Júlio Martins, n°1, 5400-342 Chaves, Portugal
4 Research Centre for Active Living and Wellbeing (LiveWell), Instituto Politécnico de Bragança, 5300-253 Bragança, Portugal
5 AquaValor—Centro de Valorização e Transferência de Tecnologia da Água, 5300-253, Portugal
6 Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, 5300-271 Bragança, Portugal

Incorporating the shell of the Portuguese chestnut (*Castanea sativa*) into chestnut flour is an innovative and sustainable strategy that enables the full utilization of this valuable agri-food resource. This approach contributes to the reduction in agro-industrial waste while enhancing the nutritional and functional properties of the resulting flour, in alignment with the principles of the circular economy and sustainable food systems. The chestnut shell is a natural source of essential amino acids, such as arginine and leucine, and non-essential ones like glutamic and aspartic acids. Its incorporation increases the protein content and improves the amino acid profile of the flour, potentially supporting muscle maintenance, metabolic processes, and overall nutritional value. Moreover, it contains bioactive compounds—including polyphenols and flavonoids—with known antioxidant and anti-inflammatory effects, offering added functional benefits. Thermal processing methods—drying, roasting, and cooking—play a key role in determining the flour's final characteristics. Drying preserves heat-sensitive amino acids, thus maintaining protein integrity. Roasting enhances the bioavailability of free amino acids, which may improve

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digestibility and nutrient absorption. Cooking promotes the extraction of phenolic compounds, increasing the flour's antioxidant capacity. Each method has specific benefits, allowing for tailored processing depending on desired outcomes. When the incorporation of chestnut shells is combined with optimized thermal treatment, the result is a flour that is not only nutritionally superior but also functionally enhanced and environmentally friendly. Such flours offer applications across various food products, appealing to consumers seeking sustainable and health-promoting alternatives.

Overall, this strategy represents a promising innovation for the agri-food sector, promoting the development of value-added products through the upcycling of by-products. The approach not only enhances the sustainability of chestnut processing but also meets the increasing consumer demand for foods that are both health-promoting and environmentally conscious.

7.30. Innovative Valorization of Bovine Bones from the Meat Industry in Paraguay: Mineral Matrices for Soil Sustainability

Claudia Gómez-Leguizamón [1,2], Laura León-Ovelar [1], Mercedes Jiménez-Rosado [2,3] and Alberto Romero [2]

1 Faculty of Engineering, National University of Asunción, San Lorenzo 2160, Paraguay
2 Department of Chemical Engineering, Faculty of Chemistry, University of Seville, 41012 Seville, Spain
3 Chemical, Environmental and Bioprocess Engineering Group, I4 Institute, University of León, 24071 León, Spain

Paraguay ranks among the top ten global exporters of beef, generating significant quantities of bovine bone by-products from its thriving meat industry. These by-products are often underutilized, representing a lost opportunity within the food production chain. In line with circular economy principles, the development of mineral matrices derived from bovine bones offers an innovative and sustainable alternative to conventional soil amendments. This work presents the conceptual design and initial development of such matrices, aimed at enhancing soil fertility while reducing reliance on synthetic fertilizers. Bovine bones obtained from industrial meat processing plants in Paraguay were calcinated at controlled temperatures (400 °C, 500 °C, 600 °C, 700 °C, and 800 °C) for one and two hours to produce mineral-rich powders. Observations revealed variations in color and texture, indicative of phase transitions and composition changes. These powders, primarily composed of hydroxyapatite and secondary phases, were subjected to TGA, FTIR, XRD, and particle size analysis to determine the best calcination conditions to produce the base material for biodegradable soil matrices. The process includes grinding, sieving, and compaction with additives, targeting matrices with suitable mechanical properties and nutrient release profiles for agricultural applications. The different calcination times and temperatures determine the physicochemical properties of the base powders, thus the functionality of the produced matrices. The designed process demonstrates a feasible pathway for transforming bovine bone waste into valuable soil amendment materials, supporting nutrient cycling within food production systems. The proposed valorization strategy provides a promising solution for integrating agro-industrial by-products into sustainable soil management. Beyond closing nutrient loops and reducing waste, this innovation offers a novel perspective on hydroxyapatite applications. Unlike conventional biomedical uses, this approach explores its potential as a mineral matrix for soil sustainability, opening new avenues for circular solutions in agriculture. Further work will focus on matrix characterization and soil functionality tests.

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7.31. Insights of Green Marketing Information from Sustainability Reports of Food Companies: A Cross-Country Analysis

Amina Irfan [1] and Paweł Bryła [2]

[1] Faculty of Management, University of Lodz, 90-131 Lodz, Poland
[2] Faculty of International and Political Studies, University of Lodz, 90-131 Lodz, Poland

This study examines the green marketing strategies employed by food companies in Poland and Sweden, with a specific focus on how these strategies align with the Triple Bottom Line (TBL) sustainability framework, which encompasses environmental, social, and economic dimensions. Using content analysis of publicly available sustainability reports, we identified key themes and concepts reflecting the companies' approaches to sustainable marketing across the three regions. Data collection involved a combination of web scraping (via Python) and manual verification. Company lists were obtained from lusha.com, a platform that ranks top companies by country. Out of 187 Polish food companies, 19 had accessible sustainability reports; in Sweden, 26 reports were obtained from a total of 244 companies. We excluded the remaining companies because we could not find sustainability reports for them, and some belonged to other product categories, such as cosmetics and food innovation technology. Additionally, we excluded food companies that mentioned their sustainability goals on their webpage but did not provide sustainability reports. This study used the supervised Bag-of-Words (BOW) technique for text analysis using R studio. We developed custom dictionaries to identify key themes related to green marketing strategies and their linkage to the triple bottom-line framework of sustainability. The findings reveal both commonalities and regional differences in the emphasis placed on environmental, social, and economic dimensions of sustainability. Notably, the social dimension was the most emphasized across both regions. This research contributes to the understanding of regional variations in green marketing communication strategies and offers insights into how food companies integrate sustainability into their public communications and reporting practices.

7.32. Lactic Acid Bacteria for More Efficient Re-Use of Agro-Food Waste in the Food Industry

Hiba Selmi [1], Antonietta Diaferio [1], Vittorio Capozzi [2], Lucia Bonassisa [3], Giuliano de Seneen [3], Maria Lucia Valeria de Chiara [2], Giuseppe Spano [1] and Mariagiovanna Fragasso [1]

[1] Department of Agricultural Sciences, Food, Natural Resources and Engineering, University of Foggia, 71121 Foggia, Italy
[2] National Research Council—Institute of Sciences of Food Production (CNR-ISPA), 70126 Bari, Italy
[3] BonassisaLab S.p.A, 70056 Molfetta, Italy

The valorisation of waste and by-products through microbial-based biotechnological solutions for more efficient re-use in the food industry represents one of the crucial issues in the green transition of food systems. Using apple, orange, tomato, broccoli, white cabbage, carrot, potato, buttermilk, scum, spinning water, and whey as model matrices and a panel of ten different lactic acid bacteria (LAB) strains (with a relevant representation of the species *Lactiplantibacillus plantarum*), we evaluated the combination of fast screening and digital solution as emerging approaches to optimise the management of the strains in the different matrices/conditions. For each matrix, the most interesting strain in terms of growth parameters was selected. The eleven stain/matrix combinations have been tested under specific conditions. After fermentation, we proposed a case study on re-use in the food industry, including the production of traditional fermented foods, innovative fermented foods, and as ingredients in non-fermented foods and beverages. In the framework of evaluating

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the feasibility of these optimisation strategies, different physical, chemical, and biological contaminants were studied to investigate the safety of the treated waste/by-products (e.g., pesticides, heavy metals, mycotoxins, and foodborne pathogens, for more than 100 contaminants). The assessment of contaminants did not detect the presence of contaminants outside the limits for the classes analysed. L.B. and GB received funding from Next-Generation EU [PNRR] in the framework of Component 2 Investment 1.3-Award Number: Project code PE00000003, Project title: "ON Foods-Research and innovation network on food and nutrition Sustainability, Safety and Security—Working ON Foods" (Cascade call, project 3SMicroBiotech4Food). V.C. is also supported by project code PE00000003. M.F. has received funding from PNRR Investment 1.4—D.D. 1032 17 June 2022, CN00000022] within the Agritech National Research Centre for Agricultural Technologies. M.L. is supported by INTelligent, ACTive MicroBIOme-based, biodegradable PACKaging for Mediterranean food – INTACTBioPack (PRIMA Section 2 Call multi-topics 2023 STEP 2).

7.33. Life Cycle Assessment as a Decision-Making Tool for the Sustainable Valorization of Agro-Industrial Byproducts in Paraguay: A Case Study of Acrocomia aculeata Endocarp

Regina León Ovelar [1,2], Elena Fernandez-Boy [2] and Heike Knicker [3]

1 Facultad de Ingeniería, Universidad Nacional de Asunción, Campus de la UNA, San Lorenzo 2169, Paraguay
2 Departamento de Cristalografía, Mineralogía y Química Agrícola, Universidad de Sevilla, Profesor García González n° 1, 41012 Sevilla, Spain
3 Departamento de Biogeoquímica, Ecología Vegetal y Microbiana, Instituto de Recursos Naturales y Agrobiología de Sevilla (IRNAS-CSIC), Avenida Reina Mercedes, 10, 41012 Sevilla, Spain

In agro-based economies with limited industrial resources, such as Paraguay, there is a pressing need for accessible tools that support the sustainable management and optimization of agro-industrial byproducts. This study presents Life Cycle Assessment (LCA) as a decision-making and optimization tool for industrial processes, applied to the valorization of *Acrocomia aculeata* endocarp—an abundant yet underutilized byproduct from the palm fruit industry that is widely processed in Paraguay. This work provides an LCA estimate that defines system boundaries and includes transport and potential packaging scenarios. The LCA covers the pathway from waste generation (endocarp produced during processing) through its conversion to biochar (450 °C), packaging, and distribution (up to 200 km). The analysis identified key environmental hotspots, with significant impacts associated with polypropylene packaging and transport logistics, despite the assumption of clean energy use for pyrolysis. These results demonstrate how LCA can guide process improvements, from exploring packaging alternatives to optimizing supply chains and increasing the use of renewable energy sources. Beyond serving as an environmental diagnostic, this work positions LCA as a scalable decision-support tool for resource-constrained agro-industrial contexts. It offers valuable support for industrial symbiosis initiatives and value chain enhancement. The proposed methodology is adaptable to other agro-industrial residues, helping industries reduce waste, improve carbon sequestration through biochar application in agriculture and contribute to climate action targets. Overall, the study advances the development of circular economy strategies in agro-industrial systems.

7.34. Life Cycle Assessment of Argentinian Dry Bean Flour

Maria Gimena Torres [1], Silvina Cecilia Andrés [2], Nadia Florencia Nagai [2], Gabriel Lorenzo [1,2] and Germán García Colli [1,3]

1 Chemical Engineer Department, National University of La Plata (UNLP), Buenos Aires, Argentina

[2] Center for Research and Development in Food Science and Technology (CIDCA), Buenos Aires, Argentina
[3] Development and Investigation Center in Applied Science 'Dr. J. J. Ronco' (CINDECA) CONICET—UNLP, Buenos Aires, Argentina

Plant-based sources are being assessed as alternatives to animal-based foods as a strategy to reduce environmental impacts. This study aimed to calculate the environmental footprint of dry bean flour made from *Phaseolus vulgaris* cultivated in northwest Argentina. Since grain pre-treatment influences the flour's nutritional properties, three different processing methods were evaluated: raw (R-BF), soaked (S-BF), and soaked and cooked (SC-BF). A comparative Life Cycle Assessment was conducted, evaluating multiple impact categories using the ReCiPe method. The functional unit was 1 kg of flour, and the primary stages assessed were seed and grain production, transportation, processing, and flour production. Inventory data were based on Argentina's 2023 harvest. All impact categories were higher for S-BF and SC-BF due to several factors. First, flour yield decreased from 0.97 for R-BF to 0.80 and 0.74 for S-BF and SC-BF. Additionally, soaking and drying before milling in S-BF increased electricity and water consumption. SC-BF required further inputs of water and natural gas for cooking. As a result, the most significant differences were observed in global warming, fossil resource scarcity, and water consumption, with values 4, 5, and 8 times higher than R-BF, respectively. Regarding ecotoxicity, pesticide use during seed and grain production had a substantial burden, contributing 82% to freshwater and 64% to terrestrial ecotoxicity. Transport and agricultural machinery accounted for up to 90% of R-BF's acidification impact; this share decreased by 20% in S-BF and SC-BF due to higher electricity use. Transport remained a major contributor in several categories because of distribution distances. Water consumption for soaking and cooking represented 6% and 15% of the total impact for S-BF and SC-BF. This analysis highlights how processing methods affect the environmental footprint of flour.

7.35. Mealworm (Tenebrio molitor) Acceptance Test of Grass and Feather Feed

Loreida Timberg

Estonian Maritime Academy, Tallinn University of Technology, 19086 Tallinn, Estonia

Sustainability and food security are critical challenges that require innovative approaches to utilize alternative raw materials effectively. Project BlueGreenFeed explores using land-based raw materials, such as grass and feathers, to produce sustainable protein for aquaculture through mealworm bioconversion. This study aimed to evaluate the acceptance, survival, and growth of mealworms fed on grass and feather-based feed components.

Mealworm cultivation was carried out using experimental feeds derived from grass and feathers alongside standard feed composed of wheat and barley (69% carbohydrates, 14% protein, 4% lipids). The growing cycle of mealworms was 12 weeks, during which mealworm survival rates, weight gain, and feed consumption were monitored. Feed textures and nutritional compositions were analyzed to assess their influence on mealworm acceptance, growth, and composition.

The results demonstrated that while grass and feather-based feeds were effective protein sources, they failed to provide lipids. The texture differences between standard feed and experimental feeds significantly impacted feed acceptance, with the light, powdery texture of grass and feather feeds proving less appealing to mealworms. This led to reduced survival rates and lower weight gain compared to mealworms fed on standard feed. Grass and feathers feed mix, as well as feathers alone, were identified as promising protein sources but lacked sufficient water content for optimal mealworm development.

The study concluded that while grass and feather-based feed components hold promise as sustainable protein sources, further optimization is required to improve feed texture

and lipid content to enhance mealworm growth and survival. Additional research is recommended to refine feed formulations and explore complementary lipid sources.

The study was done in collaboration with scientists from SINTEF in Norway, Aarhus University in Denmark, the University of Iceland and Matis in Iceland, and Tallinn University of Technology in Estonia, with the support of Blue Bioeconomy ERA-NET Cofund and its national agencies.

7.36. Next-Generation Biodegradable Antimicrobial Sanitizers: Driving Sustainable Food Safety and Environmental Innovation

Rosie Yagmur Yegin

Massachusetts Institute of Technology (MIT), Cambridge, MA 02139, USA

Ensuring food safety while promoting environmental sustainability remains a pressing challenge in the food industry. Traditional surface sanitizers, such as chlorine-based agents, raise concerns due to their toxicity, environmental persistence, and contribution to food waste. Additionally, synthetic polymers commonly used in antimicrobial formulations exacerbate microplastic pollution, intensifying environmental and regulatory pressures.

This study presents a biodegradable antimicrobial sanitizer for food-contact surfaces. The formulation features thyme essential oil, a natural antimicrobial, encapsulated within a silk fibroin matrix. Blended via 1 min sonication without solvents, the encapsulation process required no solvent removal. The resulting nanoparticles contained 8% w/w thyme oil and were diluted before antimicrobial testing. This system enhances the stability and controlled release of active compounds, enabling prolonged antimicrobial activity. Controlled release plateaued after 48 h in Milli-Q water. Remarkably, ~10 times less thyme oil was needed in the nanoparticle formulation to achieve efficacy equivalent to unencapsulated oil, tested against bacteria at OD_{600} = 1. When applied to food-contact surfaces, the formulation effectively reduced contamination by major foodborne pathogens, including *Salmonella* Typhimurium and *Listeria monocytogenes*, supporting efforts to reduce spoilage and improve hygiene. After 90 days at room temperature, nanoparticle-treated samples remained visually acceptable, showing extended shelf life in terms of appearance, odor, and general spoilage indicators, while both control and chlorine-treated counterparts became completely inedible.

Using silk, a protein-based biopolymer, eliminates the need for synthetic carriers, providing a safe, microplastic-free alternative. Unlike chlorine-based sanitizers, this system poses minimal risks to human and environmental health, making it suitable for food processing, packaging, and other hygiene-critical uses. The nanoparticle system also demonstrated long-term stability, with no change in particle size after one year.

This research illustrates how biodegradable materials and natural antimicrobials can be integrated into effective sanitation technologies aligned with sustainable food system principles, contributing to reduced foodborne illness, extended shelf life, and environmental responsibility.

7.37. Opinions, Knowledge and Attitudes of Generation Z Consumers Towards Organic Food in Poland: A Student Case Study

Katarzyna Tarnowska, Anita Szelągiewicz and Eliza Gruczyńska-Sękowska

Warsaw University of Life Sciences, Ciszewskiego 8, Bldg. 23, 02-786 Warsaw, Poland

Generation Z tends to be more environmentally conscious than previous generations. This cohort represents a growing group of consumers who are likely to significantly influence markets and consumption trends in the coming years. Research into their attitudes toward organic food can offer valuable insights for companies aiming to align their offer-

ings with growing expectations related to production transparency, ingredient quality and minimizing environmental impact.

The aim of this study was to explore how students' knowledge related to their field of study, dietary choices in the family home, sociodemographic and socioeconomic factors influence Generation Z's intentions to purchase sustainable food. A CAWI survey method was used, with a proprietary questionnaire consisting of 24 questions. The research group consisted of 218 university students in Warsaw (Poland). Due to the wide variety of academic disciplines, the respondents were divided into two groups: students of food science-related fields and students of other fields.

The results of the survey indicate that people studying majors related to food science are more knowledgeable about organic food than those studying non-food fields. Students also confirmed the influence of eating habits introduced in their family home on their present knowledge about proper nutrition. The respondents are familiar with the labeling of organic food, but their awareness of certification should be increased. The main source of information about organic food is the Internet, and supermarkets are the most common place of purchase. The key factors influencing the choice of organic food are taste, smell, appearance and health considerations. The primary barrier to purchasing organic food is its high price. The willingness to spend money on purchasing organic food depends on the students' financial situation and the type of product. An increase in demand for organic food is likely if consumer awareness grows, accompanied by acceptance of the associated costs.

7.38. Optimisation of Tray and Microwave Drying Conditions of Sustainable Extruded Lentil Analogue

Jayshree Majumdar [1,2], Shubham Mandliya [3] and Hari Niwas Mishra [4,5]

1 Research Scholar, Indian Institute of Technology KharagpUR, Kharagpur 721302, India
2 Guru Nanak Institute of Technology, Kolkata 700114, India
3 Training Officer, IHRF, BMGF, Indian Institute of Technology Kharagpur (IIT Kharagpur), Kharagpur 721302, India
4 Emeritus Professor (Food Technology), Agricultural and Food Engineering Department, Indian Institute of Technology Kharagpur, Kharagpur 721302, India

A formulation was made using legume lentil flours along with a protein isolate, and optimum moisture was added. The mixture was then extruded in an optimised condition and further dried to produce extruded lentil analogues (ELAs). The aim of this research is to optimise the microwave drying (MWD) and tray drying (TD) of ELAs. ELA tray drying was conducted at temperatures of 40 °C, 50 °C, and 60 °C, utilizing air velocities of 1 m/s and 0.5 m/s. The MW dryer was utilized to dehydrate ELAs at different microwave power settings ranging from 70 W to 200 W. The drying rate (R_d) was depicted in relation to drying time (td) and moisture content (X) on a dry basis.

The results indicated an elevated drying constant correlated with an increase in drying temperature during TD. This was associated with enhanced heat intensity and an expedited drying process. A swift reduction in drying rate (Rd) of ELAs wasrelative to drying time (td) under all drying conditions. The brief constant rate period in the drying process of ELA indicates that moisture removal took place continuously during the subsequent period of declining rate. TD data exhibited strong alignment with the Page and Henderson model as well as Fick's diffusion model, yielding R^2 values of 0.99, 0.96, and 0.98, respectively. TD exhibited a superior rehydration ratio.

In the case of MWD, increasing microwave power resulted in a reduction in whiteness and yellowness values, while browning index values increased. Comparable trends were observed in hardness; R^2 of Henderson, Page, and Pabis model exhibited values within the

range of 0.98 to 0.99. Page's equation has been shown to serve as an effective model for accurately fitting drying data across both drying processes.

Microwave drying emerged as the most efficient drying technique, yielding reduced drying duration, negligible color alteration, and enhanced rehydration properties.

7.39. Optimizing Resource Use in Sustainable Food Systems: Life Cycle Assessment of a Multi-Crop Aquaponic System in Italy

Lucia Maddaloni [1], Giuliana Vinci [2], Marco Ruggieri [2], Marco Savastano [2] and Alessia Abdel Malek [2]

1 Department of Experimental Medicine and Department of Management, Sapienza University of Rome, Via del Castro Laurenziano 9, 00161 Rome, Italy
2 Department of Management, Sapienza University, 00185 Rome, Italy

The contemporary practice of conventional farming is characterised by an exceedingly intensive utilisation of natural resources. The production of just one kilogram of crops requires approximately 2500 litres of water [32] and almost 1.8 kg of synthetic fertilisers (FAO, 2024) [33]. These practices have been identified as a primary contributor to approximately 25% of global greenhouse gas emissions (IPCC, 2014) [34] and have been linked to the acceleration of various environmental issues, including eutrophication, biodiversity loss, and soil degradation (IPBES, 2019) [35]. These practices have the potential to compromise the structural integrity of soil and the long-term fertility of agricultural land. In order to ensure the long-term sustainability of food systems, there is a requirement to adopt production methodologies that facilitate the achievement of high yields while minimising environmental impact. In this context, the present study employs a Life Cycle Assessment (LCA) to analyse an integrated aquaponic system in Italy for the cultivation of fruit, vegetables and aromatic herbs. Utilising the ReCiPe 2016 Midpoint method across 18 impact categories—with 1 kg of edible produce designated as the functional unit—it is demonstrated that the integration of aquaculture and hydroponics can result in a 40–49% reduction in environmental impacts when compared to conventional soilless systems. It is evident that there has been a significant decrease in water usage, fossil and mineral resource consumption, and greenhouse gas emissions. These findings underscore the potential of aquaponics as a scalable, resource-efficient approach, particularly in contexts where water scarcity or land constraints are prevalent. The findings emphasize the approach's capacity to enhance resilient, low-impact food production in the future.

7.40. Origin and Processing Conditions Influence Nutritional and Sensory Properties of North American Wild Rice

Alexandre Donovan Goertzen [1,2], Donna Ryland [1], Shiva Shariati-Ievari [2], April McElrea [2] and Michel Aliani [1,2]

1 Department of Food and Human Nutritional Sciences, University of Manitoba, Winnipeg, MB R3T 2N2, Canada
2 Division of Neurodegenerative and Neurodevelopmental Disorders, St. Boniface Albrechtsen Research Centre, Winnipeg, MB R2H 2A6, Canada

Introduction: A culturally significant, semi-domesticated cereal crop, North American wild rice (*Zizania* spp.) is valued for its strong protein and amino acid profile and its ability to grow on marginal land with minimal agricultural inputs. However, the wild rice industry is constrained by a limited understanding of how growing and processing conditions influence product quality. This study evaluated 11 wild rice sources for differences in nutritional and sensory characteristics.

Methods: Samples were sourced from a diverse range of commercial growers and processors, including American paddy-grown, traditionally processed Indigenous, lake-

specific Canadian, and pooled Canadian and American lake-grown wild rice. Analyses included grain size, antioxidant capacity (ORAC), total phenolics, specific phenolic compounds (via NMR), and eNose responses. Five samples underwent additional profiling for volatile organic compounds (VOCs), fatty acids, and descriptive sensory attributes.

Results: Grain size was largest in lake-specific samples and smaller in pooled, American, and Indigenous rice. Traditional Indigenous processing resulted in increased antioxidant activity and total phenolics compared to paddy-grown and commercially processed samples, though the specific contributing compounds remain unclear. eNose data showed modest differentiation, while SIMCA modeling classified samples into three distinct groups with 90.2% accuracy. VOC analysis identified 52 compounds, with traditionally processed rice displaying the richest profile, followed by paddy-grown rice. Paddy-grown rice had a higher omega-6/omega-3 ratio (1.5) than other samples (~1.0). Sensory analysis found traditionally processed samples to be most distinct, with subtler differences among lake-specific and American rice.

Conclusions: This study demonstrated that wild rice quality is influenced by both growing conditions and processing methods used, while also suggesting that wild rice grown in specific lakes may also exhibit unique properties. The elevated antioxidant activity observed in traditionally processed samples suggests that incorporating aspects of these methods into commercial practices may improve nutritional quality, though changes to sensory attributes should be considered.

7.41. Pandemic-Resilient Microscale Meat Processing: Use of Bubble-Type Setting to Reduce COVID-19 Transmissibility in Emulsified Sausage Production

Junnarose M. Purisima [1] and Gerieka Ramos Anapi [2]

[1] University of the Philippines Diliman, Quezon City 1101, Philippines
[2] Laboratory of Food Microbiology and Hygiene, Department of Food Science and Nutrition, University of the Philippines Diliman, Quezon City 1101, Philippines

A bubble-type setting is a social network-based distancing strategy in which personnel work in a bubble where they are only allowed to interact with people within the same group, and a study has shown that it is the most effective approach to flatten the curve of COVID-19 cases (Block et al., 2020) [36]. This study focuses on the utilization of bubble-type settings, particularly in the context of different variants of the virus and screeners (e.g., masks and ventilation), to control the transmissibility of the COVID-19 virus in microscale production of emulsified sausage products. A microscale production process for emulsified sausage products was simulated in a bubble-type setting using AnyLogic Version 8.7.6 Personal Learning Edition (2022), and the Wells–Riley model was adapted to determine the effect of different variants of the virus, namely Wuhan, Delta, and Omicron, and the effect of screeners (e.g., masks and ventilation) on the probability of infection (POI) with the COVID-19 virus. A two-way ANOVA was used at a 0.05 level of significance using IBM SPSS Statistics 22 to determine if different factors had a significant effect on the POI and if there was an interaction between the factors. The results showed that different variants of the COVID-19 virus, screeners (e.g., masks and ventilation), and their interaction had a significant effect on the probability of infection with the COVID-19 virus in a bubble-type setting in microscale production of emulsified sausage products, indicating that the utilization of a bubble-type setting with control measures such as wearing efficient masks and an increased ventilation rate could be used to significantly reduce the probability of infection with the COVID-19 virus in microscale production of emulsified sausage products.

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7.42. Perceived Benefits, Risks, and Determinants of Acceptance Among Algerian Consumers of Insect-Based Animal Feed for Poultry, Cattle, Small Ruminants, and Fish

Samira Negrichi [1], Salima Taleb [2,3], Abdelhakim Ridouh [1] and Ali Debbache [4]

1 Centre de Recherche en Technologies Agroalimentaires (CRTAA), Campus Universitaire Tergua Ouzemour 06000 Bejaia, Algeria
2 Department of Applied Biology, Faculty of Exact Sciences and Sciences of Nature and Life, Echahid Cheikh Larbi Tebessi University, Tebessa 12000, Algeria
3 Laboratory of Nutrition and Food Technology (LNTA), University of Constantine 1, Constantine 25000, Algeria
4 Department of Psychology, Faculty of Humanities and Social Sciences, Constantine University, Constantine 25000, Algeria

Insects, recognized for their exceptional nutritional profile, represent a promising alternative protein source for use in animal feed. As the global demand for animal-derived food products continues to rise, identifying innovative and sustainable protein solutions has become imperative. Despite their potential, the adoption of insect-based feed faces significant barriers, particularly regarding consumer acceptance and safety concerns. Many individuals are reluctant to embrace unfamiliar animal-origin products, and in Algeria, no research to date has investigated consumer attitudes toward insect-based feed alternatives. This study examines Algerian consumers' perceptions of the benefits and risks of insect-based feed (for poultry, cattle, small ruminants, and fish) and the factors influencing their acceptance. To achieve this, an online survey was conducted targeting Algerian consumers in 2024. Over 250 responses were collected and analyzed using descriptive statistics and logistic regression. Participants showed greater willingness to approve insect-based feed for poultry and fish, with 48% expressing acceptance for each, compared to only 23% approval for its use in bovines and ovines. The most influential factors affecting consumer acceptance were nutritional benefits (55%), disgust (53%), animal welfare (45%), and psychological factors (38%). The analysis of participants' responses revealed varying perceptions regarding the advantages and risks associated with using insects in animal feed. Among the advantages, the most agreed-upon aspects included improved organic waste valorization (44% to 20%), enhanced sustainability (44% to 24%), reduced production costs (46% to 29%), and increased global food availability (38% to 22%). Conversely, participants also highlighted concerns about potential risks, including allergenic reactions in humans (50% to 42%) and animals (50% to 39%), bio-diversity impacts (58% to 51%), microbiological contamination (51% to 45%), chemical residues (40% to 38%), and competition with other agricultural activities (35% to 29%). These concerns indicate a need for rigorous safety assessments, transparent communication about benefits and risks, and public education to address misconceptions.

7.43. Safety and Efficacy of an Olive Oil-Derived Nutraceutical in Inflammatory Bowel Disease (IBD) Patient-Derived Organoids: A Sustainable Approach to Precision Medicine

Daniele Bravoco [1,2], Giuseppina di Paola [2], Teresa D'Amore [3], Carlo Calabrese [4], Valeria Lucci [5], Giuliana Napolitano [5], Pellegrino Mazzone [2] and Geppino Falco [5]

1 Dipartimento di Sanità Pubblica e Medicina Preventiva, Università degli Studi di Napoli "Federico II", 80131 Napoli, Italy
2 Istituto di Ricerche Genetiche Gaetano Salvatore Biogem Scarl, 83031 Ariano Irpino, Italy
3 IRCCS-CROB Centro di Riferimento Oncologico della Basilica, 85028 Rionero in Vulture, Italy
4 Dipartimento di Scienze Mediche e Chirurgiche, Università di Bologna, 40126 Bologna, Italy

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[5] Dipartimento di Biologia, Università degli Studi di Napoli "Federico II", 80126 Napoli, Italy

Inflammatory Bowel Disease (IBD), including Crohn's disease and ulcerative colitis, is a chronic inflammatory condition of the gastrointestinal tract with complex pathogenesis involving genetic, environmental, microbial, and immune-related factors. Current pharmacological treatments, though effective for some patients, are often associated with limited long-term efficacy and significant side effects. In this context, patient-derived organoids (PDOs) have emerged as advanced 3D in vitro models that replicate the architecture, cellular diversity, and inflammatory profiles of native intestinal tissue. These models offer a powerful platform for personalized medicine and drug screening.

In this study, intestinal organoids were established from biopsies of IBD patients and healthy controls. The IBD-derived organoids retained key pathological features of the disease, including elevated expression of inflammatory markers such as IL-8 and CLDN-1, as well as increased cytokine secretion, confirming their relevance as disease models. These PDOs were then used to evaluate the anti-inflammatory effects of a natural compound derived from extra virgin olive oil, known for its antioxidant and anti-inflammatory properties.

We further evaluated a natural compound derived from extra virgin olive oil rich in stable ozonides for its anti-inflammatory potential. Using a luciferase-based NF-κB reporter system in both 2D cell lines and 3D organoids, we demonstrated that this natural compound significantly attenuates TNFα-induced NF-κB activation. Importantly, this formulation exhibited minimal cytotoxicity at therapeutic concentrations and preserved viability in cell and organoid cultures after MTT assays.

These findings highlight the utility of PDOs as a physiologically relevant model for studying IBD pathogenesis and therapeutic response. Moreover, the olive oil-derived compound emerges as a promising, safe, and sustainable alternative or adjunct to conventional IBD therapies. This work supports the integration of organoid technology with nutraceutical research to advance personalized and less toxic treatment strategies for chronic inflammatory diseases.

7.44. Selenium Biofortification of Swiss Chard Microgreens Under Indoor Vertical Farming Conditions

Alexis Pereira [1,2], Maria Inês Dias [1], Maria Beatriz Prior Pinto Oliveira [2] and José Pinela [1,3]

[1] CIMO, LA SusTEC, Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal
[2] REQUIMTE/LAQV, Departamento de Ciências Químicas, Faculdade de Farmácia, Universidade do Porto, Rua Jorge Viterbo Ferreira 228, 4050-313 Porto, Portugal
[3] Instituto Nacional de Investigação Agrária e Veterinária, I.P. (INIAV, I.P.), Rua dos Lágidos, Lugar da Madalena, Vairão, 4485-655 Vila do Conde, Portugal

Selenium (Se) is an essential micronutrient that plays a critical role in human health, and its deficiency has been linked to increased risks of cancer and cardiovascular diseases. Agronomic biofortification of microgreens with Se in indoor vertical farming systems offers a sustainable strategy to address this global health challenge and promote food security. This study aimed at evaluating the biofortification of white Swiss chard (*Beta vulgaris* subsp. *cicla*) microgreens, using two inorganic Se forms (sodium selenate and sodium selenite), and characterizing their phytochemical and mineral profiles. Microgreens were grown in a climate-controlled walk-in growth chamber equipped with LED lighting. Seeds were sown in polystyrene trays containing biodegradable cellulose sheets and vermiculite, and cultivated under a 14/10 h light/dark photoperiod at 20–25 °C and ~60% relative humidity.

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Irrigation was performed using a 3N–1P–6K nutrient solution supplemented with sodium selenate or sodium selenite at 10, 20, or 40 μM Se, as well as a mixed 20 μM treatment. Fourteen days after sowing, microgreens were harvested, and their phytochemical and mineral profiles were determined using chromatographic and spectroscopic techniques, respectively. The analysis allowed the characterization of up to 10 phenolic compounds (2 phenolic acids and 8 flavonoids), 7 betalains (2 betacyanins and 5 betaxanthins), and 17 saponins. Sodium selenite treatment resulted in higher concentrations of saponins, whereas sodium selenate led to greater phenolic compounds, betalains, and mineral accumulation. In conclusion, Se biofortification, particularly with sodium selenate, significantly improved the nutritional and functional properties of white Swiss chard microgreens grown under indoor conditions.

7.45. Study of Cultivation and Nutritional Value of Microgreens: A Bibliometric Analysis

Margarita Liasidou [1], Maria Gialeli [1], Giaginis Constantinos [1], Andreas Y. Troumbis [2] and Georgios K. Vasios [1]

[1] Department of Food Science and Nutrition, University of the Aegean, 81400 Myrina, Lemnos, Greece

[2] Department of Environment, University of the Aegean, 81100 Mytilene, Lesbos, Greece

Microgreens, known for their vibrant colors, delicate textures, and unique flavors, have gained popularity for both their culinary appeal and their nutritional value. As a new generation of functional foods, they contain higher concentrations of vitamins, minerals, and bioactive compounds compared to mature vegetables, making them an intriguing subject of research in agriculture and nutrition. This research presents a bibliometric analysis of the scientific bibliography on microgreens, aiming to provide a comprehensive overview of research trends, collaborative networks, and key thematic areas. Data from three bibliographic databases (Scopus, PubMed, and Web of Science) were extracted, combined, and cleaned. A final sample of 462 articles and reviews, from 1982 to 2023, was obtained and analyzed using the Bibliometrix R-package. Over the last decade, there has been an increase in research activity (annual scientific growth 12.48%). The countries with the greatest number of contributions are the USA, Italy, and India, while two Italian universities lead the way in research (University Naples Federicco II and University Bari Aldo Moro). The most relevant sources are *Horticulturae* (n = 28), *Foods* (n = 23), and *Agronomy* (n = 20). Among the authors, Luo Y. stands out as the most important (20 papers, TC-index = 1087, H-index = 15), Xiao Z. is the most globally cited author (288 citations, *Journal of Agricultural Chemistry*), and Pinto E. is the most domestically cited author (75 citations, *Journal of Food Composition and Analysis*). The analysis indicates that the research community is interconnected, with strong collaborative patterns. Key focus areas that emerged were the nutritional value of microgreens, innovative cultivation methods, and potential health benefits, revealing interdisciplinarity. Of particular interest is the application of advanced cultivation methods (hydroponics and aeroponics), which provide solutions for sustainable agriculture and food security. Challenges and future research directions are also highlighted, including the need to standardize cultivation methods and further explore the bioavailability and health effects of microgreens' bioactive compounds.

7.46. The Baobab Tree Conservation Crisis and Sustainability Potential in Madhya Pradesh, India: A Case for Food Security, Biodiversity, and Community Livelihoods

Dipali Saxena [1] and Rolly Kanchan [2]

[1] Department of Foods and Nutrition, Shri Vaishnav Institute of Home Science, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore, Baroli, Sanwer Road, Indore 453331, MP, India

[2] Faculty of Food Science, Department of Home Science, Deen Dayal Upadhya, Gorakhpur University, Gorakhpur 273009, UP, India

The baobab tree (*Adansonia digitata*), native to Africa but long naturalized in select regions of India, such as the Dhar district in Madhya Pradesh, is emerging at the intersection of biodiversity conservation, food security, and sustainability. Baobabs are known for their remarkable water-storing capacity (up to 117,000 L), their medicinally and nutritionally valuable fruit known locally as *khorsani imli*, and their role in supporting tribal economies through the promotion of traditional harvesting practices. This article critically examines multiple dimensions of the baobab crisis in Madhya Pradesh: from these trees' ecological importance and biocultural value to governance failures and socio-economic pressures driving unsustainable extraction. It also explores viable sustainability pathways, such as geo-tagging of individual trees, application for a Geographical Indication (GI) status for baobab fruit, community-led conservation models, and policy incentives for sustainable agroforestry practices. By highlighting baobab's multifaceted value—as a climate-resilient species, a nutritional superfood, and a cultural asset—this work underscores the need for an integrated conservation–development framework. In the context of the United Nations Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger), SDG 13 (Climate Action), and SDG 15 (Life on Land), the conservation and sustainable utilization of baobab trees present a compelling opportunity to enhance food and nutrition security, promote biodiversity, support indigenous knowledge systems, and create inclusive rural economies. Future research should prioritize developing propagation and nursery management techniques for large-scale baobab cultivation, assessing the species's carbon sequestration and climate adaptation potential in semi-arid and drought-prone areas, exploring the use of value-added processing in the development of baobab-based nutraceutical and functional food products, and evaluating community-based conservation and benefit-sharing models that ensure both biodiversity protection and sustainable livelihoods.

7.47. The Production-Loss Paradox: Exploring the Causes of Edible Vegetable Crop Loss in India

Shalini Deekonda

Department of Sociology, College of Arts and Social Sciences, Osmania University, Hyderabad 500007, Telangana, India

India's food systems have undergone a significant transformation from being food-deficient to achieving self-sufficiency and surplus. Despite this substantial progress, food loss remains a persistent and paradoxical feature of food system development. Food loss at the farm level in India is often attributed to infrastructural gaps and technical limitations. This approach overlooks the crucial role of farmers' everyday practices, shaped by institutional neglect, market dynamics, weather events, and socio-economic constraints. The objective of this manuscript is to make a research contribution in the Indian context, offering insights derived from the perspective of social practice theory. It explores how and why farmers' decisions and actions in production and harvesting, including produce management, transportation, and marketing, contribute to the continual loss of produced food.

This study is based on empirical data collected from 155 farmers from the dominant vegetable-producing districts of Telangana. This region is gaining prominence in vegetable production due to its strategic location and reliable road infrastructure, linking it to urban markets and increasing opportunities in exports. Accelerated privatization and glocalization have significantly altered agricultural practices, making Telangana a relevant case to investigate factors promoting produce loss at the farmer level. Mixed methods are employed to gather both quantitative and qualitative data, allowing for a comprehensive understanding of farmers' handling and management of produce.

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Notably, it is observed that socially constructed values emphasized fast yield over long-term sustainability, and export-centric market ideologies sidelined the needs of local producers, reinforcing suboptimal practices. This study calls for a paradigm shift towards inclusive, practice-sensitive, and justice-oriented agricultural policy and support systems.

7.48. TOFoo: A Project to Guarantee the Authenticity of Organic Products Through Non-Targeted Analyses

Solenne Jourdren [1], Emmanuelle Baconnier [1], Rodolphe Vidal [1], Lucie Tsamba [2] and Freddy Thomas [2]

[1] ITAB, Institut de l'Agriculture et de l'Alimentation Biologiques, 75012 Paris, France
[2] Eurofins Analytics France, 75012 Paris, France

Despite a strong control system based on strict specifications, European regulations and certification systems, the organic food sector remains vulnerable to fraudulent practices. This leads to a lack of consumer confidence to the detriment of all organic stakeholders. Moreover, differences in the chemical composition between organic and conventional products are well identified in the scientific literature. On this basis, the collaborative R&D project TOFoo aims to develop non-targeted analyses to guarantee the authenticity of organic products and reassure stakeholders and consumers in the end. The project began in July 2020, over a period of 5,5 years, and brings together academic institutions and industrial partners from the food analysis laboratory to the digital sectors.

A few dozen plant and dairy products, raw or minimally processed, were selected. For each product, several hundred samples were collected and analysed using non-targeted and multi-technical methods like NMR and IRMS. Their overall analytical fingerprints were used to build databases. Statistical analysis of these data enabled the elaboration of mathematical models to discriminate between organic and conventional products.

The first available results concern tomatoes and UHT milk, for which this new analytical methodology was efficient in ranking samples according to their organic or conventional production process. This non-targeted solution highlighted intrinsic characteristics linked to cultivation or feeding practices specific to the organic sector.

In conclusion, by giving tangible evidence of composition differences between organic and conventional products, analyses developed as part of the TOFoo project can contribute to improving the attractiveness of organic products and preserving consumer confidence.

7.49. Towards a Grass-Fed Certification System: The FILIERBA Project and the Future of Quality Livestock in Italy

Giovanni Peira, Giorgio Mina and Alessandro Bonadonna

Department of Management "Valter Cantino", University of Turin, 10134 Torino, Italy

The FILIERBA project aimed to explore the potential of forage-based feeding systems, particularly those using polyphite grass and hay, for the development of sustainable and high-quality beef and dairy supply chains in Piedmont, Italy. The study combined quantitative analyses, farm surveys, market assessments, and stakeholder interviews to evaluate the adoption and economic, environmental, and social sustainability of "grass-fed" production models.

Our results confirm the widespread presence of grassland resources and the use of polyphite forage in existing farming systems. Cluster analyses revealed the coexistence of both intensive and extensive production models, the latter more aligned with grass-fed principles. Despite the agronomic and environmental feasibility, the lack of structured supply chains and value recognition currently limits broader market development.

Building on international best practices (e.g., Irish Grass Fed Standard), the project outlines the need for a dedicated quality certification system for grass–hay-based products

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in Italy. Such a system should include clear production protocols, traceability requirements, and independent auditing, while responding to consumer demand for animal welfare, sustainability, and transparency.

The study proposes a roadmap for implementing a grass–hay quality label under Italy's National Quality System for Livestock (SQNZ), supporting differentiation and premium positioning in the market. The creation of a recognized certification could provide incentives for producers, increase the perceived value of grass-fed products, and contribute to regional development, biodiversity conservation, and climate goals aligned with the EU Green Deal and Farm to Fork strategy.

7.50. Two-Step Green Extraction (SFE-CO_2 + ASE) Produces Low-Contaminant Extracts from Olive Mill Wastewater Sludge for Functional Applications

Sergio Martínez-Terol, Noelia Pallarés, Pedro V Martínez-Culebras, Emilia Ferrer, Francisco J Martí-Quijal and Francisco J Barba

Department of Preventive Medicine and Public Health, Food Science, Toxicology and Forensic Medicine, Faculty of Pharmacy and Food Science, Universitat de València, 46010 Valencia, Spain

Sequential supercritical CO_2 extraction (SFE) followed by accelerated solvent extraction (ASE) was applied to six batches of olive mill wastewater (OMW) sludge (TED 13, 14, 15, 16, 20, and 22) to obtain contaminant-safe extracts. Fresh sludge, the residual SFE cakes, and the resulting oil (SFE) and aqueous (ASE) extracts were analysed for heavy metals (As, Cd, Hg, Pb) and mycotoxins. Heavy metal levels showed high variability among samples. More than 95% of the initial heavy metal content remained in the SFE cakes. The SFE oils contained between 13 and 95 μg/kg of As, 0.07 and 6.1 μg/kg of Cd, 0.10 and 4.1 μg/kg of Hg, and 4.4 and 12.2 μg/kg of Pb. Concentrations in the ASE extracts ranged from 13 to 108 μg/kg for As, 0.4 to 1.0 μg/kg for Cd, 0.10 to 5.6 μg/kg for Hg, and 4.6 to 27.3 μg/kg for Pb. Enniatins were the only mycotoxins detected. In fresh sludge, their concentrations ranged from less than 0.15 mg/kg in TED 16 to more than 1.6 mg/kg in TED 13 and TED 14. In SFE oils, levels ranged from 0.12 to 32 μg/kg, with recovery efficiencies of 75–95% when the matrix moisture content was equal to or below 13%, but falling below 10% when moisture exceeded 45%. In ASE extracts, only ENN A1 was detected, with values around 16 μg/kg in TED 14, TED 20, and TED 22. Overall, the combined SFE + ASE process produces oil and aqueous extracts whose heavy metal and enniatin concentrations remain below current food safety limits, supporting the green valorisation of olive mill sludge as a functional ingredient within a circular bioeconomy.

7.51. Unlocking the Functional and Therapeutic Potential of Ultrasound-Assisted Millet Protein Extract Using Emerging Analytical Techniques Like Ir Spectrometry, Nmr, Ftir, Circular Dichroism, XRD, and Microscopic Imaging

Sunil Meena and Upendra Singh

Department of Dairy Science and Food Technology, Institute of Agricultural Sciences, Banaras Hindu University (BHU), Varanasi 221005, India

Millets have emerged as a healthy dietary substitute to cereals due to their nutritional and functional attributes and therapeutic potentialities, due to the generation of bioactive peptides from their native protein. The aim of the study is to explore the structural, functional and thermal properties of isolated millet protein using ultrasonic wave treatment and explore it as an alternative protein for food applications. Pearl millet protein (PMP) was isolated using acid–base precipitation of defatted flour, and ultrasound (US) treatment (at different intervals: 5, 10 and 15 min with 45 KHz) was performed to improve the yield and functional properties. In US-assisted PMP samples, the particle size (789.30–1321 nm)

and zeta potential (−15.20 to −23.96 mV) were altered due to changes in the structure of the protein matrix. The FTIR spectra of control and US-assisted PMP samples also show a significant difference, which may be due to chemical breakdown and changes in the secondary structure. Circular dichroism spectra also show that the various protein fractions (i.e., α- and β- helix, turn, and random) have undergone significant modifications. The distinct XRD peaks in 8–19° revealed the presence of α-helical and β sheets structures and the tiny or diffused peaks result of processing used in protein isolation. The SEM images of PMPs revealed that US-assisted PMP samples appear more uniform in size in comparison to the unsonicated ones, with a larger, compact protein structure that broke down into disordered and irregular fragments. Thermal analysis provided insights into the thermal degradation behavior of the protein, while Nuclear Magnetic Resonance spectroscopy confirmed the presence of amino acids and organic acids or their derivatives. The intervention of the US in millet protein extraction could be beneficial as it induces several functional changes to the protein that ultimately impact its solubility and practical application in food.

7.52. Valorization of Artisanal Sour Buttermilk Through Nanofiltration and Spray Drying: Recovery of Milk Solids and Application of Permeate as a Coagulant

Subhadip Manik [1], Ganga Sahay Meena [1], Yogesh Khetra [1], Ashish Kumar Singh [1,2], Sumit Arora [3], Richa Singh [3] and Raghu H. Vishweswaraiah [4]

1 Dairy Technology Division, ICAR-National Dairy Research Institute, Karnal 132001, India
2 ICAR-National Dairy Research Institute, Karnal 132001, India
3 Dairy Chemistry Division, ICAR-National Dairy Research Institute, Karnal 132001, India
4 Dairy Microbiology Division, ICAR-National Dairy Research Institute, Karnal 132001, India

Artisanal sour buttermilk is generated as domestic waste at the household level during the conservation of milk fat in the form of clarified fat using an artisanal method. Around 15–20 kg of artisanal sour buttermilk is generated during the production of 1 kg clarified fat (ghee). Artisanal sour buttermilk has a huge bulk with low total solids (TSs-4%) and high acidity, and it is usually discarded due to the lack of any suitable technique for its preservation. Henceforth, artisanal sour buttermilk was concentrated up to 19.61% TS employing nanofiltration (NF) at 35 ± 2 °C and subsequently converted to artisanal sour buttermilk powder using spray drying. This powder exhibited excellent wettability (3 s, instant), flowability (angle of repose- 32.10°), water-binding capacity (4.20 g per g of protein), and emulsion stability (80.15%). Furthermore, NF permeate was used as a natural coagulant to prepare heat- and acid-coagulated milk gel from buffalo milk. Buffalo milk heat- and acid-coagulated gel has been criticized for its hard texture and grainy body. Buffalo milk heat- and acid-coagulated gel prepared using NF permeate exhibited significantly ($p < 0.05$) lower hardness and higher yield over cow milk heat and acid-coagulated gel. The developed process enables conversion of artisanal sour buttermilk (by-product) into an easily digestible, low-lactose and high-protein powder. The permeate is able to develop soft heat- and acid-coagulated milk gel from buffalo milk. This will also curtail environmental pollution and generate extra income for farmers. Thus, an eco-friendly process was developed to increase environmental sustainability.

7.53. Whey Valorization and Consumer Acceptance: A Cross-Cultural Path to Sustainable Food Systems

Abeera Moin [1], Maira Moin [2] and Angelo Maria Giuffrè [3]

1 Department of Food Science and Technology, University of Karachi, Karachi 75270, Pakistan

2 External Trade Department, Pakistan Bureau of Statistics, Karachi 74400, Pakistan
3 Department AGRARIA, University of Studies "Mediterranea" of Reggio Calabria, Via dell'Università, 25, 89124 Reggio Calabria, Italy

Dairy by-products such as whey hold great potential for sustainable food innovation. Despite their rich nutritional profile, whey and similar by-products are frequently discarded, contributing to environmental burdens and resource inefficiency. This study aimed to evaluate the perceptions, awareness, and acceptance of whey as a food ingredient among university students in Italy and Pakistan, which are two culturally distinct yet significant dairy-producing nations. A questionnaire-based cross-sectional survey of 288 university students, including 72 from Italy and 216 from Pakistan, to assess food waste awareness, health consciousness, willingness to consume whey-based foods, and the influence of environmental factors on food choices.

Findings revealed a high level of concern about food waste across both populations, with 98% of Pakistani and 89% of Italian students supporting the incorporation of whey into staple foods like bread and pasta. Health benefits and food waste reduction emerged as the strongest motivators for acceptance. Notably, Pakistani students showed greater acceptance, possibly due to higher food insecurity, cost sensitivity, and cultural familiarity with whey in traditional foods. Gender and religious influences also shaped food neophobia and willingness to adopt novel ingredients. The study highlights the role of cultural, socioeconomic, and environmental factors in shaping consumer attitudes toward food waste valorization.

These insights offer actionable recommendations for food system stakeholders and policymakers to design region-specific educational campaigns and develop whey-based functional foods. The findings align with global sustainability goals, particularly SDG 2 (Zero Hunger) and SDG 12 (Responsible Consumption and Production), reinforcing the potential of whey valorization in building sustainable and resilient food systems.

8. Session G: Food Biotechnology

8.1. Elucidating the Regulatory Mechanism of the Global Transcription Factor Cra on Cytidine Synthesis in Escherichia coli

Tong Ye [1,2], Cong Ma [2,3], Lu Liu [1,2], Tengteng Zhu [1,2], Xiaobo Wei [2,3], Junnan Xu [2,3], Wei Ding [3,4], Huiyan Liu [2,3] and Haitian Fang [1,2,3]

1 School of Life Sciences, Ningxia University, Yinchuan 750021, Ningxia, China
2 Ningxia Key Laboratory for Food Microbial-Applications Technology and Safety Control, Ningxia University, Yinchuan 750021, Ningxia, China
3 School of Food Science and Engineering, Ningxia University, Yinchuan 750021, Ningxia, China
4 Ningxia Key Laboratory for Food Microbial-Applications Technology and Safety Control, Ningxia University, Yinchuan 750021, Ningxia, China

Cytidine functions as an essential precursor for nutraceuticals and pharmaceuticals. The global dual-function transcription factor Cra (catabolite repressor/activator) modulates carbon flux distribution during cytidine synthesis in *Escherichia coli.* Here, we examine how Cra regulates carbon partitioning and gene expression to influence cytidine production. We generated a cra knockout strain (*E. coli* NXBG-18C) from *E. coli* K-12 using CRISPR-Cas9 and compared it with the wild-type strain through transcriptomics (RNA-Seq) and metabolic flux analysis (^{13}C-MFA). Cra deletion substantially increased cytidine yield without impairing growth, achieving a 3.77-fold higher titer (9.55 $\pm$ 0.29 g/L), a 1.21-fold elevated glucose consumption rate, and a 3.13-fold improvement in yield. Transcriptomic analysis revealed 1819 differentially expressed genes (1043 upregulated, 845 downregulated), with

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upregulated genes predominantly involved in ribosome biogenesis and the TCA cycle, while downregulated genes were linked to purine, fructose, mannose metabolism, and pentose/glucuronate interconversions. Notably, glucose PTS genes were upregulated, whereas cytidine salvage pathway genes were suppressed. ^{13}C-MFA demonstrated metabolic flux redistribution, with carbon flow favoring the TCA cycle during the log phase (8 h), elevating NADPH, ATP, and PRPP levels, while enhancing flux through central carbon pathways (EMP, PPP, TCA) and energy-related metabolites during the pre-production phase (16 h). These findings indicate that Cra deletion reprograms central carbon metabolism by upregulating glucose uptake and TCA cycle activity, downregulating competing pathways and cytidine salvage, and ultimately redirecting carbon and energy resources toward cytidine synthesis. Cra emerges as a pivotal regulator of cytidine production through its influence on central carbon metabolic genes.

8.2. Exploring the Potential of Ulva, Jania, and Padina Seaweeds for Sustainable Diets and Food Security Solutions: A Biochemical and Sensory Study

Mai Magdy Abdelrazeq

Fats and Oils Department, The National Research Center, Dokki, Cairo 12622, Egypt

This study aligns with Sustainable Development Goals (SDGs) 1, 2, 3, 12 and 13: Zero-Poverty, No-Hunger, Good-Health, Responsible Consumption and production, and Climate-Action. It investigated the potential of three macroalgae, Ulva linza (green, Chlorophyceae), Jania rubens (red, Rhodophyceae), and Padina pavonica (brown, Phaeophyceae), as sustainable dietary sources rich in macro- and micronutrients, with a specific focus on excluding oil content. The research comprised two components: (1) a biochemical analysis of lipid content and composition, and (2) a sensory evaluation of salted Nori green seaweed samples. Lipid extraction using the Soxhlet methodology revealed low oil yields across all species: Ulva (0.5%), Padina (0.2%), and Jania (0.2%). The low oil amounts were confirmed by the phosphovanillin spectrophotometric method, highlighting the need for biotechnological interventions to enhance lipid production, particularly polyunsaturated omega-3 fatty acids (PUFAs), whose presence was confirmed using GC-MS (specifically Eicosapentaenoic Acid "EPA" C20:5n-3, Docosahexaenoic Acid "DHA" C22:6n-3, and Alpha-linolenic Acid "ALA" C18:3n-3). Notably, Padina and Jania exhibited a fishy aroma, while Ulva presented a distinct rosy scent, although the three species possess distinct PUFA, particularly Omega 3 FAs. A sensory study was conducted using a cross-sectional observational design with 40 participants, where we assessed the appearance, sound, taste, aroma, texture, and overall acceptance of roasted organic (green seaweed) samples, with further statistical analysis using the parametric ANOVA test in SPSS. Results indicated the potential of seaweed as a dietary component, although it requires taste and texture modifications. Furthermore, the sensory evaluation revealed a need for increased awareness regarding seaweed farming and consumption, highlighting the need for behavioral changes to facilitate the integration of seaweed into mainstream diets. Recommendations include developing tailored recipes targeting youth preferences to promote future adoption and educational initiatives to highlight the environmental and nutritional benefits of seaweed. The sensory survey underscored the necessity of improving palatability and conducting public awareness campaigns to maximize seaweed's contribution to global food security.

8.3. A Heat Transfer Analysis to Assess the Performance of Cryopreservation Protocols of Saccharomyces eubayanus, a Wild Patagonian Yeast Relevant for the Brewing Industry

Maria Agustina Caruso [1], Diego Libkind [1], Noemi Zaritzky [2,3] and Maria Victoria Santos [1]

[1] Reference Center for Yeasts and Brewing Technology (CRELTEC), IPATEC-CONICET-National University of Comahue, San Carlos de Bariloche 8400, Province of Rio Negro, Argentina
[2] IDCA—Center of Research and Development in Food Science and Technology (University of La Plata-CONICET-CIC) Faculty of Exact Sciences, UNLP. 47 and 116, La Plata 1900, Province of Buenos Aires, Argentina
[3] Chemical Engineering Department—Faculty of Engineering—UNLP. 48 and 115, La Plata 1900, Province of Buenos Aires, Argentina

Saccharomyces eubayanus is a cryotolerant wild yeast known as the cold-adapted parent of *S. pastorianus*, the hybrid responsible for lager beer production. Due to its industrial relevance, efficient cryopreservation methods are essential to improve culture viability during long-term storage. The standard protocol (CoolCell® devices) submits cryovials at a cooling rate of 1 °C/min. An alternative technique is the direct freezing from ambient temperature to −80 °C (DU), which avoids manipulation and is cost-effective.

Both methods involve different freezing stages governed by transient heat conduction that depend on overall heat transfer coefficients (U), which reflect conductive and convective heat exchange between the cryovial and its environment. The cryopreservation protocol can be represented by the characteristic freezing time (tc), which is inversely proportional to the freezing rate, and is defined as the time elapsed between the initial freezing temperature and a reference temperature (−40 °C).

The objectives were to (i)determine *tc* and heat transfer coefficients for DU and CoolCell® (CU) protocols; (ii)correlate these parameters with the viability, vitality, phenotype, and genetic stability of *S. eubayanus* CRUB 1568^T.

Cells were harvested at early stationary phase, suspended in 10% glycerol, and stored for one year at −80 °C. Viability and vitality were evaluated, and experimental fermentations and PCR fingerprinting were performed to assess phenotypic and genetic stability. Thermal histories of cryovials were recorded using thermocouples to measure *tc*. Heat transfer coefficients were determined by computational modeling using the finite element method, incorporating temperature-dependent properties.

For the CU method, the obtained values were tc = 26.85 min, U = 4.72 W/m^{2}K, and viability = 51.2%. For DU, a higher cooling rate was observed (smaller *tc* = 10.86 min) associated with higher values of U = 18.75 W/m^{2}K and viability (71.7%), with no observed genetic or fermentation alterations of the tested strain.

In conclusion, DU, with higher cooling rates, improved cryopreservation of *S. eubayanus* and was a simpler and cost-saving process.

8.4. A New Lease Oflife for Oat Hulls—Fermentation-Based Lifeline for Disruptive Food Innovations

Seedhabadee Pooba Ganeshan and Mehmet Caglar Tulbek

Fermentation & Bioengineering, Saskatchewan Food Industry Development Centre, Saskatoon, SK S7M 5V1, Canada

The objective of this project is to derive value from oat hulls for use as food ingredients using fermentation and the tempeh fungus *Rhizopus oligosporous*. During oat milling, about 30% hulls are produced. The hulls are of low value. Small amounts are used as feed or for combustion or are simply discarded. One of the downsides to consuming oat hulls is their abrasiveness because of their high silica content. One of the objectives of this project was to first reduce the content of silica, and we were able to reduce it successfully from 6% to less than 1% using mild chemical and enzymatic treatments. Silica content was confirmed by means of ICP-MS and colorimetric silica quantification assay. The FDA-recommended daily food intake limit for silica is less than 2% by weight or 10–30 g. The results observed in this

project are therefore very promising, especially the fact that fermentation with *Rhizopus oligosporous* itself reduced silica content to 2%. Solid-state fermentation (SSF) was also conducted at a small scale (500 g) in static and agitated systems and it has indicated that the tempeh fungus is able to colonize the oat hulls and texturize them. Prototype testing of the fermented and texturized oat hulls in food products is in progress.

8.5. Advances in Fermentation-Derived Red Pigments: A Comparative Review of Natural and Synthetic Colorants in Food Biotechnology

María Carpena [1], Rafael Nogueira-Marques [1], F. Chamorro [1], A.O.S. Jorge [1,2], J. Echave [1,3], A. G. Pereira [1,4] and M. A. Prieto [1]

1 Instituto de Agroecoloxía e Alimentación (IAA), Universidade de Vigo, Nutrition and Food Group (NuFoG), Campus Auga, 32004 Ourense, Spain
2 REQUIMTE/LAQV, Department of Chemical Sciences, Faculty of Pharmacy, University of Porto, R. Jorge Viterbo Ferreira 228, 4050-313 Porto, Portugal
3 Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Campus de Santa Apolonia, 5300-253 Bragança, Portugal
4 Investigaciones Agroalimentarias Research Group, Galicia Sur Health Research Institute (IIS Galicia Sur), SERGAS-UVIGO, 36213 Vigo, Spain

In recent years, the demand for biotechnologically produced, natural, and health-conscious food colorants has grown substantially. Natural pigments derived from plants, algae, and microbial sources offer multifunctional properties such as antioxidant activity, bioavailability, and sustainability, alongside their coloring function. Among emerging technologies, microbial fermentation—particularly using filamentous fungi and yeast—has enabled the production of novel pigments from renewable and low-cost substrates such as agrifood co-products. This systematic review aimed to compare the properties, applications, and challenges associated with natural and synthetic red pigments used in food products. It was conducted following PRISMA guidelines and performed across Scopus, Web of Science, and PubMed databases. Inclusion criteria involved peer-reviewed articles published from 2005 to 2025 reporting "physicochemical properties", "stability", "bioactivity", "economic aspects", and "safety profiles" of "red pigments". From the results, Monascus spp. is an example of a well-known species due to its ability to produce azaphilone pigments in orange, yellow, and red hues, which have been extensively used in Asia as a natural food colorant. Additionally, it can produce more than 90 bioactive molecules with health benefits, including isoflavones, antioxidants, GABA, and monacolin K. Monascus-derived red pigments represent a promising sustainable alternative, showing moderate stability and affordability, although pricing data remain limited. Meanwhile, traditional pigments like carmine (E120), though color-stable, are associated with allergenicity and high cost (135–180 EUR/kg). Betanin (E162), a plant-derived pigment, is safer and less costly (5–10 EUR/kg), but less stable. Synthetic colorants such as Allura Red AC (E129) and Ponceau 4R (E124) offer performance and affordability advantages, though they raise safety concerns. This systematic review focuses on the evaluation of natural and synthetic red pigments and their potential as sustainable and functional alternatives for food formulations.

8.6. Bee Products and the Air We Breathe: Metabarcoding of Honey, Pollen, and Airborne eDNA

Pelin Taş [1,2,3] and Emre Keskin [2,3]

1 Biotechnology Institute, Dışkapı Campus, Ankara University, Ankara 06110, Turkey
2 Evolutionary Genetics Laboratory (eGL), Department of Fisheries and Aquaculture, Faculty of Agriculture, Ankara University, Ankara 06110, Turkey

[3] Agrigenomics Hub (AgriGx), Animal and Plant Genomics Research Innovation Centre, Ankara 06110, Turkey

Revealing the botanical composition of honey and the environment in which it is produced is essential for ensuring food safety, quality control, and biodiversity monitoring. Such information also supports sustainable agricultural management and enhances our understanding of plant–pollinator interactions. This study aimed to simultaneously characterize plant communities from honey, airborne particles, and pollen using an integrated DNA metabarcoding approach.

Samples were collected from a total of 13 fields over a period of 6 months and analyzed using high-throughput sequencing of plant DNA. Taxonomic identifications were conducted using reference databases, enabling direct comparison of plant assemblages among the sample types.

The results indicated that honey reflected a broad range of floral sources visited by bees, while airborne DNA provided complementary insights into the local vegetation and environmental exposure. Pollen data offered finer-resolution information on specific floral interactions. Multivariate analyses (Bray–Curtis dissimilarity and PERMANOVA) revealed significant compositional differences between the sample types, yet common taxa such as Populus nigra, Hedera helix, and Cistus laurifolius were consistently detected across all matrices, highlighting key components of regional biodiversity.

This combined eDNA-based workflow offers a robust and non-invasive tool for tracing the botanical origin of honey and monitoring plant diversity dynamics. Beyond advancing food authenticity verification, the approach holds promise for applications in sustainable agriculture, ecological assessments, and biodiversity conservation.

8.7. Development, Characterization, and Evaluation of a Peach Pulp- and Pomace-Flavored Soy-Based Yogurt Beverage: A Plant-Based, Lactose-Free, and Gluten-Free Yogurt Alternative

Hamna Zubair

Hamna Zubair Department of Biotechnology, International Islamic University Islamabad (IIUI), and National Agricultural Research Centre (NARC), Islamabad 44000, Pakistan

This research was focused on developing a lactose- and gluten-free substitute of yogurt made from soy and enhanced with peach pulp and pomace to make it more nutrient-dense, palatable, and friendly to the planet. A fermented soy beverage was prepared using Lactobacillus delbrueckii subsp. bulgaricus and Streptococcus thermophilus. After fermentation, sugar (5.92%), peach pomace (1.18%), peach pulp (1.48%), and peach jam (2.66%) were added to enhance the product's aroma and mouth feel. Protein was quantified physicochemically as 4.61 per cent using the Kjeldahl method, moisture (72.96 per cent) using the oven-drying technique, and ash content (4.71 per cent) in a muffle acid furnace. pH was observed during the process on a calibrated pH meter, with the initial value being 6.7, followed by a drop to 4.6 after fermentation and 5.8 after adding fruit derivatives. The total viable microbial count exceeded 10^7 CFU/mL, which is the requirement for yogurt classification. A trained panel of 15 members carried out sensory evaluation on a nine-point hedonic scale. The product had scored highly in the attributes of flavor (8.5), texture (7.8), and overall acceptability (8.3). According to shelf-life testing, the product was stable over a period of time under refrigeration (7–10 days) and for up to two months when frozen, with minimum textural changes reported. Peach pomace, one of the by-products of fruit processing, acts as an antioxidant agent and phenolic substance that helps in nutritional augmentation and is sustainable. This study can be used to design an acceptable, healthy, and environmentally friendly vegan alternative to yogurt that could be used by lactose-intolerant people and promote a vegan lifestyle, following the global trends of functional food production.

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8.8. Effect of Sago Starch Concentration on the Activity of Pullulanase and β-amilase Simultaneously for the Production of Maltose Syrup

Nurfadillah Nurfadillah [1], Amran Laga [2] and Februadi Bastian [3]

[1] Master Program in Food Science and Technology, Faculty of Agriculture, Hasanuddin University, Makassar 90245, Indonesia
[2] Department of Agricultural Technology, Faculty of Agriculture, Hasanuddin University, Makassar 90245, Indonesia
[3] Department of Food Science and Technology, Faculty of Agriculture, Hasanuddin University, Makassar 90245, Indonesia

Sago starch, rich in polysaccharides (approximately 85%), primarily consists of amylopectin (70–80%) and amylose (15–30%), making it a promising substrate for maltose syrup production as an alternative to cane sugar-based sweeteners. This study aims to optimize both the substrate concentration and the saccharification duration through the simultaneous application of pullulanase and β-amylase, aiming to enhance hydrolysis efficiency and shorten overall processing time. The enzymatic treatment was applied to sago starch concentrations of 10%, 15%, and 20% (*w*/*v*), and saccharification was monitored over a time range from 6 to 72 h. Results revealed that a 20% substrate concentration yielded the highest maltose content and reducing sugar levels, along with a notable increase in dextrose equivalent (DE) and viscosity. For instance, at 48 h, the maltose content reached 26.79%, reducing sugars 35.85 g/L, DE 25.14%, and viscosity 49.75 mPas. This treatment significantly improved saccharification rate, sugar conversion, and overall product quality by promoting efficient enzymatic synergy and substrate utilization. Optimizing these parameters not only enhances conversion but also offers a more sustainable, cost-effective, and scalable approach for sweetener manufacturing. These findings provide valuable insights for the food and biotechnology industries, particularly in developing reliable, eco-friendly alternatives to conventional sweeteners, and highlight the industrial potential of sago starch in high-value, functional food formulations and health-focused products.

8.9. Fermentation of Brewer's Spent Grain with Pleurotus ostreatus: A Pathway to Nutritional Enhancement

Mariano M Pascual and Carlos M Luquet

Aquatic Ecotoxicology Laboratory, Applied Ecology Center of Neuquén (CEAN), Institute of Research in Biodiversity and Environment (INIBIOMA), National Scientific and Technical Research Council (CONICET), Junín de los Ande 8371, Argentina

Brewer's spent grain (BSG) is a widely recognized byproduct of beer production that retains valuable nutritional components. Its upcycling promotes nutrient recovery from waste and minimizes the nutrient loss to the environment. The presence of antinutrient phytic acid (PA) in food and feed products is linked to decreased mineral and protein bioavailability due to the formation of insoluble complexes. The levels of PA can be effectively reduced through fermentation with microorganisms that produce phytase, which releases soluble forms of phosphorus that are more readily bioavailable. To enhance the nutritional quality of BSG, it was used as a substrate for solid-state fermentation (SSF) with the edible mushroom *Pleurotus ostreatus*, specifically targeting a reduction in the PA content and an increase in the phosphorus bioavailability. After 14 and 21 days of fermentation, we assessed the levels of PA, total phosphorus, and acid-soluble phosphorus. After 14 days of SSF, the PA content was reduced by 81%, resulting in a doubling of the soluble phosphorus content. Furthermore, the total phosphorus significantly increased at both time points. This study demonstrates that BSG can be effectively revalorized through SSF with *P. ostreatus*, significantly reducing the antinutrient PA content while enhancing the

phosphorus content, particularly regarding its bioavailable form. These findings underscore the potential for upcycling food byproducts like BSG, contributing to sustainable practices and promoting resource efficiency in food systems.

8.10. In Vitro Approaches to Assess Xenobiotic/Microbiota Interactions: Insights from Food Additives, Microplastics, and Mycotoxins

Davide Addazii, Lorenzo Nissen and Andrea Gianotti

[1] DiSTAL—Department of Agricultural and Food Sciences, Alma Mater Studiorum—University of Bologna, P.za G. Goidanich, 60, 47521 Cesena, Italy
[2] CIRI—Interdepartmental Centre of Agri-Food Industrial Research, Alma Mater Studiorum—University of Bologna, P.za G. Goidanich, 60, 47521 Cesena, Italy

Xenobiotics, including food additives, pollutants, and microplastics, are increasingly recognized for their potential to alter the human gut microbiota and its metabolic output. This study employed advanced in vitro gut models to investigate how selected xenobiotic compounds influence microbial ecology and metabolite production in the human colon environment. Two parallel experiments were conducted. In the first, three food texturizers, chitosan, chitosan made by seafood waste, and hydroxypropyl methylcellulose (HPMC), were fermented and evaluated via qPCR and GC-MS/SPME to assess microbial composition and volatile metabolites. Results showed that chitosans, particularly with a high degree of deacetylation and solubility, enhanced the growth of beneficial bacteria (e.g., *Bifidobacterium*, *Lactobacillus*) and promoted the production of health-related short-chain fatty acids (SCFAs). In contrast, HPMC favored proteolytic bacteria such as *Clostridiaceae* and led to the accumulation of harmful compounds like p-cresol and skatole, indicating a dysbiotic shift. In the second study, polyethylene (PE) and polystyrene (PS) microplastics were evaluated for their impact on the gut ecosystem. High doses of microplastics reduced SCFA production while promoting the enrichment of opportunistic bacteria (e.g., *E. coli*, *Desulfovibrio*) and the accumulation of toxic aromatic metabolites. These effects are likely driven by bacterial colonization on MP surfaces rather than direct antimicrobial action. A new study is currently in progress, focusing on foods, particularly cheeses contaminated with mycotoxins, to further explore xenobiotic–microbiota interactions in food matrices. Overall, these findings demonstrate the utility of in vitro gut models in evaluating the biological effects of dietary xenobiotics. Both chitosan and microplastics significantly modulated microbial community structure and metabolic function, highlighting potential risks and benefits.

8.11. Modeling Studies on the Level of Inhibition Using Gamma-Decalactone-Enriched Pectin Films Against Bacillus Subtilis

Jolanta Małajowicz [1], Antoni Wyskwar [2] and Sabina Galus [3]

[1] Department of Chemistry, Institute of Food Sciences, Warsaw University of Life Sciences, 02-776 Warsaw, Poland
[2] KN Biotech Student Scientific Club, Faculty of Biology and Biotechnology, Warsaw University of Life Sciences, 02-776 Warsaw, Poland
[3] Institute of Food Sciences, Warsaw University of Life Sciences–SGGW, 02-776 Warsaw, Poland

Gamma-decalactone (GDL) is a naturally occurring compound with a characteristic peach-like aroma commonly found in fruits. Beyond its sensory appeal, lactone has potential antimicrobial properties, which could be valuable in developing active food packaging materials.

This research aims to assess the level of microbial inhibition by edible coatings enriched with natural lactone. Several variants of pectin coatings with different GDL concentrations

were prepared from 2.5 to 10%. Model studies were performed against the common Gram-positive bacteria *Bacillus subtilis*. Bacteria were grown on Mueller–Hinton liquid medium with 1 g of the coatings with different GDL concentrations. The microorganisms were multiplied for 72 h at 37 °C; then, appropriate dilutions were made, and the cells were sown onto Petri dishes.

Our study demonstrates that GDL in coating films effectively inhibits the growth of Bacillus subtilis. The films containing GDL—regardless of its concentration—inhibited the growth of the bacteria, while the control samples without GDL showed visible bacterial colonies. This suggests that GDL can function as a natural antimicrobial agent when embedded into food-safe, biodegradable films.

These results support the role of GDL in extending the shelf life of fresh fruits and vegetables and open the door for further research. Upcoming experiments will investigate its effectiveness against other foodborne microorganisms, such as molds and yeasts, to evaluate its broader potential in sustainable and natural food preservation strategies.

8.12. Natural Fermentation as a Bioconversion Strategy to Enhance the Functional Value of Legumes: A Case Study on Fava Beans, Chickpeas, and Grass Peas

Ruben R. Fonseca [1], Irene C. Antunes [2,3,4], Claúdia Correia [2], Nuno Alvarenga [2,5], Igor Dias [6,7,8], Joaquina Pinheiro [9], Fernanda Simões [2], Manuela Vida [2] and Elsa M. Gonçalves [2]

1 ESTM—Escola Superior de Turismo e Tecnologia do Mar—Politécnico de Leiria, 2520-614 Peniche, Portugal
2 INIAV—Instituto Nacional de Investigação Agrária e Veterinária, Unidade de Tecnologia e Inovação, 2780-157 Oeiras, Portugal
3 CIISA—Centre for Interdisciplinary Research in Animal Health, Faculty of Veterinary Medicine, University of Lisbon, 1300-477 Lisboa, Portugal
4 Associate Laboratory for Animal and Veterinary Sciences (AL4AnimalS), Faculty of Veterinary Medicine, University of Lisbon, 1300-477 Lisboa, Portugal
5 GeoBioTec—Geobiociências, Geoengenharias e Geotecnologias, FCT-UNL, 2829-516 Caparica, Portugal
6 ESAS, UIIPS—Instituto Politécnico de Santarém, Quinta do Galinheiro, S. Pedro, 1001-904 Santarém, Portugal
7 Centro de Estudos de Recursos Naturais Ambiente e Sociedade (CERNAS), Instituto Politécnico de Santarém, Quinta do Galinheiro, S. Pedro, 1001-904 Santarém, Portugal, 8CIEQV—Life Quality Research Centre, Avenida Dr. Mário Soares n 110, 2040-413 Rio Maior, Portugal
8 MED—Instituto Mediterrâneo para a Agricultura, Ambiente e Desenvolvimento & CHANGE—Global Change & Sustainability Institute, Universidade de Évora, Pólo da Mitra, Apartado 94, 7006-554 Évora, Portugal
9 MARE—Marine and Environmental Sciences Centre/ARNET—Aquatic Research Network, ESTM—School of Tourism and Maritime Technology, Polytechnic of Leiria, 2520-614 Peniche, Portugal

Legumes are a highly valued food source, recognised for their rich protein content and beneficial bioactive compounds. However, their full nutritional potential can be limited by the presence of anti-nutritional factors (ANFs). Fermentation is a crucial processing method that effectively reduces ANFs while improving the bioavailability of beneficial nutrients, thereby maximising legumes' health benefits. Optimising these fermentation processes, tailored to specific legume species, is essential to exploit their inherent advantages fully.

This study investigated the impact of natural fermentation, involving the spontaneous microbial activity present in raw legume flours, carried out at 21 °C for 14 days, on fava

beans (*Vicia faba*), chickpeas (*Cicer arietinum*), and grass peas (*Lathyrus sativus*), focusing on their microbiological and physicochemical transformations. Egocultum provided raw legume flours. Microbiological assessments revealed a consistent proliferation of lactic acid bacteria (LABs) across all the fermenting samples, with fava beans and grass peas demonstrating robust LAB growth. Chickpeas, while exhibiting fewer LABs, showed a notable presence of moulds. Yeasts were predominantly observed in fava bean samples. Physicochemical analyses revealed a decrease in the pH and a significant increase ($p < 0.05$, Tukey test) in the titratable acidity, with increases of 113% in fava beans, 60% in grass peas, and 53% in chickpeas. The soluble solid (°Brix) content was reduced across all the legume species. Notably, the total phenolic content significantly increased ($p < 0.05$) by 224% in chickpeas and 155% in grass peas, while fava beans showed a slight increase of 13%. The antioxidant activity, measured using DPPH, ABTS, and FRAP assays, showed varied responses: fava beans' activity decreased, grass peas' ABTS activity increased (with its other activities decreasing), and chickpeas' activity consistently increased across all three assays.

These findings highlight the diverse species-specific responses to this natural fermentation process. While further optimisation is required, natural fermentation presents a promising method for enhancing the functional potential of legumes, particularly by increasing the acidity and phenolic content in certain species.

8.13. Polyphasic Characterisation of Lactic Acid Bacteria Diversity Associated with Subappennino Dauno Sheep Milk from 'Gentile di Puglia' Breed for Application in Pecorino Cheese and Design of Cereal-Based Fermented Beverage

Hülya Cunedioğlu [1,2], Ghofrane Omri [1], Michela Palumbo [3], Franco Biasioli [4], Giuseppe Spano [1], Vittorio Capozzi [3] and Mariagiovanna Fragasso [5]

1 Department of Agriculture Food Natural Science Engineering (DAFNE), University of Foggia, 71122 Foggia, Italy
2 Scienzanova S.r.l., 41125 Modena, Italy
3 Institute of Sciences of Food Production, National Research Council (ISPA-CNR), 73100 Lecce, Italy
4 Fondazione Edmund Mach, 38098 Trento, Italy
5 Department of Sciences of Agriculture, Food, Natural Resources, and Engineering (DAFNE), University of Foggia, Via Napoli, 25, 71122 Foggia, Italy

Preserving and valorising Apulian food biodiversity is a key strategy to promote the innovation of agro-food systems associated with regional Marginal Areas, including a diverse range of animals, plants, and micro-organisms (especially those of interest for food fermentation). 'Gentile di Puglia" is an autochthonous sheep breed of millenary origins typical of the South of Italy, particularly associated with Foggia province (i.e., Subappennino Dauno and Tavoliere areas), also recognised for its traditional cheese production. Here, we report a case study related to the marginal area of the Subappennino Dauno/Monti Dauni, in the north of the Apulian Region, (i) isolating lactic acid bacteria (LAB) from sheep milk (breed 'Gentile di Puglia') and (ii) performing a polyphasic characterisation of LAB for the design of a multi-strain starter culture for Pecorino cheese and the design of a cross-over cereal-based fermented beverage ('Senatore Cappelli' durum wheat variety). Regarding the characterisation of Pecorino cheese and wheat beverages, the experimental plan included evaluating the pH of the final product, conducting a sensory analysis, investigating volatilomics, antioxidant properties, total phenol content, and rheological properties, and assessing the growth of lactic acid bacteria in the final product. The evaluations concerned protechnological properties, antimicrobial activity, sensorial aspects, and the study of volatile organic compounds. An interesting protechnological variability

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among the different strains analysed was detected, highlighting the modulation of several of the properties of interest in the context of the crossover between the dairy and plant-based sectors. Mixed strains in Pecorino cheese were found interesting for several of the tested characterisation criteria, supporting the design of a mixed starter culture. MF, HC, GS and VC are supported by the funding of the European Union Next-Generation EU [PNRR—Mission 4 Component 2, Investment 1.4—D.D. 1032 17/06/2022, CN00000022] within the Agritech project. FB and MP received funding from PNRR, Investment 1.3—Award Number: Project code PE00000003, Project: ONFOODS.

8.14. Selecting a Jujube-Based Sourdough as Starter to Enhance the Texture, Nutritional and Sensory Properties of Wheat Bread

Jing Liu, Shanshan Xie, Hongfei Zhao and Bolin Zhang

Beijing Key Laboratory of Forest Food Processing and Safety, College of Biological Science and Biotechnology, Beijing Forestry University, Beijing 100083, China

The beneficial effects of fruit- and vegetable-based sourdough on bread's structure and flavor have been documented, but few studies have addressed the role of the jujube matrix in modulating textural properties, nutritional features, color, and sensory perception. This study created an innovative sourdough formula, comprising a combination of 20% *Lpb. plantarum* CICC 23121-fermented jujube with wheat dough as starter culture, for bread making. The results showed that supplementation of 20% fermented jujube-based sourdough (20% FJS) resulted in notable texture profile changes, with reductions of 19.05% in hardness, 17.82% in chewiness, 9.68% in cohesiveness, and 13.84% in gumminess compared to the control (wheat dough). These alterations in texture were attributed to the decreased cross-linking resulting from the combined effects of jujube components and LAB fermentation, leading to gluten network fragmentation and consequent dough softening. Four breads, including wheat bread (WB), jujube wheat bread (JWB), wheat sourdough bread (WSB), and jujube sourdough bread (JSB), were designed to show a 7.4% increase in the specific volume of JSB bread fermented by 20% FJS compared to conventional wheat bread. The key texture properties of the bread JSB were improved, with hardness increasing by 1.75%, chewiness by 4.36%, and elasticity by 1.30%. Moreover, the bread JSB demonstrated a superior nutritional quality, with a total dietary fiber content reaching 10.04 g/100 g. The insoluble dietary fiber (IDF), soluble dietary fiber (SDF), and total dietary fiber (TDF) and in vitro protein digestibility (IVPD) levels were elevated by 2.17-fold, 3.41-fold, 2.48-fold, and 1.24-fold, respectively. In terms of sensory ratings, overall, the JSB bread was preferred by the panels in terms of color and taste compared to the other tested breads. Therefore, incorporating jujube sourdough into bread production represents a well-designed strategy to meet contemporary consumers' dual demands for enhanced sensory quality and nutritional values.

8.15. Technology for Obtaining Mangaba Nectar and Its Physicochemical Characterization

Adriana Rodrigues Machado, Lorrane Soares dos Santos, Fernanda Teixeira de Sousa, Fabiano Guimarães Silva and Letícia Fleury Viana

Department of Food Science, Goiano Federal Institute of Education, Science and Technology, Campus Rio Verde, Rodovia Sul Goiana, Km 01, Rio Verde 75901-970, GO, Brazil

Mangaba is a well-known and appreciated fruit of the cerrado, recognized for having sweet characteristics, and can be consumed *in natura* or in the production of sweets, juices, ice cream, vinegar, etc. This work aimed to develop mangaba nectar (October 2017 harvest) and evaluate physicochemical characteristics. The mangaba was pulped manually, and its seeds were separated and then taken to the blender for homogenization. The pulp was

diluted in water 1:2 (pulp–water), metabisulfite, pectin, and gelatin (50 °C for 60 min), respectively, immediately after filtering until nectar was obtained. For the fruits and nectar, the following parameters were analyzed in triplicate: titratable acidity, pH, and soluble solids. The pH was determined by direct reading in a potentiometer; titratable acidity was determined by means of titrology with a standardized solution of sodium hydroxide at 0.1 N, having, as an indicator, the turning point of phenolphthalein. The values were expressed as percentages of soluble solids (° Brix) through adigital refractometer. The values found for mangaba were 12.87 ± 0.00 ° Brix, 12 ± 0.00%, and 3.94 ± 0.005 for soluble solids, acidity, and pH, respectively. For nectar, the values found were 2.6 ± 0.00 ° Brix, 4.8 ± 0.00%, and 4.25 ± 0.01 for soluble solids, acidity, and pH, respectively. There was a significant difference between the fruits and the nectar for the parameters of acidity and soluble solids, but not for the pH. These variations may be associated with thermal processing, pulp dilution, the addition of additives, and the fruit ripening stage. Additional sensory evaluation data revealed that the nectar was well accepted in terms of flavor, aroma, and appearance, suggesting potential for commercial consumption. Practical applications include the production of natural beverages with added value, sustainable use of cerrado fruits, and incentives for the regional agro-industry. It was concluded that the processing of mangaba significantly altered the acidity and soluble solids of the nectar, keeping the pH stable, making it feasible to use it in the formulation of food products.

8.16. Use of Chenopodium Pallidicaule Grains to Obtain a Novel Flour Fermented by Monascus Ruber in Solid-State Fermentation

Franz Tucta Huillca [1], Evelyn Quispe-Rivera [1], Ursula Gonzales-Barron [2], Vasco Cadavez [2] and Marcial Silva-Jaimes [1]

1 Faculty of Food Industries, National Agricultural University La Molina, Lima 15024, Peru
2 Mountain Research Center, Polytechnic Institute of Bragança, 5300-253 Bragança, Portugal

Kañihua (*Chenopodium pallidicaule*), a gluten-free Andean grain, has high biological and nutritional values, essential amino acids, essential fatty acids, vitamins and minerals; in addition, its seeds or grains have antimicrobial, antioxidant, antidiabetic and antihypertensive properties. Therefore, *Ch. pallidicaule* has great potential in the industry, but it is very little researched. On the other hand, *Monascus ruber* is an edible fungus widely used for the production of red pigments that have diverse biological activities with applications as food colorants and nutraceuticals that protect the body from degenerative diseases related to oxidative stress. In this novel study, *Ch. pallidicaule* flour was obtained from the solid-state fermentation of grains by *Monascus ruber* NRRL 1597. The Response Surface Method was used to optimize the fermentation process in relation to three factors, such as glucose, sodium chloride and monosodium glutamate, according to the Box–Behnken Design with 15 treatments. The dependent variables were L*, a* and b* belonging to the CIELAB color space. Modelling was performed with the R software. The results of the response variables were 40.99, 8.21 and 12.85 for L*, a* and b* with R^2 values of 0.85, 0.91 and 0.87, respectively. Therefore, pigmented flours were obtained with great potential for application in the food industry, which is increasingly demanding functional foods.

9. Session H: Foods as Medicine

9.1. Grape Antioxidant Dietary Fibre Induces Anti-Proliferative Response in Healthy Colon via Cell Cycle Arrest

Mª Elvira López-Oliva [1,2], Marina Hernández-Martín [1,2], Paula Ortega-Menéndez [1], Luis Rivera [1], Silvina Rosa Drago [3], Jara Pérez-Jimenez [4,5] and Verónica Azcutia [12]

[1] Department of Physiology, Pharmacy School, Complutense University of Madrid, 28040 Madrid, Spain
[2] Health Research Institute of the San Carlos Clinical Hospital (IdISSC), 28040 Madrid, Spain
[3] Institute of Food Technology, CONICET, FIQ–UNL, Santa Fe 3000, Argentina
[4] Department of Metabolism and Nutrition, Technology and Nutrition (ICTAN-CSIC), Institute of Food Science, 28040 Madrid, Spain
[5] CIBER of Diabetes and Associated Metabolic Diseases (CIBERDEM), Carlos III Health Institute (ISCIII), 28029 Madrid, Spain

Introduction: Dietary bioactive compounds are increasingly recognized for their role in regulating epithelial homeostasis and preventing abnormal cell proliferation. Among them, polyphenol-rich byproducts of winemaking have demonstrated antiproliferative effects in various tissues, including the colon, by modulating oxidative stress, inflammation, and cell cycle control. Grape Antioxidant Dietary Fibre (GADF) is a natural product that combines high amounts of dietary fibre and phenolic antioxidants obtained by a patent procedure from red grape pomace (*Vitis vinifera*, *var Cencibel*). In this study, we studied GADF's effect on proximal colonic epithelium proliferation and its molecular mechanisms in healthy rats.

Methods: Male Wistar rats were randomly assigned to control (Standard diet) or GADF-fed groups (5% *w*/*w* GADF replacing cellulose in an isoenergetic diet) for four weeks. Proximal colonic tissues were collected, and cytosolic and nuclear extracts were obtained. Immunohistochemistry and Western blot were conducted to assess proliferation and cell cycle markers. All procedures were approved by the Animal Care Committee of Universidad Complutense de Madrid (EU Directive 86/609/EEC).

Results: A significantly lower percentage of proliferating cell nuclear antigen (PCNA)-positive nuclei in Lieberkühn's crypts was observed in GADF-fed rats compared to controls (−30.71%, $p < 0.0001$). GADF also induced a 24-fold increase in p53 phosphorylation at Ser392 ($p < 0.0001$), with localization in both the nucleus and cytoplasm. In parallel, GADF upregulated the expression of the cyclin-dependent kinase inhibitors p21ˆCip1/Waf1 and p27ˆKip1 by 35% and 25% (both $p < 0.001$) and downregulated cyclin D1 and cyclin E by 26% and 17% ($p < 0.01$), respectively.

Conclusions: This study provides novel insights into the molecular mechanisms by which GADF modulates epithelial cell dynamics in the healthy colon. By inducing a p53-dependent G1/S cell cycle arrest, GADF effectively limits epithelial proliferation, supporting its role as a promising chemopreventive dietary component for maintaining colonic health and reducing early risk factors associated with colorectal cancer.

9.2. Identification of Key Targets and Pathways Modulated by Dietary Flavonoid Morin in Gastric Cancer: A Bioinformatics-Guided Experimental Study

Nilesh Naskar [1], Sunil Kumar [2], Lekshmi Sree Chandra [1], Uday Kumar [3], Bijo Mathew [2], Shweta Shrivastava [4] and Manish Kumar Jeengar [1]

[1] Department of Pharmacology, Amrita School of Pharmacy, Amrita Vishwa Vidyapeetham, AIMS Health Sciences Campus, Kochi 682041, Kerala, India
[2] Department of Pharmaceutical Chemistry, Amrita School of Pharmacy, Amrita Vishwa Vidyapeetham, AIMS Health Sciences Campus, Kochi 682041, Kerala, India
[3] Department of Pharmacy Practice, Amrita School of Pharmacy, Amrita Vishwa Vidyapeetham, Kochi, Kerala, India
[4] Department of Pharmacology School of Pharmacy, ARKA JAIN University, Jharkhand-832108, India

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Introduction: Gastric cancer (GC) is one of the leading causes of cancer-related mortality worldwide. Morin, a natural flavonoid present in edible plants like mulberries, figs, and almonds, has gained attention for its health-promoting properties, including anti-inflammatory and anticancer effects. This study aimed to evaluate the anticancer efficacy and molecular mechanisms of morin in gastric cancer, focusing on the AGS cell line.

Methods: We adopted an integrated approach combining network pharmacology, molecular docking, molecular dynamics simulations (100 ns), and in vitro assays, including MTT, apoptosis, ROS, mitochondrial membrane potential, cell cycle, and Western blotting, to elucidate morin's action against AGS cells.

Results: Network pharmacology analysis revealed 10 key targets, including PIK3CD, JAK2, IGF1R, and ERBB4, primarily enriched in the PI3K/Akt signaling pathway. Molecular docking confirmed strong binding affinities of morin to PIK3CD (−11.01 kcal/mol), JAK2 (−10.53 kcal/mol), and IGF1R (−9.99 kcal/mol), with stable interactions validated by dynamics simulation. Morin induced dose- and time-dependent cytotoxicity in AGS cells with a 24 h IC_{50} of ~10.7 μM and 48 h IC_{50} of ~5.4 μM. Flow cytometry and staining assays revealed S and G_2/M phase arrest, chromatin condensation, and increased apoptotic cell populations. Morin disrupted mitochondrial membrane potential and enhanced ROS generation. Western blotting showed Bax upregulation, Bcl-2 downregulation, cytochrome c release, caspase-3 activation, and PARP cleavage. Notably, morin inhibited Akt phosphorylation (Ser473) and downstream mTORC1 targets (4E-BP1, S6K), suggesting dual mTORC1/2 pathway inhibition.

Conclusions: Morin exhibits strong anticancer potential against AGS gastric cancer cells by targeting the PI3K/Akt/mTOR axis and inducing apoptosis via mitochondrial dysfunction. Its dietary origin further supports its promise as a functional food-based therapeutic candidate for GC.

9.3. Natural Strategies Against Superbugs: Anti-Virulence Effects of Stingless Bee Propolis on Clinical MRSA Isolates

Wen-Jie Ng [1,2], Yu-Jik Lim [1], Chao-Yeong Wong [1], Lei Lee [1] and Kah-Yaw Ee [3,4]

[1] Department of Allied Health Sciences, Faculty of Science, Universiti Tunku Abdul Rahman, Kampar 31900, Malaysia
[2] Centre for Biomedical and Nutrition Research, Universiti Tunku Abdul Rahman, Kampar 31900, Malaysia
[3] Department of Agricultural and Food Science, Faculty of Science, Universiti Tunku Abdul Rahman, Kampar 31900, Malaysia
[4] Centre for Agriculture and Food Research, Universiti Tunku Abdul Rahman, Kampar 31900, Malaysia

Methicillin-resistant *Staphylococcus aureus* (MRSA) remains a major public health concern due to its resistance to β-lactam antibiotics and its ability to cause persistent infections. As antibiotic resistance escalates, natural products derived from functional foods offer promising alternatives. Stingless bee propolis, a resinous compound collected by bees from plant exudates, known for its nutritional and medicinal properties, is gaining interest for its inhibitory effects against bacteria. However, its role in targeting bacterial virulence factors remains largely unexplored. This study investigated the anti-virulence effects of stingless bee propolis against clinical MRSA isolates. Following confirmation of methicillin resistance through antibiotic susceptibility testing, hydroethanolic extraction of propolis was performed. The sub-inhibitory concentration (SIC) of the extract was determined to be 1.563% (*w*/*v*) via broth microdilution. At this concentration, propolis treatment led to a reduction in β-lactamase activity (6.86–19.42%), suggesting interference with resistance mechanisms. Phenotypic assays further demonstrated significant reductions in several key virulence

traits, including protease activity (66.67–100%), haemolysin production (8.50–31.20%), nuclease activity (13.99–23.42%), surfactant production (12.86–57.14%), colony spreading (20.88–65.72%), and biofilm formation (38.42–77.17%). In addition, scanning electron microscopy (SEM) revealed distinct morphological alterations in propolis-treated MRSA cells, indicating structural disruption likely linked to the attenuation of virulence. These cellular changes support the hypothesis that propolis affects bacterial function without directly killing the bacteria. These findings highlight that stingless bee propolis, a functional food-derived substance, can disrupt multiple pathogenic mechanisms of MRSA without exerting direct bactericidal pressure. This natural compound may serve as an adjunctive therapy, reducing infection severity through the modulation of virulence, while helping preserve antibiotic efficacy. This study underscores the potential of functional food products in medical applications, bridging the gap between nutrition and therapeutics, offering a novel strategy for managing antimicrobial resistance.

9.4. Bioavailability and Metabolic Fate of Montmorency Tart Cherry Polyphenols in Human Plasma, Urine, and Stool Using Triple Quadrupole LC-MS/MS

Muhammad Jawad [1,2], Angela R. Hillman [1,3] and Robert G. Brannan [1,2]

1 Department of Translational Biomedical Sciences, Ohio University, Athens, GA 45701, USA
2 Department of Food and Nutrition Sciences, Ohio University, Athens, GA 45701, USA
3 Department of Exercise Physiology, Ohio University, Athens, GA 45701, USA

Montmorency tart cherry (Prunus cerasus L., MTC) is famous for its abundant polyphenolic content and its potential anti-inflammatory and antioxidant effects. Despite this, the metabolic processing and bioavailability of MTC polyphenols in the human body remain poorly understood. This research sought to identify the polyphenolic metabolites of MTC formulations in urine, plasma, and stool through targeted LC-MS/MS analysis. The profiling of urine metabolites was performed using a crossover design with 12 healthy adults (23 ± 3 years). Participants ingested two MTC formulations: juice (240 mL) and powder (2×0.5 g capsules) during separate 48 h interventions, with a 14-day washout period in between. Urine samples were collected at six intervals following ingestion. For plasma and stool metabolite analysis, 58 participants (aged 18–50 years) were involved in a randomized, placebo-controlled 30-day intervention. Active groups received either MTC juice (2×240 mL/day) or freeze-dried powder (2×0.5 g capsules/day), while control groups were given matched placebos. Samples were collected at four intervals to evaluate systemic absorption and gut microbial metabolism. Utilizing a TSQ Altis Triple Quadrupole LC-MS/MS, more than 30 secondary metabolites were identified, including sulfated, glucuronidated, and methylated derivatives of caffeic acid, epicatechin, and chlorogenic acid. Temporal analysis indicated rapid urinary excretion of Phase II metabolites (2–8 h) and a prolonged presence of microbial catabolites like dihydroferulic acid in stool samples for up to 48 h. Plasma metabolite profiles confirmed systemic availability and differences specific to the formulation. Stool metabolites showed the excretion of primary and secondary metabolites of polyphenols out of the body. These results illustrate that MTC polyphenols undergo significant biotransformation and are distributed differently across biological matrices. The findings offer foundational insights into the kinetics and mechanisms that contribute to the health benefits of MTC in clinical populations.

9.5. Cellular Activation Through Contact and Orally Ingested Honey with High Polarization (Wave) Achieved by Blending Monofloral Nectar

Toshihiro Ona and Junko Johzuka

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[1] Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, Kasuga 816-8580, Japan
[2] Head Office, O'Atari Inc., Onojo 816-0942, Japan

Introduction: Honey's effects on maintaining beautiful skin, hematopoiesis, etc., have been reported. Meanwhile, the unique HP-SPR (high-precision surface Plasmon resonance) method enables the transcription measurement of polarization (waves) and the activity measurement of intracellular mitochondria. In this study, the effects of honey contact were examined from the transcription of polarization, and the effects of oral intake were examined from the activation of mitochondria in skin fibroblast (dermis) cells. The results were compared between hyperpolarized honey and a commercial product.

Methods: Blends of monofloral honey from Yamaguchi, Japan, with maximum polarization transfer were used as hyperpolarized samples, and commercial products served as controls. PBS was placed inside the glass ring, an insulator on the HP-SPR sensor, and a 120-fold diluted sample was placed outside the ring and polarization (wave) transfer was measured. For oral intake, honey was digested in the stomach and via a duodenal step with enzymes, and samples with a molecular weight $\leq$10,000 were used. Mitochondrial polarization changes were measured by the HP-SPR-3D assay using the human skin fibroblast HFb16d.

Results: Hyperpolarized honey showed a very high polarization transfer capacity, about 13 times higher than the commercial product at 400 s. Water in the vicinity contacted by hyperpolarized honey is polarized through insulators and is expected to activate the throat, intestines, skin, hair, scalp, and other parts of the body. On the other hand, oral intake of hyperpolarized honey showed a concentration-dependent polarization of mitochondria, reaching approximately 3.5 times higher at 1.0 mg/mL than at 0.5 mg/mL. In contrast, at 1.0 mg/mL of the commercial product, mitochondrial polarization was only about one-fifth that of hyperpolarized honey.

Conclusions: Hyperpolarized honey is expected to prevent and improve wrinkles (anti-aging) by activating skin fibroblasts (dermis) cells, and may also contribute to the activation of various types of cells through contact and ingestion.

9.6. Comparative Evaluation of Maceration and Ultrasound-Assisted Extraction Methods on Phytochemical Profile, Total Phenolic and Flavonoid Contents, and Antioxidant Activity of Ethanolic Extracts from Selected Locally Available Philippine Citrus Fruit Peels

Precious Grace Nhitallie Cubillan and Nesteve John Agosto

[1] Department of Chemistry, University of Science and Technology of Southern Philippines, Cagayan de Oro City 9000, Philippines
[2] Center for Natural Products Research, University of Science and Technology of Southern Philippines, Cagayan de Oro City 9000, Philippines

Citrus fruits are widely cultivated for their flavor, nutrition, and economic value. However, in the Philippines, limited research exists on local species like *Citrus microcarpa*, *C. maxima*, *C. aurantium*, and especially *C. hystrix* var. *micrantha*, particularly regarding peel utilization and extraction methods. This study evaluated the efficiency of maceration and ultrasound-assisted extraction (UAE), using absolute ethanol, in extracting bioactive compounds from these citrus peels. Extracts were screened for phytochemicals and evaluated for total phenolic content (TPC), total flavonoid content (TFC), and antioxidant activity via the DPPH radical scavenging assay. Percent yields were comparable between methods, with UAE achieving similar yields in significantly shorter time, indicating its extraction efficiency. Phytochemical analysis confirmed the presence of alkaloids, flavonoids, phenols, reducing sugars, saponins, tannins, and terpenoids across most samples. Among the species studied, *C. microcarpa* exhibited the highest TPC (62.66 $\pm$ 2.04 mg GAE/g via UAE)

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and TFC (83.85 ± 2.23 mg QE/g via maceration), correlating with the strongest antioxidant activity (lowest EC_{50} values: 98.43 ± 0.79 μg/mL via maceration; 131.08 ± 1.77 μg/mL via UAE). Maceration was more effective for flavonoid extraction, while UAE enhanced phenolic yield, and antioxidant activity varied by species and method. Additionally, a significant positive correlation was found between TPC and TFC (r = +0.7833), with both showing strong negative correlations with antioxidant EC_{50} (r = −0.9282 and r = −0.7324, respectively). These findings highlight citrus peels, especially from *C. microcarpa*, as promising antioxidant sources. The study recommends optimizing extraction conditions and conducting further bioactivity testing to assess therapeutic potential.

9.7. Curcumin Alleviates Zearalenone-Induced Reproductive Impairment by Modulating the Gut Microbe–Testis Axis

Shuaiju Guo, Bangwang Peng, Junlong Niu and Zhixiang Wang

College of Animal Science and Technology, Henan Agricultural University, Zhengzhou 450046, China

Zearalenone (ZEN), a mycotoxin commonly found in cereal crops and foods, induces testicular damage and disrupts gut microbial composition, revealing a critical connection between gut microbes and the male reproductive system. Curcumin (CUR), a bioactive compound derived from ginger, is known to enhance intestinal microecological balance and exhibit anti-inflammatory properties. This study aimed to investigate the mechanism by which CUR alleviates ZEN-induced reductions in sperm quality through modulation of the gut microbe–testis axis. Forty-eight 6-week-old Balb/c male mice were randomly assigned to four treatment groups: control (CON), CUR (200 mg/kg body weight CUR), ZEN (40 mg/kg body weight ZEN), and ZEN + CUR (200 mg/kg CUR + 40 mg/kg ZEN). The experiment lasted 28 days. CUR was found to mitigate ZEN-induced reductions in testosterone levels, testicular structural damage, and disrupted spermatogenesis. ZEN exposure altered gut microbial composition, increasing the abundance of Prevotella while decreasing that of Lactobacillus. CUR counteracted these effects and reduced the ZEN-induced activation of the IL-17A-TNF-α signaling pathway proteins. In conclusion, ZEN induces testicular inflammation and reduces sperm quality by lowering testosterone levels and disrupting gut microbial balance, which drives the testicular IL-17A signaling pathway. CUR alleviates ZEN-induced testicular inflammation and sperm quality reduction by restoring beneficial gut microbes and testosterone levels.

9.8. Food-Grade Nutmeg (Myristica fragrans) Supercritical Fluid Extract in Hybrid PLGA–Lipid Nanoparticles for Targeted Colorectal Cancer Therapy

Nicolas Daniel Widjanarko [1], Raffaele Romano [2], Happy Kurnia Permatasari [3], Gilang Nanda Permana Widodo [4], Adha Fauzi Hendrawan [5], Derren David Christian Homenta Rampengan [6], Andri Frediansyah [7], Erda Qorri [8], Antonello Santini [9], Raymond Rubianto Tjandrawinata [10] and Fahrul Nurkolis [11,12,13]

1 School of Medicine and Health Sciences, Atma Jaya Catholic University of Indonesia, Jakarta, Indonesia
2 Department of Agricultural Sciences, University of Napoli Federico II, Via Università 100, 800055 Portici, Italy
3 Department of Biochemistry and Biomolecular, Faculty of Medicine, Brawijaya University, Malang 65145, Indonesia
4 Faculty of Medicine, Jenderal Soedirman University, Purwokerto, Indonesia
5 Department of Medicine, Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia
6 Faculty of Medicine, Universitas Sam Ratulangi, Manado, Indonesia

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[7] Research Division for Natural Product Technology (BPTBA), National Research and Innovation Agency (BRIN), Gunungkidul, Yogyakarta 55861, Indonesia
[8] Faculty of Medical Sciences, Albanian University, 1017 Tirana, Albania
[9] Department of Pharmacy, University of Napoli Federico II, Via Domenico Montesano, 49-80131 Napoli, Italy
[10] Department of Biotechnology, Faculty of Biotechnology, Atma Jaya Catholic University, Jakarta, Indonesia
[11] Institute for Research and Community Service, State Islamic University of Sunan Kalijaga (UIN Sunan Kalijaga), Yogyakarta 55281, Indonesia
[12] Basic Medical Science, Faculty of Medicine, Universitas Airlangga, Surabaya 60115, Indonesia
[13] Medical Research Center of Indonesia (MRCI), Surabaya, Indonesia

Background: Colorectal cancer (CRC) remains a major global health challenge due to the limitations of current therapies, including systemic toxicity and inadequate tumor specificity. Natural products like nutmeg (*Myristica fragrans*) exhibit anticancer potential, but their clinical application is limited by poor bioavailability. Integrating nutmeg extracts into nanocarriers may overcome these barriers and enhance their therapeutic efficacy.

Methods: Nutmeg extract was prepared using supercritical CO_2 extraction (NSFE) and encapsulated into hybrid poly(lactic-co-glycolic acid)–lipid nanoparticles (NSFE-PLGA-LN) via nanoprecipitation. Characterization included particle size (DLS), morphology (TEM), zeta potential, and encapsulation efficiency. Metabolomic profiling was performed using UHPLC-HRMS/MS. Bioactivity was predicted through network pharmacology and molecular docking against CRC-related targets (EGFR, PTGS2, STAT3, JAK2, PIK3CB). Cytotoxic effects were assessed in CRC cell lines (HT-29, HCT-116) and normal colon fibroblasts (CCD-18Co) using MTT assays.

Results: Metabolomic analysis identified bioactive compounds including myristicin, elemicin, β-caryophyllene, and sabinene. Network pharmacology and docking simulations revealed significant interactions with CRC-related pathways, notably apoptosis, proliferation, and inflammation, with β-caryophyllene demonstrating strong affinity (Vina score ≤ -7.2 kcal/mol). NSFE-PLGA-LN exhibited selective cytotoxicity, with IC_{50} values of 95.5 μg/mL (HT-29), 89.2 μg/mL (HCT-116), and minimal toxicity on normal CCD-18Co cells (IC_{50} = 896.5 μg/mL).

Conclusions: Hybrid PLGA–lipid nanoparticles significantly enhanced nutmeg extract's therapeutic profile, providing selective, sustained anticancer activity. These findings support further preclinical evaluation and mechanistic studies warranted for potential clinical translation.

9.9. Identification of Key Targets and Pathways Modulated by Dietary Isothiocyanate Erucin in Gastric Cancer: A Bioinformatics Approach with Experimental Validation

Sumitra Patel [1], Sunil Kumar [2], Swathi Lakshmi M [1], Dr. Aneesh T.P [3], Bijo Mathew [2], Shweta Shrivastava [4] and Manish Kumar Jeengar [1]

[1] Department of Pharmacology, Amrita School of Pharmacy, Amrita Vishwa Vidyapeetham, AIMS Health Sciences Campus, Kochi 682041, Kerala, India
[2] Department of Pharmaceutical Chemistry, Amrita School of Pharmacy, Amrita Vishwa Vidyapeetham, AIMS Health Sciences Campus, Kochi 682041, Kerala, India
[3] Department of Pharmaceutical Chemistry and Analysis, Amrita Vishwa Vidyapeetham, AIMS Health Sciences Campus, Kochi 682041, Kerala, India 682041
[4] Department of Pharmacology School of Pharmacy, ARKA JAIN University, Jharkhand 832108, India

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Introduction: Gastric cancer (GC), widely known as stomach cancer, is a critical health concern across the world. Natural products have been renowned for millennia and are highly reputable as a fashionable source of therapeutic agents. Erucin is a naturally occurring isothiocyanate found in various cruciferous vegetables, particularly in rocket (arugula) and certain types of broccoli. This study aimed to evaluate the anti-cancer effect and the mechanistic role of erucin on GC cell lines.

Methods: To understand the pharmacological potential of erucin, we employed network pharmacology, molecular docking, molecular dynamics simulations, and in vitro studies. These methods contributed to a holistic understanding of the mechanisms, interactions, and efficacy of erucin in GC.

Results: Network pharmacology analysis revealed 10 key targets, including SRC, AKT1, mTOR1, BCL2, and HIF1A, in the gastric cancer pathway. Molecular docking showed that erucin exhibited higher binding affinities for SRC, AKT1, and mTOR1 among these targets, with stable interactions validated by dynamics simulation for SRC and AKT1. Erucin induced concentration and time-dependent cytotoxicity in AGS cells with a 24 h IC_{50} of 77.3 $\pm$ 6.6 μM and 48 h IC_{50} of 52.6 $\pm$ 1.12 μM. Acridine orange/ethidium bromide (AO/EtBr) dual staining assay showed a dose-dependent increase in apoptotic cells, characterized by nuclear condensation and membrane blebbing. Erucin treatment markedly inhibited the colony formation ability of the AGS cell line in a dose-dependent manner. AGS cells treated with Erucin exhibited significantly reduced migration rates compared to control cells. Western blotting showed Bax upregulation, Bcl-2 downregulation, and cytochrome c release with downregulated SRC. These findings have antiproliferative and anti-cancer effects on AGS cells.

Conclusions: Erucin exhibits potent anti-cancer activity in AGS gastric cancer cells by directly targeting critical oncogenic regulators, including SRC, mTORC1, and AKT1. Its multi-targeted interaction profile and ability to inhibit cell proliferation, migration, and colony formation strongly support its therapeutic potential in gastric cancer management.

9.10. Immunomodulatory Potential of Probiotic Bacteria: Implications for Human and Animal Health

Isaac Oluseun Adejumo and Olufemi A. Adebiyi

Department of Animal Science, University of Ibadan, Ibadan 200005, Nigeria

The use of antibiotics in human nutrition and livestock production as growth promoters in some parts of the world has faced restrictions owing to growing concerns regarding their use, necessitating research efforts and substantial funding dedicated to finding cost-effective and sustainable alternatives. This quest for sustainable alternatives to antibiotics has led to an intense research interest in probiotics. However, their widespread application remains limited owing to an incomplete understanding of their functional mechanisms. This preliminary study focused on identifying promising candidates that will be further explored for experimental validation using animal models. This study investigated the immunogenic peptides derived from the following probiotic bacterial species: *Ligilactobacillus saerimneri* (GVGNDRRPVNAKNIKKRRAQ, GFDTDRYFEENKNEYDWGKP, EKYHLIEAEGIKRVTEEFIW, DNKVPVHVKGVEYAANAEDS, PLVLGVLFIATGYISYATYR, DVGSLLINHVLTSTLVMKQA); *Ligilactobacillus salivarius* (FSKEVADRANVENIEPGLIR, TLDKLEINTEEFMDFQKAFM, VRAKNYNAAETQVKVSVIAN, LYLVEYFINNKLHNMIVRAK, QRVHITNLYGLSGVAGLAQK, ALLDELREGTLDKLEINTEE), and *Lactobacillus acidophilus* (MKDYRLFLIDLDGTVYRG, CKDYRLFLIDLDGTVYRG, DKDYRLFLIDLDGTVYRG, EKDYRLFLIDLDGTVYRG, FKDYRLFLIDLDGTVYRG, NKDYRLFLIDLDGTVYRG). *L. saerimneri* was isolated from the cecum of a 20-day-old chicken, while *L. salivarius* was isolated from the feces of swine. They were specifically investigated for their

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ability to induce interleukin-5 (IL-5), interleukin-6 (IL-6), and interferon gamma (IFN_γ) as key cytokines involved in immune modulation. The study was approved by the Ethics Committee, Monogastric Animal Management and Behaviour, Department of Animal Science, University of Ibadan, Nigeria (MAMB02Bio25). All the selected peptides induced IL-5, IL-6, and IFN_γ. The ability to induce IFN_γ in humans was highest in peptides from *Ligilactobacillus salivarius* (0.8367), which is statistically similar to peptides from *Ligilactobacillus saerimneri* (0.800). Peptides from *Lactobacillus acidophilus* obtained the lowest value (0.7533). *L. salivarius* and *L. saerimneri* peptides are 100% immunogenic against tumor peptides, while *L. acidophilus* peptides are 66% immunogenic. These results suggest their potential sustainable applications as food supplements, feed additives, and as part of vaccine development, providing promising avenues for antibiotic alternatives.

9.11. In Vitro Anti-Inflammatory Potential of Hydrosols and Essential Oils from Fresh Female Cones of Five Juniperus spp. Collected in Greece

Efstathia Karachaliou [1], Eleftherios Kalpoutzakis [2], Maeva Wendremaire [3], Alexios-Leandros Skaltsounis [2], Loïc Briand [4] and Anne-Claire Offer [4]

1 Centre des Sciences du Goût et de l' Alimentation (CSGA), Université Bourgogne Europe, 21000 Dijon, France
2 Department of Pharmacognosy and Natural Products Chemistry, University of Athens, Panepis-timiopolis, 15771 Zografou, Greece
3 INSERM UMR 1231, Centre for Translational and Molecular Medicine, UFR des Sciences de Santé, Université de Bourgogne-Europe, 21000 Dijon Cedex, France
4 Centre des Sciences du Goût et de l'Alimentation, CNRS, INRAE, Institut Agro, Université de Bour-gogne-Europe, 21000 Dijon Cedex, France

Needle-leaved junipers (*Juniperus*, Cupressaceae) are coniferous trees and shrubs with red or blue fleshy cones, distributed across Asia, Macaronesia, and the Mediterranean Basin [37]. Recognizing its medicinal properties, the European Medicines Agency (EMA) has published two monographs on *Juniperus communis* dried cones and essential oil, highlighting their traditional use as a diuretic and for digestive, gastrointestinal, and musculoskeletal relief [38,39].

Phytochemically, monoterpenes dominate in *Juniperus* species, with the bicyclic monoterpene α-pinene being the major constituent. This study investigates the fresh female cones of five *Juniperus* species (*J. drupacea*, *J. communis* subsp. *hemisphaerica*, *J. oxycedrus* subsp. *deltoides*, *J. macrocarpa*, and *J. turbinata*) through distillation and GC-MS analysis on an Agilent HP-5MS column. The analysis revealed a total of 172 different compounds, dispersed differently in the essential oils and hydrosols. Ranging from 37 to 52 metabolites identified in each sample, the main class of compounds was terpenes, whereas the major α-pinene in essential oils ranged from 40.84% in *J. communis* subsp. *hemisphaerica* to 81.50% in *J. turbinata*.

The hydrodistillation protocol used to obtain essential oils and hydrosols, as well as the in vitro results related to anti-inflammatory activity assessed in macrophages using NADPH oxidase inhibition, will be discussed.

9.12. Nutritive Synergy and Dietary Biodiversity as Determinants of Long-Term Health Outcomes

Nika Lovrinčević Pavlović, Ivan Miškulin, Ivana Kotromanović Šimić, Darko Kotromanović, Ivan Vukoja, Matea Matić Ličanin, Jelena Kovačević and Maja Miškulin

Department of Public Health, Faculty of Medicine Osijek, The Josip Juraj Strossmayer University of Osijek, 31000 Osijek, Croatia

Introduction: A varied and balanced diet is essential for achieving an optimal nutritional status and long-term health. The concept of nutritional synergy highlights the

enhanced physiological effects that result from the interaction of nutrients and bioactive compounds from diverse food sources. This review aims to explore the role of dietary diversity and nutrient synergy in disease prevention and health promotion.

Methods: This review synthesizes findings from recent epidemiological studies, systematic reviews, and key public health documents (e.g., those published by the WHO, FAO, and EFSA). The focus is placed on dietary patterns considered nutritionally beneficial and on initiatives aimed at promoting greater diversity in food consumption.

Results: Dietary diversity supports a more resilient gut microbiota, increases levels of beneficial long-chain unsaturated fatty acids, and reduces bile acids linked to insulin resistance and inflammation. In children, diverse diets contribute to the development of a healthy gut microbiome, which may reduce the risk of allergies later in life. Evidence consistently links greater dietary variety with a reduced risk of obesity, cardiovascular disease, diabetes, certain cancers, and all-cause mortality. The Mediterranean diet exemplifies the health benefits of traditional, biodiversity-based food practices. Additional examples include educational programs like the "Colorful Plate" initiative, local food systems supported by urban gardens and farmers' markets, and EU strategies such as the "Farm to Fork Strategy" and the "EU Biodiversity Strategy for 2030."

Conclusions: A multidisciplinary approach that integrates nutrition, medicine, agriculture, and cultural practices is essential for building healthier and more sustainable food systems. Recognizing food not only as a fuel but as a form of preventive medicine highlights its critical role in maintaining public health. Ultimately, a wide variety of nutrient-rich foods remains one of the most powerful tools for promoting lifelong health and resilience.

9.13. Piezoelectrically Treated Water: Structural Modifications and Implications for Hydration, Nutrition, and Food Quality

Giorgi Goderdzishvili [1], Mark Jones [1], Abhishek Tippa [2], Krishna Madappa [2], Srinivasan Vithoba [2], Harsha Marle Krishna [2] and Petr Kačer [1]

[1] Department of Chemistry, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Praha-Suchdol, Czech Republic

[2] 4th Phase Water Technologies Pvt Ltd.—Jiva Water, Bengaluru, Karnataka 560070, India

Hydrogen bonding plays a fundamental role in defining the functional behavior of water, particularly in biological, agricultural, and food systems. This study investigates the structural modifications induced in water by piezoelectric treatment, wherein pressurized water passes through piezoelectric materials, generating mechanical stress that alters its hydrogen bonding network. Specifically, this treatment results in shortened hydrogen bond lengths and enhanced molecular organization. A multidisciplinary analytical approach was employed to characterize these changes. Fourier Transform Infrared (FTIR) and Near-Infrared (NIR) spectroscopy revealed redshifts in OH-stretching bands (~20–35 cm^{-1}), indicating restructured hydrogen bonding. ^{1}H Nuclear Magnetic Resonance (NMR) detected upfield shifts of ~0.03 ppm, suggesting changes in proton environments. Density measurements via pycnometry showed a ~0.4% increase, while surface tension and viscosity decreased by 6.7% and 5.2%, respectively. Molecular dynamics simulations confirmed a ~9% increase in hydrogen bond density, supporting a more compact and ordered molecular structure. These structural changes have tangible implications. In C. elegans, piezoelectrically treated water (PTW) increased hydration efficiency by 17%. In tomato plants, PTW irrigation led to a 23% increase in biomass and enhanced nitrate uptake. In brewing applications, PTW reduced equipment scaling by 41%, intensified aroma through an 18% increase in volatile esters, and altered carbonation dynamics, yielding smoother sensory profiles. Furthermore, the presence of 50–100 ppm dissolved salts further modulated hydrogen bonding, offering a mechanism to tailor PTW properties for specific applications. Collec-

tively, these findings position PTW as a novel functional medium with broad relevance across hydration, nutrition, and food quality domains. This research not only advances our understanding of water's molecular behaviour under piezoelectric influence, but also reveals new possibilities for its targeted use in biological and industrial systems.

9.14. Therapeutic Potential of Honey for Gut Microbiota: Insights from Metagenomic and Literature-Based Analyses

Lamia Medouni [1], Ayoub ALLAM [1], Nassim Brahimi [1], Samira Negrichi [1], Sonia Medouni-ADRAR [2], Lynda Messaoudene [1], Khokha Mouhoubi [1], Amina Abbou [1], Abdel Hakim Ridouh [1] and Souhila Haddad [1]

[1] Centre de Recherche en Technologies Agroalimentaires, Route de Targa Ouzemmour, Campus Universitaire, Bejaia 06000, Algeria

[2] Laboratory of Biomathematics, Biochemistry, Biophysics and Scientometry, Faculty of Natural and Life Sciences, University of Bejaia, Bejaia 06000, Algeria

Understanding the human gut microbiota is key to assessing dietary impacts on health. This work combines a narrative review with a metagenomic analysis of 1000 gut samples to evaluate how honey influences microbial communities. The analysis confirms that Firmicutes and Bacteroidota dominate the gut microbiota, followed by Actinobacteria and Proteobacteria. Microbial diversity is established early in life and is shaped by factors such as birth mode and diet, with colonization beginning before birth. Our analysis confirms that microbial colonization starts in utero and continues after birth, with distinct compositions observed between vaginal and cesarean deliveries. Focusing on honey, our results show that it creates a distinct microbial signature characterized by the enrichment of beneficial genera such as *Lactobacillus*, *Bifidobacterium*, *Megamonas*, and *Streptococcus* and the suppression of pathogenic species like *Escherichia coli*, *Clostridium*, *Staphylococcus*, and *Proteus*. Honey's effect is attributed to its bioactive compounds—particularly oligosaccharides and polyphenols—which promote beneficial bacteria and inhibit pathogens. Notably, polyphenols reach the lower gastrointestinal tract and exhibit stronger modulation than that of fructo-oligosaccharides alone. Therapeutically, honey has shown promise not only in adults but also in vulnerable populations like preterm infants, where it enhances the colonic microbiota when combined with infant formula. These findings suggest that honey is more than a natural sweetener—it acts as a functional food with microbiota-targeted benefits, supporting its inclusion in dietary interventions for gut health restoration.

9.15. Traditional Remedies, Benefits and Barriers to Preventive Measures of Cassava Cyanogen Poisoning in Northwestern Uganda

Jenifer Apil [1], Lucy Mulugo [1], Peter Atekyereza [2] and Bernard Obaa [1]

[1] Department of Extension and Innovation Studies, College of Agricultural and Environmental Sciences, Makerere University, Kampala P.O. Box 7062, Uganda

[2] Department of Sociology and Anthropology, College of Humanities and Social Sciences, Makerere University, Kampala P.O. Box 7062, Uganda

Cassava is a critical source of carbohydrates and food security for over 800 million people. However, its consumption poses a serious threat due to cyanide poisoning. This is particularly life-threatening among largely cassava-dependent communities, where cases of poisoning have been reported. Despite efforts to promote safer processed cassava flour, uptake still remains low. We explore traditional remedies for cassava cyanide poisoning as well as perceived benefits and barriers that hinder the uptake of safer cassava processing practices among the Lugbara communities in Northwestern Uganda. Data were collected using 10 Focus Group Discussions involving 8 traditional processors and consumers of cassava flour, 10 in-depth interviews with participants who have experienced cassava

cyanide poisoning, and 4 rounds of participant observations subjected to thematic analysis. Our findings show a range of traditional remedies, categorized as plant and animal products like tamarind juice (*Tamarindus indica*), wood ash, raw milk, and locally produced alcohol from fermented, scratched cassava residue. While there are perceived benefits of adopting recommended safety measures, such as reduced cyanide poisoning, enhanced food and income security, improved livelihoods, and cultural preservation, significant barriers persist. Barriers include limited access to improved technologies, entrenched socio-cultural norms, and a perceived low threat of cyanide poisoning. This study underscores the need for targeted social and behavioral changes through communication to overcome barriers and foster a positive shift in attitudes towards a reduction in cassava cyanide poisoning among the Lugbara communities.

9.16. Unravelling Corn Silk's Bioactive Potential for Health Enhancement: Advancing the Legacy of Traditional Medicine via Innovative Research

Danka Milovanović, Valentina Nikolić, Beka Sarić, Marijana Simić and Slađana Žilić

Maize Research Institute Zemun Polje, Slobodana Bajića 1, 11185 Belgrade-Zemun, Serbia

Corn silk (CS) (*Stigma maydis*) has been used for centuries in traditional medicine (TM) worldwide to treat various disorders owing to its antioxidant, antidiabetic, diuretic, antimicrobial, and anti-inflammatory properties. The health benefits mentioned in traditional medicine and reliable sources originate from the chemical makeup of corn silk, which includes total phenols, polysaccharides, protein, fiber, alkaloids, minerals, and vitamins. Large quantities of CS, a major by-product of corn processing, are often discarded, dissipating valuable bio-resources. By utilizing CS to develop functional and health-promoting value-added products, a part of agricultural waste would be redirected toward zero-waste production while conserving the environment and increasing the agro-economy. Our present study focused on investigating the bioactive compounds and antioxidant capacities of CS from five corn genotypes harvested at three maturity stages, or three different days of silking (DAS), in order to single out the most promising raw material that could be used to develop dietary supplements. The prevailing bioactive compounds were total phenols, which ranged from 2498.09 GAE/g (genotype ZP 6119k, 15 DAS) to 13,580.62 GAE/g (genotype ZP 5550, 15 DAS). Assessment of antioxidant capacity using different methods will show which corn silk genotypes are most suitable for health development. The antioxidant capacities determined after $ABTS^+$ scavenging activity ranged from 41.82 mmol Trolox/kg to 83.48 mmol Trolox/kg in CS extracts of two genotypes, ZP 6119k (15 DAS) and ZP 6263 (21 DAS), respectively. The results obtained in this study could be of exceptional importance for the maize breeding programs and selection of potentially most suitable hybrids for functional food and dietary supplement production.

Conflicts of Interest: The author declares no conflict of interest.

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