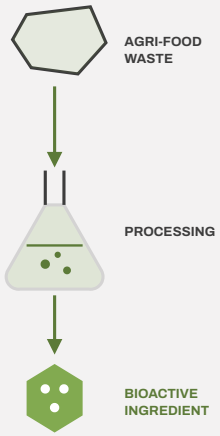
8TH INTERNATIONAL ISEKI-FOOD CONFERENCE

BOOK OF ABSTRACTS

"Innovation in Research and Education for the transition to sustainable food systems"

Edited by Rui Costa, Paola Pittia, Marwen Moussa, Rui Cruz, Margarida Vieira



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8th International ISEKI-Food Conference

Innovation in Research and Education for the transition to sustainable food systems

Book of Abstracts

Editors
Rui Costa, Paola Pittia, Marwen Moussa, Rui Cruz, Margarida Vieira

Faro, Portugal
2026

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PREFACE

As part of its mission, ISEKI-Food Association establishes and maintains a network among universities, research institutions, and companies in the food chain, in addition to working to ensure that food studies are of high quality. The 8th International ISEKI-Food Conference, hosted by the University of Algarve in Faro, Portugal, in 2026, continued this tradition by bringing together academics, students, researchers, industry professionals and policymakers to discuss the future of food research, education and industry.

The 2026 edition is held at the University of Algarve in Faro, Portugal, on 1–3 June 2026, under the theme "Innovation in Research and Education for the transition to sustainable food systems". The Conference focuses on three interconnected areas: Education and Training; Research; and Responsible food production and consumption. It is dedicated to scientists, professionals, and students from universities worldwide as well as to the food industry, with the explicit aim of bridging universities, research and industry, and of providing opportunities for delegates to exchange ideas, share application experiences, establish business or research relations, and find global partners for future collaborations.

The scientific programme is structured around five keynote lectures that frame the three thematic areas. Eduardo Esteves (University of Algarve) opens the education strand with "Beyond Teaching: Building a Culture of Pedagogical Innovation in Times of Change". Marin Rose (University of Copenhagen; CLEVERFOOD) addresses "Learning Beyond Silos: Critical Thinking for Collaborative Food System Governance". Billy Goodburn (Agri-Food Co-operative Sector) brings an industry perspective with "From Training Needs to Implementation". Marco Dalla Rosa (University of Bologna) speaks on a "Regenerative agri-food approach: skills needs for more sustainable and innovative food systems". Dan Vodnar (USAMV Cluj-Napoca) closes the keynote series with "Biotechnological Valorisation and Functional Innovations for Sustainable Food Systems". Together, the keynotes connect pedagogical innovation, cross-sector governance, industry skills needs, regenerative production, and by-product valorisation.

Poster and oral awards recognise outstanding contributions from early-career researchers, alongside the ISEKI-Food Academy Awards which honour sustained contributions to food science education and to the Association's mission.

We gratefully acknowledge the University of Algarve as host institution, the members of the Organising and Scientific Committees, the endorsing organisations — EuBioNet, GHI, GSICA, ICC, ISLE, and UNIMED — and the ISEKI-Food Association Secretariat for their support in making this Conference possible.

There were **242** abstracts presented in this Conference. Among them, **6** keynotes, **68** were selected for oral presentations and **168** for poster presentations. The abstracts of the oral and poster presentations can be found in this Book of Abstracts.

We would like to express our sincere appreciation to all participants, speakers, and contributors for their valuable input to the success of the 8th International ISEKI-Food Conference.

DISCLAIMER

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TABLE OF CONTENTS

ISBN: 978-989-9244-58-0

ISBN: 978-989-9244-58-0

ISBN: 978-989-9244-58-0

ISBN: 978-989-9244-58-0

ISBN: 978-989-9244-58-0

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BOOK OF ABSTRACTS

KEYNOTES

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KEYNOTE

LEARNING BEYOND SILOS: CRITICAL THINKING FOR COLLABORATIVE FOOD SYSTEM GOVERNANCE

Marin Rose[1]

[1] *University of Copenhagen, Copenhagen, Denmark*

Achieving fair, healthy, and sustainable food systems demands a fundamental shift in how we collaborate, who we include, and how decisions get made across disciplines, sectors, and governance levels. Yet the governance of food systems remains largely confined to disciplinary silos, institutional hierarchies, and decision-making processes that exclude the very diversity of knowledge and experience needed to transform them.

Drawing on the CLEVERFOOD project, the FOOD 2030 Networks, and outcomes from the Danish EU Presidency Conference (Copenhagen, December 2025), this presentation offers a critical reflection on a persistent gap in collaborative governance. Inclusion alone rarely guarantees meaningful influence. Power imbalances shape who defines the problem, whose knowledge counts, and whose perspectives never reach the table. Addressing this requires diverse knowledges – scientific, experiential and local – and governance that is evidence-informed and adaptive.

Shaped by nearly two decades of international experience spanning education, multistakeholder engagement, and EU Horizon project coordination, this work bridges research, policy, and practice in food system governance. The talk closes with a direct challenge, because systemic change does not start with a clear master plan, but with connections that were not there before.

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KEYNOTE

BEYOND TEACHING: BUILDING A CULTURE OF PEDAGOGICAL INNOVATION IN TIMES OF CHANGE

Eduardo Esteves[1]

[1] *Universidade do Algarve, Faro, Portugal*

Higher education is undergoing profound transformation, shaped by increasingly diverse student populations, changing expectations of Generation Z learners, growing concerns over student disengagement and dropout, and the rapid emergence of artificial intelligence. In this context, pedagogical innovation can no longer be viewed as an individual endeavor led by isolated enthusiastic teachers; it must become part of an institutional culture capable of fostering inclusion, engagement, academic success and meaningful learning.

Drawing on the experience of the University of Algarve, this keynote explores how a university-wide approach to pedagogical innovation can contribute to transforming teaching and learning practices in these times of change. Through an evidence-informed and practice-oriented perspective, the presentation discusses institutional strategies designed to support student-centered active learning methodologies, strengthen student integration and belonging, and promote faculty professional development through both formal and informal initiatives.

In this keynote I will present examples from institutional projects and initiatives at UAlg focused on pedagogical innovation and teacher capacity building, highlighting how collaborative practices, peer sharing, mentoring and continuous professional development can reinforce teaching professionalism and enhance educational quality. Attention will be given to the role of institutional support structures in creating sustainable conditions for innovation across different study cycles and disciplinary areas.

Finally, in the presentation I reflect on current and emerging challenges, including the integration of artificial intelligence into higher education, while arguing that pedagogical innovation remains fundamentally centered on people, relationships, and purposeful learning. The keynote concludes with a positive and forward-looking perspective on the capacity of universities to evolve collectively and respond creatively to contemporary educational challenges.

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KEYNOTE

FROM TRAINING NEEDS TO IMPLEMENTATION: AN INDUSTRY PERSPECTIVE

Billy Goodburn[1]

[1] *ICOS Skillnet, Ireland*

The agri-food sector is undergoing rapid transformation driven by digitalisation, sustainability imperatives, regulatory complexity, and evolving consumer expectations. In this dynamic environment, understanding current and future skills needs is critical to ensuring workforce resilience and sector competitiveness. This presentation explores how continuous engagement with industry, through direct consultation, sector forums, and structured collaboration, provides real-time insights into emerging challenges and capability requirements.

However, industry feedback alone is not sufficient. By combining these insights with robust skills intelligence, including labour market analysis, National and European research, and sector-specific studies, it becomes possible to move beyond reactive responses and towards the anticipation of future needs across short, medium, and long-term horizons.

Central to this approach is the translation of insights into targeted, practical training interventions. The presentation highlights how competency frameworks, skills matrices, and development tools can be used to identify gaps and co-design industry-led programmes that address technical, digital, sustainability, leadership, and governance capabilities. Emphasis is placed on lifelong learning, workforce transformation, and the creation of clear talent pipelines.

Ultimately, the presentation offers an industry perspective on how structured engagement and data-driven planning can bridge the gap between training needs and implementation, enabling organisations to build the skills required for a sustainable and innovative food system.

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KEYNOTE

BIOTECHNOLOGICAL VALORIZATION AND FUNCTIONAL INNOVATIONS FOR SUSTAINABLE FOOD SYSTEMS: FROM BY-PRODUCTS TO BIOACTIVE COMPOUNDS AND PSYCHOBIOTICS

Dan C. Vodnar[1]

[1] *Department of Food Science, Faculty of Food Science and Technology, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Romania*

The transition toward sustainable food systems requires integrating circular bioeconomy principles, advanced biotechnological processes, and innovative functional food strategies. This keynote addresses recent progress in the valorization of agro-industrial by-products as renewable sources of bioactive compounds, functional ingredients, and high-value biomolecules. Special attention is given to microbial bioconversion and fermentation technologies applied for the production of organic acids, omega-3 fatty acids, carotenoids, polyols, vitamin B12, and antimicrobial compounds using substrates such as crude glycerol, wheat bran, oat bran, tomato by-products, olive leaves, and apple pomace.

The presentation also highlights the development of next-generation functional foods and sustainable active packaging systems enriched with natural antioxidants and antimicrobial compounds recovered from food processing side streams. Biopolymer-based films, intelligent packaging materials, and molecular gastronomy approaches are explored as innovative tools to improve food quality, safety, stability, and consumer acceptance while advancing sustainability objectives.

In parallel, the presentation discusses the growing relevance of probiotics and psychobiotics within the microbiota-gut-brain axis and their potential implications in neurodegenerative and neuropsychiatric disorders. Recent advances in probiotic microencapsulation, prebiotic recovery from agro-food residues, and targeted functional formulations are presented as promising approaches for personalized nutrition and health promotion.

The lecture emphasizes how interdisciplinary food biotechnology can convert food waste into functional and economically valuable resources, supporting innovation, sustainability, and resilience in future food systems.

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KEYNOTE

PEOPLE READINESS FOR AI: WILL AI REPLACE EXPERTS? AND WHAT CAN WE DO ABOUT IT?

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Artificial intelligence is reshaping food chain safety – from real-time contamination detection and satellite-based mycotoxin forecasting to AI-assisted evidence synthesis and automated risk assessment workflows. Yet the limiting factor is rarely the technology; it is the people.

People readiness – the human dimension of AI adoption – is at least as critical as data readiness. Creating and developing AI-powered systems is not merely an IT challenge: it demands professionals capable of defining objectives, validating interim outputs, and critically interpreting results. Without high-level domain expertise and a functioning human-in-the-loop at every stage, AI models become black boxes that erode rather than build scientific trust.

Current curricula in food science, veterinary and agricultural sciences remain anchored in basic statistics, leaving data science, machine learning and AI literacy largely absent. The 2024 EFSA Data Readiness Symposium confirmed that the slowest component of most AI projects is not the code – it is the shortage of staff equipped to understand and critically evaluate model outputs.

Addressing this gap requires targeted action: integrating data science fundamentals into undergraduate and postgraduate programmes, launching continuing education modules that combine technical skills with explainable AI and ethical reasoning, and developing AI Act-compatible governance training for risk assessors and regulatory professionals.

AI will not replace expert risk assessors, but it will reshape the profession. Routine tasks, simpler analyses, and first-pass screening will increasingly be handled by AI, while regulatory-grade evidence synthesis and risk assessment will remain domains where human expertise, accountability and contextual judgment are irreplaceable. This transition will cause genuine disruption across scientific disciplines: workflows, career paths and training models will all need to adapt. The question is not whether this change comes, but whether we will be ready to lead it rather than react to it.

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KEYNOTE

ARE CONSUMERS THE PROBLEM OR THE SOLUTION? RETHINKING RESPONSIBILITY IN SUSTAINABLE FOOD SYSTEMS

Diana Bougeva[1,2]

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[2] *Global Harmonization Initiative, Austria*

Transitions to sustainable food systems are frequently framed around the need for consumers to make more responsible choices. While consumer behaviour clearly matters, this narrative risks oversimplifying responsibility and obscuring the structural, economic, and political conditions that shape food choices. This presentation critically examines whether consumers are best understood as the primary problem, the primary solution, or one actor within a much broader system of shared responsibility.

Drawing on research in sustainable food consumption, consumer behaviour, and food systems governance, the talk explores how responsibility is distributed across consumers, industry, and policy, and how issues of equity, affordability, access, and power constrain individual choice. It argues that over-reliance on the “ethical consumer” narrative can limit progress by shifting responsibility away from systemic drivers such as production practices, market structures, and regulatory frameworks.

The presentation proposes a systems-based reframing of responsibility, highlighting pathways through which industry innovation, policy interventions, and consumer engagement can be aligned to support sustainable transitions. By moving beyond individualised solutions, this talk aims to stimulate constructive dialogue on how responsibility for sustainable food systems can be more fairly and effectively shared.

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BOOK OF ABSTRACTS

ORAL PRESENTATIONS

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Monday – Session 1.1 – Education and Training: Challenges and New Approaches

ORAL PRESENTATION

FOOD CREATIVITY AND INNOVATION: DEVELOPMENT OF A NEW ECO-INNOVATIVE PRODUCT IN THE CENTRE OF A SUCCESSFUL PROJECT-BASED LEARNING APPROACH

Luís Miguel Cunha[1], **Susana Caldas Fonseca**[1,2]

[1]University of Porto

[2]GreenUPorto/Inov4Agro, DGAOT, Faculty of Sciences

Innovation is a key element in an increasingly demanding, rapidly changing market. For this reason, many activities in the agri-food sector focus on developing new products to meet consumer expectations and demands. Effective training in these aspects at the postgraduate level is key to fostering professional development. This study reports the implementation of a project-based learning approach in the unit on New Product Development and Sensory Evaluation of Foods, within the MSc in Consumer Sciences and Nutrition at FCUP. The main objectives of this Pedagogical Practice were to facilitate the learning of the formal contents presented within this curricular unit, while also promoting the acquisition and development of a series of essential competences [1]. As learning activities, the unit complements theoretical expositions with practical classes. It also proposes developing a final project to create an eco-innovative product using creative techniques, along with preparing its marketing plan. An innovative, project-based pedagogical practice was implemented within this unit. Under the new model, students are motivated to develop a prototype, integrating the preparation of the application dossier for the ECOTROPHELIA Portugal Award into the unit's formal activities and reorganising the themes to optimise support and catalyse creativity as early as possible, while reaching for collaborations with the industry and for partners from other areas of study to complement their expertise. Other incremental improvements have been implemented, such as sharing experiences with alumni of the MSc who participated in the competition's final. In general, implementing this pedagogical practice increased the motivation of hundreds of students, with a positive impact on the acquisition of specific skills associated with the unit and on transversal skills. This pedagogical dynamic and additional mentoring resulted in the presence in the final of the Award, over 8 editions (from 2018 to 2025), of 28 teams with FCUP students, among the 72 (39%) teams that have already participated in those finals of the ECOTROPHELIA Portugal Award, from more than 30 National Higher Education Institutions. This practice has been awarded two prizes in different Innovative Pedagogical Practices Awards.

References

1. González-Martínez, C., Ho, P., Cunha, L., Schluter, O., & Pittia, P. (2015). Identifying most important skills for PhD students in Food Science and Technology: a comparison between industry and academic stakeholders. International Journal of Food Studies, 4(2).

ORAL PRESENTATION

STUDENT EXPERIENCES AND EVALUATION OF THE BLENDED INTENSIVE PROGRAMME ON FOOD INNOVATION AND THE CONSUMER

Susana Caldas Fonseca[1], **Purificación García Segovia**[3], **Javier Martínez-Monzó**[3], **Ana Pinto de Moura**[1,4], **Vasilis Valdramidis**[5], **Marta Igual Ramo**[3], **Fernando Caetano**[4], **Luís Miguel Cunha**[1,2]

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[4]DCeT, Universidade Aberta
[5]National and Kapodistrian University of Athens

The success of efforts to design new food products and apply emerging food technologies requires a detailed understanding of how consumers perceive these new trends, enhancing the role of food consumption and innovation sciences education. To assess the impact of the Blended Intensive Program (BIP) on Food Innovation and the Consumer, on the students' satisfaction and approaches to learning. The BIP on Food Innovation and the Consumer, funded by the Erasmus+ Program, and led by the UAberta, corresponds to 3 ECTS credits and comprises two phases: i) e-learning mode (4 weeks) and ii) face-to-face (f2f) mode in Valencia (5 days). At the end of the course, an online survey was conducted among the BIP students to evaluate their attitudes towards teaching and learning in the four online modules and for the weekly activities, using a five-point Likert scale ranging from 1-definitely disagree to 5-definitely agree, and how satisfied they were with each module and the f2f week, also on a 5-point scale. About 20 (financed) + 6 (non-financed) students (19 female and 7 male) were enrolled in the BIP, both at the two phases. The BIP enrolled students were from both the 2nd cycle (MSc, n=14) and 3rd cycle (PhD, n=12) in food consumer sciences and nutrition, food science and technology, food engineering, or related fields, mainly from Portugal, Spain, and Greece. During the f2f week, the students were set in groups and had to design a food product concept and develop its prototype at the food lab. Twenty-five students from different backgrounds answered the survey. The students were highly satisfied with all modules and f2f activities (mean scores of 4.5-4.7) and showed very positive attitudes towards the learning experiences (mean scores of 4.1-4.7). In line with the spirit of the Erasmus+ training, the course fostered high levels of cultural exchange among participants from seven nationalities (Brazil, Colombia, France, Greece, Italy, Portugal, and Spain), fostering the acquisition of new skills and leaving indelible memories for the future. This was a rich experience, from academic/scientific and personal perspectives. All 26 students completed the course and were awarded a certificate, with 25 receiving a final classification of 'Excellent' and 1 receiving 'Very Good'.

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ORAL PRESENTATION

CORENET & EU4ADVICE: STRENGTHENING EU ADVISORY NETWORKS TO SUPPORT SUSTAINABLE SHORT FOOD SUPPLY CHAINS

Sofia F. Reis[1], **Artur Gregório**[2], **Luminita Ciolacu**[1], **Marta Fernandez Calvache**[3], **Patricia Mora**[3], **Fedele Colantuono**[4]

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[2]IN LOCO
[3]Innogestiona Ambiental
[4]Università di Foggia

COREnet & EU4Advice are pioneering EU-level advisory networks advancing the role of Short Food Supply Chains (SFSCs) in the transition towards sustainable food systems. These networks act as critical infrastructures within the national Agricultural Knowledge and Innovation Systems (AKIS) to accelerate the uptake of innovative, context-specific solutions by farmers and food system actors, by connecting, upskilling and empowering advisors across Member States. Established in 2022 as the first Horizon Europe advisory network explicitly dedicated to SFSCs, COREnet & EU4Advice respond to a structural gap in advisory services, where value-chain, territorial and consumer--producer interface issues have often been weakly addressed. SFSCs are recognised as levers for more resilient, fair and environmentally sound food systems and realising this potential requires advisors who can navigate technical, organisational, regulatory and market dimensions simultaneously, and who are embedded in transnational communities of practice. COREnet & EU4Advice contribute to this need by fostering systematic exchanges among advisors to enable advanced knowledge sharing, targeted capacity building and the co-identification of innovative solutions ready for practice. Currently, the SFSC advisory network has expanded to approximately 611 advisors, with numbers growing, which illustrates both the relevance of the thematic focus and the attractiveness of the networking, learning and recognition opportunities provided. SFSCs intersect with all relevant advisory thematic domains, from agroecological production practices to climate mitigation, biodiversity, rural employment and social innovation. COREnet & EU4Advice promote coherence among multiple advisory initiatives and support more systemic governance of sustainable food systems. Strengthening and linking these networks will be key for translating innovation potential into lasting transformations of European food systems.

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ORAL PRESENTATION

EFFECTS OF ENVIRONMENTAL LABELS ON STUDENTS' FOOD CHOICES IN AN EXPERIMENTAL RESTAURANT

Raphael Monod[1], Lydiane Nabec[2], Stéphan Marette[3], Marine Masson[1], Gwenola Yannou - Le Bris[1]

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Environmental labelling is in line with the implementation of the French Egalim law (2016), which introduces the obligation to develop a more sustainable food offering in collective catering. Nevertheless, labelling's effect is limited by consumers' motivation to take them into account, process them and use them in their consumption decisions (Nabec, 2017). INFOCAMPUS project analysed the effects of an environmental score (Eco-score) on students' food choices in a self-service restaurant. This study was conducted in an experimental restaurant that replicates the conditions of a university canteen. Two groups came to a free lunch at our facility. 205 students participated in the study (101 in the control condition without Eco-scores and 104 in the intervention group that had access to environmental information). They had to answer a questionnaire regarding their food habits and environmental concerns (eco-sensibility) before and after lunch. Their lunch consisted of a starter, a main dish, a dairy product and a dessert. For each item (starters, main, dairy, dessert) students had the choice between foods having a good Eco-score (B -- low environmental impact) and foods having a bad Eco-score (D -- high environmental impact). Eco-scores were physically presented next to each food for only one group of students (the intervention group). The other one was used as a control, for which no scores nor environmental information were displayed (control group).

Results showed no significant effect of environmental labels on students' food choices in a real-life context. Almost all students in the intervention group saw the Eco-scores in the self but only half of them declared that the Eco-scores influenced their choices according to our post lunch questionnaire. A broader discussion will be made about the reasons why all the students were not impacted by such labels and on how to increase the comprehension and effectiveness of the labels to remedy this situation.

References

Nabec L. (2017), Améliorer les comportements alimentaires avec l'étiquetage nutritionnel : vers un agenda de recherche au service du Bien-Être des consommateurs, Recherche et Applications en Marketing, 32(2): 1-29.

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Monday – Session 1.2 – Skills for the Future

ORAL PRESENTATION

GAPS AND THEIR IMPLICATIONS FOR FUTURE CURRICULUM REFORM IN FOOD SCIENCE, TECHNOLOGY, AND ENGINEERING (FST&E)

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An AI-assisted comparative analysis of 3-recent publications demonstrates strong thematic convergence around curriculum modernization, project-based learning, interdisciplinarity, sustainability, and regional contextualization in FST&E education. These priorities align with contemporary models of future-ready professional development. However, analysis of the literature reveals several critical gaps. Notably, the integration of regulatory science, food law, and policy engineering is limited, despite their central role in system design, compliance, innovation deployment, and risk-based decision making in highly regulated food systems. While experiential and project-based learning are emphasized, structured training in entrepreneurship, technology translation, intellectual property management, and process commercialization is underrepresented, constraining research-to-market and SME-driven innovation pathways. Digitalization and AI-enabled approaches are largely framed from a tools-centric perspective, with inadequate attention to physical process understanding, first-principles modeling, data quality and governance, cyber-physical systems, responsible AI implementation and ethics. Also, curriculum reform is primarily discussed in terms of content coverage, with limited adoption of competency-based assessment frameworks capable of validating transferable, interdisciplinary, and professional engineering competencies. Experiential learning remains predominantly anchored in conventional laboratory and internship models, overlooking emerging paradigms (e.g., digital twins, remote experimentation, virtual simulation environments). The prevailing focus on degree-centric education neglects the engineering imperative for lifelong learning, modular upskilling, and micro-credentialing in response to innovation, regulatory, and societal changes. Collectively, findings indicate that current FST&E curriculum reform remains incomplete and would benefit from a systems-oriented engineering education paradigm integrating regulatory competence, ethical digitalization, innovation engineering, robust competency validation, hybrid laboratory skills, enhanced health and nutrition advocacy, and lifelong learning pathways.

References

Hingston, P. A. and Bracewell, D. D. (2021). Strengthening undergraduate food science programs: Comparing industry relevance of the Institute of Food Technologists' Essential Learning Outcomes with graduate proficiency levels. Journal of Food Science Education, 20(4), 130-145.

Naseer, F., Tariq, R., Alshahrani, H. M., Alruwais, N. and Al-Wesabi, F. N. (2025). Project based learning framework integrating industry collaboration to enhance student future readiness in higher education. Scientific Reports, 15(1), 24985.

Saguy, I. S., Silva, C. L. M. and Cohen, E. (2025). Open-ended feedback on education innovation of food science, technology and engineering. J of Agri Earth & Environmental Sciences, 4(3), 01-07.

Saguy, I. S., Silva, C. L.M. and Cohen, E. (2025). Innovative curriculum strategies for managing the future of food science, technology and engineering education. Journal of Food Engineering 392, 112474.

Saguy, I.S., Silva, C.L.M. and Cohen, E. (2024) Emerging challenges and opportunities in innovating food science technology and engineering education. npj Sci Food 8, 5.

ORAL PRESENTATION

GLOCAL ECOSYSTEMS AND EXPANDED KNOWLEDGE FOR GREEN SKILLS AND CAPABILITY IN THE FOOD SECTOR

Paola Pittia[1], Maarten van der Kamp[2], Cecilia Tonelli[2], Milena Corredig[3], Mohan Reddy[4], Milena Marzano[5], Germana Di Falco[6], Antonio Vicente[7], Dan Vodnar[8], Dariusz Kozdra[9], Jesus Frias[10]

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The agri-food systems challenged by global environmental and socio-economic issues require the renewal of their task force and educate the new generation of job seekers towards sustainability and resilience. Moreover, the EU Green Deal is driving a green- and digital-based innovation that could occur only by implementing a paradigm shift of the food production and the availability of an up-skilled workforce meeting timely the fluid job market needs. Artificial Intelligence (AI) tools represent a disruptive contribution in promoting the food system green and digital transition supporting the development of a smart intervention model to boost the required skills and competences. GEEK4Food (www.geek4food.com) is an Erasmus project developing a cross-sectorial framework to support the food system transition towards sustainable and green solutions by an integrated approach that applies Artificial Intelligence (A.I.) tools coupled with reactive and fast responding educational modules design and delivery. The main project outcome is the AI-based virtual, interactive learner-centric, platform that, based on skill mapping allows the agri-food system's actors (learners, HE institutions, business and policymakers) to collaborate in shaping educational offerings on green skills and to merge learners' needs with training offers and agri-food job opportunities. Key element of the platform is the GEEK4Food Skill Passport, an AI-based tool able to determine and forecast current and future green skills for the food sector to timely support the development of educational and training paths matching the job market needs. A forward-looking model of training design has been designed to implement HE and cross-sectoral trainings intended for graduates and food professionals to enhance green skills. The evidence- and impact-based solutions of the project will be used to embed multi-level and multi-actor policy actions supporting skill-fluidity for the green transition of the food sector. The AI-supported and impact-driven patterns of the GEEK4Food model aims to favour innovative green training and educational models and provide tools for all the main actors including policy makers of the food systems to promote adherence to green transition.

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ORAL PRESENTATION

A DIGITAL TRAINING PLATFORM FOR SUSTAINABLE FOOD PACKAGING DESIGN

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Packaging is perceived often as major source of environmental pollution and food contamination. These concerns highlight the need for a comprehensive educational approach. Materials science, food technologies, and packaging courses have remained compartmentalized, inhibiting the training of packaging professionals with an integral and comprehensive perspective. The collaborative project FitNESS, funded by the European Commission under the ERASMUS+ program, aims to bridge this gap by providing a robust online knowledge base accessible on all screens for current and future food packaging. The goal is to raise awareness among all professions involved through basic courses and to effectively enhance the knowledge and skills of professionals or future professionals through advanced courses on health and toxicological assessment, sustainability of packaging, multiple criteria design of safe and responsible packaging, and materials science. New circular economy principles (reduce, collect, recycle, reuse) are particularly addressed in relation to the shelf life of food products and the risks of wastage. The content of the open-source and clonable platform (https://FitNESS.agroparistech.fr) stands as one of the most significant sources of educational content validated by more than a dozen European institutions, featuring online exercises and links to packaging design and calculation tools.

Diverse content types such as presentations, multimedia, and interactive elements, the step-by-step process of transforming these materials into an interactive, online educational format. Key stages include converting PowerPoint-like slides into web-friendly formats, integrating multimedia elements using HTML 5 and JavaScript, and deploying the reveal.js framework for interactive presentations. The diagram culminates in creating an open-source static website enriched with a searchable database of concepts derived from the original content.]

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ORAL PRESENTATION

AI BASED SURROGATE OF MECHANISTIC CFD IN TWIN SCREW EXTRUDER FOR PROTEIN TEXTURIZATION

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High-Moisture Extrusion (HME) is a key technology for texturizing plant-based proteins (as in the case of meat analogue production). However, the twin-screw extruder (TSE) at its core largely operates as a black-box. The complex rheological behaviour of protein melts and the intricate geometry of co-rotating TSE complicate precise process control. While simulations based on mechanistic models provides detailed insights into flow behaviour and temperature profiles, its high computational cost precludes its use for real-time monitoring of product quality. This study presents an AI (deep learning) surrogate model, serving as a foundational component for future Digital Twin (DT) applications, designed to predict steady-state fluid dynamics within the extruder barrel, facilitating the rapid assessment of processing conditions. A 3D convolutional neural network (CNN) is proposed based on an Encoder-Decoder architecture. The model accepts voxelized representations of screw geometries and operating parameters, generating full volumetric predictions for velocity vector fields (u, v, w) and pressure distributions (p). To address the high sparsity inherent in volumetric engineering data, a domain-specific Z-score normalization was implemented. This approach ensures robust feature scaling by accounting for the predominance of solid boundaries, preventing statistical bias in the training data. The Encoder-Decoder framework effectively captures the hierarchical relationship between screw configuration and local flow dynamics. By reducing simulation time from hours to seconds, this data-driven approach allows the rapid prediction of velocity, shear and pressure profiles. This capability is critical for advanced process control, enabling the fine-tuning of thermomechanical parameters to optimize the techno-functional properties and final texture of the extrudates.

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ORAL PRESENTATION

FROM SKILL NEEDS TO TRAINING SOLUTIONS: THE I-RESTART APPROACH TO RESKILLING AND UPSKILLING IN THE EUROPEAN AGRI-FOOD SECTOR

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The rapid transformation of the agri-food sector---driven by sustainability goals, digitalisation, and evolving labour market demands---requires new approaches to workforce development. The Erasmus+ project I-RESTART (Inclusive REskilling and upSkilling Toward competitive Agrifood and veterinary sectoR: European agenda StraTegy) addresses this challenge by identifying emerging skill needs and translating them into targeted training opportunities across Europe.

A multi-method approach was used to identify skill needs across three key domains: animal production, the food industry, and veterinary activities. Data collection included 27 sectoral focus groups with 219 stakeholders, a European web-based survey with more than 500 respondents, and scenario analysis exploring future sustainability pathways ("local", "continued", and "tech" routes). This process enabled the identification of transversal and sector-specific competencies, particularly in sustainability, digitalisation, entrepreneurship and soft skills, One Health approaches, and emerging sectoral trends.

Based on the results, the project developed a structured catalogue of skill needs and translated it into training resources organised in thematic modules and micro-lessons. In total, more than 1,000 hours of learning content across 12 thematic areas have been designed to support flexible, modular learning opportunities for professionals, students, and trainers. All training materials are freely accessible through a dedicated online learning platform.

This contribution presents the I-RESTART methodology linking skill needs analysis to training design and discusses how collaborative, cross-sectoral approaches can support education providers in responding to the evolving competence requirements of the agri-food sector. The experience offers insights for educators, policymakers, and industry stakeholders seeking to align training systems with the green and digital transitions shaping Europe's agri-food future.

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Monday – Session 2.1 – Innovative Technologies

ORAL PRESENTATION

IMPACT OF PULSED ELECTRIC FIELD PRETREATMENT ON PHYTOCHEMICAL RETENTION AND BIOACCESSIBILITY OF HOT-AIR DRIED SWEET POTATO

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Sweet potato flours are promising functional ingredients due to their richness in bioactive compounds, yet the impact of emerging processing technologies on their nutritional quality and digestive behaviour remains underexplored. Pulsed electric field (PEF) pretreatment is a non-thermal technology capable of inducing cell permeability and potentially improving the quality and functionality of dried ingredients. This study evaluated the effect of PEF pretreatment (3.0 kV/cm, 200 bipolar pulses, 20 µs) on the phytochemical composition, antioxidant activity, microstructure, and in vitro bioaccessibility of hot-air dried (75 °C / 5 h) sweet potato. Three cultivars with contrasting flesh pigmentation (white, orange, purple) were processed with and without PEF. Analyses included phytochemical quantification (total phenolics, carotenoids, anthocyanins), antioxidant activity (DPPH, FRAP), in vitro bioaccessibility (INFOGEST protocol), microstructural features (SEM), and matrix-phytochemical interactions (FTIR). Results showed that varietal composition was the dominant factor governing phytochemical content and antioxidant activity, with PEF inducing only limited, compound-specific changes. Anthocyanins were particularly sensitive, showing pronounced losses in the purple-fleshed cultivar due to electroporation-induced microstructural disruption. The impact of PEF on bioaccessibility was highly variety-dependent: it enhanced phenolic release in the low-anthocyanin cultivars but significantly reduced the bioaccessible antioxidant pool in the anthocyanin-rich matrix, indicating substantial pre-digestive degradation. Complementary SEM and FTIR analyses revealed a strong pigment association with the fibre-rich fraction, providing a mechanistic basis for the observed differences in stability and digestive behaviour. This study demonstrated that PEF does not confer universal benefits for sweet potato flour; its effectiveness is critically dependent on the intrinsic phytochemical composition and matrix structure of the raw material.

ORAL PRESENTATION

3D FOOD PRINTING FOR DUAL DELIVERY OF HYDROPHILIC AND HYDROPHOBIC BIOACTIVE COMPOUNDS

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Bioactive food compounds, such as lutein, have numerous health-promoting activities. However, they have poor chemical stability and bioavailability, limiting their efficacy. Thus, in this study, both hydrophobic (lutein) and hydrophilic (anthocyanins) were simultaneously encapsulated into starch/zein gels using an innovative coaxial 3D food printing. Briefly, lutein-loaded zein gel was employed as the core layer, while starch gel was used as the outer layer in a coaxial extrusion 3D printing. A spiral-cube-shaped geometry was used to investigate the effects of layer height (0.4-1 mm), nozzle size (0.33-0.08 mm), printing temperature (55-95 °C), and ink concentrations (10-15%). The effects of different zein concentrations (20, 40, and 60%) and printing speeds (4, 8, 14, and 20 mm/s) were also investigated. The 3D-printed samples were characterized using scanning electron microscopy, Fourier transform infrared spectroscopy, x-ray diffraction, microCT, chemical stability, and simulated digestion methods. The sample printed with a zein concentration of 40% at a printing speed of 14 mm/s exhibited the best shape integrity. When lutein was encapsulated in starch/zein gels, only 39% of lutein degraded after 21 days at 25 °C, whereas 78% degraded at the same time when crude lutein was studied. After storing at 50 °C for 21 days, 20% and 1% of lutein were retained in the lutein-loaded 3D print and control sample, respectively. With the developed 3D printing encapsulation approach, the bioaccessibility of lutein was increased by ~7-fold compared to the crude lutein. Similarly, anthocyanins' chemical stability (42% vs. 70% degradation) and bioaccessibility (38% vs. 20%) were improved compared to the unencapsulated form, respectively. As a result, the developed dual-layered starch/zein encapsulation approach can serve as a platform technology to enhance the stability and bioaccessibility of both hydrophilic and hydrophobic bioactive compounds. The proposed approach allows the food industry to design functional foods loaded with bioactive compounds with higher flexibility and precision.

References

Ahmadzadeh, S., Barekat, S. & Ubeyitogullari, A. (2025). Enhancing lutein and anthocyanins stability and bioaccessibility through simultaneous encapsulation using coaxial 3D food printing. npj Sci Food 9, 96. <https://doi.org/10.1038/s41538-025-00439-2>

Ahmadzadeh, S., & Ubeyitogullari, A. (2024). Lutein encapsulation into dual-layered starch/zein gels using 3D food printing: Improved storage stability and in vitro bioaccessibility. International Journal of Biological Macromolecules, 266, 131305. <https://doi.org/10.1016/j.ijbiomac.2024.131305>

Ahmadzadeh, S. & Ubeyitogullari, A. (2023). Enhancing the stability of lutein by loading into dual-layered starch-ethyl cellulose gels using 3D food printing, Additive Manufacturing, 69, 103549. https://doi.org/10.1016/j.addma.2023.103549

ORAL PRESENTATION

UV-C TREATMENT OF SHALGAM DRINK: QUALITY ALTERATIONS AND MICROBIAL INACTIVATION

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Due to their health benefits and distinctive sensory properties, traditional fermented products are attracting increasing interest worldwide. Shalgam (also known as Turnip juice) is a red-colored, cloudy, and sour non-alcoholic beverage produced through lactic acid fermentation using black carrot, bulgur flour, sourdough, salt, turnip, and water. Attempts to prolong the shelf life of shalgam using heat treatment frequently cause discoloration and negatively affect sensory qualities, especially taste and aroma. Consequently, exploring alternative non-thermal methods, such as UV-C processing, is necessary to evaluate their impact on the juice's physical and sensory characteristics, as well as their effectiveness in controlling native microflora and spoilage bacteria. The effects of UV-C processing on turnip juice were investigated using a Box-Behnken Design (BBD), with the explanatory variables being the number of lamps (1--11), temperature (4--30 °C), and number of cycles (1--5), with respect to responses including pH, °Brix, titratable acidity, total monomeric anthocyanin content (TMAC), color parameters (L*, a*, b*), total antioxidant capacity (TAC), total phenolic content (TPC), total mold and yeast (TMY), and total mesophilic aerobic bacteria (TMAB). In processed samples, L*, a*, b* values decreased compared to the control, while ΔE values increased. The number of lamps and cycles were identified as significant factors affecting the L* value of UV-treated shalgam juice. Among treatments, UV 4 (6 lamps, 1 cycle, 30 °C) exhibited the highest b* value, whereas UV 10 (11 lamps, 3 cycles, 4 °C) had the lowest. TPC ranged from 367.43 to 734.26 mg GAE/mL and was significantly influenced by the number of lamps, cycles, and temperature ($p < 0.05$). TAC values varied between 66.83% and 87.45%, while TMAC ranged from 7.60 to 13.73 mg/mL, with the highest value observed in UV 6 (6 lamps, 3 cycles, 17 °C). TMAB counts were reduced to 2.45 ± 0.08 log CFU/mL in UV 5 (1 lamp, 3 cycles, 30 °C). Sensory properties of shalgam were not significantly affected by UV-C treatment ($p > 0.05$). Optimum UV-C conditions were determined to be 4 °C, 5 lamps, and 4 cycles, under which the TMAC reached 13.58 mg/mL.

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ORAL PRESENTATION

EFFECT OF TEMPERATURE-CONTROLLED PULSED MICROWAVE EXTRACTION ON PHENOLIC PROFILE AND ANTIOXIDANT ACTIVITY OF HAWTHORN FRUIT EXTRACTS

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Hawthorn fruits are a valuable source of phenolic compounds with documented antioxidant and health-promoting properties. The present study investigated the effect of temperature-controlled pulsed microwave-assisted extraction (MAE) on the phenolic profile and antioxidant activity of hawthorn (*Crataegus laevigata*) fruit extracts, with particular emphasis on the role of microwave power intensity. Extraction was performed using a designed MAE system enabling precise control of temperature, extraction time, microwave power, and total energy input. The influence of process parameters was evaluated using spectrophotometric methods to determine total phenolic content (TPC), total flavonoid content (TFC), and antioxidant activity (FRAP, DPPH, ABTS), as well as UHPLC-ESI-MS/MS analysis for qualitative and quantitative characterization of individual phenolic compounds. The results demonstrated that extraction efficiency and antioxidant activity increased with rising temperature and extraction time, while microwave power exerted a compound-specific effect. Chlorogenic acid and isoquercetin were identified as the dominant phenolic constituents, whereas flavonoid aglycones and minor phenolic acids occurred at substantially lower concentrations. Although total microwave energy input was comparable across power levels, higher microwave power selectively enhanced the extraction of certain compounds, particularly ferulic acid and quercetin glycosides. Antioxidant activity showed strong correlation with phenolic content, confirming the key role of phenolic compounds in the antioxidant potential of hawthorn extracts. The applied temperature-controlled pulsed MAE system proved to be an effective and reproducible approach for obtaining phenolic-rich hawthorn extracts with high antioxidant activity.

References

Froehlicher, T., Hennebelle, T., Martin-Nizard, F., Cleenewerck, P., Hilbert, J.-L., Trotin, F., & Grec, S. (2009). Phenolic profiles and antioxidative effects of hawthorn cell suspensions, fresh fruits, and medicinal dried parts. Food Chemistry, 115(3), 897--903. https://doi.org/10.1016/j.foodchem.2009.01.004

Liu, J., Yuan, J., & Zhang, Z. (2010). Microwave- assisted extraction optimised with response surface methodology and antioxidant activity of polyphenols from hawthorn (*Crataegus pinnatifida* Bge.) fruit. International Journal of Food Science & Technology, 45(11), 2400--2406. https://doi.org/10.1111/j.1365-2621.2010.02416.x

ORAL PRESENTATION

ANTIMICROBIAL AND ANTIOXIDANT PROPERTIES OF GRAPE STEM EXTRACTS OBTAINED BY ULTRASOUND-ASSISTED EXTRACTION

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Agro-industrial by-products, such as grape stems, are increasingly recognised as sustainable sources of bioactive compounds with potential application in food packaging systems. This study evaluated the antimicrobial and antioxidant activities of grape stem extract (GSE), aiming to support its incorporation into cellulose-based absorbent membranes for active food packaging.

Grape stem extracts (Touriga Nacional) were obtained using an ultrasound-assisted extraction (UAE) technique in an ultrasonic bath. Four grams of dried milled stems were extracted with 20 mL of a 50:50 (v/v) ethanol:water solution for 15 min at 25 °C ± 5 °C. The mixture was centrifuged, the solvent was removed using a rotary evaporator at 38 °C, and the extract was subsequently freeze-dried. Antioxidant capacity was measured by Trolox equivalent antioxidant capacity (TEAC), and the results were presented as mmol Trolox equivalent (TE)/g of lyophilised extract. The antimicrobial activity was determined using the viable cell count assay method against *Staphylococcus aureus* ATCC 25923 and *Escherichia coli* ATCC 11775, at ~1x10^6^ CFU/mL standardised by OD600. The GSE concentrations were tested between 0 and 12% (w/v), with Brain Heart Infusion used as the control. Samples were incubated at 37 ºC, and counts were obtained after 24h as log CFU/mL.

GSE exhibited an antioxidant activity of 0.70 ± 0.01 mmol TE/g, which is higher than the values reported by Costa et al. (2023) for red-steam varieties (~0.58 mmol TE/g). Regarding antimicrobial activity, after 24 h of incubation in BHI, S. aureus counts increased from 5.52 ± 0.13 to 9.28 ± 0.05 log CFU/mL. The addition of 3% GSE limited growth to 5.62 ± 0.00 log CFU/mL, with no viable colonies detected at concentrations of 6% and above. In contrast, *E. coli* counts increased from 5.59 ± 0.37 to 9.06 ± 0.07 log CFU/mL in BHI and reached 7.63 ± 0.03 log CFU/mL in the presence of 3% GSE, with counts reduced to the limit of detection only at a 9% concentration.

The results demonstrate that GSE obtained by UAE exhibits relevant antioxidant capacity and marked antimicrobial activity, particularly against S. aureus. These findings support the potential application of GSE as functional additives in cellulose-based absorbent pads, contributing to the development of sustainable active food packaging systems.

References

Costa, R. D., Domínguez-Perles, R., Abraão, A., Gomes, V., Gouvinhas, I., & Barros, A. N. (2023). Exploring the Antioxidant Potential of Phenolic Compounds from Winery By-Products by Hydroethanolic Extraction. Molecules, 28(18), 6660. https://www.mdpi.com/1420-3049/28/18/6660

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ORAL PRESENTATION

GREEN TECHNOLOGIES FOR ERGOSTEROL EXTRACTION FROM SHIITAKE MUSHROOM

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Edible mushrooms are valued not only for their flavor but also for their medicinal properties. Mushroom production generates substantial waste, including spent substrate, stalks, and misshapen mushrooms^1^. These fungi contain valuable compounds such as ergosterol (ERG), a fungal sterol with reported hypocholesterolemic, antioxidant, and antitumoral activities^2,3,4^. Soxhlet (SOX) is widely used to extract ERG but relies on organic solvents (e.g., n hexane) whose ecotoxicity, hazardous waste, and high carbon footprint raise environmental concerns. Hence, greener and more selective alternatives, such as Supercritical CO_2 Extraction ($scCO_2$), have been explored. Integrating $scCO_2$ with biomass pre treatments may further improve ERG extraction efficiency.

This study aims to explore the synergy between the scCO2 and biomass pre-treatments -- ultrasound (US), microwave (MW) and enzymatic (EZ) - to obtain ERG-rich extracts from mushrooms, using GC-MS for quantification.

$ScCO_2$ extraction was optimized using *Lentinula edodes* (shiitake) as a model matrix to support later translation to mushroom byproducts, focusing on high pressure conditions and their effect on ERG concentration compared with SOX. Fixed parameters were biomass quantity (10 g), CO_2 flow (20 g/min), and extraction time (3 h). Pressure (350--800 bar), temperature (40--70 °C), and co-solvent (ethanol, 0--10 ml/min) were optimized by Response Surface Methodology in MODDE® software. Optimal conditions---690 bar, 69 °C, and no co-solvent---yielded an extract 118% richer in ERG than SOX.

Shiitake underwent the pre-treatments described, and the resulting extracts were compared with untreated ones. US showed no improvement, whereas MW increased ERG levels by 62% relative to untreated SOX extracts. EZ was the most promising, yielding 63--138% more ERG-rich extracts. Overall, MW and EZ stand out as effective strategies for enhancing ERG extract concentration.

In conclusion, scCO2 proved to be an efficient method for obtaining ERG-rich extracts, outperforming SOX. MW and EZ pre-treatment increased the extraction efficiency, yielding more concentrated extracts. These results demonstrate the potential of combining green processes to recover valuable compounds, supporting a sustainable valorization of agricultural by-products.

References

1 - Heleno, S. A., Prieto, M. A., Barros, L., Rodrigues, A., Barreiro, M. F., & Ferreira, I. C. F. R. (2016). Optimization of microwave-assisted extraction of ergosterol from *Agaricus bisporus* L. by-products using response surface methodology. *Food and Bioproducts Processing, 100*, 25--35. https://doi.org/10.1016/j.fbp.2016.06.006

2 - Gil-Ramírez, A., Ruiz-Rodríguez, A., Marín, F. R., Reglero, G., & Soler-Rivas, C. (2014). Effect of ergosterol-enriched extracts obtained from *Agaricus bisporus* on cholesterol absorption using an in vitro digestion model. *Journal of Functional Foods, 11(C)*, 589--597. https://doi.org/10.1016/j.jff.2014.08.025

3 - Guillamón, E., García-Lafuente, A., Lozano, M., D´Arrigo, M., Rostagno, M. A., Villares, A., & Martínez, J. A. (2010). Edible mushrooms: Role in the prevention of cardiovascular diseases. *Fitoterapia, 81(7)*, 715--723. https://doi.org/10.1016/j.fitote.2010.06.005

4 - irenzuoli, F., Gori, L., & Lombardo, G. (2008). The Medicinal Mushroom *Agaricus blazei* Murrill: Review of Literature and Pharmaco-Toxicological Problems. *Evidence-Based Complementary and Alternative Medicine, 5(1)*, 3--15. https://doi.org/10.1093/ecam/nem007

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Monday – Session 2.2 – Food Waste and Byproducts Valorization

ORAL PRESENTATION

SUBCRITICAL WATER AS AN ENHANCER FOR THE EXTRACTION OF CELLULOSE FROM AGRO-INDUSTRY BY-PRODUCTS

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Food waste is a major concern in the world. In 2023, the EU generated over 58 million tons of food waste, with primary production accounting, including agriculture, for approximately 10% [1]. Agriculture generates large volumes of lignocellulosic by-products that are frequently undervalued [2]. Cellulose recovery from these sources offers a direct pathway to increase the valorization of food industry by-products by converting them into renewable, functional materials.

In this work, subcritical water (SCW) was applied as i) a pre treatment to improve the cellulose purity obtained through the conventional pulping process and ii) a potential technology to improve the efficiency of the pulping. SCW promotes the degradation of linkages between polysaccharides and lignin and selectively removes hemicelluloses, thereby improving cellulose purity [3, 4]. Orange peels, tomato pomace, and corncobs, three major agro industry by products, were pre-treated with SCW before applying conventional NaOH pulping at 95 ºC; the cellulose content and yield of the recovered solids was compared with those obtained from conventional soda pulping after Soxhlet pre-treatment and without pre treatment. Moreover, pulping performed at 50 bar and 95 ºC was performed to investigate whether cellulose could be obtained in a single step. The cellulose content, yield, crystallinity, and morphology of the recovered solids were evaluated using TGA, FTIR, XRD and SEM.

SCW pre-treatment (10 min at 120 °C and 50 bar) to dry corncobs produced the most significant improvement in cellulose recovery. This treatment increased the cellulose content of the pulped solids from 67.0 to 79.2 g~cellulose~/100 g~pulped solids~ yielding 22.2 g~cellulose~/100 g~dry corncobs~. Additionally, alkaline pulping performed at 50 bar near subcritical conditions on corncobs also yielded favourable results, producing 25.1 g~cellulose~/100 g~dry corncobs~, with the resulting solids containing 74.7 g~cellulose~/100 g~pulped solids~. On the other hand, none of the pre treatments resulted in an increase in the cellulose content of the tomato pomace or orange peel' residues.

These results showed that SCW improved cellulose purity and recovery, highlighting its potential as an effective pre-treatment for valorising food industry lignocellulosic by-products.

References

1. Eurostat (2025) Food waste and food waste prevention by NACE Rev. 2 activity - tonnes of fresh mass. Online data code: env_wasfw. https://doi.org/10.2908/ENV_WASFW

2. Blasi A, Verardi A, Lopresto CG, Siciliano S, Sangiorgio P (2023) Lignocellulosic Agricultural Waste Valorization to Obtain Valuable Products: An Overview. Recycling 8:. https://doi.org/10.3390/recycling8040061

3. Nguyen Thi BT, Ong LK, Nguyen Thi DT, Ju Y-H (2017) Effect of subcritical water pretreatment on cellulose recovery of water hyacinth (*Eichhornia crassipe*). J Taiwan Inst Chem Eng 71:55--61. https://doi.org/10.1016/j.jtice.2016.12.028

4. Lachos-Perez D, Martinez-Jimenez F, Rezende CA, Tompsett G, Timko M, Forster-Carneiro T (2016) Subcritical water hydrolysis of sugarcane bagasse: An approach on solid residues characterization. J Supercrit Fluids 108:69--78. https://doi.org/10.1016/j.supflu.2015.10.019

ORAL PRESENTATION

VALORIZATION OF PORTUGUESE GOAT WHEY THROUGH THE PRODUCTION OF KEFIR

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We used whey, which is the major by-product of the dairy industry and is considered a significant environmental pollutant, as a raw material to produce kefir, thus addressing the challenges of waste management and generating a high value-added nutritional food. To carry out the first part of our experiment, we adopted two different Behnken experimental designs to optimize fermentation conditions. These designs enabled the evaluation of the effects of critical experimental factors, namely: the ratio of kefir grains/whey, the fermentation time, and the fermentation temperature, to determine the best triplet variables for the growth increase of kefir's grains, pH, acidity and moisture content. After selecting the best triplets variable, we moved on to the second part of the experiment, where we enriched the whey with either powder milk at different concentrations (1%, 2%, 3%) or goat's milk at different concentrations (30%, 50%, and 60%), and we analyzed again the growth increase of kefir grains, pH drop, acidity, humidity, and textural properties (firmness, consistency, cohesiveness and viscosity index) and we concluded the experiment with a sensory analysis focused on appearance, odor, taste, sourness, smoothness and overall acceptance. From the first part of the experiment, we determined that the optimal combination was obtained with kefir grains to whey ratio of 1%, an incubation time of 24 hours, and a temperature of 26 °C. Subsequently, our results were analyzed using Principal Component Analysis (PCA), which allowed us to summarize most of the findings in Figures 1 and 2. The results show that the first principal component (PC1, 47.7% of variance) represents the taste and overall acceptance with a positive correlation between taste, appearance, consistency, and overall acceptance; and a negative correlation with acidity, pH drop, and moisture. The second component (PC2, 21.3% of variance) reflects texture and smoothness, positively associating viscosity index, Smoothness, and Odor; and negatively associating firmness and Acidity. Based on our results, we can optimize whey valorization and improve kefir production, 40 to 60% of goat's milk should be used to maximize acceptance and taste, and more than 3% of powder milk to improve viscosity and texture, while avoiding excessive acidity and a watery appearance.

References

Deshmukh, N., Rao, P. S., Sharma, H., M.H., S. K., N., L. N., & C.T., M. K. (2024). Waste to Nutrition: The Evolution of Whey, a Byproduct to Galactooligosaccharides Production. Food Chemistry Advances, 4, 1-12.

Yadav, J.S.S., Yan, S., Pilli, S., Kumar, L., Tyagi, R.D., Surampalli, R.Y., (2015). Cheese whey A potential resource to transform into bioprotein, functional/nutritional proteins and bioactive peptides. Biotechnology Advances, 33(6), 756-774.

ORAL PRESENTATION

VALORIZATION OF TUNA BYPRODUCTS THROUGH HIGH-PRESSURE-ASSISTED ENZYMATIC HYDROLYSIS: YIELD AND HEPATOPROTECTIVE POTENTIAL

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[1]ANFACO-CYTMA

The European H2020 EcoeFISHent project (https://ecoefishent.eu/) is focused on the development of innovative and sustainable strategies for the valorization of fish-processing side streams, with the objective of supporting circular economy principles within the seafood sector. Large volumes of byproducts generated during fish processing, such as heads, frames, skins and trimmings, are still underexploited despite their high protein content and potential as sources of bioactive compounds. EcoeFISHent aims to convert these materials into high-value ingredients and functional substances suitable for applications in food supplements, cosmetics, packaging materials, soil amendments and the automotive industry.

The present work aimed to evaluate the application of high-pressure processing (HPP) as a pretreatment of enzymatic hydrolysis of dehydrated cooked tuna byproducts. HPP is a non-thermal technology known to modify protein conformation through the disruption of non-covalent interactions, potentially increasing enzyme accessibility and improving hydrolysis efficiency. In addition to assessing hydrolysis yield, this study investigated whether HPP pretreatment could enhance the biological functionality of the resulting protein hydrolysates, specifically their hepatoprotective capacity against lipid accumulation in human liver cells.

A homogeneous mixture of dehydrated cooked tuna byproducts and water was prepared and packaged in bottles. Samples were subjected to HPP treatments using an industrial-scale unit with a vessel capacity of 55 L. Two pressure levels were tested, 2000 and 6000 bar, in order to compare the effects pressure on protein structure and subsequent enzymatic hydrolysis. In all cases, two consecutive pressure cycles of 5 min were applied. Hydrolysis parameters, including enzyme type, enzyme concentration and liquid-to-solid ratio, had been previously optimized. Control treatments included an assay without HPP treatment (HPP blank) and an assay without HPP or enzyme addition (enzyme blank), allowing the effects of pressure and enzymatic action to be evaluated independently. All experiments were carried out in triplicate.

Enzymatic hydrolysis was conducted using the commercial protease 3G-PBN-66L, selected based on its performance in prior optimization trials. The enzyme was added at a concentration of 0.8 g per 100 g of dehydrated byproducts. Hydrolysis reactions were carried out at 60 °C and pH 9.5 for 2 h, with a liquid-to-solid ratio of 9.5:1. At the end of the reaction and after enzyme inactivation at 90 ºC for 10 min, hydrolysates were recovered and analyzed for protein content. Hydrolysis yield was calculated as the ratio between the amount of protein dissolved in the hydrolysate and the total protein content of the dehydrated raw material.

Moreover, the biological activity of the hydrolysates was assessed using in vitro assays with human hepatoblastoma. A preliminary cell viability test was conducted to determine non-cytotoxic concentrations of the hydrolysates. Subsequently, their hepatoprotective effect was evaluated by measuring their ability to reduce intracellular fatty acid accumulation, a key marker associated with liver steatosis and metabolic dysfunction.

Only hydrolysates from HPP-pretreated tuna byproducts exhibited a significant hepatoprotective effect, reducing fatty acid accumulation by 27% and 19% at 2000 and 6000 bar, respectively, when tested at 0.5 mg/mL, the highest non-cytotoxic concentration. In contrast, hydrolysates produced without HPP pretreatment did not display any measurable protective activity, highlighting the critical role of HPP in enhancing the biofunctional properties of the proteins.

Enzyme blank experiments indicated that approximately 16% of the protein content was solubilized in the absence of enzymatic activity, suggesting that factors such as alkaline pH, elevated temperature, and mechanical agitation contributed to protein dissolution. Samples subjected to HPP pretreatment also showed slightly higher hydrolysis yields than non-pretreated controls, with yields of 49% and 48% after pretreatment at 2000 and 6000 bar, respectively, compared to 43% in samples without HPP (Figure 1). No significant differences were observed between the two pressure levels tested, suggesting that moderate pressures are sufficient to improve protein susceptibility to enzymatic hydrolysis.

This study demonstrates that high-pressure processing is an effective pretreatment to enhance both hydrolysis efficiency and hepatoprotective activity of protein hydrolysates derived from fish-processing side streams. To the authors knowledge, no previous studies have reported the effect of high-pressure processing as a pretreatment to enzymatic hydrolysis of fish-processing byproducts on the hepatoprotective capacity of the resulting protein hydrolysates. The integration of HPP and enzymatic hydrolysis represents a promising strategy for the sustainable valorization of marine byproducts, contributing to the development of high-value functional ingredients within a circular economy framework.

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ORAL PRESENTATION

FROM FRUIT WASTE TO FUNCTION: BIOBASED MULTIFUNCTIONAL EDIBLE FILMS DEVELOPED VIA WHOLE-WASTE VALORISATION AND GREEN PECTIN ENGINEERING

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Food waste represents a significant economic global challenge, and, specifically in Ireland, it results in average household losses of approximately €700 annually and an estimated national economic impact of €1.29 billion (Environmental Protection Agency, 2023). Consequently, the demand for innovative strategies to valorise agri-food waste into functional materials for circular food systems has increased substantially over the last years. This work presents an integrated zero-waste valorisation approach for fruit processing by-products, turning apple and/or citrus wastes into bioinspired multifunctional edible materials. Two complementary pathways were explored: (i) direct incorporation of treated fruit waste powders as film ingredients and (ii) recovery and green modification of citrus waste pectin as a biopolymer base.

Alginate-based edible films incorporating citrus waste powder, apple pomace powder, and natural hydrophobic agents were optimised using response surface methodology. The optimised formulation, functionalised by addition of 1.10% w/v citrus waste powder, 1.40% w/v apple pomace powder and 3.50% v/v carnauba wax/coconut oil solution, exhibited enhanced mechanical, surface, and functional performances, supported by strong intermolecular interactions within the biopolymer matrix (confirmed by FTIR analysis). In parallel, pectin was extracted from pomace and orange peels and modified using high-power ultrasound (HPU) as a chemical-free, green processing technology. Optimized HPU-treated pectin (2 min) generated films with improved elasticity, water resistance, UV shielding, and antioxidant activity. Overall, this study demonstrates the feasibility of combining different waste valorisation strategies for high-performance material applications, contributing to sustainability and innovation in circular food systems.

References

Deng et al.,(2024).Ultrasonics Sonochemistry,106,106883,https://doi.org/10.1016/j.ultsonch.2024.106883.

Dixit et al.,(2025).Carbohydrate Polymer Technologies and Applications,9,100708, https://doi.org/10.1016/j.carpta.2025.100708.

Environmental Protection Agency - EPA, Food Waste Statistics for Ireland, 2025. https://www.epa.ie/our-services/monitoring--assessment/waste/national-waste-statistics/food/ (accessed June 30, 2025).

Hernandez-Hernandez et al.,(2024). Trends in Analytical Chemistry,175,117728, https://doi.org/10.1016/j.trac.2024.117728.

Kalita et al.,(2025). Food Control,171,111105, https://doi.org/10.1016/j.foodcont.2024.111105.

Luo et al.,(2024). Food Hydrocolloids,152,109898, https://doi.org/10.1016/j.foodhyd.2024.109898.

M.C. Gaspar, M.E.M. Braga. (2023) Curr Opin Food Sci, 50. https://doi.org/10.1016/j.cofs.2023.101006.

Monday – Session 2.3 – Food Quality and Safety

ORAL PRESENTATION

ASSESSING GREEK PROPOLIS SAFETY: PESTICIDES FROM HIVE AND ENVIRONMENT

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Propolis is a chemically complex natural product whose composition reflects its botanical origin, while its quality may also be influenced by beekeeping practices and environmental

conditions. In this study, 59 Greek propolis samples collected from different regions (among which 4 of them organic products) were analysed to evaluate their safety profile and chemical composition. Pesticide residues, primarily associated with compounds commonly used in Varroa mite control in apiculture, were quantified using a validated GC--MS/MS multiresidue method.

Seventeen among 59 studied samples shown pesticide residues at concentrations exceeding European Union maximum residue limits (MRLs). The most frequently detected residues include compounds directly associated with in-hive Varroa control treatments (taufluvalinate, piperonyl butoxide, coumaphos and amitraz metabolites such as 2,4-dimethylphenyl formamide) as well as pesticides of agricultural origin (chlorpyrifos), indicating both apicultural and environmental sources of propolis contamination. Moreover, all studied propolis samples, were analysed by GC--MS for the determination of their chemical profiles , following an analytical approach, involving derivatisation to trimethylsilyl ethers, prior to analysis.This combined analytical approach highlights how pesticide residues originating from Varroa control practices or from agricultural sources are reflected in the chemical quality and safety of Greek propolis and provides a scientific basis for evaluating and improving apicultural practices aimed at reducing contamination. Furthermore, the characteristic chemical profiles of the analyzed propolis confirm their geographic origin from different regions of Greece as well as the influence of harvest periods towards their chemical composition which will be further discussed.

References

G.E. Miliadis, P. Malatou, P. Tsiantas, A. Vrettakou, V.I. Evangelou, Ch. Anagnostopoulos, G. Siragakis -- Carryover effect in pesticide residues analysis by LC-MS/MS, Hellenic Veterinary Medical Society Journal -- Vol. 68, 2017

K. Graikou, M. Popova, O. Gortzi, V. Bankova, I. Chinou - Characterization and biological evaluation of selected Mediterranean propolis samples LWT -- Food Science and Technology (2015)

M. Popova, K. Graikou, I. Chinou, V. Bankova- GC--MS profiling of diterpenic compounds in Mediterranean propolis from Greece ournal of Agricultural and Food Chemistry (2010)

Miliadis G., Tsiantas P., Siragakis G.-Problems encountered in LC-MS/MS analysis for the determination of pesticide residues in food Journal of the Hellenic Veterinary Medical Society (2017)

ORAL PRESENTATION

BALANCING NUTRITIONAL QUALITY AND MICROBIAL SAFETY: LYCOPENE STABILITY AND INACTIVATION OF ALICYCLOBACILLUS ACIDOTERRESTRIS VIA COMBINED HEAT AND UV-C TREATMENTS

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Ultraviolet-C (UV-C) radiation is a nonthermal disinfection method with a strong germicidal effect on a range of microbial contaminants and minimal impact on nutrients. In this work, the advantage of applying a continuous-flow pasteurization, by combining heat with UV-C radiation (UV-C-H) compared to single-heating (H), was studied in a functional tomato juice (FTJ) (pH=3.70±0.06, °Brix=5.27±0.21) and a functional tomato sauce (FTS) (pH=4.04±0.02, °Brix=7.96±0.16), both prepared with a high-lycopene tomato cultivar Heinz VHL® 'H1657'. The kinetic parameters of lycopene degradation during H and UV-C-H pasteurization (UV-C doses ranging between 40 and 782 J/ml) were estimated using the Paired Equivalent Isothermal Exposures (PEIE) method based on the Arrhenius Model, giving the following estimates; EaFTJ(H)=132.88±3.87 kJ.mol-1, kFTJ(H)80°C= 0.039±0.001 min-1 and EaFTJ(UV-C-H)=30.96±3.96 kJ.mol-1 and kFTJ(UV-C-H)80°C=0.035±0.002 min-1, EaFTS(H)=69.64±3.81 kJ.mol-1, kFTS(H)80°C= 0.032±0.0004 min-1 and EaFTS(UV-C-H)=56.15±5.12 kJmol-1 and kFTS(UV-C-H)80°C= 0.056±0.003 min-1. Kinetic inactivation parameters of *Alicyclobacillus acidoterrestris* (Aa) spores (inoculated in both products to evaluate microbial safety) were also estimated by the PEIE method but based on the Bigelow model, zFTJ(H)=27.0±2.0 °C, DFTJ(H)80°C=10.9±0.6 min, zFTJ(UV-C-H)=20.3±0.8 °C, DFTJ(UV-C-H)80°C=2.9±0.1 min, zFTS(H)= 34.4±3.0 °C, DFTS(H)80°C= 12.2±0.2 min, zFTS(UV-C-H)=26.4±2.00 °C, DFTS(UV-C-H)80°C= 3.2±0.2 min.

Using the estimated kinetic parameters, an optimization was performed to find time-temperature combinations that maximized lycopene retention while achieving a 5D reduction in Aa spores. For H pasteurized products, to obtain a 5D reduction in the juice, 90 °C for 23 minutes was needed and for the sauce, 95 °C for 22 minutes, allowing only a 5% and 15% lycopene retention in the juice and sauce, respectively. In UV-C-H pasteurized products, a 5D reduction in Aa was achieved at 90 °C for 5 minutes for juice and 95 °C for 4 minutes for sauce, allowing 80% and 60% lycopene retention, respectively. As a result, UV-C-H more efficiently yields a 5D reduction in Aa spores while increasing lycopene retention in tomato-based products than H pasteurization.

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ORAL PRESENTATION

FUTURE LAB 2030 - ANALYTICS, ARTIFICIAL INTELLIGENCE AND A DIGITAL TWIN - MEAT SPOILAGE USING THE EXAMPLE OF MINCED MEAT

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The project "ZL2030 - Future scenarios for consumer protection based on food quality and safety information, innovative measurement methods and AI", here referred to as Future Lab 2030, aims to use artificial intelligence (AI) methods to enable continuous prediction of the sensory and microbiological quality of food by assessing the impact of process changes in real time. Minced pork and turkey breast were selected as exemplary matrices for the validation study. For both matrices microbiological spoilage is a relevant aspect of food safety.

A digital twin of the product is created using data from a variety of mostly innovative measurement methods, such as Next-Generation Sequencing (NGS), spectroscopy or volatilome analysis. A variety of different methods is necessary, as the digital twin must be suitable to describe both, the main physico-chemical as well as biological processes relevant for changes in the quality status.

When it comes to assessing the freshness of food, the increased quality demands of consumers must be reconciled with the needs of food manufacturers and retailers. This is one of the key points in the conflict between food safety and food waste, as the freshness of food affects not only its sensory properties, but also its safety and shelf life. Particularly in the case of fresh and highly perishable goods such as meat and meat products, various conditions along the food chain - from production to transport and retail - can affect product quality even before it reaches the consumer. This influence on product quality depends both on dynamic changes in physico-chemical processes and on the microbiome, i.e. the totality of microorganisms present in the food in question.

The analytical focus of the LGL as a partner in the project consortium was on the application of NGS-based microbiome analysis. In particular, changes in the composition of the microbiome during food storage and in relation to different storage conditions (e.g. temperature or gas phase in the packaging) were analysed. The particular challenge of the microbiome analysis was the comparatively low number of bacteria in the fresh product combined with the large amount of accompanying eukaryotic DNA.

In addition to microbiome analysis, a metatranscriptome analysis was conducted to gain insight into active metabolic processes during meat spoilage. This approach enabled the detection of classic spoilage organisms, with results comparable to the microbiome data, albeit nit in terms of overall development. It also allowed the coverage of key metabolic pathways involved in energy production and substrate degradation through expressed genes. Furthermore, it confirmed many externally detected volatile organic compounds (VOCs) via transcriptome data. However, the analysis was limited by maximum data volume and high matrix content, despite RNA depletion, resulting in reduced effective yield.

The lecture will present results from the microbiome analysis using DNA metabarcoding for the matrix minced meat, as well as results from the metatranscriptome analysis based on RNA sequencing.

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ORAL PRESENTATION

EXPLORING THE ANTIBIOTIC-RESISTANCE PROFILE OF STAPHYLOCOCCUS AUREUS RECOVERED FROM PORTUGUESE FERMENTED MEAT PRODUCTS

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Chouriça and alheira are traditional Portuguese sausages with culinary, cultural, and economic significance. However, its artisanal production is often linked to non-standardised manufacturing processes and hygiene practices, which may result in contamination by foodborne pathogens and antimicrobial resistance (AMR) dissemination.

In this study, forty-seven *Staphylococcus aureus* isolates from chouriça (RTE, n=22) and alheira (non-RTE, n=25) sausages were subjected to antimicrobial susceptibility testing by disk diffusion following EUCAST guidelines, against 14 antibiotics. The resulting data were analysed performing descriptive analysis and Principal Component Analysis (PCA) with the AMR R Package.

Resistance was observed only to eight antibiotics, with 68.08% of isolates resistant to at least one agent and low rate of multidrug-resistant isolates (6.4%). All strains were susceptible to cefoxitin, indicating the absence of methicillin-resistant S. aureus isolates. Benzylpenicillin resistance was most common, especially in RTE (50%) and non-RTE (40%), erythromycin resistance was higher in RTE (40.9%), and norfloxacin resistance appeared only in non-RTE products (16%). PCA extracted two components that explain the majority of resistance variation and revealed clear clustering by sausage type, indicating distinct resistance profiles between RTE and non-RTE sources. Detection of antibiotic-resistant S. aureus in fermented sausages, particularly to antibiotics so common in human treatment, probably results from poor hygiene practices during manufacturing and improper fermentation, allowing the survival of human-derived strains in the end product. Improving hygiene is important to curb AMR spread; therefore, future research should focus on resistance transmission and genotypic characterization.

References

Lin, Q., Sun, H., Yao, K., Cai, J., Ren, Y., & Chi, Y. (2019). The Prevalence, Antibiotic Resistance and Biofilm Formation of *Staphylococcus aureus* in Bulk Ready-To-Eat Foods. Biomolecules, 9(10), 524. https://doi.org/10.3390/biom9100524

Miklasińska-Majdanik, M. (2021). Mechanisms of Resistance to Macrolide Antibiotics among *Staphylococcus aureus*. Antibiotics, 10(11), Article 11. https://doi.org/10.3390/antibiotics10111406

Prabhu, K., Rao, S., & Rao, V. (2011). Inducible Clindamycin Resistance in *Staphylococcus aureus* Isolated from Clinical Samples. Journal of Laboratory Physicians, 3(1), 25-27. https://doi.org/10.4103/0974-2727.78558

EUCAST, 2025. eucast: Disk diffusion methodology. URL https://www.eucast.org/ast_of_bacteria/disk_diffusion_methodology

ORAL PRESENTATION

ASSEMBLY, ANNOTATION, AND FUNCTIONAL CHARACTERIZATION OF LACTIC ACID BACTERIA FROM TRADITIONAL PORTUGUESE FOODS

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Lactic acid bacteria (LAB) play a crucial role in the production of fermented foods, contributing to both safety and sensory quality. However, leveraging LAB for industrial applications requires high-resolution genomic characterization. This study presents the assembly and functional annotation of 97 LAB isolates to evaluate their biotechnological traits and safety profiles.

Samples were primarily isolated from *alheira* (n=59) and cheese (n=37) and were analyzed using an Illumina Whole-Genome Sequencing pipeline. Raw reads were processed for quality control using Falco and fastp. De novo assembly was performed with Shovill v1.1.0 (SPAdes-based), and assembly quality was validated using Quast and Bandage. Structural and functional annotation was conducted using Prokka v1.14.6. The pipeline integrated specific tools for functional mining, e.g., antiSMASH v7.0 for bacteriocin discovery, AMRfinderPlus v3.11 for antimicrobial resistance (AMR) genes, and Abricate v1.0.1 for virulence factor screening.

The most frequent species identified across the dataset were *Leuconostoc mesenteroides* (n=23), **Enterococcus lactis** (n=20), and **Lactococcus cremoris** (n=13). Functional characterization identified significant technological traits, particularly in **Lacticaseibacillus paracasei** and **Lactiplantibacillus plantarum**, which exhibited a high frequency of genes related to lactose metabolism, citrate utilization, and exopolysaccharide production. Stress tolerance genes (acid, bile, and thermal) and complex proteolytic systems were also identified. Safety assessments revealed no AMR genes across the samples. However, seven **Enterococcus faecalis** strains carried virulence factors related to biofilm formation and cell adhesion (i.e, *Ebp* pili system). Additionally, 35 samples showed potential for biogenic amine production.

Overall, strains revealed promising technological features, useful for their application as bioprotective cultures. Additionally, the presence of virulence factors and biogenic amine pathways in certain isolates highlighted the importance of thorough genomic screening. This information supports the development of precision fermentation studies and contributes to the valorisation of traditional Portuguese food.

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ORAL PRESENTATION

GREEN SYNTHESIS OF CARBON NANODOT--PHENOLIC HYBRIDS FOR SUSTAINABLE ANTIMICROBIAL APPLICATIONS

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Bioactive phenolic compounds such as thymol and carvacrol exhibit strong antimicrobial properties; however, their application in food safety is often limited by instability and reduced bioavailability. Synthesized from sustainable precursors, carbon nanodots (CNDs) offer a novel way to improve the effectiveness of natural antimicrobials.

In this study, CNDs were synthesized from sucrose and glycine using a green Maillard reaction--based approach and subsequently loaded with selected phenolic compounds (thymol, carvacrol) to form hybrid CND--phenolic systems. The formation of hybrid structures was confirmed by fluorescence spectroscopy, where a quenching effect was observed with excitation at 340 nm and a characteristic emission peak at 420 nm, indicating interactions between CNDs and phenolic molecules. Fourier-transform infrared (FTIR) analysis further supported these interactions through the appearance of characteristic phenolic bands and increased band intensities, suggesting hydrogen bonding and π--π interactions. Transmission electron microscopy (TEM) revealed quasi-spherical carbon nanodots with nanoscale dimensions ($^{<}$ 10 nm). Molecular weight distribution determined by HPLC--GPC showed values in the range of 6.5--6.7 × 10^5 Da, confirming the formation of well-defined carbon nanodot structures. The loading efficiency reached 23.8% for thymol and 24.3% for carvacrol, demonstrating effective incorporation into the carbon nanodot matrix.

The antimicrobial activity of the CND--phenolic systems will be assessed by determining minimum inhibitory concentrations (MICs) against representative microorganisms. It is expected that incorporating phenolic compounds into carbon nanodots will yield synergistic antimicrobial effects compared to the free compounds, highlighting the potential of CND-based systems as innovative and sustainable tools for improving food quality and safety.

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Tuesday – Session 2.1 – Innovative Technologies and Biotechnologies

ORAL PRESENTATION

BIOAROMA PRODUCTION USING YEASTS: TOWARDS A SUSTAINABLE VALORISATION OF AGROINDUSTRIAL BYPRODUCTS

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Fermentation processes are a cornerstone of the bioeconomy. Interest in using them towards the sustainable production of bio-based aroma compounds (bioaroma) from renewable resources is growing. Rising demand for natural products alongside strict regulations against non-biobased molecules in food, fragrance, and cosmetics further support biomass valorisation. Besides, the valorisation of agro-industrial residues is increasingly essential due to their huge volumes generated [1]. In order to develop robust fermentation processes for full scale industrial implementation, these must be combined with pre/post-treatment steps and optimized within a multi-criteria approach. Indeed, favourable conditions are needed for high cellular activity, whereas emerging "non-conventional" substrates expose cells to inhibition effects. Moreover, when metabolites accumulate in the fermentation medium, similar deleterious effects can occur. The integration of fermentation with extraction (extractive fermentation) aims to tackle these limitations and intensify the bioproduction. However, there are still several questions to be answered, such as using robust microorganisms, finding optimal bioprocess conditions and choosing biocompatible recovery operations. Furthermore, there is a need to evaluate techno-economic and environmental aspects of the process viability [2]. Within SayFood, Paris-Saclay Food and Bioproduct Engineering Joint Research Unit, we have been conducting interdisciplinary research projects on extractive fermentation to produce bioaroma compounds (isoamyl acetate, 2-phenylethanol, ethyl acetate, etc) using yeasts [3-4]. Membrane-based techniques of pervaporation and membrane contactors are studied given their expected biocompatibility and compliance with green chemistry principles [5-6]. Such an approach raises scientific questions of utmost importance that need interdisciplinary work strategy in line with the scientific challenges exposed above: bioprocess engineering, downstream processing, integrated process modelling and environmental/economic assessment. In this presentation, we intend to share some examples illustrating our scientific approach and a selection of results, wishing to contribute to insightful discussions and feedback.

References

1. FAO (2019), Moving forward on food loss and waste reduction. 2. Jorge, F.T.A. et al. (2025) Biotechnological production of 2-phenylethanol from agroindustrial byproducts: experimental evaluation, techno-economic analysis, and life cycle assessment. Biofuels Bioprod. Biorefining 19, 1190--1206. 3. Mitri, S. et al. (2022) Bioproduction of 2-phenylethanol through yeast fermentation on synthetic media and on agro-industrial waste and by-products: A review. Foods 11, 109 4. Cordero-Soto I. N. et al. (2021). Intensification of 2-phenylethanol production using an aerated system assisted by a membrane-based solvent extraction technique. Rev. Mex. Ing. Quím. Vol. 20, No. 2. 739-750 5. Akpari E., Moussa M., (2024). Separation of metabolites produced by *Yarrowia lipolytica*. In *Yarrowia lipolytica* Yeast: from metabolic engineering to biotechnological applications and downstream processing. Koubaa M., Mitri S., Louka N. (Eds). Elsevier S&T Books. ISBN: 9780443220920. Publication Date: 01-Jun-25 6. Agudelo P.A et al. (2024). Pervaporation coupled to fractional condensation for rational recovery of bio-based ethyl acetate. Euromembrane Conference, Prague, Czech republic, September 8th-12th.

ORAL PRESENTATION

DRY FRACTIONATION AND BIOPROCESSING FOR SUSTAINABLE PLANT-BASED INGREDIENTS AND FOODS

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The availability of attractive plant-based foods is essential to support the transition towards a more sustainable diet. Many plant protein ingredients to make such foods are currently wet extracted using alkaline-extraction isoelectric precipitation. Unfortunately, this wet extraction requires the use of chemicals, a lot of water and energy to obtain highly pure and bland tasting protein isolate powders. Conversely, dry fractionation consisting of the combination of fine milling and dry separation is a much eco-friendlier approach to prepare protein-rich ingredients, as it eliminates water use and thus requires significantly less energy (Schutyser et al., 2025). Protein ingredients made with dry fractionation are less pure in protein but richer in micronutrients and fibres and the proteins retain their native functionality. However, the presence of antinutrients and off-flavours currently limit their use in many food applications. An overview will be provided of recent advances in dry fractionation and bioprocessing to overcome the hurdles for application of dry fractionated ingredients in foods. To optimise the performance of milling and air classification of starch-rich pulses, recently a population-balance-based model was developed and verified for pulses. Moreover, recently milling and air classification was successfully applied to fractionate oats, achieving a threefold increase in protein (Tagle-Freire et al., 2025). Challenges and potential solution routes to mitigate flavour issues and lower presence of anti-nutrients in dry-enriched ingredients will be reviewed. Specifically, a promising bioprocessing strategy using lactic acid fermentation to improve the nutritional quality and taste of dry-enriched pulse ingredients will be introduced (Xing et al., 2020, 2021). Recent additional results show that both bacterial strain and pulse type selection can improve the flavour and sensory profile and facilitate desired removal of raffinose oligosaccharides. This shows that lactic acid fermentation is a promising strategy, which can help product developers to make different choices in preparing plant-based foods.

References

Schutyser, M., Novoa, S. C., Wetterauw, K., Politiek, R., & Wilms, P. (2025). Dry Fractionation for Sustainable Production of Functional, Nutritional and Palatable Grain Legume Protein Ingredients. Food Engineering Reviews. https://doi.org/10.1007/s12393-024-09394-2

Tagle-Freire, D., Stieger, M., Forde, C. G., & Schutyser, M. A. I. (2025). Protein enrichment of oat flour by fine milling and air classification. Journal of Cereal Science, 126, 104315. https://doi.org/10.1016/J.JCS.2025.104315

Xing, Q., Dekker, S., Kyriakopoulou, K., Boom, R. M., Smid, E. J., & Schutyser, M. A. I. (2020). Enhanced nutritional value of chickpea protein concentrate by dry separation and solid state fermentation. Innovative Food Science and Emerging Technologies, 59. https://doi.org/10.1016/j.ifset.2019.102269

Xing, Q., Kyriakopoulou, K., Zhang, L., Boom, R. M., & Schutyser, M. A. I. (2021). Protein fortification of wheat bread using dry fractionated chickpea protein-enriched fraction or its sourdough. LWT, 142. https://doi.org/10.1016/j.lwt.2021.110931

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ORAL PRESENTATION

SPROUTING IMPROVES PROTEIN QUALITY AND IN VITRO DIGESTION RATES OF LEGUMES AND CEREALS

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Proteins are essential macronutrients in human nutrition, supplying essential amino acids for growth and other physiological functions. Animal-based protein consumption has been linked to health risks and environmental concerns, leading to a shift towards plant-based protein sources. Nevertheless, plant-based proteins exert lower protein digestibility rate in comparison to animal-based proteins. However, sprouting is a bioprocess that improves the digestibility of plant-based proteins by activating endoproteases, weakening cell walls, and reducing anti-nutritional factors. This study aimed to investigate the effect of sprouting of various legumes and cereals (quinoa, mung bean, green lentil, white kidney bean, red bean, and wheat) on the *in vitro* kinetic release rates of amino acids and to evaluate its influence on their nutritional qualities. With this aim, wheat, mung bean, green lentil, white kidney bean, and red bean were sprouted for 0, 24, 40, 56, and 72 h, while quinoa was sprouted for 0, 8, 16, 24, and 32 h at 20°C, 95% relative humidity, and in darkness. Subsequently, native and sprouted legume and cereal samples were subjected to *in vitro* digestion (0, 20, 30, 60, 90, 120, and 180 minutes for the intestinal phase), and amino acid concentrations were monitored kinetically. The changes in nutritional protein quality of legumes and cereals during sprouting were assessed by calculating the area under the curve of amino acid concentrations of these foods during in vitro digestion, expressed as a percentage of their counterpart of egg, which is considered as a reference food for its exceptional amino acid bioavailability.

The nutritional protein quality of cereals and legumes significantly improved. The protein quality of white kidney beans increased from 67% to 90%, while green lentils increased from 68% to 88%, mung beans from 72% to 89%, quinoa from 45% to 49%, red beans from 54% to 60%, and wheat from 57% to 64% with different durations of sprouting. Moreover, sprouting enhanced the initial *in vitro* digestion rates of red beans by 1.35-fold, quinoa by 1.54-fold, mung beans by 1.42-fold, and white kidney beans by 1.75-fold. The overall results indicate that sprouting plant-based materials is an effective bioprocess for obtaining ingredients with enhanced protein digestibility and nutritional quality.

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ORAL PRESENTATION

COMPARATIVE EVALUATION OF ENCAPSULATION TECHNOLOGIES FOR STABILISATION AND CONTROLLED RELEASE OF NATURAL BIOACTIVES FOR FOOD AND FEED APPLICATIONS

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Natural bioactive compounds from plant and algal sources offer promising alternatives to synthetic additives in sustainable food and feed systems. However, their application is often limited by thermal instability, oxidative degradation, volatility, and low bioavailability during processing and storage. Encapsulation technologies provide a strategic approach to stabilise sensitive compounds and enable controlled release.

This study presents a comparative evaluation of four encapsulation methods: spray drying, electrohydrodynamic processing (electrospraying), ionic gelation, and emulsion--freeze-drying. Bioactives, including olive leaf polyphenols, citrus flavonoids, algal extracts, and essential oils, were incorporated into protein- and polysaccharide-based matrices such as zein, maltodextrin, alginate, chitosan, and collagen.

Encapsulation efficiency, particle morphology, thermal behaviour (DSC), structural interactions (FTIR), and release kinetics were analysed. Results showed strong matrix-dependent performance. Spray drying produced scalable micron-sized powders with high encapsulation efficiency. Ionic gelation provided improved gastric protection and sustained intestinal release. Electrohydrodynamic techniques enabled submicron structures and excellent protection of thermolabile compounds, but limited throughput. Emulsion--freeze-drying preserves volatile compounds under mild conditions, though it requires higher energy.

No single technology was universally optimal; instead, rational selection based on bioactive properties and processing constraints is essential. These findings support the development of stable, functional ingredients that contribute to more resilient and sustainable food systems.

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References

[1] Estevinho, B. N., & López-Rubio, A. (2024). Recent Advances in Encapsulation for Food Applications. Foods, 13(4), 579. https://doi.org/10.3390/foods13040579.

[2] Rezagholizade-Shirvan, A., Soltani, M., Shokri, S., Radfar, R., Arab, M., & Shamloo, E. (2024). Bioactive compound encapsulation: Characteristics, applications in food systems, and implications for human health. Food Chemistry: X, 24, Article 101953. https://doi.org/10.1016/j.fochx.2024.101953.

[3] Xu, Y., Yan, X., Zheng, H., Li, J., Wu, X., Xu, J., Zhen, Z., & Du, C. (2024). The application of encapsulation technology in the food industry: Classifications, recent advances, and perspectives. Food Chemistry: X, 21, Article 101240. https://doi.org/10.1016/j.fochx.2024.101240.

Tuesday – Session 2.2 – Green and Sustainable Packaging

ORAL PRESENTATION

MONOLAYER PACKAGING MATERIAL AS A SUSTAINABLE PACKAGING SOLUTION FOR SOUS-VIDE COOKED CLAMS

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Venerupis corrugata clam, a European native premium species, has a shelf life of ca four days. Its rapid quality deterioration pose significant challenges to commercialization and value addition. Sous-vide cooking is a promising high-quality preservation strategy. This technique requires high-performance packaging withstanding vacuum, heat sealing, thermal treatment and oxygen barrier - properties that are typically achieved through multilayer structures based on fossil-derived polymers such as polyamide/polypropylene (PA/PP). To improve packaging circularity, bio-based materials are emerging as promising alternatives. This study aims at evaluating the potential for extending the shelf-life clams through sous-vide cooking and chilled storage at 3 °C, using a monolayer bio-based polyamide 11 packaging, in comparison to a reference multilayer material PA/PP. Live clams were packaged and the performance of the packaging materials was evaluated during the process and storage thorough microbiology, chemical and sensory analysis (Figure 1). The clams quality and appearance were satisfactory for the entire time of study, and the odour was acceptable up to 22 days (Figure 2). However, a lack of freshness and an intense of cooked odour after 16 days were reported. The permeability of the films was assessed to test the impact of processing and of relative humidity after processing. The WVTR results (Figure 3A) shows that PA/PP is less impacted to high humidity and temperature than PA11bio and the presence of polypropylene helps to maintain lower the water vapour permeability. The PA11bio had higher OTR than PA/PP at the different relative humidity conditions and the sous-vide processing seems to contribute to a reduction of the OTR Figure 3B. The process proved to be an effective strategy for extending the shelf life of cooked clams at least 16 days. The bio-based PA11 demonstrated performance comparable to that of the conventional PA/PP multilayer control.

References

Abel, N., Rotabakk, B. T., & Lerfall, J. (2022). Mild processing of seafood --- A review. Comprehensive Reviews in Food Science and Food Safety, 21(1), 340--370. <https://doi.org/10.1111/1541-4337.12876>

Elvevoll EO, Eilertsen K-E, Aschan M and Bandarra NM (2023) New marine low trophic resources as food: nutritional and food safety aspects. Front. Aquac. 2:1254038. doi: 10.3389/faquc.2023.1254038

Goes CB, Teixeira S, Mena C, Silva F, Cruz A, Basílio I, Hogg MC, Sivertsvik M, Teixeira P, Poças F. Extending the Shelf-Life of Live Clams, *Venerupis corrugata*---Important Aspects of Current Packaging and Advances in Modified Atmosphere Packaging. Foods. 2025; 14(9):1629. <https://doi.org/10.3390/foods14091629>

Skipnes D., Øines S., Rosnes J.T.& Skåra T. (2002) Heat Transfer in Vacuum Packed Mussels (*Mytilus edulis*) During Thermal Processing, Journal of Aquatic Food Product Technology, 11:3-4, 5-19, DOI: 10.1300/J030v11n03_02

Zavadlav, S., Blažić, M., Van de Velde, F., Vignatti, C., Fenoglio, C., Piagentini, A. M., Pirovani, M. E., Perotti, C. M., Bursać Kovačević, D., & Putnik, P. (2020). Sous-Vide as a Technique for Preparing Healthy and High-Quality Vegetable and Seafood Products. Foods, 9(11), 1537. https://doi.org/10.3390/foods9111537

ORAL PRESENTATION

PLANT-BASED ACTIVE PACKAGING: SYSTEMS AND FUNCTIONALITIES IN SUSTAINING FOOD PRODUCTS

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Recent innovations in food packaging have evolved beyond conventional containment, offering additional functionalities aimed at improving food safety, quality, and sustainability. Among these innovations, plant-based active packaging has emerged as a promising approach to enhance food quality and shelf-life through interaction between packaging materials and the packaged food or its surrounding environment. Active packaging systems incorporating plant-based components can be broadly classified into antimicrobial, antioxidant, and insect-repellent systems, as well as systems with enhanced water and oxygen barrier properties that aim to delay spoilage and improve food safety. The effectiveness relies on bioactive substances that are capable of interacting with food or the surrounding environment to delay the deterioration process. In plant-based active packaging, these bioactive components are commonly derived from natural products such as plant oils, essential oils, and plant-derived phenolic compounds. The incorporation of plant oils into polysaccharide-based films has been shown to improve film flexibility and moisture barrier properties, supporting their potential in biodegradable packaging. Natural bioactive compounds such as essential oils derived from curry leaves, cinnamon bark, clove, oregano, thyme, rosemary, and others have demonstrated potential antimicrobial, antioxidant, and insect-repellent activities. In our study, chitosan-based films incorporated with curry leaf essential oil (CLEO) demonstrated enhanced antioxidant, antibacterial, and insect-repellent properties. This approach provides an added layer of protection beyond conventional packaging. Applications of plant-based active packaging systems in food products, particularly those prone to microbial spoilage and oxidative deterioration such as fresh produce, meat, seafood, and ready-to-eat meals, have shown promising results in reducing contamination and enhancing overall food safety. Overall, plant-based active packaging represents a multifunctional and eco-friendly approach that supports both the preservation of food products and environmental sustainability, paving the way for future innovation in food packaging.

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ORAL PRESENTATION

ACTIVE FILMS BASED ON CHITOSAN WITH PROTEIN HYDROLYSATES FROM COD FISH BY-PRODUCTS -- DEVELOPMENT AND CHARACTERIZATION

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With the global expansion of fish production and consumption around 70 % of fish is processed before sales, producing a significant amount of waste, however this waste still often contains nutrient-rich by-products. To valorize this waste, protein hydrolysates were recovered from cod bones using subcritical water extraction and subsequently integrated into chitosan matrices to develop bioactive films. To evaluate their potential in food packaging, active films were fabricated via the solvent casting technique. The film-forming solutions consisted of chitosan (1.5 % w/v) dissolved in 1 % acetic acid, with glycerol added at 30 % (w/wchitosan) as a plasticizer. The hydrolysate, which showed antioxidant properties, was integrated at concentrations of 25 % and 50 % (w/wchitosan). The incorporation of the hydrolysates shifted the color of the resulting films from a light-yellow to a brownish color, which led to a decrease in transmittance at 600 nm from 88 % for the control chitosan film to 79 % and 76 % for the film incorporated with 25 % and 50 %, respectively. No significant changes were observed in terms of the water vapor permeability of the films. Additionally, the films maintained their mechanical properties as well as the contact angle. In terms of solubility in water, a slight increase was observed with the increase of hydrolysate concentration. The successful formulation of these active films demonstrates that protein hydrolysates derived from cod bone can effectively add bioactive traits to chitosan matrices. This method promotes a circular economy by upgrading discarded biomass into active packaging solutions that enhance food preservation and reduce waste generation further down the supply chain. Additional work is being carried out to explore the co-incorporation of the solid extraction residue alongside the hydrolysates, aiming for the total valorization of the cod bone biomass.

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ORAL PRESENTATION

UPCYCLING FRESH PRODUCE WASTE INTO MODIFIED PECTIN--ZEIN PICKERING EMULSIONS FOR PROTEIN-ENHANCED, PLASTICIZER-FREE, PLANT-DERIVED EDIBLE COATINGS

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The transition toward sustainable-circular food systems requires multifunctional packaging solutions based on renewable resources as food waste. In this study, fresh produce waste (pomace and orange peels) was valorised as a sustainable source of citrus pectin to develop bio-based Pickering emulsions for edible coating applications. Citrus waste-pectin (2.0% w/v) was subjected to high-power ultrasound (HPU, 2-5 min) to obtain high-methoxyl pectin (HMP). Ultrasound treatment induced controlled structural rearrangements, as evidenced by increased degree of esterification (up to 73.50%) and methoxyl content (~11.7%) while maintaining stable equivalent weight, indicating modification without extensive polymer degradation. Enhancing methoxylation increased pectin hydrophobicity, which helps adsorption at oil-water interface and favours effective Pickering stabilization. Ultrasound-modified HMP was subsequently combined with increasing zein concentrations (0.0-2.0% w/v) to form plant-derived polysaccharide-protein complexes for stabilising oil-in-water Pickering emulsions (oil = 0.6). The influence of zein on interfacial, colloidal, microstructural, and rheological properties was comprehensively evaluated. Zein incorporation enhanced interfacial adsorption and reduced surface tension, leading to improved particle uniformity (~75% and ~50% reduction in particle size and polydispersity index, respectively), finely structured emulsions, uniform droplet size distributions, enhanced antioxidant activity (DPPH/ABTS), reduced creaming rate, with increased emulsifying activity and stability indices. Microscopy confirmed dense and continuous particle layers at the oil--water interface, while rheological analysis revealed shear-thinning and elastic behaviour, indicating interconnected droplet networks. When applied as edible coatings to fresh-cut pineapple, selected formulations (1.0 and 1.5%) effectively reduced weight loss, inhibited microbial growth, and delayed quality deterioration during refrigerated storage, extending shelf-life by up to four days. Overall, this study demonstrates a viable strategy for upcycling fresh produce waste into high-performance, plasticizer-free, plant-derived edible coatings, for circular packaging solutions.

References

Aslan Türker, D. (2025). Influence of charged polysaccharides and zein nanoparticles on the interfacial and emulsification properties of Pickering emulsions. Food Hydrocolloids, 161. <https://doi.org/10.1016/j.foodhyd.2024.110887.>

Charles, A. P. R., Rajasekaran, B., Awasti, N., Choudhary, P., Khanashyam, A. C., Majumder, K., Wu, Y., Pandiselvam, R., & Jin, T. Z. (2025). Emerging chitosan systems incorporated with polyphenols: Their applications in intelligent packaging, active packaging, and nutraceutical systems -- A comprehensive review. In International Journal of Biological Macromolecules (Vol. 308). Elsevier B.V. <https://doi.org/10.1016/j.ijbiomac.2025.142714.>

Hernandez-Hernandez, O., Ferreira-Lazarte, A., Tiwari, B., & Villamiel, M. (2024). Update of high-intensity ultrasound applications for the extraction of pectin from agri-food by-products. In TrAC - Trends in Analytical Chemistry (Vol. 175). Elsevier B.V. https://doi.org/10.1016/j.trac.2024.117728.

Li, W., Hong, Q., Yu, M., Cui, J., sun, Y., Mi, L., Yu, Y., Jiang, J., Yang, W., & Hu, Y. (2024). Mechanistic enhancement of emulsification function in zein/pectin complex nanoparticles by short linear glucan. Food Hydrocolloids, 151. <https://doi.org/10.1016/j.foodhyd.2024.109787.>

Schroën, K., Shen, X., Hasyyati, F. I., Deshpande, S., & van der Gucht, J. (2024). From theoretical aspects to practical food Pickering emulsions: Formation, stabilization, and complexities linked to the use of colloidal food particles. In Advances in Colloid and Interface Science (Vol. 334). Elsevier B.V. <https://doi.org/10.1016/j.cis.2024.103321.>

Tasnim, M., & Islam, M. N. (2026). Active edible coatings for smart food preservation and sustainability: A review. In Carbohydrate Polymer Technologies and Applications (Vol. 13). Elsevier Ltd. <https://doi.org/10.1016/j.carpta.2025.101061.>

Zhang, W., Gu, X., Liu, X., & Wang, Z. (2021). Fabrication of Pickering emulsion based on particles combining pectin and zein: Effects of pectin methylation. Carbohydrate Polymers, 256. <https://doi.org/10.1016/j.carbpol.2020.117515.>

Zhu, M., Wang, H., Sun, T., Lv, J., Wang, K., Huan, S., Li, Z., Liu, Y., Liu, S., McClements, D. J., & Bai, L. (2025a). Plant-based Pickering emulsions using cellulose nanofibers and soy protein isolate: Stabilization and high environmental resistance. Food Hydrocolloids, 162. <https://doi.org/10.1016/j.foodhyd.2024.110943.>

Tuesday – Session 2.3 – New, Alternative, and Novel Food Sources and Ingredients

ORAL PRESENTATION

EXTRUSION PROCESSING OF BREWER'S SPENT GRAINS (BSG) TOWARD PROTEIN RECOVERY

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With the rising demand for proteins, some agro-industrial byproducts arise as potential new sources. BSG constitutes 85% of the brewing industry by-products, containing 20-25%d.b of proteins. This work developed processing alternatives to extract proteins from BSG, with focus on developing viable proteins sources. In this scenario, the reactive extrusion technology was employed, considering the potential scale up, processing time, and reduced solvent application. Different processing conditions were evaluated, including screw profile and speed, NaOH concentration, solvent/biomass ratio, pH, and temperature. Extrusion was able to both modify the biomass and extract proteins, promoting fractioning. Thanks to extrusion, the process time has been reduced to 2-5 minutes in a continuous operation, compared to up to 12 hours with conventional extraction, which is generally batch-based, while also reducing solvent consumption (solvent/biomass ratio of 1.5/1, compared to 10-20/1 in the conventional process). Additionally, the protein recovery (yield) was about 84%, a high value comparable with traditional approaches. The protein concentration in the final product attained maximum 35%d.b., representing a 60% increase in relation to the initial biomass. Both pre-treatment of maceration and post-treatment of solid-liquid extraction were associated with extrusion with the objective of increasing the product's protein content. Although pre-maceration increased the protein concentration by 20%, the protein recovery reduced by 60-80%; post solid-liquid extraction had negligible performance. This result highlights the proteins are tightly complexed with other components of BSG, being necessary to develop further processes to increase protein purity. Even so, extrusion proved to be a valuable tool to recover proteins from agro-industrial byproducts with potential industrial application.

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ORAL PRESENTATION

A GLOBAL SUSTAINABILITY EVALUATION OF PLANT-BASED ALTERNATIVE FOODS USING MULTI-CRITERIA DECISION ANALYSIS

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Alternative protein foods have been extensively evaluated in the last decade, since they are seen as a valid strategy towards more sustainable food systems. However, evaluations of health, environmental, and profit impacts are rarely combined at the food level, making it difficult to set priorities among options. In light of this, this study combines those impacts and allocates a single sustainability performance score to each food. Also, while food safety is a key element in the food system, it's often overlooked in sustainability assessments. For this reason, its impacts are also addressed in this study, along with nutritional, environmental and profit ones. The study focused on alternative and traditional protein foods, with the aim of prioritising them over their global sustainability performance. The trade-offs and synergies resulting from the integration of different impacts have been highlighted through a participatory multi-criteria decision analysis (MCDA). Results showed that alternative protein foods outscore traditional foods in terms of global sustainability, but different trends emerged when examining individual aspects. The MCDA also highlights the existing, complex interactions among those aspects, providing a structured basis for decision-making to eventually support safe, healthy, and more sustainable dietary transitions. In fact, understanding how individual foods impact each aspect will support policy-makers towards comprehensive, sustainability-oriented decisions. In addition, the results of this work emphasise the need to integrate food safety considerations into sustainability assessments to better inform policies and consumers regarding alternative foods.

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ORAL PRESENTATION

INVESTIGATION OF THE FORMATION OF N-ACYLAMINO ACIDS IN FOOD AND CULTURE MEDIUM MODEL SYSTEMS

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Endocannabinoids and endocannabinoid-like compounds are lipid-derived signalling molecules mainly consisting of fatty acid amides and monoacylglycerols. This group includes several classes of bioactive lipids, such as *N*-acylethanolamides, *N*-acylamino acids, and *N*-acylneurotransmitters. *N*-acylamino acids (NAAs) are formed by the covalent attachment of fatty acids to amino acids via amide bonds and have emerged as important endogenous signalling molecules involved in the regulation of pain and inflammation. Among them, *N*-acyl glycines (NAGly) represent a prominent subclass implicated in cellular signal transduction. *N*-arachidonoylglycine exhibits analgesic and anti-inflammatory effects, while other NAGly, such as *N*-oleoyl glycine (OGLY) and *N*-palmitoyl glycine (PGLY), have been associated with adipogenesis, lipid metabolism, and nitric oxide production.

Previous studies by our research group demonstrated that fermented foods, particularly sausage, cheese, and cocoa, are rich sources of NAAs, and that their levels increase during sausage fermentation, suggesting a potential role of microbial enzymes in their formation. However, the underlying formation mechanisms of these compounds in foods remain largely unclear. Therefore, this study aimed to elucidate possible transformation mechanisms by monitoring changes in NAAs using different model systems in the presence of specific precursors and microorganisms. A sausage-like model system was developed, followed by a culture medium model system containing glycine and lipid sources (olive oil or sunflower oil) to evaluate the effect of precursors on the formation of NAAs by sausage starter cultures. Findings from the sausage-like model system indicated that microorganisms could contribute to NAA formation through *N*-acyltransferase-like enzymatic activity. Subsequently, NAGly, especially OGLY and PGLY, were found at higher concentrations in culture medium model systems supplemented with glycine and fatty acids. In conclusion, this study shows that both fatty acids and amino acids, as acyl and amine sources of NAAs, and microbial activity play a decisive role in the biosynthesis of NAAs in fermented foods.

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ORAL PRESENTATION

UTILIZATION OF BANANA PEELS FOR MANUFACTURING OF PECTIN: OPTIMIZATION OF EXTRACTION, CHARACTERIZATION OF TECHNO-FUNCTIONALITY, AND TESTING OF PERFORMANCE IN VEGAN MAYONNAISE

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Turkey with recent banana production approaching 1 million metric tons is a major producer of this fruit in the sub-tropical zone. Due to lack of suitable climate conditions, the majority of banana farming in Turkey is performed with relatively cold tolerant varieties in greenhouses. However, cold weather, frequent disasters from hail, frost and storms cause great losses in banana plantations. The losses also continue at the post-harvest stage as most banana varieties grown in Turkey suffer from defects such as self-splitting of peels, browning, and fast softening causing detaching from bunch during marketing. This research aimed at utilization of peels obtained from wasted banana fruits to pectin. Pectin was extracted from peels of three banana waste: overripe defected summer bananas separated in supermarkets as waste (PEC1), unripe double bananas separated at pre-harvest stage in winter as waste (PEC2), and unripe premature bananas separated at the pre-harvest stage in winter as waste (PEC3). Hot organic acidic extraction of peels was optimized using a Box-Behnken design. The effect of commercial cellulase treatment before extraction of peels at the determined optimal conditions was also tested. The resulting pectins were then characterized for their molecular characteristics (galacturonic acid, sugar composition, degree of esterification, phenolic and protein content, and antioxidant activity) and techno-functional properties (water and oil holding capacities (WHC/OHC) and emulsion capacity and stability (ES) comparatively against commercial citrus and apple pectins. Cellulase treatment increased the pectin extraction yield from peels significantly. PEC1 exhibited the highest WHC (5.8 g/g) and OHC (4.7 g/g), followed by PEC2 and PEC3. PEC3 possessed the highest phenolic content (4.69 µg GAE/100 g) while PEC2 exhibited the highest protein content (12.64 g/100 g), and PEC1 displayed the highest antioxidant capacity (34.28 µmol Trolox/100 g). PEC1 and PEC3 showed good ES effect comparable with commercial pectins while PEC2 showed poor ES. PEC3 performed well in stabilization of aquafaba vegan mayonnaise and formed a creamy texture. Pectin obtained from peels of wasted bananas is a good candidate as a techno-functional additive in emerging emulsion-based vegan foods.

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ORAL PRESENTATION

APPLICATION OF TANGENTIAL FLOW FILTRATION TO PRODUCE EXTRACELLULAR VESICLES FROM CARROTS INTENDED FOR NUTRACEUTICALS AND FOOD APPLICATIONS

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As global demand grows for natural, minimally processed, health-promoting ingredients, Plant Derived Vesicles (PDEVs) are emerging as promising alternatives thanks to their biocompatibility, stability, and capacity to carry diverse bioactives. However, their large-scale production is limited by low yields, variable purity, and inefficient processes. This study evaluates Tangential Flow Filtration (TFF) to produce Carrot Derived Extracellular Vesicles (CDEVs) for next-generation functional foods and nutraceuticals. TFF was assessed as a more sustainable and scalable alternative to conventional ultracentrifugation (UC). Compared with UC, TFF offers reduced shear stress, continuous operation, lower energy consumption, and improved scalability. The objective was to design a process maximizing PDEV recovery while preserving vesicle structure and functionality, generating cleaner and more concentrated fractions suitable as functional ingredients. Two production processes were compared. In both, organic carrots were peeled, cut, and ground to obtain juice, which was centrifuged three times (2000g, 5000g, 15000g; 30 min each). The supernatant was filtered (10--1 µm) to remove debris after each centrifugation. In Process 1, as the last step, vesicles were isolated by ultracentrifugation (110000g, 90 min). In Process 2, the solution was pre-filtered (0.45 µm) and subjected to TFF with a 300 kDa cut-off. Processes were compared for yield, mass balance, and efficiency. CDEV concentration was measured by NTA; mass balance was determined gravimetrically (% w/w); efficiency was based on normalized processing time. Antioxidant activity (ABTS, FRAP), total polyphenol content (TPC), size, concentration (NTA), and z-potential (DLS) were evaluated to assess functional and physical properties. Both methods showed similar yield and mass balance. However, TFF was markedly more efficient, requiring one-third of the time to produce the same number of vesicles. Vesicle size and stability were comparable. UC-derived CDEVs showed higher TPC, whereas TFF-derived CDEVs exhibited higher antioxidant activity. These findings support TFF as a sustainable, scalable strategy for producing highly bioactive plant vesicles, fostering innovation in green food processing and advanced nutraceutical development.

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Tuesday – Session 2.4 – Food Product and Ingredients Development

ORAL PRESENTATION

STRUCTURAL AND FUNCTIONAL RESPONSE OF HIGH-MOISTURE MEAT ANALOGUES TO FREEZE-DRYING AND REHYDRATION

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The development of sustainable and shelf-stable meat analogues is a key challenge for future food systems, as first-generation products often exhibit limited structural stability and textural consistency during processing and storage [1,2]. High-moisture extrusion is widely employed to generate fibrous protein networks; however, the structural response of these anisotropic matrices to post-processing operations such as freeze-drying and rehydration is still poorly understood [3].

In this study, high-moisture meat analogue systems were produced by extrusion using pea protein isolate--based matrices progressively enriched with cricket flour at increasing inclusion levels (15 --75%). This formulation strategy enabled the generation of matrices with different network densities, interaction strengths, and degrees of anisotropic organization. The extruded systems were analyzed in their fresh, freeze-dried, and rehydrated states to systematically evaluate structure--processing relationships under dehydration--rehydration stress. The characterization of the samples were performed by textural properties, dynamic rheology, anisotropy index, water interaction parameters, and microstructural features.

Freeze-drying caused a marked reduction in elastic modulus (*G*'), indicating partial disruption of the protein network, in agreement with previous observations on dehydrated structured protein foods [4,5]. Upon rehydration, the cricket enriched matrices exhibited pronounced microstructural reorganization, leading to denser and more cohesive protein domains [6]. These systems showed reduced swelling and water uptake but improved water retention efficiency, suggesting the formation of compact, water-restrictive networks that limited deformation during hydration [7,8]. Confocal microscopy confirmed the persistence of continuous protein domains and partial recovery of viscoelastic behavior despite incomplete rehydration.

Overall, the results demonstrate that freeze-drying can act as a structural modifier rather than a purely degradative step in high-moisture meat analogues. Understanding these mechanisms provides design criteria for dry-stored or instant-rehydrated products with improved textural stability and extended shelf life.

References

1] Dekkers, B. L., Boom, R. M., & van der Goot, A. J. (2018) Structuring processes for meat analogues. Trends in Food Science & Technology, 81, 25--36. https://doi.org/10.1016/j.tifs.2018.08.011

[2] Kyriakopoulou, K., Dekkers, B., & van der Goot, A. J. (2019) Plant-based meat analogues. In Sustainable Meat Production and Processing. Elsevier. https://doi.org/10.1016/B978-0-12-814874-7.00006-7

[3] Osen, R., Toelstede, S., Wild, F., Eisner, P., & Schweiggert-Weisz, U. (2014) High moisture extrusion cooking of pea protein isolates: Raw material characteristics, extruder responses, and texture properties. Journal of Food Engineering, 127, 67--74. https://doi.org/10.1016/j.jfoodeng.2013.11.023

[4] Feyzi, S., Varidi, M., Zare, F., & Varidi, M. J. (2018) Effect of drying methods on the structure, thermo and functional properties of fenugreek (*Trigonella foenum graecum*) protein isolate. Journal of the science of food and agriculture, 98(5), 1880--1888. https://doi.org/10.1002/jsfa.8669

[5] Ye, M., Wang, Z., Yan, X., Zeng, Z., Peng, T., Xia, J., Zhao, J., Wang, W., Gong, D., & Yu, P. (2024). Effects of Drying Methods on the Physicochemical and Functional Properties of *Cinnamomum camphora* Seed Kernel Protein Isolate. Foods, 13(6), 968. https://doi.org/10.3390/foods13060968

[6] Deng, Y., Luo, Y., Wang, Y., Yue, J., Liu, Z., Zhong, Y., Zhao, Y., & Yang, H.. (2014). Drying-induced protein and microstructure damages of squid fillets affected moisture distribution and rehydration ability during rehydration. Journal of Food Engineering. 123. 23-31. https://doi.org/10.1016/J.JFOODENG.2013.09.006

[7] van der Sman, R. G. M. (2015) Biopolymer gel swelling analysed with scaling laws and Flory--Rehner theory. Food Hydrocolloids, 48, 94--101. https://doi.org/10.1016/j.foodhyd.2015.01.025

[8] Tolstoguzov, V. (2003) Some thermodynamic considerations in food formulation. Food Hydrocolloids, 17, 1--23. https://doi.org/10.1016/S0268-005X(01)00111-4

ORAL PRESENTATION

DEVELOPMENT AND SCALE-UP OF ALGAE-BASED FOODS: FROM FORMULATION TO INDUSTRIAL TRIALS

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Scaling up laboratory prototypes is a major challenge in the food sector because it involves transforming small scale, controlled experiments into industrial processes that must be robust, stable, and reproducible. While laboratory environments allow precise control of critical processing parameters such as temperature, agitation, and processing time, maintaining this same level of control becomes increasingly difficult as production volumes grow. In addition, variability in raw materials plays a significant role during scale up and requires careful attention to ensure consistent product quality.

Aligning with the growing trends of vegetarianism and health-conscious lifestyles, this work evaluates the factors that impact the scale-up of algae-based analogues: a algae pastry inspired in the "traditional Portuguese codfish pastry", and an egg analogue for bakery applications.

The scale-up of the algae pastry was challenged by the variability of macroalgae in color and flavor, requiring consistent sourcing and sensory evaluation. Laboratory work involved 27 formulations to reach 72% acceptance, showing high sensitivity to formulation changes. Fresh ingredients like potatoes and onions were unsuitable at industrial scale due to moisture-control limitations affecting dough rheology and texture. A 20-kg pilot trial required several adjustments to address raw-material variability and process differences, demonstrating the complexity of moving from prototype to industrial production.

Egg analogue development required 28 formulations to achieve the desired techno functionality for bakery applications and a satisfactory level of sensory acceptance. During scale up, the primary constraints affected ingredient homogeneity, making it essential to control the sequence in which ingredients were incorporated. Because the product is a non pasteurized dry mix, all components must also meet strict low microbial load requirements, necessitating rigorous ingredient screening and handling procedures to prevent cross contamination.

Considering the promising consumer acceptance and the successful validation of industrial-scale production, the developed products are well positioned for a shorter time to market.

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ORAL PRESENTATION

HIGH-PRESSURE HOMOGENIZATION AS A TOOL TO IMPROVE THE TECHNO-FUNCTIONAL PERFORMANCE OF SPIRULINA PROTEINS IN EXPANDED SNACK FORMULATIONS

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Starch-based extruded snacks often suffer from low protein content and an unbalanced amino acid profile (1). The incorporation of sustainable alternative proteins represents a promising strategy to improve both the nutritional profile and structural properties of these products. *Limnospira platensis* (Spirulina) is a filamentous cyanobacterium recognised for its high protein content and functional profile (2, 3). However, the accessibility and functionality of Spirulina proteins are limited by the presence of a rigid cell wall. In this study, protein extracts from Spirulina were obtained using high-pressure homogenization (HPH) at different pressure levels (20--100 MPa) and compared to conventional alkaline extraction. Extracts were characterized in terms of protein content, techno-functional properties (water/oil holding capacity, emulsifying/foaming capabilities) and rheological behaviour. Selected extracts were incorporated into pea starch formulations to produce expanded snack prototypes using a thermo-molding process. HPH significantly improved solubility, oil-holding, and emulsifying properties compared to the alkaline extraction method. Phycobiliproteins, particularly C-phycocyanin, showed a higher purity index in HPH extracts, indicating better accessibility. However, rheology revealed a trade-off: while HPH enhances dispersion, excessive stress (at 100 MPa) caused denaturation and reduced water holding capacity (WHC). Prototypes with Spirulina biomass and HPH extracts (100 MPa) reached Expansion Index (EI) up to ~2.6, significantly outperforming the pea starch control (EI ~1.2) and 50 MPa extracts. Mechanical characterization (3-point bending tests) indicated increased fragility (lower flexural modulus) compared to the control. This fragility was primarily driven by the degree of expansion, although the normalized flexural modulus indicated an intrinsic matrix weakening by Spirulina ingredients. This suggests that despite reduced WHC, the intense structural modification at 100 MPa is likely required to mimic the high expansion of whole biomass.

References

1. Brennan, M. A., Derbyshire, E., Tiwari, B. K., & Brennan, C. S. (2013). Ready-to-eat snack products: the role of extrusion technology in developing consumer acceptable and nutritious snacks. International Journal of Food Science & Technology, 48(5), 893--902. https://doi.org/https://doi.org/10.1111/ijfs.12055

2. Martínez-Sanz, M., Larsson, E., Filli, K. B., Loupiac, C., Assifaoui, A., López-Rubio, A., & Lopez-Sanchez, P. (2020). Nano-/microstructure of extruded Spirulina/starch foams in relation to their textural properties. Food Hydrocolloids, 103(105697), 105697. https://doi.org/10.1016/j.foodhyd.2020.105697

3. Mohammadi, M.; Soltanzadeh, M.; Ebrahimi, A. R.; Hamishehkar, H. (2022). Spirulina Platensis Protein Hydrolysates: Tech-no-Functional, Nutritional and Antioxidant Properties. Algal Research, 65, 102739. https://doi.org/10.1016/j.algal.2022.102739.

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Tuesday – Session 2.5 – Green and Sustainable Packaging

ORAL PRESENTATION

DEVELOPMENT OF CHITOSAN EDIBLE FILM BY USING OLIVE KERNEL EXTRACT PREPARED BY DEEP EUTECTIC SOLVENT

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Food packaging plays a protective role by enhancing self-life and maintaining quality of the food products. Due to environmental concerns of the use of petroleum-based plastics, researches have been focused on the evaluation of eco-friendly materials. Chitosan, a cationic polysaccharide, has gathered significant interest due to its excellent film-forming ability, biodegradability and biofunctional properties. The solvent casting methodology is the most common way of preparing edible film, by diluting chitosan in acetic solutions and following by the addition of a plasticizer. Recent studies showed that the selection of the appropriate dilution media and plasticizer can alter the properties of the films (Loukri et al., 2023; Yu et al., 2023). Deep eutectic solvents, composed of a hydrogen acceptor and a hydrogen bond donor, have shown good plasticizing properties in the edible films. In this frame, the aim of the study was the preparation of edible films from chitosan with the use of natural extract of olive kernels incorporated via DES. To the best of our knowledge, there is limited research in utilization of DES as part of solvent media for the preparation of chitosan films (Chandra Roy et al., 2021; Ciocirlan et al., 2025; Shi et al., 2023; Sokolova et al., 2018). The developed films were characterized by various mechanical, physical and permeability tests. The results demonstrated that the presence of DES affected functional properties of the films, to those prepared by conventional methods. The proposed methodology utilizes the DES as solvent media and at the same time as carrier of the bioactive compounds for the preparation of the sustainable alternative for food packaging applications.

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References

Chandra Roy, V., Ho, T. C., Lee, H. J., Park, J. S., Nam, S. Y., Lee, H., Getachew, A. T., & Chun, B. S. (2021). Extraction of astaxanthin using ultrasound-assisted natural deep eutectic solvents from shrimp wastes and its application in bioactive films. Journal of Cleaner Production, 284. https://doi.org/10.1016/j.jclepro.2020.125417

Ciocirlan, O., Gavrila, A., Isopencu, G., Motelica, L., Oprea, O. C., Nicoara, A. I., Sima, S., & Stanescu, P. (2025). Formulation and Characterization of Chitosan Films Incorporating Hawthorn Polyphenolic Extracts via Natural Deep Eutectic Solvents. Polymers, 17(24). https://doi.org/10.3390/polym17243250

Loukri, A., Kyriakoudi, A., Oliinychenko, Y., Stratakos, A. C., Lazaridou, A., & Mourtzinos, I. (2023). Preparation and characterization of chitosan-citric acid edible films loaded with Cornelian cherry pomace extract as active packaging materials. Food Hydrocolloids, 150, 109687. https://doi.org/10.1016/j.foodhyd.2023.109687

Shi, F., Hai, X., Zhu, Y., Ma, L., Wang, L., Yin, J., Li, X., Yang, Z., Yuan, M., Xiong, H., & Gao, Y. (2023). Ultrasonic assisted extraction of polyphenols from bayberry by deep eutectic supramolecular polymer and its application in bio-active film. Ultrasonics Sonochemistry, 92. https://doi.org/10.1016/j.ultsonch.2022.106283

Sokolova, M. P., Smirnov, M. A., Samarov, A. A., Bobrova, N. V., Vorobiov, V. K., Popova, E. N., Filippova, E., Geydt, P., Lahderanta, E., & Toikka, A. M. (2018). Plasticizing of chitosan films with deep eutectic mixture of malonic acid and choline chloride. Carbohydrate Polymers, 197, 548--557. https://doi.org/10.1016/j.carbpol.2018.06.037

Yu, J., Xu, S., Goksen, G., Yi, C., & Shao, P. (2023). Chitosan films plasticized with choline-based deep eutectic solvents: UV shielding, antioxidant, and antibacterial properties. Food Hydrocolloids, 135. https://doi.org/10.1016/j.foodhyd.2022.108196

ORAL PRESENTATION

KNOWLEDGE, PERCEPTIONS, AND SUSTAINABILITY CHALLENGES OF PACKAGING IN ONLINE FOOD DELIVERY

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The rapid growth of online food delivery services has transformed contemporary food systems, intensifying environmental challenges related to single-use packaging, waste generation, and barriers to the transition toward sustainable food systems. This study investigates how packaging-related decisions in platform-mediated delivery ecosystems influence sustainability outcomes, considering interactions among food service establishments, digital platforms, packaging suppliers, consumers, and policy makers across the food value chain.

The research was conducted in Brazil, specifically in the interior of São Paulo state, and adopts a quantitative, descriptive, and exploratory design based on data collected through a structured questionnaire administered to 58 small and medium-sized establishments. The survey investigated packaging practices, key determinants of packaging choice, environmental perceptions, and awareness of circular economy and sustainable consumption principles. Data were analyzed using descriptive statistics and frequency analysis.

Results indicate that packaging decisions are mainly shaped by operational risk management, emphasizing food preservation, temperature retention, leak prevention, and cost constraints. Single-use solutions remain prevalent, combining materials such as paper and plastics, while biodegradable alternatives and reuse-based models are still marginal. Although formal circular economy awareness is limited, establishments demonstrate willingness to reduce waste and identify consumer education as a key driver for sustainability-oriented innovation.

The study underscores that improving packaging sustainability in online food delivery requires coordinated, circular value chain-oriented actions integrating operational performance, platform governance, economic viability, and waste management infrastructure. These findings provide actionable insights for advancing innovation in research and education toward sustainable food systems.

References

BALDWIN, C. J. The 10 principles of food industry sustainability. Hoboken: John Wiley & Sons, 2015.
CAZÓN, P.; VÁZQUEZ, M.; VELAZQUEZ, G. Sustainable food packaging applications based on polymer nanocomposites. Materials, Basel, v. 10, n. 6, p. 1--20, 2017.
DOSPINESCÚ, N.; DOSPINESCÚ, O.; TĂTĂRUȘANU, M. Analysis of the influence factors on the reputation of food-delivery companies: evidence from Romania. Sustainability, Basel, v. 12, n. 10, p. 4142, 2020. DOI: 10.3390/su12104142.
FAO -- FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS. The state of food and agriculture 2020: overcoming water challenges in agriculture. Rome: FAO, 2020.
GALATI, A.; CRESCIMANNO, M.; VRONTIS, D.; SIGGIA, D. Contribution to the sustainability challenges of the food-delivery sector: findings from the Deliveroo Italy case study. Sustainability, Basel, v. 12, n. 17, p. 7045, 2020. DOI: 10.3390/su12177045.
IAKOVOU, E.; BOCHTIS, D.; VLACHOPOULOU, M.; BENOS, L. Food traceability: a managerial perspective. British Food Journal, Bingley, v. 118, n. 8, p. 1993--2008, 2016.
SHARMA, R.; DHIR, A.; TALWAR, S.; KAUR, P. Over-ordering and food waste: the use of food delivery apps during a pandemic. International Journal of Hospitality Management, Amsterdam, v. 96, p. 102977, 2021. DOI: 10.1016/j.ijhm.2021.102977.

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ORAL PRESENTATION

ETHYLENE-SCAVENGING NANOCRYSTAL-REINFORCED PECTIN/LIGNIN AEROGEL-BASED FRESHNESS PRESERVATION SYSTEM

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Reducing postharvest losses of climacteric produce requires sustainable and effective ethylene management strategies. This study presents a bio-based active packaging system based on nanocrystal-reinforced pectin/lignin aerogels designed for ethylene scavenging and freshness preservation. Low-methoxyl pectin extracted from sunflower heads and lignin recovered from hazelnut shells were valorized as structural biopolymers to fabricate highly porous aerogels via ionic gelation followed by freeze-drying. Ethylene-scavenging nanocrystals, including ZIF-8, α-Mg-formate (MgF), clinoptilolite (KLN), and ZIF-8@KLN hybrids, were synthesized and incorporated into the aerogel matrix to enhance gas adsorption capacity without compromising pore accessibility. The novelty of the system lies in integrating ethylene-binding nanocrystals into a three-dimensional biopolymer aerogel network rather than conventional dense film matrices, thereby minimizing pore blockage and preserving adsorption efficiency. The effects of lignin addition on mechanical strength, hydrophobicity, and structural stability were systematically evaluated, alongside nanocrystal loading levels. Ethylene adsorption performance was quantified under controlled conditions, and the developed aerogels were tested in the packaging of climacteric tomatoes stored at 23 °C and 50% relative humidity for four weeks. Results demonstrate that nanocrystal-doped pectin/lignin aerogels significantly reduced ethylene accumulation and delayed quality deterioration compared to control samples. The proposed system offers a circular-economy-driven, biodegradable alternative to conventional ethylene scavengers and provides a scalable platform for next-generation active packaging applications.

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ORAL PRESENTATION

OPTIMIZATION OF PHENOLIC COMPOUNDS EXTRACTION FROM TOURIGA NACIONAL GRAPE STEMS FOR SUSTAINABLE PACKAGING APPLICATIONS

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The food sector faces increasing challenges from food scarcity, population growth, and economic and public health impacts of food losses and outbreaks. Conventional petroleum-based plastics are being replaced by sustainable alternatives, including biodegradable, edible, and bioactive packaging that preserves food quality and extends shelf life [1]. Valorization of agri-food by-products through biorefinery approaches offers a promising route to high-value biomaterials. Among these, grape stems stand out for their structural properties and richness in bioactive compounds, enhancing mechanical and barrier performance while providing antioxidant and antimicrobial functionalities [2].

The present work focuses on the initial stage of a broader project aimed at developing bioactive absorbent pads from grape stem-derived compounds. Specifically, the study aimed to optimize ultrasound-assisted extraction of phenolic compounds from grape stems of Touriga Nacional, a red grape variety from the Douro Demarcated Region, by evaluating different mass-to-volume ratios (1:5, 1:20, and 1:40), ethanol--water solvent systems (50:50 and 70:30, v/v), and extraction times (15, 30, and 60 min). Total phenolic content was quantified to determine extraction efficiency, and the optimal condition was subsequently characterized by high-performance liquid chromatography (HPLC) to identify the main phenolic constituents. The highest extraction efficiency was obtained using a 1:5 (m/v) ratio, a 50:50 ethanol--water system, and 15 min of ultrasound, yielding 333.59 mg gallic acid equivalents (GAE)/g sample. HPLC analysis revealed 24 phenolic compounds in six classes. Flavan-3-ols were the most abundant (41.0 %), followed by anthocyanins (16.2 %), phenolic acids (13.8 %), flavonols (12.9 %), flavanonols (9.5 %), and stilbenes (6.5 %).

These results demonstrate the potential of grape stems as a source of phenolic compounds for sustainable, functional packaging materials.

References

[1] Versino, F.; Ortega, F.; Monroy, Y.; Rivero, S.; López, O.V.; García, M.A. Sustainable and Bio-Based Food Packaging: A Review on Past and Current Design Innovations. Foods 2023, 12, 1057, doi:10.3390/foods12051057.

[2] Gouvinhas, I.; Queiroz, M.; Rodrigues, M.; Barros, A.I.R.N.A. Evaluation of the Phytochemistry and Biological Activity of Grape (*Vitis vinifera* L.) Stems: Toward a Sustainable Winery Industry. In Polyphenols in Plants; Elsevier, 2019; pp. 381--394 ISBN 9780128137680.

Tuesday – Session 2.6 – Consumer and Sensory Sciences

ORAL PRESENTATION

A SYSTEMATIC REVIEW OF THE PERFORMANCE OF DIETS FROM MULTIPLE DIMENSIONS: HEATH, ENVIRONMENTAL, ECONOMIC AND SOCIAL. PERSPECTIVES FROM THE METHODOLOGICAL APPROACH

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The integration of multiple dimensions in sustainability science is becoming increasingly vital as it encompasses economic, social, health, and environmental considerations. This multidimensional approach allows for a more holistic understanding of sustainability, especially in the context of dietary practices, which significantly impact public health and environmental outcomes. However, evaluating diet performance to assess these dimensions concurrently poses considerable challenges due to the diverse impacts and trade-offs that exist among them. This study aims to provide the first systematic review of methods for evaluating diet performance while considering multiple dimensions simultaneously. I examine studies that include measures of diet performance focusing on three critical components: (1) efficiency, which pertains to how effectively resources are utilized; (2) effectiveness, which assesses whether desired health and environmental outcomes are achieved; and (3) trade-offs, which explore the compromises that must be made between different performance dimensions. Evaluating trade-offs in sustainable nutrition is particularly important, especially when comparing health and environmental dimensions, and when designing methods for transitioning to sustainable diets. It can generally be argued that enhancing one dimension often leads to a detriment in another. For instance, increasing agricultural output to meet dietary needs may result in adverse environmental effects, such as deforestation or biodiversity loss (Bashiri et al., 2025). Conversely, recent studies suggest that health and environmental outcomes can improve simultaneously under certain conditions (Zhang et al., 2025; Mazac et al., 2024). Therefore, this study places particular emphasis on evaluating trade-offs by incorporating both qualitative and quantitative scores in the assessment process. This review compares the measures of trade-offs among dimensions in multiple studies and highlights their socio-political implications to foster a transition toward more sustainable dietary choices. Papers are systematically sourced from databases including PubMed, ScienceDirect, and Web of Science, covering the period from years 2020 to 2026. I select papers that examine at least two of the outlined dimensions, allowing for a comprehensive analysis. The outcome is a robust set of methodologies that not only highlights their respective advantages and disadvantages but also considers the specific indicators used in each study. I analyze methodologies employing various approaches, including optimization techniques and multi-criteria decision-making methods, alongside traditional assessment frameworks. Each study's indicators, spanning environmental, economic, health, and social aspects, are compared to understand better how they influence dietary choices and sustainability. In this review, I also assess the weight of evidence across the selected studies using several key actions. The first is criteria establishment, wherein I develop specific criteria to evaluate the strength and quality of evidence based on factors such as study design, sample size, and potential biases. The second action involves comparative analysis, allowing for a juxtaposition of findings from different studies to identify those that provide stronger evidence regarding dietary sustainability. Third, I employ evidence grading, assigning a scoring system that categorizes findings as strong, moderate, weak, or inconclusive. Following this, an impact assessment is conducted to evaluate how profoundly the evidence supports or contradicts existing dietary guidelines and policy recommendations. Finally, I perform a synthesis of conclusions, summarizing the implications of the quality of the evidence and highlighting any uncertainties or gaps in knowledge. With this accumulated information, I construct a framework that clarifies the current state of research in this area and identifies potential avenues for future exploration. Ultimately, this study aims to contribute to a better understanding of how dietary choices can be optimized across multiple dimensions of sustainability, particularly when leading towards a sustainable transition. By doing so, it offers a foundational resource for researchers and policymakers who are striving for more holistic strategies in food systems, advancing the discourse on sustainable dietary practices in a rapidly evolving global landscape.

References

Bashiri et al, 2025. Integrating multi-criteria decision-making with multi-objective optimization for sustainable diet design. Journal of Cleaner Production 500 (2025) 145233. Zhang et al, 2025. More habitual deviation alleviates the trade-offs between dietary health, environmental impacts, and economic cost. Journal of Industrial Ecology 2025;29:503--517. Mazac et al, 2024. Exploring tradeoffs among diet quality and environmental impacts in self selected diets: a population based study. European Journal of Nutrition (2024) 63:1663--1678

ORAL PRESENTATION

SENSORY QUALITY VS. SENSORY PREFERENCE: TRAINED PANEL AND CONSUMER EVALUATIONS OF VIRGIN OLIVE OILS

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Extra virgin olive oil (EVOO) is widely recognized for its sensory quality and health benefits. Official quality classification relies exclusively on trained sensory panels following International Olive Council (IOC) standards. However, consumer acceptance ultimately drives market success, making it essential to understand how technical evaluations align with consumer perception. This study compared the sensory characterization and consumer acceptance of national and imported olive oils as evaluated by trained assessors and Brazilian consumers, with an applied focus on market implications. Six samples were evaluated: three Brazilians EVOO produced in São Paulo, Minas Gerais, and Rio Grande do Sul, two imported oils selected to represent the most consumed products in Brazil (two Portuguese EVOO blends) and one Spanish oil composed of refined and virgin olive oil. Sensory profiling was performed using the Rate-All-That-Apply (RATA) method with 20 predefined attributes, assessed by 16 trained evaluators and 120 consumers with diverse sociodemographic backgrounds. Consumer acceptance was also measured using hedonic scales. Both groups were able to discriminate the samples; however, marked differences in sensory perception were observed. Consumers showed higher acceptance of imported blends, which were associated with characteristic olive oil aroma and flavor, ripe fruit, nutty notes, and lower bitterness and pungency. In contrast, trained assessors identified defect-related attributes in these oils, such as vinegar, rancid, and moldy notes. Brazilian EVOOs were characterized by green sensory notes, higher bitterness, and pungency attributes valued in technical assessment but less familiar to consumers. These findings reveal a clear gap between technical sensory quality and consumer preference, driven largely by familiarity. From an industry perspective, the results highlight the need for targeted communication, education, and positioning strategies to promote Brazilian EVOOs and align product profiles with consumer expectations while preserving sensory quality standards.

References

Sá, D. G.C.F. A olivicultura e o azeite no Brasil. Documentos, 138, Embrapa Agfrpindústria de Alimentos, Rio de Janeiro/RJ, 27p , 2024.

Sá, D. G.C.F.;,Campos, R. S.;,de faria-Machado, A. Aceitação de azeites de oliva da Região da Mantiqueira (MG): entendendo consumidor e azeite brasileiros. Documentos, 138, Embrapa Agfrpindústria de Alimentos, Rio de Janeiro/RJ, 27p., 2019.

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ORAL PRESENTATION

FROM SEA TO MARKET: IMPACTS OF MICROSPORIDIA IN WILD POUTING ON FOOD QUALITY AND SAFETY

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In recent years, an increase of parasitic infections has been reported in fish species intended for human consumption, raising questions about product quality and food safety. Among these parasites, Microsporidia are of particular interest due to being recognized as an emerging zoonotic hazard. This study investigated whether microsporidian infections influence fillet quality in wild pouting (*Trisopterus luscus*), a commercially important species harvested in the NE Atlantic. Additionally, a screening for four Microsporidia species known to infect humans was performed throughout the different seasons (spring, summer, autumn and winter). Quality alterations of the fillet were analyzed - color parameters, pH, texture, and proximate composition. Zoonotic risk was assessed using a multiplex TaqMan PCR targeting the ITS and SSU rRNA regions to detect **Enterocytozoon bieneusi**, **Encephalitozoon intestinalis**, **Encephalitozoon hellem**, and **Encephalitozoon cuniculi**.

Results showed that infected fish revealed a decrease in fillet whiteness and elevated pH values. While overall proximate composition remained largely unchanged, ash content declined in specimens with the highest infection levels. The TaqMan qPCR screening did not detect DNA for any of the four targeted zoonotic Microsporidia species in muscle tissue. These findings indicate that, despite the confirmed presence of microsporidia in the muscle, the specific zoonotic species tested were not identified, suggesting a low likelihood of transmission to consumers through fillet consumption. Collectively, these findings demonstrate that although microsporidian infections may negatively affect fish fillet quality, they do not appear to increase zoonotic risk, carrying important implications for seafood quality assessment and fisheries management strategies.

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ORAL PRESENTATION

EATING THROUGH FAITH: HALAL FOOD, REPONSIBLE CONSUMPTION, AND WELLBEING IN MUSLIM MIGRANT CONTEXTS

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This paper examines the intersection of religious food ethics and responsible food consumption among first-generation Muslim migrants, focusing on their perceptions of halal food and its implications for nutrition and wellbeing. The study explores how Muslim migrants reconcile religious dietary obligations with principles of sustainability and ethical responsibility in Western countries by employing qualitative semi-structured interviews with 25 participants living in Australia, New Zealand, and the United Kingdom. The findings align with existing literature on food ethics and migrant wellbeing, while extending it by showing how consuming halal food serves as a broader framework for responsible food consumption practices. Participants in this study understood halal food as not only a religious obligation but also an environmentally, socially, and culturally responsible food choice. Their narratives indicate that their halal food consumption is guided by religious ethics alongside a conscious commitment to responsible consumption, supporting individual health, nutrition, and wellbeing, as well as facilitating processes of acculturation. This study contributes to a better understanding of the role of food consumption in enhancing subjective wellbeing among migrants, and also indicates how religious and belief-based food choices shape dietary practices and promote positive health outcomes. It also positions food as a pathway through which religious commitments intersect with environmental and social responsibility, and further associates with wellbeing. Future research could further look into the role of community support in shaping access to halal foods and their wider implications for the health and wellbeing of migrants.

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ORAL PRESENTATION

CONSUMER PERCEPTIONS OF PLANT-BASED FOODS IN BRAZIL: THE ROLE OF LANGUAGE AND ENVIRONMENTAL CONCERN

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Growing concerns about health and sustainability have been shaping consumer behavior and affecting the global plant-based food market. The aim of this study was to investigate the Brazilian consumers' perceptions of plant-based foods by comparing responses elicited by the English term plant-based and its Portuguese translation, considering the moderating role of environmental concern. An online study was conducted with 1,085 individuals, who were randomly assigned in one of two experimental conditions: i) exposure to the term "alimentos plant-based" (n=545) or ii) "alimentos à base de plantas" (n=540). Participants reported the first four words that came to mind when reading the assigned term, and they were classified according to their level of environmental concern (low, moderate or high). A total of 3,483 responses were analyzed using triangulation analysis, resulting in 43 categories grouped into 16 main dimensions. Distinct patterns emerged between the two terms. The Portuguese expression was predominantly associated with the dimension "health and nutrition" (53%), whereas "plant-based" elicited a broader range of associations, with vegetable being the most frequently cited dimension (40%). Participants exposed to "plant-based" more frequently mentioned terms related to "Food and drinks" ($p < 0.05$), "Cereals and nuts", "Environmental aspects", "Food profile", "Positive hedonic and emotional associations", and "Product characteristics" ($p < 0.01$), as well as "Culinary preparation", "Doubt, lack of knowledge and indifference" and "Health and nutrition" ($p < 0.001$) compared to the other group. In addition, plant-based group with higher environmental concern further intensified associations as "Food profile", "Health and nutrition", and "Negative hedonic and emotional associations". These findings reveal a linguistic and conceptual gap in Brazilian consumers' understanding of plant-based foods - as the two terms generated distinct perceptions - with important implications for product positioning, consumer education, and sustainability communication. From an applied perspective, the results highlight the need for clearer terminology and targeted communication strategies to support informed consumer choices and foster the development of plant-based markets.

References

Haws, K. L., Winterich, K. P., Naylor, R. W. Seeing the world through GREEN-tinted glasses: Green consumption values and responses to environmentally friendly products. Journal of Consumer Psychology, v. 24, n. 3, p. 336-354, 2014.

Meixner, O., Malleier, M., Haas, R. Towards sustainable eating habits of generation Z: Perception of and willingness to pay for plant-based meat alternatives. Sustainability, v. 16, n. 8, p. 3414, 2024.

Noguerol, A.T. M., Pagán, J., García-Segovia, P.., Varela, P. et al. Green or clean? Perception of clean label plant-based products by omnivorous, vegan, vegetarian and flexitarian consumers. Food Research International, v. 149, p. 110652, 2021.

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Tuesday – Session 2.7 – Food Products and Ingredients Development

ORAL PRESENTATION

CREATING PROTEIN-ENRICHED EXTRUDED SNACKS USING YELLOW MEALWORM (TENEBRIO MOLITOR) AND LUPIN BEAN FLOUR BLENDS

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Protein diversification can help mitigate climate change, but alternative proteins still face functional and sensory challenges that limit market acceptance. The objectives of this work were to formulate and map the physical, compositional, optical and texture properties of puffed-extruded snacks incorporating controlled blends of yellow mealworm (*Tenebrio molitor*) flour (YM) and lupin bean protein concentrate (L), and to subsequently fit an appropriate statistical model to the resulting data, to support product optimisation.

A 13-run experimental mixture design was applied, using corn flour as the primary ingredient (at least 85%), while L and YM were evaluated for physical and compositional characteristics, including sectional expansion index (SEI) and porosity, as well as colour and texture attributes. The resulting data were analysed and fitted to optimal response surface models.

Almost all samples expanded acceptably, except extrudates with 10% YM, 10% YM + 5% L, and 15% YM (SEI values: 1.31, 4.58, and 1.09, respectively; control 10.22), with these samples also deviating from the pattern of the others regarding bulk density (significantly increased) and porosity (significantly decreased). Most water-related parameters were similar to control, especially the swelling index (between. 6-7 mL/g; control 6 mL/g), and the water content (ca. 0.030-0.040 g/g; control 0.041 g/g), whereas hygroscopicity decreased significantly with protein incorporation, except in samples where insect was not included. As for the optical properties, all samples became darker (lower *L values), which is a known effect of adding dry edible insects, although lupin incorporation also had an impact. Texture properties showed that mostly all samples were similar to control in terms of crunchiness, except the mentioned samples that did not expand, which were harder and more difficult to break. After evaluating various statistical models and their goodness of fit, the cubic model was selected as the optimal overall response surface, making it suitable for use in further product development.

Overall, the study shows that snacks fortified with mealworm and lupin proteins can be successfully produced with acceptable structural, visual, and textural properties, if protein content inclusion remains within moderate values.

References

Cunha, L. M., & Ribeiro, J. C. (2019). Sensory and consumer perceptions on edible insects. *Edible insects in the food sector: Methods, current applications and perspectives*, 57-71.
Malila, Y., Owolabi, I. O., Chotanaphuti, T., Sakdibhornssup, N., Elliott, C. T., Visessanguan, W., Karoonuthaisiri, N., & Petchkongkaew, A. (2023). Current challenges of alternative proteins as future foods. *npj Science of Food*, *8*(1), 53. https://doi.org/10.1038/s41538-024-00291-w

ORAL PRESENTATION

EXPLORING PLANT-BASED SYSTEM FOR GUMMY CANDY: PEA PROTEIN AND HIGH-ACYL GELLAN GUM AS GELATIN ALTERNATIVES.

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The global gummy candy market is expanding, driven by product innovation aimed at addressing emerging consumer trends. The growing demand for sustainable, vegan formulations together with the expansion of the halal market has increased interest in alternatives to animal-derived ingredients, creating new opportunities for confectionery manufacturers [1].

Within this context, the present study investigates the potential of pea protein isolate (PPI)--based gel, combined with high-acyl gellan gum (HAGG) as structuring agents for gelatin replacement in gummy confectionary. PPIs were selected for their high nutritional quality, availability and low allergenicity, HAGG was used to enhance network cohesion and gel stability [2]. Gels were prepared at different PPI:HAGG ratios to evaluate the influence of the hydrocolloid fraction on the structural and rheological properties of the resulting plant protein matrices. Collagen-based gels and PPI-only gels were used as reference systems. Mechanical and viscoelastic properties were characterized with static and dynamic rheological analyses. Compared to collagen-based gels, systems composed solely of PPIs exhibited significantly lower storage modulus (G′) values and higher tan δ values indicating the formation of a weaker and less effectively crosslinked networks. The addition of HAGG positively contributed to the formation of the gels, improving their stability and structural cohesion [3]. Within the experimental range of PPI:HAGG ratios tested (7:1; 4:1; 2:1), a clear trend was observed in the viscoelastic response. The formulation with the highest HAGG fraction at constant solids showed higher G′ and lower tan δ, indicating increased elasticity and stronger cohesion within the plant protein network. Resistance to mechanical deformation was enhanced, confirming the critical role of HAGG in supporting the structural integrity of the matrix. Overall, the results show that the PPI-to-hydrocolloid ratio is a key parameter for tuning the viscoelastic properties of plant protein--based gels. Rheological analysis proved effective in guiding formulation strategies for the partial replacement of gelatin in gummy confectionery, supporting the development of sustainable plant-based systems suitable for industrial processing.

References

[1] Polaris Market Research. (2024). Gummy market size, share & industry analysis report. https://www.polarismarketresearch.com/

[2] Abdl Aali, R.A.K.; Al-Sahlany, S.T.G. Gellan Gum as a Unique Microbial Polysaccharide: Its Characteristics, Synthesis, and Current Application Trends. Gels 2024, 10, 183. https://doi.org/10.3390/gels10030183

[3] Li, Y., Qi, X., Rong, L., Li, J., Shen, M., & Xie, J. (2024). Effect of gellan gum on the rheology, gelling, and structural properties of thermally induced pea protein isolate gel. Food Hydrocolloids, 147, 109379.

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ORAL PRESENTATION

DESIGNING HYBRID FOOD STRUCTURES: NETWORK EMULSIONS AND POROUS SOLIDS VIA CITRUS FIBER INTEGRATION

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Citrus fruits are the most cultivated fruit category worldwide, and juice extraction generates substantial by-products, accounting for 50--60% of the processed material. These residues contain essential oils, pectins, and insoluble dietary fiber. While essential oils and pectin have been widely studied, the insoluble fiber fraction remains underexploited in food applications. Understanding its functional and physicochemical properties could enhance citrus by-product valorization and support the development of innovative, naturally derived food systems (Tan et al., 2024). Citrus fiber is able to stabilize an oil-in-water emulsions, creating a network microstructure (Panzanini et al., 2025).

This study introduces a new interpretation of these emulsions as porous solids that self-assemble around the dispersed phase. Rheology and microscopy are used to visualize and investigate this hypothesis. Emulsions containing different fiber (3--5% w/w) and oil (20--30% w/w) concentrations are dispersed in water or apricot purée and subjected to centrifugation and freeze-thaw cycles.

Stabilization is strongly influenced by the dispersing medium: aqueous systems exhibit an improved resistance to applied stress, whereas apricot-based matrices show a greater structural mobility and reduced mechanical stability. Higher fiber levels produce denser networks behaving similarly to porous structures, enabling controlled release of the dispersing phase.

Viewing network-based emulsions as porous solids provides a useful framework for interpreting their functionality and highlights citrus fiber as a promising structuring agent for next-generation food formulations with tunable stability and release properties.

References

Tan, R., Tang, Q., Wang, L., Tan, R., Tang, Q., Wang, L., Xia, B., Wang, L., & Fu, C. (2024). Organic acid treatments on citrus insoluble dietary fibers and the corresponding effects on starch in vitro digestion. International Journal of Biological Macromolecules, 275. https://doi.org/10.1016/j.ijbiomac.2024.134082

Panzanini, M., Spigno, G., Pastrana, L., & Roberta, D. (2025). Exploring citrus fiber as an emulsifying agent: Synergy with low methoxyl pectin and amidated pectin for advanced food formulations. Food Hydrocolloids, 168. https://doi.org/10.1016/j.foodhyd.2025.111474

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ORAL PRESENTATION

OPTIMISING PHYSICO-CHEMICAL PROPERTIES OF NITRATE-NITRITE-REDUCED BACON RASHERS USING D-OPTIMAL DESIGN AND THE EFFECTS OF NITRATE, NITRITE, ASCORBATE AND HIGH-PRESSURE PROCESSING

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Nitrites are widely used in cured meat production for preservation and the development of characteristic colour and flavour. However, their use is increasingly challenged due to health concerns and growing consumer demand for clean label products. Reformulation strategies and emerging processing technologies have been investigated to compensate for nitrite reduction in meat products. This study aimed to optimise the quality of nitrate- and nitrite-reduced and high-pressure processed (HPP) bacon rashers using response surface methodology. Twenty-two formulations were developed using a D-optimal design, varying levels of nitrate, nitrite, and ascorbate were used. Quality attributes evaluated included instrumental colour, pH, lipid oxidation, and residual nitrate and nitrite levels. The optimal formulation, based on the evaluated quality parameters had 11.3 mg/kg NaNO~3~, 55.5 mg/kg NaNO~2~ and 1000 mg/kg sodium ascorbate, and a desirability score of 0.78. However, HPP at 400 MPa induced lipid oxidation and caused an increase in pH and lightness (*L) relative to conventionally nitrite-cured bacon. These results indicate that bacon rashers can be produced with a reduction up to 91% nitrate and 54% nitrite while maintaining colour stability, and minimising both lipid oxidation and residual nitrate/nitrite. This work brings evidence to enable the industry to produce cured meat with low levels of nitrate/nitrite in compliance with legislation and health concerns.

References

Bolumar, T., Orlien, V., Sikes, A., Aganovic, K., Bak, K. H., Guyon, C., Stubler, A. S., de Lamballerie, M., Hertel, C., & Bruggemann, D. A. (2021). High-pressure processing of meat: Molecular impacts and industrial applications. Compr Rev Food Sci Food Saf, 20(1), 332-368. https://doi.org/10.1111/1541-4337.12670

European Commission. (2023). EU Commission Regulation 2023/2108 of 6 October 2023 amending Annex II to Regulation (EC) No 1333/2008 of the European Parliament and of the Council and the Annex to Commission Regulation (EU) No 231/2012 as regards food additives nitrites (E 249-250) and nitrates (E 251-252). Retrieved 11 January 2024 from <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32023R2108>

Flores, M., & Toldra, F. (2021). Chemistry, safety, and regulatory considerations in the use of nitrite and nitrate from natural origin in meat products - Invited review. Meat Sci, 171, 108272. https://doi.org/10.1016/j.meatsci.2020.108272

King, D. A., Hunt, M. C., Barbut, S., Claus, J. R., Cornforth, D. P., Joseph, P., Kim, Y. H. B., Lindahl, G., Mancini, R. A., Nair, M. N., Merok, K. J., Milkowski, A., Mohan, A., Pohlman, F., Ramanathan, R., Raines, C. R., Seyfert, M., Sørheim, O., Suman, S. P., & Weber, M. (2023). American Meat Science Association Guidelines for Meat Color Measurement. Meat and Muscle Biology, 6(4). https://doi.org/10.22175/mmb.12473

Zhang, Y., Zhang, Y., Jia, J., Peng, H., Qian, Q., Pan, Z., & Liu, D. (2023). Nitrite and nitrate in meat processing: Functions and alternatives. Curr Res Food Sci, 6, 100470. https://doi.org/10.1016/j.crfs.2023.100470

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ORAL PRESENTATION

NATURAL ENCAPSULATED SPICY EXTRACT AS AN ALTERNATIVE TO A COMMERCIAL SPICY AROMA IN CANNED TUNA

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Consumers are increasingly looking for products with clean, healthier, and more sustainable labels. To achieve this goal, food processing industries are exploring alternatives to replace commercial aromas with natural ones, as long as they maintain or improve product sensory profile and nutritional value. Many of the natural aromas derived from aromatic herbs and spices can be used in combination with strategies for salt reduction. Thus, this study aimed to evaluate the effects of replacing a commercial flavouring with a natural encapsulated spicy extract combined with a 40% NaCl reduction on commercial stability, sterility, physicochemical and sensory properties, as well as overall liking of canned skipjack tuna (*_Katsuwonus pelamis_*) stored for up to 2.5 years at room temperature.

Three prototypes of canned tuna in oil were prepared under industrial conditions (Cofisa, S.A.; ≈400 cans/formulation): i) CTR-P: commercial spicy canned tuna (business as usual); ii) RED-P: commercial spicy canned tuna with a 40% NaCl reduction and iii) RED-ME-P: natural spicy canned tuna with a 40% NaCl reduction. Cans were aged over 8 months at 20 °C and 40 °C (simulating a 2.5-years ageing period).

Overall, neither the formulation nor the ageing process significantly affected product stability, sterility, proximate composition, lipid oxidation, or sensory attributes (assessed instrumentally and by a trained panel). Total volatile basic nitrogen contents remained within safe values (<45 mg/100 g) for this product type. The NaCl contents were 1.1% in CTR-P and 0.7% in both RED-P and RED-ME-P, confirming an approximate 40% Na reduction in both cases. Such reduction enables a "reduced in sodium" claim in accordance with Regulation (EC) No 1924/2006. All prototypes achieved an overall liking of approximately 80--90%, with scores ranging from "moderately liked" to "extremely liked" on the hedonic scale.

In conclusion, replacing a commercial flavouring with a natural encapsulated spicy extract combined with a 40% reduction in NaCl did not compromise quality, safety, or consumer acceptance in canned skipjack tuna over a 2.5-year storage period, highlighting the potential of this approach for producing healthier formulations without detrimental effects on key attributes.

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ORAL PRESENTATION

EDIBLE INSECTS IN THE LANDSCAPE OF ALTERNATIVE PROTEINS: ACCEPTANCE, RISK PERCEPTION, AND CONSUMER SEGMENTS IN HUNGARY (2016--2023)

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In the context of the sustainability challenges facing the global food system, research activity on alternative protein sources has intensified significantly. Although insect consumption (entomophagy) is widespread in many countries, it remains rare in Europe, despite the fact that the European Food Safety Authority (EFSA) has approved several insect species as safe for human consumption under the novel food authorization procedure in recent years. A substantial proportion of European consumers intuitively associate the use of insects as food with potential health hazards and public health risks. Additional behavioural factors observed include food neophobia (resistance to novel foods) and disgust.

The aim of this study was to assess the acceptance and risk perception of insect-based foods in comparison with conventional and other alternative protein sources within the Hungarian population. Data were derived from three waves of quantitative consumer surveys conducted in 2016, 2021, and 2023, applying a repeated cross-sectional design to enable trend analysis. Each wave included more than 1,000 respondents. The samples were representative with respect to gender, age, and region of residence. Data analysis was performed using IBM SPSS Statistics 27.0, including cross-tabulation and both hierarchical and k-means cluster analyses.

The findings indicate that 81.69% of respondents were aware that certain insect species are authorized for human consumption in the EU. Nevertheless, 63.06% of the Hungarian population reported rejecting insect-based products, representing a decrease of 7.51 percentage points compared to 2016 (72.57%) and 2021 (70.18%). The proportion of respondents willing to consume an insect-based food product was 6.58%, while 30.36% were uncertain. Younger and male participants were less likely to reject insect consumption. Curiosity emerged as the primary motivation for consumption, followed by perceived sustainability benefits. Cluster analysis incorporating attitudes toward other protein sources identified three consumer segments: respondents resistant to alternative protein sources (54.3%), those more receptive to animal-based meat substitutes (20.4%), and those more receptive to plant-based substitutes (25.4%).

References

Kasza, G., Izsó, T., Szakos, D., Nugraha, W. S., Tamimi, M. H., & Süth, M. (2023). Insects as food-Changes in consumers' acceptance of entomophagy in Hungary between 2016 and 2021. Appetite, 188, 106770.

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ORAL PRESENTATION

ALGAE AS FUTURE FOODS? EXPLORING PORTUGUESE CONSUMERS' CONCEPTUALISATIONS ACROSS ACCEPTANCE SEGMENTS

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Understanding consumer heterogeneity is key to successfully introducing new sustainable foods. Algae are recognised as a promising food source, but their incorporation into daily diets depends on consumer acceptance [1]. Evidence linking the conceptualisation of algae-based foods to distinct acceptance profiles is limited. Therefore, this study aimed to segment Portuguese adults according to their acceptance of edible algae and to characterise each segment in terms of their conceptualisation and associated determinants.

A web-based questionnaire was applied to 494 individuals. Conceptualisation was assessed using free word association [2], and acceptance of different algae-based product categories was measured through the Food Action Rating (FACT) scale [3]. Exploratory Factor Analysis was used to identify food groups within the FACT scale. Cluster analysis was conducted to identify consumer segments. Frequencies of evoked dimensions were calculated, and correspondence analysis was used to explore associations between segments and conceptualisations.

Four consumer segments emerged: Rejecters (n = 116), Moderate Critics (n = 123), Moderate Admirers (n = 182) and Acceptors (n = 73). Across all segments, 'Preserved and flavourful foods' had the highest acceptance levels, while 'Convenience food and meal solutions' had the lowest. "Algae" was mostly associated with nature, specifically the aquatic environment, while "algae and food" was mainly associated with Asian food, particularly sushi. Rejectors and Moderate Critics associated algae significantly more with nature and less with food, whereas the opposite was observed for moderate admirers and acceptors. Concepts related to health, nutrition and innovation were significantly more evoked by Moderate Admirers and Acceptors, and less by Rejectors. Acceptance varied significantly by gender, education, marital status, and financial situation. Associations with consumption of ethnic foods and green consumption values (positive), as well as with food neophobia (negative), were also found.

This segmentation approach provides actionable insights for developing new algae-based foods tailored to distinct consumer profiles, thereby supporting the effective integration of sustainable, healthy products into the food supply chain.

References

1. Diaz, C. J., Douglas, K. J., Kang, K., Kolarik, A. L., Malinovski, R., Torres-Tiji, Y., Molino, J. V., Badary, A., Mayfield, S. P. (2023). Developing algae as a sustainable food source. Frontiers in nutrition, 9, 3147.

2. Sousa, P. M., Moreira, M. J., Moura, A. P., Lima, R. C., Cunha, L. M. (2021). Consumer Perception of the Circular Economy Concept Applied to the Food Domain: An Exploratory Approach. Sustainability, 13(20), 113403.

3. Schutz, H. G. (1965). Food action rating scale for measuring food acceptance. Journal of Food Science, 30(2), 365-374.

Tuesday – Session 2.8 – Food Waste Valorization

ORAL PRESENTATION

VALORIZATION OF AFRICAN CATFISH BY-PRODUCTS FOR SUSTAINABLE FOOD APPLICATIONS AND ANIMAL FEEDS

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The growing demand for alternative and sustainable protein sources is reshaping the global food and feed industries. Currently, the main protein sources in animal feed are oilseed meals---such as soybean, rapeseed, and sunflower---which are ubiquitous in livestock systems. Nonetheless, in aquaculture, fishmeal continues to be in high demand. However, both sources face sustainability constrains and increasing costs, while global demand for animal products continues to rise due to population growth. Developing countries are particularly vulnerable, as they have limited access to affordable high-quality protein and are expected to experience the most severe impacts of climate change. These trends underscore the urgent need for innovation, create novel value chains, and implement circular economy strategies framed within a One Health approach that links environmental, animal, and human well-being.

In this regard, this study aims to contribute to the valorisation of by-products from the filleting of African catfish (*Clarias gariepinus*) through the production of silages (CS) and protein hydrolysates (FPH). CS were prepared from all by-products (heads, skin, bones, fins, and viscera), while FPH were produced only from fractions without viscera. The resulting products were intended for animal feed (CS) and food applications (FPH). CS and FPH were characterized for their proximate composition and lipid oxidation (TBARS for both, and peroxide index for CS), and microbiological analyses. Soluble and non-protein nitrogen and the percentage of liquefaction were evaluated in the CS. FPH was analysed for the antimicrobial potential of peptides with different molecular weights (separated by ultrafiltration) and for its bioaccessibility using the INFOGEST protocol.

The main findings show that CS and FPH are sustainable and safe sources of protein. FPH has high bioaccessibility. CS has the potential to be used in wet feed or as a substitute for fish meal (5-15%) in pellets, as well as organic fertilizer in agriculture. The main potential of FPH is as a protein ingredient for food products. Both products can create new income opportunities for small-scale aquaculture and agricultural producers and increase food security through sustainable and circular agri-food value chains.

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ORAL PRESENTATION

UPCYCLING APPLE POMACE INTO VALUE-ADDED SOUR BEER VIA CONTROLLED CO-FERMENTATION

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Sustainable food systems require innovative food waste valorisation strategies. Apple pomace, a major by-product of the juice industry, is a promising brewing adjunct due to its fermentable sugars and bioactive compounds.

This study evaluated the effect of apple pomace on fermentation performance, acidification, amino acid utilisation and volatile profile in sour beer produced by controlled co-fermentation with *Levilactobacillus brevis* and *Saccharomyces cerevisiae*. Pomace from Golden Delicious and Topaz varieties was added at pomace-to-wort ratios of 1:3, 1:5 and 1:10, while pomace-free beer served as control. Fermentation progress was monitored through pH, titratable acidity and extract. Sugars, organic acids and ethanol were quantified by HPLC-RID, free amino acids by GC-FID, and volatiles by GC-MS.

Pomace-enriched sour beers showed lower pH (3.93 - 4.07) than the control (4.24), while Topaz at 1:3 resulted in the highest titratable acidity (3.74 g/L lactic acid). Glucose was completely depleted in all samples. Residual maltose was low in Golden Delicious beers (0.537 - 1.045 mg/mL) and control (0.791 mg/mL), but higher in Topaz variants (3.552 - 4.825 mg/mL), indicating variety-dependent fermentation behaviour. Organic acid analysis showed higher lactic acid levels in pomace-enriched sour beers (up to 4.32 ± 0.03 mg/mL) compared to the control sour beer (3.27 ± 0.02 mg/mL), with malic and citric acids contributing to total acidity. Ethanol production increased in Topaz beers. Total free amino acids decreased from 10994 mg/L in wort to 2329 - 2966 mg/L in fermented beers, indicating active nitrogen assimilation during co-fermentation, with proline accounting for 60 - 80% of total amino acids. Volatile analysis indicated variations in aroma compounds, especially higher alcohols (such as phenylethanol), depending on pomace addition.

Apple pomace enhanced acidification, ethanol production and nitrogen metabolism, supporting its potential as a sustainable adjunct. Controlled co-fermentation represents a circular bio-processing strategy for converting fruit by-products into value-added drinks.

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ORAL PRESENTATION

VALORISATION OF OLIVE POMACE THROUGH SUBCRITICAL WATER HYDROLYSIS FOR BIOACTIVE PEPTIDE RECOVERY

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Bioactive peptides (BAP) are short amino acid chains with health benefits abundant in agri-food by-products and have potential uses in food, pharma-, and nutraceutical industries. Traditional protein extraction and hydrolysis methods use expensive and time-consuming processes requiring acids, enzymes, or microbes [1,2]. A new alternative sustainable tool uses subcritical water (SW), an environmentally safe solvent [3,4].

This work aimed to explore and optimize the use of SW hydrolysis (SWH) to recover BAP from olive pomace (OP), an agri-food by-product generated from olive oil processing industries.

OP was characterized in terms of nutritional and amino acid composition using AOAC methodologies and liquid chromatography after hydrolysis, respectively. SWH process was optimized using response surface methodology, following a Central Composite Rotatable Design aiming to minimize average molecular weight (aMW) of the hydrolysates (higher degree of hydrolysis) while maintaining antioxidant activity. The process parameters studied were temperature (152 -- 288 °C), hydrolysis time (14 -- 136 min) and amount of biomass (2.93 -- 57.1 g) at constant pressure. All hydrolysates were characterized regarding process yield (PY, %), aMW by size-exclusion chromatography (SEC) [5], and molecular fingerprint by nuclear magnetic resonance (NMR). Ongoing pre-clinical assays include antioxidant (ORAC) and anti-proliferative activities, and cytotoxicity evaluation in confluent Caco-2 cultures and intestinal epithelial cells.

Results showed a PY between 10.5 - 43.7% and extensive hydrolysis with aMW values between 209 - 371 g/mol. Process conditions with significant impact on the aMW were temperature and the amount of biomass with a negative and positive significant impact, respectively. The statistical model exhibited robust predictive performance ($R^2 = 0.99$; $Q^2 = 0.97$) for the fit to aMW, indicating the model's effectiveness and accuracy in predicting the aMW. These results allowed the identification of the optimal hydrolysis conditions. NMR fingerprint showed a high carbohydrate and phenolic content in the hydrolysates.

SWH successfully generated peptides from olive pomace. This work improved the knowledge of subcritical water for protein hydrolysis of plant sources towards the recovery of BAP.

References

[1] I. Sereewatthanawut, S. Prapintip, K. Watchiraruji, M. Goto, M. Sasaki, and A. Shotipruk, "Extraction of protein and amino acids from deoiled rice bran by subcritical water hydrolysis," Bioresour. Technol., vol. 99, no. 3, pp. 555--561, Feb. 2008, doi: 10.1016/j.biortech.2006.12.030.
[2] H. Vo and M. D. A. Saldaña, "Hydrolysis of pea protein concentrate in subcritical water media with addition of citrus pectin and citric acid," Journal of Supercritical Fluids, vol. 195, Apr. 2023, doi: 10.1016/j.supflu.2023.105866.
[3] T. Powell, S. Bowra, and H. J. Cooper, "Subcritical Water Processing of Proteins: An Alternative to Enzymatic Digestion?," Anal. Chem., vol. 88, no. 12, pp. 6425--6432, Jun. 2016, doi: 10.1021/acs.analchem.6b01013.
[4] J. Zhang, C. Wen, H. Zhang, Y. Duan, and H. Ma, "Recent advances in the extraction of bioactive compounds with subcritical water: A review," Jan. 01, 2020, Elsevier Ltd. doi: 10.1016/j.tifs.2019.11.018.
[5] S. G. Wubshet et al., "FTIR as a rapid tool for monitoring molecular weight distribution during enzymatic protein hydrolysis of food processing by-products," Analytical Methods, vol. 9, no. 29, pp. 4247--4254, 2017, doi: 10.1039/C7AY00865A.

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Tuesday – Session 2.9 – New Trends in Food Nutrition and Health

ORAL PRESENTATION

MATRIX-DRIVEN MODULATION OF GUT MICROBIOTA METABOLISM BY BERRY FIBER--(POLY)PHENOL FRACTIONS

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Dietary fiber and (poly)phenols from berries have been individually associated with prebiotic effects and health benefits; however, their combined behavior within complex food matrices remains poorly understood. This study evaluated the impact of berry-derived fiber--(poly)phenol fractions on gut microbiota activity using in vitro gastrointestinal digestion followed by fecal fermentation. Freeze-dried berries, insoluble and soluble fiber-rich fractions, and a (poly)phenol-rich extract were incubated with human fecal inoculum for 48 h, and short-chain fatty acids (SCFAs) by GLC-FID and microbiota-derived (poly)phenol metabolites by UHPL-HRMS, were quantified. All samples significantly increased total SCFAs production compared to the blank, reaching 115--127 mM at 48 h. Soluble fiber-rich fractions enhanced acetate formation, accounting for up to 70% of total SCFAs, while insoluble fiber-rich fractions promoted delayed propionate and butyrate production, with butyrate levels increasing 1.8-fold between 24 and 48 h. Notably, the (poly)phenol-rich extract exhibited a prebiotic-like effect comparable to fiber-containing matrices. UHPLC-HRMS analysis revealed that fiber composition strongly influenced the release kinetics, bioaccessibility and microbial biotransformation of (poly)phenols, particularly flavan-3-ols and ellagic acid. Fiber-rich matrices promoted a sustained and delayed formation of low-molecular-weight phenolic metabolites, including phenylvaleric acids, phenylpropanoic acids and urolithin A, reaching concentrations of up to 4 μM after fermentation. Importantly, these metabolites are recognized as key mediators of the biological effects of dietary (poly)phenols, suggesting that berry fiber--(poly)phenol matrices may enhance colonic delivery and prolong microbial exposure to bioactive compounds. Overall, these results underscore the importance of matrix-driven effects in shaping (poly)phenol metabolism and support the development of innovative berry-based ingredients targeting gut health and metabolic resilience.

References

(1) Inada, K. O. P.; Leite, I. B.; Martins, A. B. N.; Fialho, E.; Tomás-Barberán, F. A.; Perrone, D.; Monteiro, M. Jaboticaba Berry: A Comprehensive Review on Its Polyphenol Composition, Health Effects, Metabolism, and the Development of Food Products. Food Research International 2021, 147, 110518. https://doi.org/10.1016/J.FOODRES.2021.110518. (2) Ma, J.; Piao, X.; Mahfuz, S.; Long, S.; Wang, J. The Interaction among Gut Microbes, the Intestinal Barrier and Short Chain Fatty Acids. Animal Nutrition 2021. https://doi.org/10.1016/J.ANINU.2021.09.012. (3) Rodríguez-Daza, M. C.; Pulido-Mateos, E. C.; Lupien-Meilleur, J.; Guyonnet, D.; Desjardins, Y.; Roy, D. Polyphenol-Mediated Gut Microbiota Modulation: Toward Prebiotics and Further. Front Nutr 2021, 8. https://doi.org/10.3389/FNUT.2021.689456.

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ORAL PRESENTATION

HONEY CHLORELLA VULGARIS-FORTIFIED WHEAT--SPELT BRIOCHE: ANTIOXIDANT ACTIVITY, PATHOBIONT SUPPRESSION, AND GUT MICROBIOTA MODULATION

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The global transition toward sustainable nutrition requires innovative formulation strategies that integrate protein fortification with validated gut health modulation. This study describes a multi-tiered pipeline for a functional brioche formulated with an optimised 50:50 wheat:spelt blend and 4% (w/w) White *Chlorella vulgaris*.

Systematic physicochemical characterisation (XRD, DSC, ATR-FTIR, ICP-OES) of organic French flours revealed complementary profiles: wheat exhibited superior mineral density (651 vs 398 mg/100g) and protein digestibility (43% vs 36%), whereas spelt contributed elevated phenolics (309 vs 189 mgGAE/100g) and enhanced essential amino acids. The optimised blend, fortified with White C. vulgaris, achieved protein levels exceeding 12% of energy, satisfying EU nutritional claims (Reg. 1924/2006).

Following INFOGEST 2.0 in vitro digestion, HepG2 hepatocyte assays confirmed high biocompatibility (<20% inhibition) and a 40% enhancement in intracellular antioxidant capacity, suggesting hepatoprotective potential via synergistic interaction of spelt phenolics and Chlorella-specific antioxidants.

16S rRNA gene sequencing of in vitro fecal fermentations revealed significant microbial community restructuring (PERMANOVA: pseudo-F=5.99, p=0.004). The fortified formulation suppressed the pathobiont Desulfovibrio piger by 97%, corroborated by an 86% PICRUSt2-predicted reduction in adenylylsulfate reductase activity. Concomitantly, SCFA-producing genera were enriched - Dorea (4.7-fold), Phascolarctobacterium (2.5-fold), and Megasphaera (exclusively detected in the fortified brioche) - alongside a 138% increase in predicted propionate kinase activity.

These findings establish microalgal-ancient grain formulations as an effective approach for developing multi-functional bakery products addressing protein quality, bioactive delivery, and pathobiont-targeted gut modulation.

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ORAL PRESENTATION

ANTI-OBESOGENIC EFFECTS OF FORMULATIONS COMPRISING GLUCOSINOLATES AND MYROSINASE OF BRASSICA

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Broccoli-derived ingredients enriched in sulforaphane (SFN) with potential to improve metabolic health, were evaluated in terms of stability and bioactivity of the different SFN-rich formulas on key metabolic enzymes and lipid accumulation in 3T3-L1 adipocytes, as well as subjecting them to in vitro gastrointestinal digestion models representing the adult population. The tested formulation prototypes incorporated an enteric-coated myrosinase enzyme designed to enhance the conversion of glucosinolates into bioactive isothiocyanates. All SFN-rich formulations significantly inhibited the activity of lipoprotein lipase and α-glucosidase, enzymes directly involved in triglyceride uptake and postprandial glucose release, respectively, making them relevant targets for managing adiposity and glycaemic control. The commercial formulations had the most significant inhibitory effect, with a moderate enzyme inhibition level of 40-50%. However, compared with non-digested samples, the digested formulations showed reduced enzyme inhibition, decreasing from ~50--60% to ~30--40%, implying a partial degradation during digestion. Notably, the myrosinase-encapsulated products, preserved composition and activity. Overall, these findings highlight the potential of SFN-rich broccoli formulations to modulate key metabolic enzymes, while underscoring the importance of digestive dynamics, and support formulation strategies to maintain SFN bioactivity in adults at risk of metabolic dysfunction.

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References

(1) Brodkorb, A.; Egger, L.; Alminger, M.; Alvito, P.; Assunção, R.; Ballance, S.; Bohn, T.; Bourlieu-Lacanal, C.; Boutrou, R.; Carrière, F.; et al. INFOGEST Static in Vitro Simulation of Gastrointestinal Food Digestion. Nat. Protoc. 2019, 14, 991--1014.

(2) Costa-Pérez, A.; Sánchez-Bravo, P.; Medina, S.; Domínguez-Perles, R.; García-Viguera, C. Bioaccessible Organosulfur Compounds in Broccoli Stalks Modulate the Inflammatory Mediators Involved in Inflammatory Bowel Disease. Int. J. Mol. Sci. 2024, 25, 800.

(3) Zhang, Y.; Zhang, W.; Zhao, Y.; Peng, R.; Zhang, Z.; Xu, Z.; Simal-Gandara, J.; Yang, H.; Deng, J. Bioactive Sulforaphane from Cruciferous Vegetables: Advances in Biosynthesis, Metabolism, Bioavailability, Delivery, Health Benefits, and Applications. Crit. Rev. Food Sci. Nutr. 2025, 65, 3027--3047

ORAL PRESENTATION

EFFECT OF DIETARY FIBRE OF ORANGE AND ORANGE JUICE IN THE BIOACCESIBILITY OF (POLY)PHENOLS DURING IN VITRO DIGESTION AND COLONIC FERMENTATION

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Orange (*Citrus senensis*) composition is rich in dietary fibre (DF) and (poly)phenols (PPs). Previous studies have shown that DF interacts with PPs, thereby influencing their bioaccessibility, bioavailability, and their potential health benefits. The main objective of this research was to evaluate the production of postbiotics from DF-rich fractions, namely insoluble fraction (IF) and total fraction (TF), obtained from orange and orange juice through aqueous-ethanolic extractions. To this end, the four DF-rich fractions obtained were subjected to in vitro gastrointestinal digestion [1], followed by in vitro fecal fermentation with human fecal inoculum for 24 h [2]. Aliquots of fermented fecal samples were collected at 0, 6,10 and 24h to quantified short chain fatty acids (SCFAs) by GC-FID, other postbiotics (ammonia, D-lactic acid and L-lactic acid) by spectrophotometry, and PPs-derived metabolites by HPLC-QqQ-MS/MS, all reflecting microbial metabolic activity. Following fermentation of IF and TF samples, an increase in total SCFAs over time was observed, reaching a maximum concentration of 121 and 146 mM at 24 hours, respectively, as a result of DF. IF from orange juice exhibited the highest production of propionate, butyrate and other minor SCFAs, which may be related to its sugar content. Ammonia levels also increased over time, however the increase in SCFAs, and therefore the decrease in pH, may limit ammonia production. In contrast, lactate isomers disappeared over time, consistent with their role as intermediate metabolites in SCFAs production [3]. Flavanones present in all the DF-rich fractions obtained from both orange fruit and orange juice, were metabolized into low molecular weight compounds, mainly phenylacetic acids and phenylpropanoic acids [4]. PPs-derived metabolites generated from IF of orange juice (933 µmoles/100 g d.w) were significantly higher than those from the IF of fresh fruit (419 µmoles/100 g d.w). This difference may be attributed to thermal treatment, which likely enhances PPs release from the food matrix, thereby favoring their metabolization by colonic bacteria. Overall, these results suggest that juice processing may increase the bioaccessibility and, therefore, the bioavailability of PPs, while SCFA are formed through microbial fermentation of DF.

References

[1] Brodkorb, A., Egger, L., Alminger, M., Alvito, P., Assunção, R., Ballance, S., ... & Recio, I. (2019). INFOGEST static in vitro simulation of gastrointestinal food digestion. Nature protocols,14(4), 991-1014.
[2] Pérez-Burillo, S., Molino, S., Navajas-Porras, B., Valverde-Moya, Á. J., Hinojosa-Nogueira, D., López-Maldonado, A., ... & Rufián-Henares, J. Á. (2021). An in vitro batch fermentation protocol for studying the contribution of food to gut microbiota composition and functionality. Nature protocols, 16(7), 3186-3209.
[3] Blaut, M. (2018). Composition and function of the gut microbiome. In The Gut Microbiome in Health and Disease (pp. 5--30). Springer International Publishing. https://doi.org/10.1007/978-3-319-90545-7_2.
[4] Núñez-Gómez, V., Jesús Periago, M., Luis Ordóñez-Díaz, J., Pereira-Caro, G., Manuel Moreno-Rojas, J., & González-Barrio, R. (2024). Dietary fibre fractions rich in (poly)phenols from orange by-products and their metabolisation by in vitro digestion and colonic fermentation. Food research international (Ottawa, Ont.),177, 113718. https://doi.org/10.1016/J.FOODRES.2023.113718

ORAL PRESENTATION

NUTRITION CLAIMS IN THE DIGITAL FOOD ENVIRONMENT: REGULATORY COMPLIANCE OF VEGAN AND VEGETARIAN PRODUCTS IN PORTUGAL AND SWEDEN

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The European Union (EU) regulates mandatory and voluntary food information, including specific rules for nutrition claims [1]. Aligned with the plant-based trend, marketing elements are increasingly present in vegan/vegetarian products, a relevant part nutrition-related [2]. However, their compliance in the online retail environment remains unclear [3]. This study reports on the prevalence and regulatory compliance of nutrition claims on vegan/vegetarian foods available in leading online grocery stores in Portugal and Sweden.

Data were collected in March-August/2025 from the Continente® and ICA® online platforms. All products displayed in the "vegan and vegetarian" tab were included. Duplicated or misclassified items were excluded. All nutrition claims were registered and assessed for regulatory compliance.

A total of 837 products were included (PT: n=563; SE: n=274), with 1447 nutrition claims identified (PT: n=1040; SE=407). Most products had at least one nutrition claim (PT: 64.1%; SE: 51.5%), with an average of nearly 3 claims/product in both countries. In Portugal, nutrition claims were particularly frequent in algae (100% of products, mean±s.d. claims/product: 3.5±1.0), supplement powders (100%, 3.5±1.7) and plant-based milk substitutes (PBMS) (96%, 3.6±1.0), while in Sweden were more common in PBMS (66%, 4.0±1.8) and plant-based yoghurt (87%, 5.0±1.6). The highest proportion of claims were related to vitamins/minerals (PT: 44%: SE: 54%, mostly in PBMS and plant-based yoghurt), followed by protein in Sweden (21%, mostly in meat substitutes) and sugars in Portugal (19%, mostly in PBMS). The majority of nutrition claims complied with EU regulations (PT: 66.8%; SE: 80.3%), although a relevant part did not comply (PT: 11.7%; SE: 14.0%) or were not verifiable based on available website information (PT: 21.4%; SE: 5.7%). In general, compliance was lower in claims related to energy and sugars in Portugal, and to sugars and fat in Sweden. Product categories with lower compliance were algae, supplement powders and fish analogues in Portugal, and fish analogues, sweet pastries and snacks in Sweden.

Improving the clarity, compliance and verifiability of online nutrition claims is essential to support informed purchase of plant-based foods in an increasingly prominent digitalised food environment.

References

1. Commission Regulation (EU) No 1047/2012 of 8 November 2012 amending Regulation (EC) No 1924/2006 with regard to the list of nutrition claims

2. Gerber, S., Dix, S. R., Cash, S. B. Marketing plant-based versus animal-sourced foods in online grocery stores: A comparative content analysis of sustainability and other product claims in the United States. Bus Strat Env 2024; 33(5):4958--4973. https://doi.org/10.1002/bse.3717

3. Sharib, J. R., Pomeranz, J. L., Mozaffarian, D., Cash, S. B. Disclosure of mandatory and voluntary nutrition labelling information across major online food retailers in the USA. Public Health Nutr 2024; 27(1):e203. https://doi.org/10.1017/S1368980024001289

ORAL PRESENTATION

DUAL ACE-INHIBITORY AND ANTI-INFLAMMATORY POTENTIAL OF WHEAT-CHICKPEA BAGELS FORTIFIED WITH WHITE AND HONEY CHLORELLA VULGARIS: A SEED-TO-CELL APPROACH

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Chronic inflammation and hypertension are interconnected cardiometabolic risk factors. Food-derived bioactive peptides modulating inflammatory cytokines and inhibiting angiotensin-I-converting enzyme (ACE) represent promising dietary strategies. This study describes an integrated approach for wheat-chickpea bagels fortified with 4% (w/w) of two colour-mutant *Chlorella vulgaris* strains, White (WC) and Honey (HC), to compare their technological performance and bioactive potential.

Principal component analysis revealed strain-dependent signatures: WC preserved control-like elastic texture and golden colour, while HC produced softer, adhesive crumb with yellow-green hue. Both formulations qualified for EU "source of protein" claims and maintained high bioaccessibility (68-73%). Mineral profiling confirmed additional claims for phosphorus, copper, and manganese.

Following INFOGEST simulated gastrointestinal digestion, intestinal digests were evaluated for ACE-inhibitory activity and IL-6 modulation in Caco-2 cells. A clear potency hierarchy was observed (WC>HC>Control). The WC formulation exhibited 30% enhanced inhibitory potency compared to control, suggesting enhanced antihypertensive potential linked to bioactive peptides released during proteolytic digestion of microalgal proteins.

In parallel, digested bagels demonstrated anti-inflammatory capacity: IL-6 secretion - a key mediator linking intestinal inflammation to systemic cardiometabolic dysfunction - was attenuated relative to digestion blanks, suggesting protective effects on epithelial homeostasis.

The convergence of ACE inhibition and IL-6 attenuation in a single food matrix represents a compelling dual-functionality paradigm. The WC formulation emerges as the optimal candidate, combining enhanced bioactivity with technological acceptability. These findings position C. vulgaris-fortified bakery products as multifunctional foods targeting cardiometabolic health through complementary mechanisms.

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ORAL PRESENTATION

HOMOGENIZATION AT DIFFERENT PRESSURES AS A TOOL FOR ALTERING THE PROPERTIES OF AGAR-BASED FLUID GELS INTENDED FOR DYSPHAGIA

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Fluid gels are promising for developing dysphagia-friendly foods due to their adjustable rheological and lubricating properties (Mills et al., 2013; Chouhan et al., 2019). However, systems prepared in the traditional way may have large particles that reduce sensory acceptance and stability (Dyglė et al., 2026). It was assumed that high-pressure homogenization (HPH) could solve these issues by altering particle size and structural properties (Masbernat et al., 2026; Zhai et al., 2026). Thus, this study investigated how HPH at pressures ranging from 10 to 60 MPa affects the visual appearance, stability, particle-size distribution, and rheological properties relevant to swallowing in agar and agar--collagen fluid gels designed for dysphagia diets.

The main goal of particle size reduction was achieved, although the system responses varied depending on their composition. Agar fluid gels showed inconsistent responses to homogenization, with particle size decreasing at 10--20 MPa and increasing at 30--60 MPa due to particle interactions and aggregation. In contrast, agar--collagen fluid gels displayed a steady decrease in particle size and polydispersity as pressure increased, reaching 65.82 μm and a span index of 1.861 at 60 MPa. After pressure was applied, both agar and agar--collagen fluid gels showed changes in apparent viscosity. The agar fluid gels shifted from nectar-like to honey-like consistency and moved from IDDSI Level 2 to Level 3 over the 10--60 MPa range. Meanwhile, in agar-collagen fluid gels, this change in consistency has only been achieved after applying 50 MPa of pressure. Fluid gels also exhibited very low shear yield stresses across all pressure conditions (below 10 Pa), consistent with facilitated swallowing. Furthermore, the dynamic stability of the systems was improved by applying homogenization technology, which was directly linked to higher pressure levels.

Overall, these results demonstrate that pressure modulation via HPH effectively controls the rheological and structural properties of fluid gels used in dysphagia diets, with outcomes also influenced by the systems' initial composition.

References

1. Chouhan, G., Moakes, R.J.A., Esmaeili, M., Hill, L.J., deCogan, F., Hardwicke, J., Rauz, S., Logan, A., Grover, L.M., 2019. A self-healing hydrogel eye drop for the sustained delivery of decorin to prevent corneal scarring. Biomaterials 210, 41--50. https://doi.org/10.1016/j.biomaterials.2019.04.013

2. Dyglė, G., Eisinaitė, V., Damulevičienė, G., Leskauskaitė, D., 2026. Agar-collagen fluid gels as a dysphagia food: Rheological characterization vs fiberoptic endoscopic evaluation of swallowing. International Journal of Biological Macromolecules 339, 149776. https://doi.org/10.1016/j.ijbiomac.2025.149776

3. Masbernat, O., Lopez, C., Risso, F., Lalanne, B., Garcia, L., Roger, K., Berton, M., 2026. Fragmentation of milk fat globules in a High-Pressure Homogenizer. Journal of Food Engineering 412, 112963. https://doi.org/10.1016/j.jfoodeng.2026.112963

4. Mills, T., Koay, A., Norton, I.T., 2013. Fluid gel lubrication as a function of solvent quality. Food Hydrocolloids 32, 172--177. https://doi.org/10.1016/j.foodhyd.2012.12.002

5. Zhai, J., Batool, Z., Jin, G., Aadil, R.M., Geng, F., Wang, J., Hu, G., 2026. Enhanced rehydration of egg white powder by high-pressure homogenization: A quantitative proteomic perspective. Food Chemistry 505, 148004. https://doi.org/10.1016/j.foodchem.2026.148004

ORAL PRESENTATION

VEGETARIAN CANNED MEALS WITH SEA SPAGHETTI FOR A NUTRITIOUS DIET

Antónia Juliana Pais-Costa[1], António Pires[2], Gilberto Costa[2], Cristina Soares[3], Helena Oliveira[4,1], Manuela Machado[5], António Marques[4,1], Ana Cação[6], Helga C Augusto[6], Maria Leonor Nunes[1], Amparo Gonçalves[4,1]

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Many consumers follow vegetarian or plant-based diets for health, ethical, and environmental reasons, yet the availability of nutritionally balanced canned meals for this market segment remains limited. Additionally, iodine deficiency is still prevalent in European populations, particularly among individuals reducing or excluding animal-based foods. In this context, this study aimed to develop a vegetarian canned meal that is nutritionally balanced, contributing to iodine intake, using seaweed as a natural iodine source.

A canned meal prototype was developed combining rehydrated **Himanthalia elongata** (sea spaghetti), white beans, carrots, and a filling medium composed of light brine, olive oil, and seasonings. The development included laboratory-scale formulation, where rehydration was optimized to ensure safe iodine levels, followed by industrial-scale processing. The final product was characterized in terms of chemical composition and sensory properties.

Sensory evaluation highlighted a slight seaweed/marine and spicy flavour; adequate texture (chewiness) of the seaweed, without unpleasant mout hfeeling (bitterness or astringency). The chemical composition assessment indicates that this prototype can claim the following: "high protein" (over 20% energy from protein), "high fibre" (over 3 g fibre/100 kcal) and "high iodine" (71 µg/100 g product, corresponding to over 30% of Nutrient Reference Value, suitable for consumers aged ≥ 14 years). The iodine concentration found in the product demonstrated the effectiveness of the seaweed rehydration in reducing iodine concentrations to recommended safe levels.

Overall, the results demonstrate the feasibility of producing a vegetarian canned meal with balanced sensory and nutritional profiles.

References

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BOOK OF ABSTRACTS

POSTER PRESENTATIONS

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Education and Training Challenges towards sustainability and innovation

POSTER PRESENTATION

CALENDULA OFFICINALIS L. AS A FUNCTIONAL FOOD INGREDIENT: TECHNOLOGICAL APPLICATIONS, QUALITY DETERMINANTS AND PROCESSING STRATEGIES

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Marigold (*Calendula officinalis* L.) is valued as a multifunctional ingredient in functional foods due to its nutritional value, technological versatility, and natural origin. Dried flowers provide 57.68 g dietary fiber, polysaccharides, 8.7 g protein, 6.09 g fat, and 5.66 g ash, enhancing health-promoting foods. Their yellow-orange color and saffron-like flavor improve sensory qualities, allowing use as natural flavors and colorants for clean label products.

Properties of marigold products depend on variety, cultivation system, and environment. Modern methods, including greenhouse and hydroponics with artificial light, allow control of phytochemicals and high-quality, pesticide-free material. Light spectrum, fertilization, and electrical conductivity influence carotenoid and flavonoid accumulation. Targeted harvesting considers phytochemical distribution between ligulate and tubular flowers, which may range from 13 % to 62 % within one variety due to climate.

Marigold extracts and powders enhance antioxidant and nutritional quality while maintaining acceptable sensory traits. In organic yogurt, reducing capacity rose from 0 to 21 mg QE/100 g with 0.25 g extract/100 g yogurt. In pasta, total phenolics increased from 0.46 to 110 mg GA/100 g after adding 5 % flower powder. High antimicrobial activity against E. coli and S. aureus, plus carotenoid content of 0.7--2.7 % in dried flowers, supports use as a natural preservative and colorant. Marigold is thus a promising alternative to synthetic additives, though further research is needed on standardization, stability, and scale-up processing.

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POSTER PRESENTATION

CALENDULA OFFICINALIS L. -- PHYTOCHEMICAL PROFILE AND HEALTH-PROMOTING PROPERTIES: FROM ANTIOXIDANT ACTIVITY TO NEUROPROTECTIVE POTENTIAL

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Calendula officinalis L. is one of nearly 25,000, commonly known as pot marigold, is a species of plant in the Asteraceae family, long used in traditional medicine and gaining importance in functional food research. Recent scientific research focuses on its rich phytochemical composition and broad spectrum of health-promoting properties, as well as its potential use in food.

Pot marigold flowers are a rich source of bioactive compounds. To date, over 500 chemical components have been identified in pot marigold, including flavonoids 0.8--1.7%, carotenoids, from 0.2% to 3.51%, saponins in content 0,44% -- 0,57% , essential oils 0,13 to 0,97%, phenolic acids from 26,5 to 109,27 mg GAE/g in dried flowers, and another like terpenoids, coumarins, and quinones.

The qualitative and quantitative composition of active compounds in pot marigold flowers depends on several factors, such as the variety, climatic conditions, cultivation system, flower development stage, and post-harvest processing. The ratio of ligulate to tubular flowers varies by up to almost 50% depending on growing conditions.

Numerous studies have confirmed the potent free radical scavenging properties of marigold extracts using DPPH (129 mgAAE/100 g dry flower), ABTS (from 0,09 to 0,62 mmol Trolox/100 g dry flower), and FRAP (315 mg AAE/100 g dry flower) assays, as well as the inhibition of lipid peroxidation and modulation of inflammatory mediators, including TNF-α and interleukins. Furthermore, marigold also exhibits potent anti-inflammatory, regenerative, antimicrobial, neuroprotective, and anticancer potential.

Experimental studies indicate modulation of oxidative stress in neuronal tissues and antiproliferative effects on selected cancer cell lines. The ability to inhibit the proliferation of cancer cells was determined to be between 70% and 100%. These findings support the potential role of marigold as a valuable bioactive ingredient in health-promoting foods and dietary supplements.

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POSTER PRESENTATION

COMPARATIVE SHELF-LIFE EVALUATION OF ULTARVIOLET-C TREATED BOVINE MILK: MICROBIOLOGICAL STABILITY AND QUALITY COMPARED TO EXTENDED SHELF-LIFE MILK

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Research has been focusing on finding alternative, non-thermal, sustainable techniques which will be capable of successfully replacing the conventional thermal treatment. One of those emerging novel techniques is based on Ultraviolet C (UV-C) light. UV-C light has been proven to destroy directly the bacterial cells or indirectly target their DNA and prevent their replication^1^. The penetration and accordingly the effectiveness of the UV light though, is highly dependent on a lot of factors such as the flow, the type of lamp, the nature of the product, such as its opacity and turbidity and other^2^.

In this study, a pilot UV-C system (Sure Pure SP1) was used to study the effect of Ultraviolet C (UV-C) light technology on semi-skimmed (1.5%) and full fat (3%) bovine milk. The products were inoculated with four different pathogens; *Listeria innocua* (NCTC 11288), *Staphylococcus aureus* (NCTC 6571), *Escherichia coli* (NCTC 9001) and *Salmonella Enteritidis* (NCTC6676). UV-C treated milk and was compared microbiologically and qualitative to Extended Shelf-Life bovine milk processed at 96 ºC/13sec through shelf life (30 days).

Microbiological results demonstrated a clear effect of fat content on UV-C efficacy. *Listeria innocua* was the most resistant strain in both milk types, achieving a 5 $\log_{10}$ CFU/mL reduction at doses of 1920 J/L and 1520 J/L for 3% and 1.5% fat milk, respectively. Qualitative analysis showed significantly lower lipid oxidation levels in UV-C--treated milk, assessed by malondialdehyde (MDA), regardless of fat content. In addition, volatile compound analysis using Smart Nose and principal component analysis (PCA) revealed that the aromatic profile of UV-C--treated samples closely resembled that of raw milk. Protein oxidation assessment further indicated higher carbonyl levels (μM/mg protein) in ESL milk compared with UV-C--treated milk for both fat contents.

Last but not least, HPLC analysis was conducted at various time points during shelf life to determine vitamin D_3 content, revealing higher concentrations in UV-C--treated milk than in ESL milk.

Overall, the results indicate that UV-C treatment has strong potential as a stand-alone alternative to conventional pasteurization, ensuring microbiological safety while preserving lipid and protein quality and enhancing nutritional value.

References

1Delorme, M. M., Guimarães, J. T., Coutinho, N. M., Balthazar, C. F., Rocha, R. S., Silva, R., Margalho, L. P., Pimentel, T. C., Silva, M. C., Freitas, M. Q., Granato, D., Sant'Ana, A. S., Duart, M. C. K. H., & Cruz, A. G. (2020). Ultraviolet radiation: An interesting technology to preserve quality and safety of milk and dairy foods. Trends in Food Science and Technology, 102(March), 146--154. https://doi.org/10.1016/j.tifs.2020.06.001

2Orlowska, M., Koutchma, T., Kostrzynska, M., Tang, J., & Defelice, C. (2014). Evaluation of mixing flow conditions to inactivate *Escherichia coli* in opaque liquids using pilot-scale Taylor -- Couette UV unit. Journal of Food Engineering, 120, 100--109. https://doi.org/10.1016/j.jfoodeng.2013.07.020

POSTER PRESENTATION

CALIFORNIA--DENMARK INNOVATOR FELLOWSHIP: BRIDGING RESEARCH AND INNOVATION IN SUSTAINABLE FOOD SYSTEMS

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The California -- Denmark Innovator Fellowship shows a key challenge in Danish researcxh and innovation landscape, meaning that much of the food and planetary research projectshas not been translated into innovation applications and start-ups. This gap limits Denmark's global impact of bringing innovative solutions in the sustainable green food system.
Denmark's strong academic research in food and planetary health has not effectively translated into commercial applications, limiting its global impact. This gap, between research and commercialization, hampers the development of innovative solutions necessary for the green transition and the creation of a sustainable global food system.
The program's vision is to enhance the Danish innovation ecosystem to support the green transition through pioneering research, entrepreneurial exchange, and fostering international collaborations within the field of food and planetary health.
The program's mission is to provide leading young fellows within Denmark and the University of California campuses with exposure to world-class biotechnology-based entrepreneurship, innovation, venture capital, scientific research, and international network-building opportunities to accelerate the creation of a future food system that improves human and planetary health.
The proposed solution is a bilateral exchange program between Denmark and the United States, targeting postdocs from Denmark and PhD students and postdocs from UC Davis (i.e. fellows) interested in sustainable food systems. For each of three years, three California-based fellows will spend six months in Denmark, and three fellows from Denmark will spend six months in California, each learning about the other's approach to innovation and entrepreneurship.
These eighteen fellows represent a transatlantic bridge of talent and knowledge flow between the Danish and California innovation ecosystems. It addresses barriers to innovation by fostering an entrepreneurial mindset among early-career researchers, activating the commercialization of groundbreaking academic research, and building strong international networks. The expected impact includes an increase in start-ups, patents, and research collaborations in the short term, positioning Denmark as a leader in agri-food innovation and significantly contributing to the global green transition in the longer term.
The program is jointly administered by UC Davis and Danish Technical University (DTU). These institutions will source fellows from universities across Denmark to ensure an academically and institutionally diverse cohort. We will also ensure placement of UC Davis fellows at universities across Denmark. Fellows coming to California will spend half their time with a research lab on campus that practices technological innovation, and the other half with the Innovation Institute for Food and Health, conducting commercialization research under the guidance of IIFH leadership, partners, and venture capital mentors. Fellows going from California to Denmark will spend three months in a lab at a research university, followed by three months at the BioInnovation Institute or DTU Skylab.
The expected impact of developing this fellowship exchange can be seen through different levels: individual/ social, institutional, and system levels.
System-level includes strengthened cooperation within the Danish / European and US Education area, enhanced and alignedment with both regional priorities.
Institutional level impact relates to improved internalization strategies and exchange of educational practices, e.g., applied science, innovation knowledge, case studies, project--based learning between all institutions involved -- DTU, UC Davis, and BII.
Individual or social level impact refers to the ability for PhD and Postdocs from both regions to collaborate and learn from the different institutions involved, not only at the research but at the cultural working level. The social impact involved the benefits of the researchers participating in different local conferences. Engagement in Masterclasses and short academic trainings, visiting industrial partners and research centers. Additionally, each of them will be able to stranght its intercultural awareness, adaptability, and soft skills while performing multicultural research and innovation practises abroad.
Therefore, the California-Denmark Innovator Project enhances the internationalisation and global exchange of practises which can serve as a base and narrative for future bigger food innovation projects between US and Denmark.
Through this structured exchange, the California--Denmark Innovator Fellowship Program builds a powerful bridge between two globally significant innovation ecosystems, enabling the development of transformative solutions for future food systems and planetary health.

References

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https://start.uni.dk/news-and-calendar/california-denmark-innovator-fellowship
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Bronke I., Hobley T., Rask T., Ottesen P., Armstrong D., Schmitz H., Siegel J., Guacan R., Kellner L.,
DTU National Food Institute, Technical University of Denmark
Innovation Institute for Food & Health, UC Davis
Bioinnovation Institute, BII

POSTER PRESENTATION

BRIDGING THE GAP IN RISK ASSESSMENT TRAINING: THE XORA PORTAL FOR HARMONIZING RISK ASSESSMENT TRAININGS WITHIN THE ONE HEALTH FRAMEWORK

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In an era of emerging global threats, high-quality and standardized training in risk assessment has become paramount. Within the food safety sector, achieving reliable and science-based health outcomes requires practitioners who are not only technically proficient but also deeply integrated into the One Health framework. To address the fragmentation of existing educational offerings, the xORA portal (www.xoraeducation.eu) was established. Originally developed under the EFSA-funded project, the European Excellence Label (EEL), the initiative has now evolved into a sustainable repository managed by a consortium of leading European institutions dedicated to risk science.

The portal serves as a quality-certified repository designed to harmonize and elevate risk assessment education across Europe. It operates through a synergy of four key stakeholder groups:

Learners: Professionals and students seeking reliable, up-to-date training to enhance their competencies.

Course Providers: Organizations that can promote their training programs globally after undergoing a certification process by the xORA reviewers.

Reviewers: Independent experts with recognized experience in diverse risk assessment fields. Their role is to ensure that submitted training programs meet specific quality requirements regarding both structure and content, granting the xORA Label accreditation only to those that achieve these high standards.

Employers: Organizations and regulatory bodies looking to invest in the professional development of their workforce through certified educational paths.

xORA is currently in its implementation phase, actively expanding its content and organizing strategic activities to foster a community of practice. As the portal grows, it serves as a useful aid within the food safety risk assessment sphere and a strategic point of aggregation for the training needs of risk assessors. This contribution will present the portal's architecture, the specific quality criteria used for accreditation, and the ongoing activities designed to expand the portal and attract stakeholders who can benefit from the xORA ecosystem. By aligning educational supply with professional demand, xORA contributes to building a more resilient, expert, and well-connected risk assessment community. Beyond its role as a certified marketplace for high-quality trainings, xORA also provides an important foundation for the creation of a future European Master's Degree in Risk Assessment. The initiative supports alignment between academic institutions, regulatory bodies, and scientific organizations

References

Condoleo R.1, Gollnick N2., Lechleider M.2, Nadolny I.2, Unger C.3, Engelstad H.4, Lau Baggeson D. 5, Bronke I.5, Gross-Bošković A.6, Služek Buzjak V.6, Sijm T.H.M.7, van der Lugt T.7, Engelhardt T.8, Falcone G.M.1, Iulietto M.F.1, Palomba S.1, Brajon G.1, Jozwiak A.8
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POSTER PRESENTATION

SUSTAINABILITY EVALUATION OF PLANT-BASED PROTEIN SOURCES BY INTEGRATING NUTRITIONAL, ENVIRONMENTAL AND FOOD SAFETY DIMENSIONS

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In the current context of climate change and updated nutritional guidelines, the link between diet, health, and environmental sustainability is emerging as a central focus of scientific and policy discourse [1]. Shifting diets toward plant-based proteins is desiderable for both environmental sustainability and nutritional adequacy. Legumes are a promising focus due to their nutrient density and low environmental impact [2], yet intake remains far below recommended levels. This doctoral project addresses this gap by providing a comprehensive assessment of Italian legumes, integrating nutritional, environmental, and food safety perspectives. Data on eight legume species (beans, chickpeas, lentils, peas, fava beans, green beans, soybeans, and lupins) were collected from scientific literature and national databases. Nutritional quality was evaluated using the Nutrient Rich Food Index (NRF 14.3), revealing that unprocessed dried legumes, particularly chickpeas, achieve the highest scores, while canned products show reduced vitamin and mineral content, confirming processing as a key factor in nutrient loss.

Environmental impacts were assessed through Life Cycle Assessment using SimaPro, from cultivation to storage (cradle-to-farm-gate) [3] [4]. Legumes consistently showed significantly lower impacts than beef, with reductions of up to tenfold in climate change indicators. Food safety risks, including mycotoxins, pesticide residues, and heavy metals [5], were evaluated using AI-based predictive tool and following EFSA risk assessment guidelines. Among contaminants, aflatoxin B1 approached safety thresholds, highlighting the need for enhanced monitoring and potentially legal limits for legumes.

This integrated approach identifies legume species that best combine high nutritional value, low environmental footprint, and manageable safety risks, providing robust evidence to support their role as alternative protein sources in sustainable, health-promoting diets.

References

[1] Rockström, J., Thilsted, S. H., Willett, W. C., Gordon, L. J., Herrero, M., Hicks, C. C., ... & DeClerck, F. (2025). The EAT--Lancet Commission on healthy, sustainable, and just food systems. The Lancet, 406(10512), 1625-1700.

[2] Shahid, N. (2025). Legumes Production Under Changing Climate. In Climate Smart Agriculture for Future Food Security (pp. 191-221). Singapore: Springer Nature Singapore.

[3] International Organization for Standardization. (2006a). ISO 14040:2006 - Environmental management - Life cycle assessment - Principles and framework. https://www.iso.org/standard/37456.html

[4] International Organization for Standardization. (2006b). ISO 14044:2006 - Environmental management - Life cycle assessment - Requirements and guidelines. https://www.iso.org/standard/38498.html

[5] Mihalache, O. A., Elliott, C., & Dall'Asta, C. (2024). Human health impact based on adult European consumers' dietary exposure to chemical contaminants and consumption of unprocessed red meat, processed meat, and legumes. Exposure and Health, 16(6), 1421-1433.

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POSTER PRESENTATION

DEVELOPMENT AND IMPLEMENTATION OF A GAME-BASED EDUCATIONAL TOOL FOR MICROBIOLOGICAL RISK AWARENESS IN TENEBRIO MOLITOR PRODUCTION

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As the demand for sustainable protein sources increases, *Tenebrio molitor* larvae are gaining popularity as an alternative protein source for human consumption. This species has been evaluated as safe for human consumption by the European Food Safety Authority under controlled production, however, food safety hazards remain relevant during key checkpoints from farm to fork. Potential vulnerabilities may be found all throughout the product chain including rearing, feed storage, processing, handling, preparation and storage. With the need for effective science communication strategies to promote microbiological literacy and evidence-based risk public perception, this project presents the development of a game-based learning intervention for microbiological food safety education focused on mealworm larvae. The board game simulates the production chain and integrates hazard identification, preventive measures, cross-contamination and hygiene concepts into an interactive learning framework. Participants progress using a dice system, encountering real microbiological hazard scenarios for each phase of production cycle. To move forward, participants must answer evidence-based quiz questions and apply preventative measures to ensure food safety across the production. The team that gathers most "Safety Points" while avoiding "Hazard" cards wins the game. The educational framework combines experiential learning and applies problem-solving to translate complex microbiological concepts into accessible knowledge for diverse audiences (4--99 years). This game was piloted during two scientific events in 2025: International Microorganism Day and European Researchers' Night, with qualitative observation indicating high participant engagement and improved awareness of microbiological hazards and preventive measures. This intervention aims to promote informed discussion on microbial risk awareness and prevention in novel foods, mainly of edible insects. By integrating sustainability discourse with microbiological safety education, this initiative demonstrates how interactive tools can bridge research and public engagement, fostering informed dialogue on alternative protein systems and reinforcing the importance of food safety in the adoption of more sustainable eating habits.

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POSTER PRESENTATION

ASSESSMENT OF MUCILAGE EXTRACTED FROM OPUNTIA FICUS INDICA CLADODES AS A NOVEL ADDITIVE FOR THICKENING AND GELLING FOOD PURPOSES.

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The global food industry is increasingly looking for novel functional hydrocolloids to replace traditional additives, driven by a growing consumer demand for sustainable and recognizable ingredients (Dickinson, 2003). *Opuntia ficus-indica* (OFI) cladodes represent an abundant but underutilized agricultural by-product, often classified as waste or pruning residues in the traditional agri-food chain. This research highlights the potential of OFI mucilage as a "green" and sustainable alternative to commercial hydrocolloids (Quinzio et al., 2018), such as pectin, which currently dominates the market. This research utilised a green extraction process for this biopolymer through physical methods such as microwave heating and centrifugation rather than chemical solvents (Du Toit and De Witt, 2011). This solvent-free approach not only follows the principles of green chemistry, but also ensures the recovery and valorisation of OFI cladodes in a circular economy model, transforming what is typically considered a waste product into a high-value functional ingredient. OFI mucilage exhibits diverse technological properties, including significant water-binding capacity (Medina-Torres et al., 2000), emulsifying activity and complex rheological behaviour. These characteristics make it a viable candidate for a wide range of industrial applications, potentially serving as a natural thickening, gelling and stabilizing agent in products such as dairy beverages, baked goods, sauces and edible coatings. Furthermore, its ability to trap water and create networks allows for its application as a natural fat replacer in low-fat food products, or as a nutraceutical edible coating for the preservation of fresh-cut fruits. For this purposes, in this research the physical-chemical, sensory and rheological profiles of this mucilage were compared with those of commercial pectin in order to assess the feasibility of using prickly pear by-products as an additive in an environmentally sustainable manner and for the efficient use of resources in the agri-food sector.

References

1. Dickinson, E. Hydrocolloids at interfaces and the influence on the properties of dispersed systems. Food Hydrocoll. 2003, 17, 25.

2. Quinzio, C.; Ayunta, C.; Alancay, M.; de Mishima, B.L.; Iturriaga, L. Physicochemical and rheological properties of mucilage extracted from Opuntia ficus indica (L. Miller). Comparative study with guar gum and xanthan gum. J. Food Meas. Charact. 2018, 12, 459--470.

3. Du Toit, A.; De Wit, M.A. Process for Extracting Mucilage from *Opuntia Ficus-Indica* and Aloe Barbadensis. South Africa Patent. No. PA153178/P, 12 May 2011.

4. Medina-Torres, L.; Brito-De La Fuente, E.; Torrestiana-Sanchez, B., & Katthain, R. Rheological properties of the mucilage gum (*Opuntia ficus-indica*). Food Hydrocoll. 2000, 14, 417--424.

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POSTER PRESENTATION

HIGH PRESSURE PROCESSING TO EXTEND SHELF LIFE OF LIQUID MIXTURES AND PRESERVE HIGH QUALITY ARTISANAL ICE CREAM

Federica Torregrossa[1], **Luciano Cinquanta**[1], **Diego Planeta**[1], **Matteo Pollon**[1]
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The consumption and, consequently, the production of artisanal gelato is significantly growing worldwide (Genovese et al. 2022) necessitating, in each production facility, the optimization of productivity and the extension of liquid base shelf life to reach wider markets. Traditional thermal pasteurization, while effective for safety, can negatively impact the sensory profiles of heat-sensitive ingredients. This research evaluates the High-Pressure Processing (HPP) as a non-thermal pasteurization alternative, applying hydrostatic pressures of 600 MPa to ensure microbiological stability (Gezai Abera W., 2019; Lopes A.C., 2024) while minimizing the effects typically associated with high-heat treatments (Tsai M. et al. 2018). The research focused on three formulations, with different chemical compositions: lemon, mango and pistachio. The liquid mixtures were treated with HPP and stored under refrigerated conditions in sealed vacuum bags up to 30 days to assess the possibility of extending the commercial window prior to the final whipping stage. A comprehensive multi-analytical approach was employed to characterize the effects of HPP on these matrices. Microbiological stability was monitored by assessing spoilage and pathogenic populations to ensure safety throughout storage. Structural and physical properties were evaluated through texture analysis, melting rate and overrun measurements to identify any changes in the system structure. Rheological behaviour was investigated by studying viscoelastic properties, while the phase transitions were examined through thermal analysis using differential scanning calorimetry (DSC). Furthermore, the volatile organic compounds (VOCs) and sensory profiles were assessed, while colorimetric evaluations were conducted to verify that the visual and characteristics of the artisanal product remained preserved. This research aims to validate HPP as a sustainable and innovative tool for the artisanal sector, effectively bridging the gap between food safety and the preservation of high- quality ice cream products.

References

1. Genovese A, Balivo A, Salvati A, Sacchi R (2022). Functional ice cream health benefits and sensory implications. Food Res Int 161:111858.

2. Gezai Abera W (2019). Review on high-pressure processing of foods. Cogent Food Agric 5:1. https://doi.org/10.1080/23311932.2019.1568725

3. Lopes AC, Queir RP, In RS, Pinto CA, Casal S, Delgadillo I, Saraiva JA (2024). High-Pressure Processing Effects on Microbiological Stability, Physicochemical Properties, and Volatile Profile of a Fruit Salad. Foods 13:1--24.

4. Tsai M, Cheng M, Chen B, Wang C (2018). Effect of high-pressure processing on immunoreactivity, microbial and physicochemical properties of hazelnut milk. Int J Food Sci Technol 53:1672--1680

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POSTER PRESENTATION

ENHANCING THE FUNCTIONALITY OF CRANBERRY JUICE USING LACTICASEIBACILLUS RHAMNOSUS AND TANNASE

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The study aimed to increase the functionality of cranberry juice through hydrolysis with tannase and fermentation with probiotic bacteria.

Cranberry juice (*Vaccinium macrocarpon*) is characterized by a high content of bioactive polyphenolic compounds, including proanthocyanidins and tannins, which are responsible for its health-promoting properties. However, the natural form of these compounds is characterized by limited bioavailability and a bitter, astringent taste. Tannase leads to the release of gallic acid, a compound with significantly higher bioavailability and antioxidant activity than the parent tannins. This process also reduces the drink's bitter taste, improving its organoleptic properties. Fermentation increases the functionality and health benefits of fruit juices while improving their safety, shelf life, taste, and the bioavailability of nutrients. It makes fermented juices attractive to a healthy diet and potentially a functional food. Freshly squeezed cranberry juice (55 mL) was enriched with tannase (2.8 mL, 1 mg ml^{-1}) and inoculated with a monoculture of *Lactobacillus casei* subsp. rhamnosus (3 mg). The mixture was incubated at 30 °C in a conical flask. Samples were taken after 0, 24, 48, and 72 hours. The concentration of gallic acid, total phenol, and organic acid content, pH values, *Lactobacillus* cell count, and antioxidant activity (DPPH test) were measured each time. A functional probiotic drink with increased polyphenol bioavailability was obtained, while maintaining the key health-promoting properties of cranberries and significantly reducing the undesirable tart taste.

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POSTER PRESENTATION

PRESERVING BLUEBERRY QUALITY: INFLUENCE OF EXTRACT, PULSED LIGHT, AND COMBINED TREATMENTS FOR EXTENDING SHELF-LIFE DURING STORAGE

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Blueberries are highly perishable fruits, and preserving their sensory and microbiological quality during storage is a major challenge for the food industry. This study evaluated the effects of black currant leaf polyphenols extract, pulsed light treatment, and their combination on sensory, colorimetric, textural, and microbiological properties of fresh blueberries over 10 days of storage. Blueberries were inoculated with *Staphylococcus aureus* and treated with polyphenol extract at concentrations 0.07 and 0.03 g/mL, pulsed light (5 or 10 pulses), or a combined treatment of extract (0.07 g/mL) and 10 light pulses. Sensory analysis revealed a significant decrease in purple coloration only after 8 and 10 days of storage, with atypical color appearance exclusively in these samples. A significant reduction in characteristic blueberry aroma was observed from day 6 onward, occurring in parallel with the appearance of a „greenish odor". Firmness and overall visual appeal declined significantly only on day 10. Among treatments, atypical coloration was observed in pulsed light and combined extract-light samples, significant softening occurred only in the combined treatment, and overall visual appeal was lower in treated samples than in controls. Colorimetric analysis showed a significant decrease in L* values only on day 10, while total color difference (ΔE*) also became statistically significant only at the end of storage. Comparing treatment types, L* values decreased significantly in samples treated with pulsed light, whereas a significant ΔE* was observed only in the combined extract-light treatment. Microbiological analysis revealed relatively stable total microbial loads during storage (log CFU 2.28--3.50), while pulsed light alone (5 pulses) reduced *S. aureus* counts to 1.66 compared with 3.94 log CFU in control samples. Overall, pulsed light proved effective in controlling microbial growth, whereas polyphenol extract and combined treatments primarily influenced texture and color. These findings suggest that pulsed light, alone or in combination with natural extracts, represents a promising strategy for extending blueberry shelf life while maintaining microbiological safety with only moderate sensory impact.

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POSTER PRESENTATION

FOOD WASTE AS A SOURCE OF FERULIC ACID -- AN OVERVIEW

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Food waste, particularly cereal brans and sugar beet pulp, represents a sustainable source of ferulic acid (FA). Extracting FA from complex food waste matrices for applications in food and pharmaceutics requires subsequent purification to achieve high purity levels, yet the complexity of these matrices often drives up costs and compromises economic viability, while common methods like alkaline and enzymatic hydrolysis provide viable approaches to overcome these hurdles. This work summarizes extraction and purification strategies for FA recovery from agro-industrial by-products, highlighting their advantages and limitations.

Alkaline hydrolysis(NaOH or KOH), yields substantial amounts of FA, although it simultaneously generates degradation products, along with wastewater and various environmental risks. Enzymatic hydrolysis, on the other hand, utilizes cellulases or feruloyl esterases (FAE) delivers high yields characterized by superior specificity compared to alkaline methods, minimal byproducts, and enhanced eco-friendliness. Emerging approaches, including NADES-ultrasound extraction or the combination of FAE and holocellulase, significantly boost overall efficiency by leveraging green solvents and substantially shorter processing times.

Purification processes include acidification, solvent extraction (ethyl acetate or ethanol), evaporation, resin adsorption, and ethanol precipitation. Although enzymatic methods outperform alkaline ones in terms of specificity and sustainability, they are hindered by higher enzyme costs and greater labor intensity, whereas alkaline methods, despite providing superior yields, suffer from poor selectivity and the production of toxic effluents.

Key challenges in the isolation and purification of FA from food waste encompass lignocellulosic recalcitrance that obstructs FA accessibility, strong ester bonds necessitating pretreatments, low method specificity, variable waste composition, scale-up difficulties, solvent toxicity, as well as limitations in achievable purity.

Ultimately, the valorization of food waste for FA extraction aligns with circular bioeconomy principles by reducing waste accumulation while providing high-value antioxidants suitable for applications in food, pharmaceuticals, and agriculture.

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POSTER PRESENTATION

FORMATION OF THERMOCHROMIC INDICATORS USING NATURAL PIGMENTS FOR MONITORING FOOD REHEATING PROCESSES

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Thermochromic sensors are characterized as a handy method to monitor the temperature profile of food products used in intelligent packaging systems. Those sensors are capable of responding to temperature change through visible color difference, and function as a thermal history index during processing, transportation, or storage. Recently, studies have increasingly focused on natural pigments to enable safer applications in the food industry. Natural pigments, such as anthocyanins and betalains, are susceptible to degradation under conditions including heating, pH, oxygen, and light exposure; therefore, their inherent instability causes their color to change as temperature increases, promising their use for thermochromic indicators. In this study, crude anthocyanins and betalains were employed to fabricate thermochromic labels, and their feasibility for use as reheating indicators was evaluated. The pigments were dissolved in neutral and weakly alkaline buffer solutions to prepare thermochromic solutions, and then immobilized onto filter paper and dried to form thermochromic labels. The efficiency of indication was evaluated by heating in a boiling water bath. Color changes were determined, and the relation between the extent of color difference of the labels and the core temperature of the foods was analyzed. During heating in boiling water for 30 min, anthocyanins-based labels exhibited an increase in a* and b* values. Additionally, the ΔE increased with heating time (up to 15), indicating a visible difference, that the coloration of lable converted from blue to gray and ultimately to brown. Use of betalains to prepare indicator labels exhibited a faster color change during heating. A significant decrease in the a* and an increase in b* were determined in a 15-min heating. The color of the label shifted from pink to orange and finally to yellow, and the ΔE values were determined to be ca 20-25, also showing a visible difference. Both thermochromic labels demonstrated a significant correlation between ΔE and core temperature of heated products. In conclusion, the use of anthocyanin and betalain to prepare thermochromic labels and then monitor food reheating demonstrated a significant coloration change, and corresponded to the core temperature of the food.

References

Khalaf, M. M., Gouda, M., Hamdalla, T. A., Abou Taleb, M. F., & Abd El- Lateef, H. M. (2024). Preparation of thermochromic ink from anthocyanidin- encapsulated alginate nanoparticles for anticounterfeiting applications. Luminescence, 39(7), e4842.

Kumar, J., Akhila, K., Kumar, P., Deshmukh, R. K., & Gaikwad, K. K. (2023). Novel temperature-sensitive label based on thermochromic ink for hot food packaging and serving applications. Journal of Thermal Analysis and Calorimetry, 148(13), 6061-6069.

Pratiwi, R., Maharani, D. S., & Redjeki, S. G. (2025). Betalain Pigments: Isolation and Application as Reagents for Colorimetric Methods and Biosensors. Biosensors, 15(6), 349.

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POSTER PRESENTATION

WATER FOOTPRINT OF DIETARY INTAKE AND PLANT-BASED PROTEIN PROFILES BY AGE AND SEX GROUPS IN TURKIYE: A SECONDARY ANALYSIS OF THE TURKIYE NUTRITION AND HEALTH SURVEY 2019 REPORT

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Sustainable dietary habits help to achieve and maintain optimal health and to reduce environmental impacts. The aim of this study is to calculate the dietary water footprint (WF) (I. Green, II. Blue, III. Grey) by age and sex groups based on the food consumption records of the Türkiye Nutrition and Health Survey (TNHS) 2019 report, and to profile the amount and proportion of plant-based protein intake within total protein intake.

This study is a secondary analysis of the data in the TNSH 2019 report. Using the means of food groups consumed by age (I. 15--18 years, II. 19--64 years, III. ≥65 years) and sex, consumption amounts (g/day), energy (kcal), and macronutrients (g), the mean plant-based and animal-based protein intakes, their proportions of total protein intake, and the total WF were summarized. In addition, to ensure comparability between sexes, the total WF was standardized to energy intake and expressed as L/1000 kcal.

Among a total of 12453 participants, the mean total dietary WF was 2151.41 L/person/day, and the green WF was 1768.23 L/person/day. The food groups contributing most to the total dietary WF were red meat and bread. When the total WF was standardized to energy intake, values were higher in men than in women across all age groups except those aged ≥65 years (≥65 years: men 1172.46 L/1000 kcal, women 1210.90 L/1000 kcal). When daily protein intake was evaluated, plant-based protein intake was higher than animal-based protein intake for all age and sex groups. The proportion of plant-based protein intake within total protein intake was 57.4% for women and 64.1% for men.

In conclusion, it was determined that the dietary habits of the Turkish population are plant-food--based, and, in line with this, the identified WF levels were found to be below the global average. However, to support sustainability, while developing national dietary guidelines and sustainability policies, strengthening behavior change strategies aimed at reducing food groups with high contributions to the WF and promoting accessible plant-based protein alternatives may be considered among the priority issues.

References

Sustainable Health Diets Guiding Principles. Available online: https://www.fao.org/3/ca6640en/CA6640EN.pdf (Accessed January 2026).

Mekonnen, M. M., & Hoekstra, A. Y. (2011). The green, blue and grey water footprint of crops and derived crop products. Hydrology and earth system sciences, 15(5), 1577-1600.

Mekonnen, M. M., & Hoekstra, A. Y. (2012). A global assessment of the water footprint of farm animal products. Ecosystems, 15(3), 401-415.

Türkiye Nutrition and Health Survey (TNHS) Report (2919). <https://krtknadmn.karatekin.edu.tr/files/sbf/TBSA_RAPOR_KITAP_20.08.pdf> (Accessed January 2026).

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Innovation in Teaching and training methodologies

POSTER PRESENTATION

PEERS LEARNING AND ASSESSMENT TO PROMOTE ACTIVE PEDAGOGY IN FOOD ENGINEERING WITHIN THE ERASMUS MUNDUS FIPDES JOINT MASTER'S DEGREE

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Peer, collaborative, and cooperative learning approaches are attractive to help students effectively achieve diverse learning outcomes. Rather than relying solely on the teacher as the main source of knowledge, these approaches encourage students to actively interact with their classmates. In this context, peer learning refers to situations where students work together to understand concepts, solve problems, or complete tasks. This type of learning often occurs through discussions, group work, peer tutoring, or collaborative projects [1]. Peer assessment, on the other hand, involves students evaluating and providing feedback on the work of their classmates. With clear guidelines provided by the teaching team, students review assignments such as essays, presentations, or projects' deliverables and formulate constructive comments. Research on peer assessment indicates that it encourages students to analyse and reflect on academic work while developing evaluative and critical thinking skills [2, 3]. It can improve the quality of students' work and promote deeper engagement with learning tasks [4]. As part of pedagogical approach within the Erasmus Mundus Joint Master's degree in Food Innovation and Product Design (FIPDes.eu), peer learning and peer-assessment tools have been integrated into food engineering courses. Over more than 10 years, we have tested several strategies such as think--pair--share, peer tutoring, group problem solving, collaborative projects. Being integrated in international and intercultural groups within FIPDes, students participate to intercultural team-building activities. We have observed that integrating peer learning and peer assessment into teaching practices could significantly enhance student engagement and understanding. By working together and learning to evaluate each other's work, students improved their involvement in the educational process. Furthermore, team-building activities brought key moments of exchange, mediation and personal sharing in a protected environment, and helped the students develop reflexivity, cultural awareness and intercultural intelligence. In this scientific communication, we will share the details about some of the tools mentioned above and the feedback gained from our experience within FIPDes programme.

References

1. Blum-Kulka, S., et S. Dvir-Gvirsman (2010). « Peer Interaction and Learning ». In International Encyclopedia of Education. Elsevier 2. Van Gennip, N. A. E.; Segers, M. S. R.; Tillema, H. H (2009). Peer Assessment for Learning from a Social Perspective: The Influence of Interpersonal Variables and Structural Features. Educ. Res. Rev. 4 (1), 41--54. 3. Lu, J., Law, N (2012). Online peer assessment: effects of cognitive and affective feedback. Instr Sci 40, 257--275. 4. Topping, K. J. (1998). Peer assessment between students in colleges and universities. Review of Educational Research, 68(3), 249--276.

POSTER PRESENTATION

THE EQVEGAN EU PROJECT OFFERS INNOVATIVE PROFESSIONAL TRAINING FOR THE PLANT-BASED FOOD INDUSTRY

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The increasing global demand for plant-based foods has intensified the need for a highly skilled workforce in the vegan food sector. This study presents the outcomes of the EQVEGAN project (European Qualifications & Competences for the Vegan Food Industry), funded under the Erasmus+ Sector Skills Alliance Programme, which aims to address skills gaps and support workforce development in the plant-based processing industry. The project, implemented by a consortium of 15 institutions from 11 countries, developed a vocational skills portal and a European certification system for professionals in vegan food production. Within this framework, the Poznań University of Life Sciences delivered professional training at EQF6 and EQF7 levels, combining theoretical and practical components across four modules: plant-based processing, green skills, digitalisation and automation, and soft skills. The programme was conducted in a hybrid format. Training quality was evaluated using an online questionnaire completed by both participants and instructors. The results demonstrated high satisfaction with the training concept, content, and delivery. These findings indicate that structured, competency-based training programmes can effectively support skills development in the rapidly evolving plant-based food sector. The details will be presented in the event. Funding: EU Erasmus+ Sector Skills Alliance (621581-EPP-1-2020-1-PT-EPPKA2-SSA-EQVEGAN).

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New skills for new jobs

POSTER PRESENTATION

BRIDGING COMPETENCY GAPS IN FOOD DISTRIBUTION: OBSERVATORY INSIGHTS FROM PORTUGAL

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The food distribution sector in Portugal has a key contribution to minimise losses and waste in the supply chain, but persistent skills gaps are hindering sustainable practices. The food distribution sector in Portugal works with a variety of perishable products through fragmented networks of small businesses and cooperatives. Continued gaps in digital skills and sustainability practices mean that reducing waste and adopting the circular economy throughout the supply chain is challenging. As part of the Food Chase project - Food Supply-Chain Ecosystems for Sustainability (WP2 - Food Supply Chain ecosystem for Sustainability) a Permanent Observatory on Skills Anticipation and Recognition conducted targeted surveys to assess competencies among students and experts in Portuguese distribution sector, focusing on technical, digital, green entrepreneurial and resilience skills.

Among students, 71% reported moderate familiarity with essential concepts like supply network projection, HACCP/ISO 22000 principles and storage optimisation, alongside limited awareness of advanced logistics and certifications. Key gaps included practical training in waste reduction, digital tools and financial viability assessment for sustainability initiatives around 50%.

Around 75% of the experts rated traceability utilisation highly and endorsed its essentials (safety, recalls, transparency), but highlighted deficiencies in handling non-distributed goods, advanced forecasting, Incoterms and technologies like thermometers or IoT for perishables. Barriers to digital adoption encompassed costs, integration issues, and expertise shortages was mentioned by 100% of the experts, with 50% highlighting training gaps in sustainability practices.

These insights reveal aligned needs for enhanced digital proficiency, financial literacy, regulatory knowledge, and hands-on sustainability training across experience levels. Integrating findings into Food Chase's Farm-to-Fork Specialist curriculum will bridge gaps, promote resilient distribution practices and foster circular economy competencies in Portugal's resilient food distribution ecosystem.

Acknowledgements

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POSTER PRESENTATION

TRAINING FUTURE FOOD SCIENTISTS IN PROCESS ANALYTICAL TECHNOLOGY (PAT) THROUGH ATR-FTIR SPECTROSCOPY AND CHEMOMETRICS: A FRUIT WINEMAKING PROJECT

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Transition to Food Industry 5.0 and Future Work requires reskilling programs for food scientists and technologists to promote systems thinking and the ability to interpret process-analytical signals for decision-making [1]. In fermentation-based production systems such as wineries and breweries, non-destructive spectroscopic sensing combined with multivariate analysis is increasingly used for process control and quality assurance [2]. Developing such skills within academic environments demands a shift from single-parameter or technique-centered laboratory exercises to process-oriented, data-integrated learning models. Within this context, two undergraduates and one MSc student were engaged in a research-integrated laboratory project using fermenting peach puree as a model system. Adopting an interdisciplinary approach, students were trained in enzymatic maceration, alcoholic fermentation with *Saccharomyces cerevisiae*, physicochemical monitoring (°Brix, pH, yeast dynamics), and sequential ATR-FTIR spectral acquisition over two weeks. Spectral evolution was analyzed using different signal processing algorithms and Principal Component Analysis (PCA) tools to capture the dynamic chemical fingerprint of the fermentation process. At this phase, students evaluated multivariate models through quality metrics and successfully linked PC scores and loadings evolution to sugar and ethanol biotransformation trends (i.e. three PCs explained >95% data variance), enabling precise identification of critical fermentation stages and endpoints. They also provided holistic mechanistic explanations in written reports, integrating microbiological and physicochemical treatments rather than treating spectra as isolated outputs. This approach significantly enhanced student engagement and analytical autonomy by shifting the focus from traditional protocol-driven experimentation to data-driven reasoning. Our research-oriented model further supports how Universities can effectively cultivate expertise for modern roles in food process-analytical technology (PAT) and quality assurance positions

References

[1] Leon, R. D. (2023). Employees' reskilling and upskilling for industry 5.0: Selecting the best professional development programmes Technology in Society, 102393, https://doi.org/10.1016/j.techsoc.2023.102393

[2] Ordoudi, S. A. (2026). [MIR/FTIR spectroscopy for precision winemaking in smart wineries: state of the art, challenges, and prospects](https://www.tandfonline.com/eprint/N98BCK5BGSIESFUC3UF4/full?target=10.1080/05704928.2026.2629006). Applied Spectroscopy Reviews, 1--27. <https://doi.org/10.1080/05704928.2026.2629006>

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Digitalization and Innovative Teaching tools

POSTER PRESENTATION

GAMIFIED ELEARNING FOR CAPACITY BUILDING IN SHORT FOOD SUPPLY CHAINS

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The transition toward sustainable and innovative food systems requires well-trained professionals. Trainers must adapt both in content and in their pedagogical approach, and eLearning using gamification offers new opportunities for enhancing professional education, by fostering engagement and motivation.

Within the EU-funded project EU4Advice, which aims to strengthen the capacities of Short Food Supply chain (SFSC) advisors across Europe, a gamified eLearning training approach was designed and piloted. The eLearning training consists of four modules: (1) Foundations of SFSC; (2) Motivations and Rationale for Engaging in SFSC; (3) Business Models and Value Creation; and (4) Performance Measurement and Tools. Each module is divided into lessons designed for flexible, self-paced, online access. The structure promotes incremental learning, with modules released sequentially to ensure progressive knowledge building. Gamification, understood as the integration of game mechanics such as points, badges, progress tracking, and sequential module unlocking into non-game learning contexts, was systematically embedded into the course structure. Each completed activity, such as watching instructional videos, completing quizzes, or reflecting on key messages, rewards participants with points. Upon finishing a module, learners receive a digital badge certifying competency acquisition.

The gamified eLearning training was piloted in the Netherlands tailored to the profiles of young advisors at bachelor and master level, who need structural yet easy to follow basic knowledge on SFSCs. The efficacy of the pedagogical approach was evaluated to better understand if by combining technical knowledge with innovative teaching tools, eLearning using gamification can contribute to modernizing advisory training and strengthening the resilience and performance of SFSC advisors across Europe.

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Food quality and safety

POSTER PRESENTATION

DEFINING AND EVALUATING A MULTIPARAMETRIC EARLY OXIDATION RISK INDEX IN WHITE WINES THROUGH A MACHINE LEARNING-BASED DATA FUSION APPROACH

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The early detection of oxidative instability in white wines remains a methodological challenge. Widely accepted, conventional tests rely on empirically defined Browning Index endpoints (BI, absorbance at 420 nm), usually monitored over extended periods of thermal incubation (5--12 days), without standardized predictive thresholds. Meanwhile, early shifts in the redox buffering capacity due to variations in phenolics and other active species may be captured in specific yet underexplored visible and mid-infrared regions of their spectra (1, 2). The present study re-evaluates physicochemical and multi-spectral (visible, mid-infrared) datasets, aiming to define a benchmark for early oxidation risk assessment. Dry white wines from Greek wineries, covering two vintages, nine grape varieties and both pre- and post-bottling stages, were subjected to controlled thermal stress (60 °C) for 8--24 hours to capture early-stage oxidative dynamics followed by short-term monitoring of browning development over one week. Oxidation--reduction potential (ORP) and its rate of change, free and total sulfur dioxide depletion, browning evolution (ΔA420) and Total Phenolic Content (as Gallic Acid Equivalents) were all combined to define a multiparametric Early Oxidation Risk index, that enables classification of wines with varying oxidation degrees (low-medium-high) and susceptibility patterns. Spectral features extracted from diagnostically relevant UV--Vis (350--370 nm) and ATR-FTIR regions (>2700 cm^{-1}) were then integrated to evaluate their complementary diagnostic contribution. Supervised Machine Learning (ML) modeling approaches indicated that data fusion may assist the low/high risk discrimination of wines compared to single-modality baselines (spectral-only or redox-only). The proposed Early Oxidation Risk Index enables the translation of descriptive spectroscopic data into a ML-assisted screening tool for rapid, non-destructive identification of white wines with higher oxidative susceptibility. This approach contributes to the development of standardized early-stage diagnostic methods for proactive stability management and sustainable quality control in winemaking.

References

1. Sen I, Ozturk B, Tokatli F, et al (2016) Talanta Combination of visible and mid-infrared spectra for the prediction of chemical parameters of wines. Talanta 161:130--137

2. Ordoudi SA (2026) MIR / FTIR spectroscopy for precision winemaking in smart wineries : state of the art , challenges , and prospects wineries : state of the art , challenges , and prospects. Appl Spectrosc Rev 0:1--27

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POSTER PRESENTATION

FILLET QUALITY OF BLACK SCABBARDFISH (APHANOPUS CARBO) FROM PORTUGUESE COAST: EFFECT OF PARASITISATION AND SEASONALITY

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Black scabbardfish, *_Aphanopus carbo_* (BSF) is an economically important deep-water species caught in Portugal coast with a highly selective fishing gear (the bottom longline) -- a sustainable practice which uses targeted bait, minimises bycatch and ensures the capture of high quality fish. However, BSF caught in Portugal has been reported to be infected with *Anisakis* [1] and a severe case of anisakiasis has been reported in the same area [2]. Moreover, it is expected to find high levels of anisakis infection in BSF, due to its predatory nature. Thus, it is important to monitor the presence of *Anisakis* in this fish species due to its gastronomic and economic importance in Portugal, coupled to the zoonotic potential of *Anisakis*. This study aimed to evaluate parasitisation by *Aniskais* in BSF and its potential effect on fillet quality. BSF specimens were caught off the coast of mainland Portugal, at Sesimbra area, covering seasonality (summer 2023 -- spring 2024; N=30/season). The fish was landed in the Sesimbra auction and then was transported in ice to MC's Azambuja warehouse, from where it was delivered in the same conditions to the laboratory. The viscera and visceral cavity were examined for *Anisakis* [3]. Fillet quality was assessed by instrumental determinations on the dorsal muscle. The pH value was measured using a WTW 539 pH meter. A puncture test was carried on a TA.XT Plus texture analyser, equipped with a 5 kg load cell; the hardness was measured by puncturing the muscle up to 60% of the original height at a constant speed of 1.0 mm/s, using a spheric probe of 12.5 mm diameter. The L*, a* and b* colour coordinates were recorded with a Minolta CR-400 portable colorimeter. The results evidenced that all the specimens were infected with *Anisakis* [3] although the level of parasitisation did not significantly affect the quality of fillets, regardless of the season. The colour of fillets differed significantly among seasons and the texture was significantly different in spring in comparison to the other seasons. In conclusion, the level of *Anisakis* infection did not affect the quality of fillets, which was affected only by seasonality.

References

[1] Regional Studies in Marine Science, 40 (2020),101538: https://doi.org/10.1016/j.rsma.2020.101538

[2] International Journal of Infectious Diseases 2017;64:38--41. https://doi.org/10.1016/j.ijid.2017.08.012

[3] Food and Waterborne Parasitology, 41, e00305: <https://doi.org/10.1016/j.fawpar.2025.e00305>

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POSTER PRESENTATION

A SYSTEMATIC REVIEW OF FOOD BUSINESS OPERATORS' PERCEPTIONS REGARDING FOOD FRAUD

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Little is known about Food Business Operators (FBOs)' perceptions of food fraud. As key actors in the food supply chain, understanding these perceptions provides valuable insights into the challenges they pose. A systematic literature review was conducted using "Scopus", "Web of Science" and "PubMed" (2015-2025), following the PRISMA 2020 guidelines. Of 269 identified studies, 17 met the inclusion criteria: studies addressing attitudes, perceptions, and beliefs about food fraud among FBOs, published in English and peer reviewed. Methodological quality was assessed using the Mixed Methods Appraisal Tool (MMAT), and the data were systematised using a thematic narrative approach. Four main themes emerge: (1) FBOs´ general knowledge and perceptions of food fraud; (2) Food fraud exposure and abilities to manage food fraud risks and authenticity; (3) Food fraud assessments; (4) Information sharing, institutional trust and whistleblowing intentions. Most studies focused on food fraud assessments (n = 10), whereas fewer addressed general knowledge, exposure, risk management, information sharing, trust, and whistleblowing intentions, revealing gaps in the literature. Evidence indicates that FBOs are generally aware of food fraud and that their perceptions of product vulnerability align with scientific findings. Vulnerability is unequal across the supply chain, influenced by company segment, size, and position within the chain, with processors showing higher concern and engagement in formal control measures. Information sharing and whistleblowing emerge as key prevention mechanisms. These findings underscore the importance of integrating FBOs' perceptions into targeted, sector-specific policies, management strategies, and training to address vulnerabilities across supply chains.

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POSTER PRESENTATION

DIETARY SWINE PROTEIN HYDROLYSATE MODULATES ALLERGEN-ASSOCIATED PROTEINS IN EUROPEAN SEABASS MUSCLE: A PROTEOMIC ASSESSMENT

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The increasing use of alternative ingredients in aquafeeds raises important questions regarding their impact on allergenic risk in farmed fish. This study evaluated how replacing fish protein hydrolysate (FH) with swine protein hydrolysate (SH) influences muscle proteome and the abundance of allergenic proteins in European seabass *(*Dicentrarchus labrax*), a commercially relevant species. Four experimental diets were tested: two control diets (animal protein-based (Ctrl Pap) and vegetal protein-based (Ctrl Veg)) and two corresponding diets including 3% SH in replacement of FH (Pap Sh3; Veg Sh3). High-resolution LC--MS/MS proteomic profiling revealed clear diet-dependent effects, particularly in fish fed the Pap Sh3 diet. A targeted assessment of allergenic proteins (collagens, myosins, tropomyosins, parvalbumins, and metabolic enzymes) identified substantial changes in Pap Sh3 fed fish, including up-regulation of several myosin and tropomyosin isoforms. Parvalbumin, the major fish allergen, was significantly down-regulated in the Ctrl Pap vs Pap Sh3 comparison, suggesting that allergenic modulation is strongly influenced by dietary background ($p<0.05$). No reduction in parvalbumin abundance was detected in vegetal protein based diets. These results demonstrate that SH can modulate the abundance of allergenic proteins in European seabass muscle and highlight the influence of dietary background on proteomic responses. Further work is needed to assess whether these changes translate into altered IgE-binding capacity and improved food safety.

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POSTER PRESENTATION

APPLICATION OF HYDROCOLLOID GUMS IN THE PROCESSING OF CREAM CHEESE FROM GOAT MILK

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Cheeses produced from the milk of goats and sheep are among the most traditional dairy products in the Mediterranean region. In southern Portugal, cheeses made from these milks are especially characteristic. This study aimed to develop a cream cheese with a suitable spreadability using hydrocolloid gums, thereby contributing to the diversification of dairy products derived from Algarvian goat milk. Cream cheeses were produced using local goat milk, salt (12 g/L), calcium chloride (0.5 g/L), and a vegetable coagulant (30 drops/L). Three hydrocolloid gum formulations were tested: A1 (locust bean gum), A2 (xanthan gum), and A3 (1:1 mixture of locust bean gum and carrageenan). Each gum was added at 0.5% (w/w). Product quality and safety were assessed through measurements of pH, moisture (%), and fat (%), and through microbiological analyses for *Staphylococcus aureus*, *Escherichia coli*, aerobic mesophilic microorganisms (30 °C), and fungi. The pH values did not differ significantly among the formulations (6.49±0.032) but decreased slightly during storage (6.42±0.05). Moisture content was lower in A2 (27.7±1.1%) immediately after production, and all samples showed a slight reduction during storage. Fat content was lowest in A3 (11.8 ± 0.4%), while A1 and A2 showed similar values (12.0 ± 0.0% and 12.1 ± 0.3%, respectively). Neither *S. aureus*, *E. coli*, nor moulds were detected at any point. Mesophilic counts were higher in A1 and A3 (about 3 log CFU/g). In A2, counts were approximately 1 log CFU/g and remained stable during storage. Yeast counts increased from 1 log CFU/g on the first day to approximately 2 log CFU/g after 4 days of storage. The cream cheeses showed similar quality properties, with all samples complying with the microbiological hygiene criteria established by the European Commission (EC, 2007). Among the tested hydrocolloids, locust bean gum produced the best spreadability, making it the most suitable option for cream cheese derived from Algarvian goat milk.

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POSTER PRESENTATION

MICRO- AND NANOPLASTICS RELATED TO THE DAIRY SYSTEM: SOURCES, PACKAGING MIGRATION AND PATHWAYS TOWARD SUSTAINABLE FOOD SAFETY

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Micro- and nanoplastics (MNPs, <5 mm) have emerged as ubiquitous contaminants in food, raising growing concerns for food safety and human health. While marine-derived foods have been extensively studied, liquid foods, including water, beverages, sauces and especially milk remain underexplored despite their high consumption and susceptibility to contamination. As milk and dairy foods studies are limited in MNPs, all liquid foods will be reviewed. Evidence increasingly indicates that MNPs enter liquid food through multiple pathways, including raw materials, food processing environments and packaging materials subjected to mechanical, thermal and chemical stress during use, therefore theses will be included in obtaining research data that encompasses the dairy systems.

This work synthesizes an extensive review of current occurrence, sources and migration mechanisms of MNPs in liquid food, with particular emphasis on packaging-derived contamination associated with sustainable biodegradable materials. This includes the review of conventional plastics and bio-based alternatives such as polylactic acid that can act as significant sources of MNPs. Processing conditions and food matrix interactions are important factors that need to be considered. Mitigation strategies and methodologies for identification will be reviewed especially in the dairy industry.

Importantly, biodegradable packaging does not inherently equate to lower MNP exposure and may release equal or greater particle burdens under thermal or mechanical stress. The mitigation strategies from improved raw material control, removal technologies and sustainable packaging solutions were identified. When integrated with spectroscopic techniques for waste sorting, machine learning-based method improve sorting accuracy, resulting in improved recycling because of polymer purity and material integrity, thereby reducing cross-contamination and secondary fragmentation during plastic reprocessing. Collectively, this work contributes to the understanding of the MNP in liquid food systems and underscores the need for consideration innovations that support future sustainable and safe food systems.

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POSTER PRESENTATION

EFFECT OF THYME ESSENTIAL OIL AGAINST PATHOGENIC MICROORGANISMS INOCULATED ON CHICKEN BREAST

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Food contamination remains a global concern, leading to interest in natural alternatives to synthetic preservatives used in food. Thyme essential oil has garnered attention due to its broad-spectrum antimicrobial and antioxidant properties. This study aimed to evaluate the antimicrobial efficacy of thyme essential oil on chicken breast against foodborne pathogenic bacteria, in order to assess its potential to reduce microbial contamination. Solutions of thyme essential oil (TEO) at 28 (TEO28) and 14 (TEO14) µL/mL were prepared with Tween 80 1% (v/v). Chicken breast pieces (25×25×5 mm and 5g) were inoculated with 80 µL of bacterial suspension (5×10^6 CFU/mL) consisting of two different cocktails: *Escherichia coli* and *Staphylococcus aureus* (Mix A) and *Salmonella* Typhimurium and *Listeria monocytogenes* (Mix B), standardised by OD600. Samples were allowed to rest for 20 minutes to promote microbial adhesion and subsequently treated with 2 mL of each solution. Inoculated chicken breast samples (non-treated) were used as control (CNT). All samples were covered with plastic wrap, stored at 3 ± 1 °C and analysed at 0, 2, 5, 8, and 12 days. Decimal serial dilutions were prepared and spread-plated onto selective agar for microbial enumerations. The results were expressed as log CFU/g. *E. coli* counts were 0.87 and 1.16 log lower in samples treated with TEO 14 and TEO 28 ($P < 0.001$), respectively, compared with CNT samples at day 0. Counts decreased consistently over time, with the TEO 28 treatment exhibiting the lowest values, ~1 log lower than CNT at day 12. For *S. aureus*, reductions of ~0.7 log were observed for TEO 14 and TEO 28 compared with CNT at the final day of storage. The highest reductions were obtained for *S.* Typhimurium, with reductions of 1.72 and 1.44 log for TEO 14 and TEO 28, respectively, compared with CNT at day 12 ($P < 0.001$). For *L. monocytogenes*, counts increased by 2 log over time in all samples; however, counts in the TEO 28 treatment were ~1 log lower than CNT on the last day of storage. Thyme essential oil exhibited promising antimicrobial activity on chicken breast, being most effective against *E. coli* and *S.* Typhimurium. These results highlight its potential as a natural preservative for meat, capable of reducing pathogenic contamination during refrigerated storage.

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POSTER PRESENTATION

EFFECT OF TOASTING ON QUALITY AND SENSORY ATTRIBUTES OF OAT FLAKES AND BRAZIL NUTS INTENDED FOR USE IN FUNCTIONAL MUESLI

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The quality of functional muesli depends on its product stability and sensory appeal. This study examined the effects of toasting temperature and time on the sensory characteristics, moisture content, and lipid stability of gluten-free oat flakes and Brazil nuts (*Bertholletia excelsa*) to determine optimal processing conditions. Oat flakes were toasted at 120.0, 150.0, and 180.0 ± 0.5 °C and Brazil nuts at 120.0, 130.0, 140.0 and 150.0 ± 0.5 °C for 5, 10, 15, and 20 min. Sensory attributes (appearance, aroma, flavor, and texture) were evaluated, and moisture content was determined. Toasting significantly influenced sensory quality ($p < 0.05$); oat flakes achieved the highest sensory scores at 180.0 ± 0.5 °C for 5 min, exhibiting a golden-brown color, crisp texture, and balanced flavor. Brazil nuts showed optimal sensory quality at 140.0 ± 0.5 °C for 15 min, with enhanced nutty aroma, flavor, color, and crispness. Moisture content decreased with increasing temperature and toasting time, reaching optimal levels of 3-5% for oat flakes and 0.5-0.8% for Brazil nuts. The peroxide value of Brazil nuts increased with higher temperatures and longer toasting times, rising from 1.12 meq O_2 kg^{-1} in fresh nuts to 3.75 meq O_2 kg^{-1} at 150.0 ± 0.5 °C for 20 min, indicating accelerated lipid oxidation under excessive heating. These results demonstrate the importance of carefully controlling toasting conditions to balance sensory quality with lipid stability. Moderate temperatures or shorter toasting times are recommended for producing functional muesli with high sensory appeal, stable moisture content, and preserved nutritional value.

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POSTER PRESENTATION

QUALITY PROFILE OF PLAIN AND LEMON-FLAVORED GOAT'S MILK KEFIR DURING SHELF-LIFE

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The global probiotic food market is rapidly growing, with Europe valued at about 14 billion USD in 2025, largely driven by fermented dairy foods such as yogurt and kefir. Kefir is a fermented probiotic drink produced from animal or plant milks through combined lactic acid and alcoholic fermentation, and goat's milk kefir is notable for its high nutritional quality and good digestibility. This study aimed to evaluate the physicochemical, microbiological, and textural characteristics of goat's milk kefir during refrigerated storage, and to compare plain and lemon-flavored varieties. while simultaneously conducting a sensory evaluation to assess consumer preferences between them.

Two kefir types were produced: a control (plain) and a lemon-flavored kefir obtained by adding 1% (v/v) lemon extract to the milk and kefir grains before fermentation, to enhance flavor and potentially affect fermentation dynamics. Fermentation was carried out at 20 °C for 24 h using a grains/milk ratio of 0.9%, followed by storage at 4 °C. Over 13 days, pH, titratable acidity, syneresis, proteolysis, firmness, viscosity, consistency, and counts of lactic acid bacteria and mesophilic microorganisms were monitored, while sensory evaluation was performed on samples stored up to 2 days. Data were analyzed using linear models and variance analysis, with graphical representations generated in R.

Lemon-flavored kefir maintained a lower pH (around 4.0), which favored pathogen inhibition, reduced proteolysis, and improved textural stability. Both formulations showed similar firmness and cohesiveness, but the lemon-flavored kefir exhibited higher viscosity and consistency, providing a better mouthfeel and higher consumer acceptability. Microbiological analysis showed slightly higher lactic acid bacteria and mesophile counts in the plain kefir, while remaining within desirable probiotic levels for both products. Sensory results confirmed a significant preference for the lemon-flavored kefir ($p<0.05$). Overall, lemon-flavored goat's milk kefir combined favorable sensory properties with stable physicochemical and microbiological quality during 15 days of refrigerated storage, highlighting its potential as a value-added probiotic dairy product and a promising target for further optimization in industry.

References

Akan, S. (2020). Impact of storage time on the content of kefir. Eurasian Journal of Food Science and Technology, 4(2):82-90

Arroum et al., (2023). Camel's kefir milk: Optimisation of processing conditions. Journal of Camel Practice and Research, 30, 221--227. https://doi.org/10.5958/2277-8934.2023.00029.2

Ozcan et al., (2018). The shelf life characteristics of plain and fruit flavored kefir: Microbiological and techno functional properties. Journal of Animal Husbandry and Dairy Science, 2:918. https://doi.org/10.22259/2637-5354.0204003

Solanki et al., (2023). Shelf-life study of fortified sweetened milk kefir during storage. The Pharma Innovation Journal, 12(2): 2514-2521

Tratnik et al., (2006). The quality of plain and supplemented kefir from goat's and cow's milk. International Journal of Dairy Technology, 59(1), 40-46. https://doi.org/10.1111/j.1471-0307.2006.00236.x

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POSTER PRESENTATION

A COMPREHENSIVE FOOD SAFETY INDICATOR - APPLICATION TO ALTERNATIVE PROTEIN FOODS

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At present, the food safety domain lacks an inclusive and flexible indicator that enables a comprehensive overview of the safety performance of foods. In light of current, sustainability-oriented food consumption trends, such an indicator is required to enable more proactive food safety evaluations. This study proposes a comprehensive food safety indicator, which draws on a semi-quantitative approach to allocate foods with a food safety score, addressing the presence of contaminants and microbial hazards as well as allergenic potential. For validation, it is applied to selected foods, in this case alternative and traditional protein based foods. The results showed that when combining considerations on potential contamination and allergenicity, alternative protein foods performed better than traditional ones, allowing for differentiation among foods. In the future, the food safety indicator can be used for evaluating the effect of future transitions on food safety. Also, it could be integrated with those of nutrition and environmental impact, to include food safety in global sustainability estimates.

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POSTER PRESENTATION

ENHANCING SUSTAINABLE INNOVATIVE FOOD SYSTEMS: AN ASSESSMENT OF POST-HARVEST HANDLING AND FOOD SAFETY MANAGEMENT IN GWAGWALADA AREA COUNCIL, ABUJA

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Sustainable food security in Nigeria's Federal Capital Territory is currently undermined by systemic inefficiencies in post-harvest management. This study investigates the food safety protocols and handling practices of agricultural produce and livestock in the Gwagwalada Area Council. Using a mixed-methods approach, including structured questionnaires, stakeholder interviews, and visual ethnographic assessments, the research identified critical "hotspots" for food contamination and loss. Findings reveal that 30% of producers rely on rudimentary open-air sun-drying on bare soil (as seen in Image 1), exposing crops to mycotoxins and environmental pollutants. Furthermore, the transition of livestock products from abattoirs to markets lacks cold-chain infrastructure, leading to rapid microbial deterioration and reduced marketability. Urban grazing and proximity of livestock to unsanitary environments (Image 2) further exacerbate zoonotic risks. While traditional preservation methods are intended to extend shelf life, they currently fail to meet international safety standards. The study concludes that transitioning to a sustainable food system in Abuja requires a triple-helix innovation model: integrating low-cost solar-drying technologies, decentralized refrigeration (Cold-Hubs), and rigorous enforcement of Good Agricultural Practices (GAP). These interventions are essential to reduce food waste, enhance nutritional quality, and improve the economic resilience of smallholder farmers.

References

Flanders Investment and Trade (2020). The Agriculture and Food Industry in Nigeria. Market Report.

FAO (2021). The State of Food and Agriculture: Making food systems more resilient to shocks and stresses. * ISEKI-Food Association. Integrating Food Science and Engineering Knowledge Into the Food Chain.

•https://ebonyheraldnewsonline.com.ng/addressing-post-harvest-losses-and-improving-agric-information-dissemination-in-farming-communities/

https://ebonyheraldnewsonline.com.ng/investment-in-storage-systems-key-to-reducing-post-harvest-losses-supporting-farmers-by-michael-adedotun-oke/

https://dailytrust.com/experts-guide-tinubu-on-plan-to-revive-commodity-boards-storage/

https://postharvestinstitute.illinois.edu/wp-content/uploads/2017/04/PHL2015PROGRAM.pdf

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POSTER PRESENTATION

EVALUATING THE ANTIMICROBIAL POTENTIAL OF SUPERNATANTS FROM DAIRY-ORIGIN LACTIC ACID BACTERIA: A SYSTEMATIC META-REGRESSION STUDY

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Dairy product contamination with *Listeria monocytogenes*, *Salmonella enterica*, and *Staphylococcus aureus* is frequently linked to cheese-related outbreaks. Indigenous lactic acid bacteria (LAB) have been sought as producers of novel antimicrobial compounds for use as bioprotective cultures. This meta-analysis evaluated the antagonistic effects of LAB isolated from dairy products against these pathogens.

The screening of articles focused on research published between 2000 and 2022, written in English or Portuguese, specifically concerning the activity of milk-origin LAB. The inclusion criteria were: the identification of strains at the species level, detailed measurement of inhibition diameters (ID) in millimeters, and description of sample sizes (N). Then, meta-regression models were generated to estimate the impact of pathogen type, LAB genus, assay type, pH, incubation time, and inoculum volume as moderators influencing the ID results.

The meta-analysis included 35 studies, totaling over 500 observations of LAB as supernatants, cell-free lysates, or bacteriocins. *Enterococcus* strains showed the highest inhibition against *L. monocytogenes* (15.90 ± 2.14 mm), while *Lacticaseibacillus* was most effective against *S. aureus* (11.89 ± 0.57 mm). Well diffusion tests outperformed spot and disk tests, and more acidic supernatants produced significantly higher IDs ($p < 0.001$). A significant inverse association was found between the concentration of the inoculated pathogen and the measured ID; for instance, at 8 log CFU/mL, the ID was 12 mm. Moreover, a direct association was observed between incubation duration and ID, e.g., at 72 hours, inhibition values tended to exceed 20 mm.

Overall, indigenous LAB demonstrate remarkable antimicrobial activity, especially against *L. monocytogenes*. These findings highlight their potential as natural bioprotective agents in artisanal and industrial dairy production. Furthermore, they provide useful benchmarks for optimizing LAB selection to reduce reliance on chemical additives.

References

Fernandes, N., Loforte, Y., Cadavez, V., & Gonzales-Barron, U. (2024). Susceptibility of Foodborne Pathogens to Milk-Origin Lactic Acid Bacteria Supernatants: A Comprehensive Meta-Regression Study. Foods, 13(16), 2635. https://doi.org/10.3390/foods13162635

Loforte, Y., Fernandes, N., de Almeida, A. M., Cadavez, V., & Gonzales-Barron, U. (2025). A Meta-Analysis on the In Vitro Antagonistic Effects of Lactic Acid Bacteria from Dairy Products on Foodborne Pathogens. Foods, 14(6), 907. https://doi.org/10.3390/foods14060907

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POSTER PRESENTATION

UNDERSTANDING PERCEPTIONS AND BELIEFS OF PARENTS OF YOUNG CHILDREN IN RELATION TO EMERGING FOOD SAFETY RISKS: AN INTERVIEW STUDY IN FRANCE, GERMANY, HUNGARY, AND THE UK

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Climate change is a systemic "threat multiplier" for Europe's food systems, creating new food safety hazards and intensifying existing ones. These new and emerging risks make clear communication with the public more difficult, and it remains unclear whether vulnerable groups---such as parents of young children---experience or interpret these risks differently than less vulnerable people. This study examines how parents of children aged 0--5 in the UK, France, Germany, and Hungary (n=20 per country) perceive and respond to climate-related food-safety risks and what this means for future risk-communication policy and practice.

Current food safety regulations have tended to focus mainly on food safety risks with which people are familiar. Examples include microbial hazards associated with inappropriate food handling practices. Climate-related events---including heat, flooding, and drought---may result in novel and unfamiliar risks, which have been recognised in both EFSA's CLEFSA framework (2020) and the FSA's Climate Adaptation Report (2025), where "static" regulatory controls for increasingly dynamic risks have been identified, the need for more adaptive approaches (EU-Commission, 2025; Parry et al., 2019). There is evidence that policy responses remain fragmented (Jensen et al., 2020), and climate change may often be framed as a broad "sustainability" issue rather than a direct public health concern (World Economic Forum, 2024).

Previous research shows (Sari et al., 2025) that citizens may not consider "systemic" food safety risks as being relevant to them. As people may perceive long-term climate impacts as being distant and invisible, consumers may underestimate their relevance and risks to themselves ("optimistic" or "green" bias). It is therefore important to test approaches that increase the relevance of climate change-related risks to individuals, including potentially vulnerable groups. In this case study approach, we will test the hypothesis that parents of children aged 0--5 require communication tailored, actionable, and empowering, enabling them to identify emerging risks, reduce optimistic bias, and provide insights from lived experience regulatory systems.

References

EFSA, Maggiore, A., Afonso, A., Barrucci, F., & Sanctis, G. D. (2020). Climate change as a driver of emerging risks for food and feed safety, plant, animal health and nutritional quality. EFSA Supporting Publications, 17(6), 1881E. https://doi.org/https://doi.org/10.2903/sp.efsa.2020.EN-1881

EU-Commission. (2025). Eurobarometer 550: Food safety in the European Union. EU Commission. 2025 Eurobarometer on Food Safety in the EU | EFSA

Jensen, A., Nielsen, H. Ø., & Russel, D. (2020). Climate Policy in a Fragmented World---Transformative Governance Interactions at Multiple Levels. Sustainability, 12(23). https://doi.org/10.3390/su122310017

Parry, L., Radel, C., Adamo, S. B., Clark, N., Counterman, M., Flores-Yeffal, N., Pons, D., Romero-Lankao, P., & Vargo, J. (2019). The (in)visible health risks of climate change. Social Science & Medicine, 241, 112448. https://doi.org/https://doi.org/10.1016/j.socscimed.2019.112448

Sari, N. H., Feliciano, R. J., Orszagh, E., Moriceau, N., Benighaus, L., Reale, F., Dendler-Rafaeld, L., Kasza, G., Szakos, D., & Frewer, L. J. (2025). Citizen preferences for risk communication associated with emerging food risks linked to climate change. Journal of Risk Research, 28(8), 893-911. https://doi.org/10.1080/13669877.2025.2553851

Reframing climate change as a human problem, not planetary | World Economic Forum

POSTER PRESENTATION

META-ANALYSIS ON THE EFFECT OF PLANT EXTRACTS AS A POST-PROCESSING INTERVENTION TO REDUCE CAMPYLOBACTER CONCENTRATION IN POULTRY MEAT

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Campylobacter on poultry meat remains a major food-safety challenge, and there is increasing interest in natural, plant-derived antimicrobials as complementary post-harvest controls. We systematically reviewed the evidence and quantified their effectiveness in reducing Campylobacter on poultry meat, while identifying key drivers of variability. A PRISMA-guided search was performed in Scopus (1995--2024). From 4,080 records, 74 studies were retained for qualitative synthesis and standardized data extraction. Eligibility for meta-analysis required comparable quantitative outcomes (log CFU/g or equivalent) with a control group and sufficient reporting; 3 studies met these criteria, providing 196 effect-size observations. Random-effects meta-regression was used to estimate log reductions and explore moderators relevant to practical application (sample weight, applied concentration, storage time, and inoculum level in challenge tests). Overall, plant extracts were associated with a mean reduction in Campylobacter (estimate 1.493 log; SE 0.563; $p = 0.008$). In univariate moderator analyses, larger sample weights, higher applied concentrations, and longer storage times were associated with greater log reductions (all $p < 0.001$), whereas higher inoculum levels were associated with smaller reductions ($p = 0.036$). In the multivariable plant-extracts model, sample weight and extract concentration remained significant moderators ($p < 0.001$), whereas storage time was not ($p = 0.213$), although a slight time-related pattern was observed for cinnamaldehyde at >80 h. Although the direction of effects was consistent with dose dependence, the quantitative evidence base remains small (three primary studies) and heterogeneous. Overall, these findings support the potential of plant-derived antimicrobials to reduce Campylobacter on poultry meat and to complement established hygiene and processing controls. More standardized, industry-relevant trials - reporting dose, contact time, temperature, baseline loads, and sensory/regulatory constraints - are needed to confirm robustness and support implementation-oriented recommendations.

References

EFSA Panel (BIOHAZ) Scientific Opinion on Quantification of the Risk Posed by Broiler Meat to Human Campylobacteriosis in the EU. EFSA Journal 2010, doi: 10.2903/j.efsa.2010.1437.

Haddaway, N.R.; Page, M.J.; Pritchard, C.C.; McGuinness, L.A. PRISMA2020 : An R Package and Shiny App for Producing PRISMA 2020- compliant Flow Diagrams, with Interactivity for Optimised Digital Transparency and Open Synthesis. Campbell Systematic Reviews 2022, 18, e1230, doi:10.1002/cl2.1230.

Havelaar, A.H.; Kirk, M.D.; Torgerson, P.R.; Gibb, H.J.; Hald, T.; Lake, R.J.; Praet, N.; Bellinger, D.C.; de Silva, N.R.; Gargouri, N.; et al. World Health Organization Global Estimates and Regional Comparisons of the Burden of Foodborne Disease in 2010. PLoS Med 2015, 12, e1001923, doi: 10.1371/journal.pmed.1001923.

Higgins, J.P.T.; Thompson, S.G. Quantifying Heterogeneity in a Meta- analysis. Statistics in Medicine 2002, 21, 1539--1558, doi:10.1002/sim.1186.

Loretz, M.; Stephan, R.; Zweifel, C. Antimicrobial Activity of Decontamination Treatments for Poultry Carcasses: A Literature Survey. Food Control 2010, 21, 791--804, doi: 10.1016/j.foodcont.2009.11.007.

Micciche, A.; Rothrock, M.J.; Yang, Y.; Ricke, S.C. Essential Oils as an Intervention Strategy to Reduce Campylobacter in Poultry Production: A Review. Front. Microbiol. 2019, 10, 1058, doi:10.3389/fmicb.2019.01058.

Posit Team. RStudio Integrated Development Environment for R. Posit Software, PBC, Boston, MA. USA Available online: https://www.scirp.org/reference/referencespapers?referenceid=3810421 (accessed on 13 October 2025).

Shrestha, S.; Wagle, B.R.; Upadhyay, A.; Arsi, K.; Upadhyaya, I.; Donoghue, D.J.; Donoghue, A.M. Edible Coatings Fortified With Carvacrol Reduce *Campylobacter Jejuni* on Chicken Wingettes and Modulate Expression of Select Virulence Genes. Front. Microbiol. 2019, 10, 583, doi:10.3389/fmicb.2019.00583.

Shrestha, S.; Wagle, B.R.; Upadhyay, A.; Arsi, K.; Donoghue, D.J.; Donoghue, A.M. Carvacrol Antimicrobial Wash Treatments Reduce *Campylobacter Jejuni* and Aerobic Bacteria on Broiler Chicken Skin. Poultry Science 2019, 98, 4073--4083, doi:10.3382/ps/pez198

Viechtbauer, W. Conducting Meta-Analyses in R with the Metafor Package. J. Stat. Soft. 2010, 36, doi:10.18637/jss.v036.i03.

World Health Organization; Food and Agriculture Organization of the United Nations Risk Assessment of Campylobacter Spp. in Broiler Chickens: Technical Report. 2009.

Zakariene, G.; Serniene, L.; Malakauskas, M. Effects of Lactic Acid, Linalool and Cinnamaldehyde against *Campylobacter Jejuni* in Vitro and on Broiler Breast Fillets. 2015, 72, 45--52.

POSTER PRESENTATION

BEYOND SORBATE: STRUCTURAL AND MICROBIAL STABILITY OF A CLEAN-LABEL SALTED CARAMEL FILLING

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Clean-label reformulation of high-solids bakery fillings presents a dual challenge: ensuring microbial stability while maintaining structural functionality. This study evaluated the replacement of potassium sorbate with a natural preservation system consisting of red fruit extract and tapioca starch rich in sorbic acid (compound P, 0.5%) in an industrial salted caramel cream filling. Three formulations were produced: a clean-label formulation (P), a sorbate control (C+), and a preservative-free control (C−). Samples were stored for 180 days at 22 °C and 62% relative humidity and periodically analyzed for microbiological quality (TVC, yeasts and molds, aerobic and anaerobic spore-formers), physicochemical parameters (pH, water activity, °Brix), color (CIELab) and rheological behavior (consistency index K and flow behavior index n).Yeasts and molds were detected only in the preservative-free control at the end of storage, confirming that low water activity alone (~0.80) was insufficient to ensure microbial stability. Both the C+ and the P formulation effectively suppressed microbial growth throughout the 180-day storage period, demonstrating equivalent antimicrobial efficacy. A gradual pH decrease of approximately one unit (≈5.6) was observed, while water activity and °Brix (~70) remained stable. Despite the dark caramel matrix masking visible differences, CIELab parameters varied mainly during the first 30 days, particularly luminosity ($L*$) in the clean-label formulation, before stabilizing. All formulations exhibited desirable pseudoplastic behavior. Initially, the C+ showed the highest n value (0.38), while the clean-label formulation presented the lowest (0.17), with high consistency indices (~10^7). After 120 days, all formulations converged to n ≈ 0.16. Although consistency decreased over storage (K from ~10^7 to ~10^3), shear-thinning behavior remained within technologically acceptable limits. Overall, the natural preservation system achieved antimicrobial performance comparable to potassium sorbate while maintaining functional rheology in a structurally demanding, high-solids matrix. These findings support clean-label preservation strategies as technologically viable solutions for industrial pastry fillings rather than merely reformulative alternatives

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POSTER PRESENTATION

MOLECULAR CHARACTERIZATION OF LISTERIA MONOCYTOGENES ISOLATES FROM FOOD AND CLINICAL SOURCES IN PORTUGAL

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Listeria monocytogenes is a gram-positive foodborne pathogen responsible for listeriosis, a severe disease with significant public health impact due to its high hospitalization and mortality rates among elderly, immunocompromised individuals and pregnant women. Infection is mainly associated with the consumption of ready-to-eat foods, including dairy, meat, fish and fresh produce. The species is genetically diverse and currently classified into four evolutionary lineages, fourteen serotypes and more than one hundred clonal complexes (CCs), some of which are widely distributed in Europe and worldwide.

This study aimed to characterize the population structure of *L. monocytogenes* isolates collected in Portugal from diverse sources, including cheese, "alheira" (traditional, smoked, and naturally fermented sausage originating from northern Portugal) and bakery processing facilities and respective environments, clinical cases and food products, all belonging to the Escola Superior de Biotecnologia culture collection. A total of 547 isolates were subjected to whole-genome sequencing using Illumina platforms following standard library preparation protocols.

The analysis revealed a structured clonal distribution dominated by a limited number of high-frequency lineages. Among food isolates, CC9 and CC121 accounted for nearly half of the strains. Additional CCs, including CC87, CC1, and CC2, were recurrent, while several others were detected at lower frequencies, reflecting substantial genetic diversity. Distinct distribution patterns were observed across food matrices, with CC1 widely distributed across sources, CC3 more frequently associated with meat and dairy environments, and CC9 and CC2 predominantly linked to bakery. Overall, the Portuguese *L. monocytogenes* population is shaped by matrix-associated clonal dynamics, with a restricted number of predominant lineages driving circulation within the food chain. These findings underscore the strategic value of integrated, lineage-informed genomic surveillance to enable early identification of emerging high-risk clones, improve source attribution, and support timely, targeted interventions - ultimately strengthening outbreak prevention and enhancing food safety risk mitigation at a national level.

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POSTER PRESENTATION

PSEUDOMONAS SPP. BIOFILM COATED MICROPLASTICS PROMOTE CAMPYLOBACTER JEJUNI SURVIVAL IN AEROBIC CONDITIONS

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Campylobacter jejuni is a leading bacterial human gastroenteritis worldwide. Despite its microaerobic physiology and limited tolerance to atmospheric oxygen, it is routinely exposed to oxygenated environments during poultry slaughter, processing, and subsequent handling. The poultry intestinal tract is the primary reservoir, with carcass contamination occurring during slaughter and cutting. Chilled storage promotes psychrotrophic communities on meat and packaging surfaces. They are often dominated by Pseudomonas spp., which may locally reduce oxygen availability and create transient microhabitats permitting survival of oxygen-sensitive bacteria. In our previous work, we also detected microplastics (MPs) on packaged chicken meat, suggesting their shedding from packaging and raising the possibility that MPs serve as mobile vectors for biofilm-mediated pathogen protection and transfer.

Thus, we investigated the effect of 24-hour Pseudomonas spp. biofilm pre-coated MPs on C. jejuni survival under microaerobic and aerobic conditions. Chicken-meat isolates of *Pseudomonas aeruginosa*, P. lundensis, and P. fragi were pre-coated on 5 mm MPs from commercial polyethylene terephthalate poultry packaging. Pre-coated or uncoated microplastics were co-incubated with C. jejuni under aerobic or microaerobic conditions, and viability was quantified by plate counts (CFU).

The benefit of Pseudomonas pre-coating on C. jejuni survival was limited to aerobic conditions. Under aerobic atmosphere, pre-formed biofilms on microplastics increased recovery of C. jejuni compared with uncoated particles. Under microaerobic conditions, C. jejuni remained viable on both pre-coated and uncoated microplastics, with negligible additional benefit from pre-coating; notably, no survival was detected in the presence of a P. aeruginosa biofilm. Pre-coated Pseudomonas spp. biofilms on MPs may act as oxygen-buffered shelters that allow C. jejuni persistence at time scales relevant to processing and storage. These findings indicate that MPs can act as biofilm-associated vectors, enabling pathogen survival under unfavourable conditions and facilitating transfer in food-processing environments.

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POSTER PRESENTATION

PREPARATION OF A SHORT-TERM FRESHNESS INDICATOR COMPOUNDING WITH ANTHOCYANINS.

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Intelligent packaging is an innovative technology that integrates sensing functions with traditional packaging systems, to monitor the condition of the packaged product in real-time. A colorimetric freshness sensor functions for food safety and waste reduction, and also contributes to the Sustainable Development Goals. In this study, a short-term freshness indicator label was prepared using a natural pigment (purple sweet potato anthocyanins, PPA) as the chromogenic substance, with oxidizing agents (ascorbic acid (AA) and hydrogen peroxide (H_2O_2)) to catalyze discoloration. The freshness indicator label was formed using a sensing reagent solution containing 3% PPA immobilized and dehydrated on a fabric paper substrate. A mixture of 0.5 M AA, 15% H_2O_2, and 5% glycerol was deposited onto the paper strip to initiate monitoring activity. The indication of freshness was then used to monitor ready-to-eat products, and the scope was visually determined according to the extent of color difference. The results showed that all PPA-containing indicators exhibited high sensitivity to both AA and H_2O_2, producing noticeable discoloration within 30--120 min, with the surface color of the labels gradually changing from pink to colorless, and the color difference (ΔE) values being greater than 5, demonstrating excellent chromogenic response and clear visual distinguishability. Additionally, a QR code-type sensor was prepared by stamping an ink formulated with 3% PPA, glycerol, and xanthan gum on paper. At the time for monitoring food freshness, a catalytic agent containing 0.5 M AA and 15% H_2O_2 was applied onto the sensor. The surface color change of the sensor led to the QR codes becoming unscannable within 120 minutes, providing a distinct visual warning. In conclusion, a chromogenic QR code label prepared by combining anthocyanins with ascorbic acid and hydrogen peroxide effectively indicates freshness for short-term applications, and is useful for monitoring ready-to-eat foods.

References

Gomes, V., Pires, A. S., Mateus, N., de Freitas, V., & Cruz, L. (2022). Pyranoflavylium-cellulose acetate films and the glycerol effect towards the development of pH-freshness smart label for food packaging. *Food Hydrocolloids*, *127*, 107501.

Rosales-Murillo, S. S., Sánchez-Bodón, J., Hernández Olmos, S. L., Ibarra-Vázquez, M. F., Guerrero-Ramírez, L. G., Pérez-Álvarez, L., & Vilas-Vilela, J. L. (2024). Anthocyanin-loaded polymers as promising nature-based, responsive, and bioactive materials. *Polymers*, *16*(1), 163.

Yun, D., Yong, H., Xu, F., Li, N., Guan, T., & Liu, J. (2025). Purple sweet potato anthocyanin-g-dialdehyde locust bean gum: An innovative polymeric colorant with good stability and application potential in food intelligent packaging. *Food Hydrocolloids*, *163*, 111121.

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POSTER PRESENTATION

EFFECTS OF HEATING METHOD ON CONTENT OF FURAN AND ITS DERIVATIVES IN TOMATO PRODUCTS

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Furan is a heterocyclic compound consisting of a five-membered aromatic ring with four carbon atoms and one oxygen atom. It can be generated in thermally processed foods, along with structurally related furan derivatives, through the thermal degradation or rearrangement of carbohydrates, thermal degradation of amino acids, and oxidation of ascorbic acid, polyunsaturated fatty acids, or carotenoids. Furan and furfuryl alcohol have been classified as Group 2B possible carcinogens by the International Agency for Research on Cancer (IARC), and several other furan derivatives have also been reported to exhibit potential carcinogenicity.

The objectives of this study were to establish an analytical method based on headspace solid-phase microextraction Arrow coupled with gas chromatography--tandem mass spectrometry (HS-SPME arrow GC-MS/MS) for tomato-based matrices, and to apply this method to investigate the effects of different processing conditions on the formation of furan and its derivatives in tomato products. Optimal extraction was achieved using a CAR/PDMS fiber at 40oC for 15 min. Separation and quantification were performed using GC-MS/MS equipped with an SH-I-5 Sil MS capillary column operated in multiple reaction monitoring (MRM) mode, enabling the separation of eleven furan compounds and one internal standard (d_4-furan) within 9 min.

Furan and its derivatives were detected in all tomato products prepared using both hot-break and cold-break processes, as well as in control samples. In tomato juice, higher levels of furan and its derivatives were observed in hot-break products compared to cold-break products. For tomato paste, long-term heating on a gas stove for 4 h resulted in higher furan levels than short-term heating using a double-jacketed kettle for 1.5 h. Tomato sauce samples were further classified into control, acidified (pH=3.7), and ascorbic acid--fortified groups. Acidification promoted furan formation, whereas the addition of ascorbic acid effectively suppressed the formation of furan and its derivatives.

Overall, controlling heating intensity and duration, avoiding low pH conditions, and appropriately supplementing ascorbic acid may effectively reduce the formation of furan and its derivatives in tomato products.

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POSTER PRESENTATION

FORMATION BEHAVIOR OF FURAN AND ITS DERIVATIVES AND N-NITROSAMINES IN JERKY UNDER DIFFERENT PROCESSING CONDITIONS AND FOOD ADDITIVE APPLICATIONS

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Processing contaminants formed during food manufacturing have become a critical issue affecting food quality and safety. Among these, furan and its derivatives and N-nitrosamines (NAs) are commonly found in thermally processed foods; many of these compounds are classified by the International Agency for Research on Cancer (IARC) as carcinogenic or potentially carcinogenic to humans. While previous research has largely focused on furans or NAs individually, there is a lack of systematic study regarding their simultaneous generation and co-occurrence behavior under actual food processing conditions. In this study, jerky was selected as a model food matrix because its manufacturing process involves prolonged heating, low water activity, and the use of various food additives. Analytical methods previously developed for furan determination in different food matrices were first evaluated and optimized for jerky. Solid-phase microextraction (SPME) at 40°C for 15 min was identified as the most suitable extraction condition for jerky. The effects of different food additives applied individually or in combination, together with varying roasting temperatures and heating durations, on the formation of furan and its derivatives as well as NAs were systematically investigated. Chemical analysis was performed using SPME arrow coupled with gas chromatography--tandem mass spectrometry (GC--MS/MS). A CAR/PDMS SPME arrow combined with an SH-I-5Sil-5MS capillary column (30 m × 0.25 mm ID, 0.25 μm film thickness) enabled the simultaneous determination of nine NAs and eleven furan-related compounds within 15--16 min. Analysis of commercial jerky samples revealed detectable levels of several NAs and furan-related compounds. The results showed that processing temperature and heating duration were key factors influencing the formation of both furan and NAs, with higher temperatures and longer heating times leading to increased contaminant levels. The addition of antioxidants was associated with reduced NAs formation, whereas curing agents promoted NAs generation. These findings demonstrate the complex roles of food additives during thermal processing and provide useful insights for managing process contaminants to enhance food safety and quality.

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POSTER PRESENTATION

HIGH-PRESSURE PROCESSING CONTROLS SPOILAGE AND MICROBIOTA IN REFRIGERATED READY-TO-EAT RAW SOY SAUCE MARINATED CRAB

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This study aimed to evaluate the microbial inactivation efficacy and preservation performance of high-pressure processing (HPP; 300 and 600 MPa for 5 min) applied to ready-to-eat raw soy sauce--marinated crab (*Plagusia squamosa*). The results demonstrated that treatment at 600 MPa effectively reduced aerobic plate counts (APC), psychrotrophic bacteria counts (PBC), and Enterobacteriaceae to below the detection limits. Moreover, during refrigerated storage at 4 °C, only the 600 MPa--treated samples maintained effective suppression of these microorganisms for up to 15 days. In addition, both 300 and 600 MPa treatments significantly retarded the formation of total volatile basic nitrogen (TVB-N) throughout refrigerated storage. Based on the Taiwan Food and Drug Administration (TFDA) guideline requiring APC levels below 5.0 log CFU/g for ready-to-eat raw seafood products, the 600 MPa treatment extended the product shelf life to 12 days. High-throughput sequencing (HTS) analysis further revealed that HPP markedly reduced species richness and simplified the microbial community structure. By selectively suppressing spoilage-associated microorganisms, HPP played a critical role in delaying crab meat spoilage. Overall, HPP at 600 MPa for 5 min exhibited superior non-thermal pasteurization efficacy, effectively enhancing both the storage stability and food safety of ready-to-eat raw soy sauce--marinated crab.

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POSTER PRESENTATION

MICROBIOLOGICAL QUALITY AND OCCURRENCE OF LISTERIA MONOCYTOGENES IN PORTUGUESE READY-TO-EAT MEAT PRODUCTS

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Listeria monocytogenes is a resilient gram-positive foodborne pathogen capable of surviving a wide range of environmental stresses, including low temperatures, acidic conditions and high salt concentrations. Its persistence in food-processing environments and ready-to-eat (RTE) foods represents a significant public health concern due to its ability to cause listeriosis, a severe foodborne disease particularly affecting pregnant women, neonates, the elderly and immunocompromised individuals. Continuous monitoring of RTE foods is therefore essential to support food safety management. This study assessed the occurrence of L. monocytogenes and the microbiological quality of Portuguese RTE meat products. A total of 68 samples were collected from supermarkets. Samples were analysed for the presence and enumeration of L. monocytogenes and lactic acid bacteria, together with standard microbiological indicators of process hygiene, namely total aerobic mesophilic count, Enterobacteriaceae, *Escherichia coli* and coagulase-positive staphylococci. Analyses were performed according to relevant ISO standards. Results were interpreted following the Instituto Nacional de Saúde Doutor Ricardo Jorge guides, with most products classified as category 1C (RTE foods subjected to post-processing handling). Microbiological results showed considerable variability among products, particularly for total aerobic mesophilic counts, reflecting differences in handling and packaging practices. Lactic acid bacteria were frequently detected, especially in fermented products. *E. coli* was generally detected at low levels, with one sample exceeding the reference value, indicating possible hygiene deficiencies. Most samples complied with guide values for coagulase-positive staphylococci, although elevated counts were observed in a limited number of products. *Listeria monocytogenes* was detected in three out of 68 samples (4.4%), namely turkey bacon, paio do cachaço and smoked ham in cubes. Overall, the results highlight the importance of continued surveillance and targeted hygiene improvements during post-processing to ensure the microbiological safety of RTE meat products.

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POSTER PRESENTATION

FORMATION AND ACCUMULATION OF HYDROXYMETHYLFURFURAL DURING THE PRODUCTION AND STORAGE OF CARROT-BASED JUICE PRODUCTS

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The formation and accumulation of hydroxymethylfurfural in foods is a topical issue in modern scientific research, aimed at regulating the concentration of this compound in various food groups. Despite numerous studies, data on the HMF content in carrot juice products is lacking. The aim of the work: to establish the nature of the dependence of the formation and accumulation of hydroxymethylfurfural on various factors in order to assess the quality and safety of the processes of manufacturing and storing carrot-based juice products. During the work, standardized methods were used to determine the physicochemical parameters of vegetable raw materials and carrot-based juice products. The study identified changes in the concentration of HMF in juice products during storage under controlled standard conditions and heating to 100--120°C. It was determined that enrichment with carbohydrates (sucrose, glucose, and fructose) and organic acids (ascorbic and citric) during simultaneous heat treatment leads to the accumulation of HMF in carrot juice products. The study yielded new data on the protein and carbohydrate composition of fresh carrots and carrot juice products; the content of hydroxymethylfurfural in commercial carrot juice samples; the influence of ingredient composition and initial hydroxymethylfurfural content on the level of its accumulation during heat treatment of carrot juice products; and the dominant influence of sucrose compared to other carbohydrates and citric acid compared to ascorbic acid on hydroxymethylfurfural formation during heat treatment of carrot juice products.

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Green and sustainable packaging solutions

POSTER PRESENTATION

BEYOND BIOPLASTICS: EXPLORING THE LOW-TOXIC BACILLUS CEREUS 1.2_25 FROM MILK THISTLE SEEDS FOR THE PRODUCTION OF VALUABLE METABOLITES

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Bacillus cereus is a versatile producer of biologically active metabolites with promising roles in biocontrol, biofertilization, bioremediation, and sustainable production of valuable biochemicals. Among its notable applications, this bacterium has emerged as a promising candidate for the production of bioplastics, specifically polyhydroxyalkanoates (PHAs), such as polyhydroxybutyrate (PHB). These biodegradable polymers hold substantial promise for use in medicine, agriculture, and packaging. The studied **Bacillus cereus** strain 1.2_25 was isolated from seeds of milk thistle (**Silybum marianum**). On November 14, 2025, it was deposited in the Polish Collection of Microorganisms (PCM) at the Ludwik Hirszfeld Institute of Immunology and Experimental Therapy, Polish Academy of Sciences, Wrocław, Poland, under accession number B/00576. Detailed molecular analysis confirmed a favourable safety profile for this isolate. PCR-based assays did not detect genes encoding the hemolytic toxin HBL or the cytotoxin K (cytK). Furthermore, no genes responsible for cereulide synthesis (the emetic toxin) were found. However, the analysis confirmed the presence of genes encoding the non-hemolytic enterotoxin NHE. Metabolic profiling revealed an intensive production of organic acids under aerobic conditions, a phenomenon indicative of overflow metabolism. This metabolic adaptation occurs when partially oxidised metabolites are excreted despite the presence of oxygen, typically due to an imbalance between carbon uptake rate and the capacity of the tricarboxylic acid (TCA) cycle or the electron transport chain. The key intermediate in this process is acetyl-CoA, which also serves as the precursor for polyhydroxybutyrate (PHB) biosynthesis. Consequently, the observed organic acid excretion indicates a substantial intracellular pool of acetyl-CoA that could be redirected. This study aimed to comprehensively profile the metabolite profiles of **Bacillus cereus** strain 1.2_25 cultivated under nitrogen-limited conditions with excess carbon. Metabolite identification and characterisation were performed using Fourier-transform infrared spectroscopy (FT-IR) and high-performance liquid chromatography (HPLC).

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POSTER PRESENTATION

DEVELOPMENT OF CHITOSAN NANOCOMPOSITE FILMS INCORPORATING PHYTOSOMES FOR ACTIVE FOOD PACKAGING APPLICATIONS

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Chitosan, a natural copolymer of glucosamine and N-acetyl glucosamine, is a promising material for sustainable food packaging, offering an alternative to conventional plastics due to its bioactivity, film-forming ability and natural origin.

This study focuses on the development of chitosan-based nanocomposite films incorporating phytosomes loaded with orange essential oil and phenolic extract from rose petals. The essential oil was added at concentration of 12 mg/mL, while the phenolic extract was incorporated at 1000 ppm. Phytosomes were prepared using a novel heating-based method with glycerol as an environmentally friendly solvent, enabling food-grade, solvent-free encapsulation of bioactive compounds. The active-loaded phytosomes were successfully embedded into the chitosan matrix, producing uniform, transparent, and flexible films. Three types of films were produced i.e., chitosan (CH), chitosan enriched with essential oil (CH-EO) and chitosan enriched with rose petals phenolic extract (CH-RE).

The mechanical properties of the developed films were determined in tensile strength testing protocols. Tensile strength was found to be 2.261, 0.859 and 0.897 MPa for CH, CH-EO and CH-RE films, respectively. On the other, hand the enrichment of chitosan films with essential oil led to a significant decrease in the elastic modulus from 5.172 to 1.968 MPa while the enrichment with phenolic extract did not have a statistically significant effect. Moisture absorption behavior was determined with the development of water sorption isotherm at 25°C, fitted with the GAB model. The antimicrobial activity of the developed films was evaluated against two major foodborne pathogens, *Staphylococcus aureus* and *Escherichia coli*, according to the BS ISO 22196:2011 protocol. Results demonstrated that all types of chitosan films effectively inhibited the growth of both pathogens, indicating their potential for active food packaging applications.

The resulting nanocomposite films demonstrated mechanical robustness, controlled moisture uptake, enhanced functional properties, and significant antimicrobial activity. This approach offers a sustainable and scalable strategy for next-generation packaging materials capable of improving food preservation, shelf-life extension, and microbial safety.

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POSTER PRESENTATION

BIO-COATED FOOD CONTACT CARDBOARD FOR FROZEN COD: SAFETY, ANTIMICROBIAL ACTIVITY AND SHELF-LIFE PERFORMANCE

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Corrugated cardboard is an attractive and sustainable alternative to plastic for frozen food packaging, yet its limited barrier properties, structural resilience and potential migration of substances to the food items remain the biggest concerns for its adoption. This work evaluates a bio-based coating composed of a mixture of beeswax and chitosan applied to cardboard intended for food contact, addressing both safety and preservation performance within the context of sustainable food systems. The biological activity of the coating itself was first characterized through cytotoxicity (IC50) and antimicrobial assays, including minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) determination. To assess its practical relevance, a shelf-life study was designed and is being conducted, comparing uncoated and coated cardboard packaging at 4 storage points, initial freezing (T0, November), and every two months after at -18° C (T1, January; T2, March; T3, May), with the objective of verifying the packaging's performance over the course of 1 year. Quality evaluation of the food samples includes microbiological counts, total volatile basic nitrogen (TVB-N), lipid oxidation (TBARS), pH, colorimetry, texture profile analysis (TPA), and sensory assessment. Results demonstrated measurable antimicrobial activity of the coating without evidence of harmful cytotoxicity transferring into the food item. After frozen storage, coated samples showed improved preservation indicators, with reduced microbial growth and slower formation of spoilage and oxidation markers, accompanied by better maintenance of texture. Sensory analysis, however, shows a slight decrease in quality, mostly due to the samples being very heterogeneous (frozen cod pieces), showing significant differences in colour even before freezing. Differences in physicochemical parameters support a beneficial effect during long-term frozen storage. Overall, the study explores and supports the feasibility of bio-coated cardboard as a lower-impact packaging solution capable of contributing to food product stability and waste reduction. The integration of a bio-based material with validated performance represents a good practical step towards more sustainable frozen food packaging systems.

References

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POSTER PRESENTATION

DEVELOPMENT OF BIOPOLYMERS FROM MARINE RESOURCES FOR SUSTAINABLE SOLUTIONS

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Greenhouse gas emissions, marine pollution, and the accumulation of persistent plastic waste due to the slow degradation of fossil-based polymers are among the most significant environmental impacts associated with conventional plastics. Increasing market demand, regulatory pressures, and environmental concerns have intensified the need to develop sustainable alternatives, particularly for applications in food and fresh produce packaging.

In this context, the present work investigates the development of biodegradable and bioactive plant pots derived from marine resources, promoting the direct use of algal biomass and the valorisation of industrial by-products within a circular economy framework. Several macroalgae species were evaluated, including cultivated species (Ulva sp., *Porphyra dioica*, *Gracilaria gracilis*, *Chondrus crispus*, *Fucus vesiculosus*, *Codium tomentosum*) and the wild invasive species *Sargassum muticum*, with respect to polysaccharide type and content. Different extraction methodologies were applied according to the polysaccharide class targeted (e.g., agar, carrageenans, ulvans, and alginates), resulting in extraction yields ranging from 5% (agar) to 26% (sulphated polysaccharides).

Mussel shell waste from the aquaculture industry, rich in calcium carbonate, was incorporated with algal biomass and algae-derived biopolymers to produce biodegradable composite materials. Preliminary results identified promising formulations containing whole brown macroalgae, sodium alginate, and ground mussel shell, which were suitable for the production of plant pots via thermoforming (Figure 1). These findings highlight the potential of marine-based materials as sustainable alternatives for packaging and horticultural applications.

References

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POSTER PRESENTATION

TWO-COMPONENT SYSTEMS FOR THE ENCAPSULATION OF CARVACROL BY SPRAY DRYING: OPTIMIZATION OF PROCESS PARAMETERS

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Active packaging materials have emerged as an answer to growing food losses caused by microbial contamination and oxidation by enabling the controlled release of active ingredients, thereby extending shelf life. With increasing demand for natural active ingredients, carvacrol is notable for its antioxidant and antimicrobial properties. However, its volatility and sensitivity to external conditions limit its effectiveness. Encapsulation of carvacrol by spray drying (SD) is an effective way to address this. Optimizing the SD process, particularly the choice of wall material and drying temperature, is essential for maximum efficiency. β-cyclodextrin (β-CD) chemical structure makes it favorite for encapsulating non-polar compounds like carvacrol, but the incorporation of gum arabic (GA) or carboxymethyl cellulose (CMC) could further enhance process yield and powder stability, and increase encapsulation efficiency. The aim was to examine the effect of SD conditions on carvacrol encapsulation and identify the optimal parameters for producing powders with desirable properties. β-CD was mixed with either GA or CMC in 1:3, 1:1, and 3:1 ratios and then combined with carvacrol (1:1). The mixtures were spray-dried at 140, 170, and 200 °C. Process yield, moisture content, and carvacrol retention were evaluated for each formulation. Statistical analysis was performed to determine the optimal parameters. Process yield ranged from 59.2 to 81.3%, moisture content from 2.4 to 8.4%, and carvacrol retention from 7.4 to 38.7%. β-CD:GA mixture showed a higher process yield, while the β-CD:CMC combination resulted in lower moisture content. However, both mixtures exhibited similar carvacrol retention. The highest β-CD proportion (3:1) in both mixtures yielded the best results, with 75.1%, process yield, 33.6% carvacrol retention and 3.9% moisture content. Notably, 140 °C was sufficient to produce a powder with desirable properties. SD effectively encapsulated carvacrol, with β-CD:GA and β-CD:CMC mixtures both showing promising results. The optimal conditions involved a 3:1 β-CD ratio, producing the highest process yield, carvacrol retention, and lowest moisture content at 140 °C. These results demonstrate the potential of these wall materials in enhancing carvacrol encapsulation, for use in active food packaging.

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POSTER PRESENTATION

INFLUENCE OF ALGINATE COATINGS WITH PLANT EXTRACTS AND NISIN ON THE COLOUR OF CHICKEN MEAT

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Films and coatings are being widely studied to improve the quality and preservation of fresh meat products. This study aimed to evaluate the effectiveness of sodium alginate (SA) coatings enriched with plant extracts and nisin in preserving the surface colour of chicken breast during storage.

SA (1%) and glycerol (0.5 %) were mixed in distilled water overnight. Then, laurel (LLE) and olive (OLE) freeze-dried extracts were dissolved in distilled water and added: LLE2% and OLE 1% + LLE 1% (MIX). Nisin was dissolved in 0.01 N HCl and added to the film-forming solution at 1%. Chicken breast pieces were coated by spraying, followed by cross-linking with CaCl~2~. Coated and uncoated (control) samples were packed and stored at 4 °C. Colour measurements were conducted over 13 days using a Minolta colorimeter. CIELab parameters L*, a*, and b* were recorded by reflectance measurements. The changes in the surface colour were measured by the Hunter total colour difference (Δ*E*), using the samples before treatment as the reference baseline for comparison. The coatings were treated as an integral part of the sample and were not removed.

Overall, L* values decreased gradually over time with no significant differences between groups. The a* values ranged from -1.29 (slightly greenish) to 2.28 (reddish) while b* values increased for LLE2% (before treatment: 10.7; after treatment: 16.2) and MIX samples (from 9.4 to 15.9), which probably influenced the colour (yellowish) of the coatings. In contrast, L* a* and b* parameters were similar between the control and nisin groups. At 0 days, Δ*E* values were higher for LLE2% and MIX samples. During the storage time, the differences were more pronounced in the control samples. On the last day of storage, the ΔE increase for control samples exceeded 5 units, while LLE2% and MIX showed increases of less than 3 units.

The results showed that the coatings were effective in minimising colour changes and maintaining the visual consistency of the samples over time. These results support the use of bio-based coatings with natural additives as a promising strategy for the preservation of chicken meat.

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POSTER PRESENTATION

SYNTHESIS OF FUNCTIONALIZED GRAPHITIC CARBON NITRIDE ASSISTED BY ULTRASOUND AS A FILLER FOR SUSTAINABLE FOOD PACKAGING

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The food industry struggles with fossil-fuel plastics' environmental impact due to their low biodegradability and waste issues. To address this, it develops competitive, sustainable alternatives by reinforcing biodegradable polymers with fillers to create green composites suitable for packaging applications.1 Graphitic carbon nitride (g-C3N4) is a non-metallic semiconductor that has been investigated for its photocatalytic properties. With a bandgap that enables effective visible light absorption, its high stability and non-toxicity make it a very promising semiconductor for bacterial inhibition2. Its composition allows it to generate electron-hole pairs that, upon recombination, produce reactive oxygen species (ROS) that oxidize the cell membranes of pathogenic bacteria and organic compounds3.

For instance, as reported by Ni et al. (2021)4 a bionanocomposite of chitosan and negatively charged g-C3N4 film could extend the shelf life of tangerines to 24 days. With an antimicrobial efficiency up to 99 % against *E. coli* and *S. aureus*, with 30% w/w. To incorporate this material into other biopolymeric matrices and reduce the required percentage, its dispersion and photocatalytic activity need improvement. This study evaluates a method that combines the thermopolymerization of a g-C3N4 precursor with an oxygen dopant, followed by ultrasound-assisted exfoliation. Thermal polymerization was carried out using two precursors, urea (CNU) and melamine (CNM), with varying NH_4HSO_4 proportions. The dispersions were characterized by SEM equipped with an EDX detector, and the particle size distribution was measured using dynamic light scattering (DLS).

The results showed that both precursors incorporated oxygen, which facilitates dispersion. The CNU sample produced smaller particles (D50 of 344 nm) and better colloidal dispersion than CNM (D50 of 409nm). This approach effectively and eco-friendly improves g-C_3N_4 dispersibility for incorporation into biopolymeric matrices like PHBV, enabling sustainable, light-activated antimicrobial food packaging.

References

(1) Koreshkov, M.; Antreich, S. J.; Bismarck, A.; Fritz, I.; Reimhult, E.; Takatsuna, Y.; Zirbs, R. Sustainable Food Packaging Using Modified SiO2 Nanofillers in Biodegradable Polymers. Mater. Chem. Front. 2024, 8 (16), 2754--2763. https://doi.org/10.1039/D4QM00206G.

(2) Sutharsan, M.; Senthil Murugan, K.; Narayanan, K.; Natarajan, T. S. Chitosan/Polyvinyl Alcohol/g-C3N4 Nanocomposite Film: An Efficient Visible Light-Responsive Photocatalyst and Antimicrobial Agent. Processes 2025, 13 (1), 229. https://doi.org/10.3390/pr13010229.

(3) Kang, S.; Fang, Z.; He, M.; Chen, M.; Gao, Y.; Sun, D.; Liu, Y.; Chen, M.; Dong, M.; Liu, P.; Cui, L. An Instant, Biocompatible and Biodegradable High-Performance Graphitic Carbon Nitride. J. Colloid Interface Sci. 2020, 563, 336--346. https://doi.org/10.1016/j.jcis.2019.12.021.

(4) Ni, Y.; Shi, S.; Li, M.; Zhang, L.; Yang, C.; Du, T.; Wang, S.; Nie, H.; Sun, J.; Zhang, W.; Wang, J. Visible Light Responsive, Self-Activated Bionanocomposite Films with Sustained Antimicrobial Activity for Food Packaging. Food Chem. 2021, 362, 130201. https://doi.org/10.1016/j.foodchem.2021.130201.

POSTER PRESENTATION

PHENOLIC MIGRATION FROM ACTIVE PACKAGING POLYLACTIC ACID/CINNAMON BARK OIL FILMS

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The growing demand for sustainable food packaging has driven interest in biodegradable materials with added functionality. Polylactic acid (PLA) is a promising bio-based alternative to conventional plastics but lacks intrinsic active properties. Incorporating natural phenolic-rich additives such as cinnamon bark oil (CBO) offers a strategy to enhance PLA functionality. This study investigated the phenolic migration behaviour, antioxidant activity, and UV-blocking performance of PLA/CBO films to evaluate their suitability for food-contact applications. PLA films containing 15% and 30% (w/w) CBO were prepared and characterised for physical, barrier, mechanical, optical, and chemical properties. Phenolic migration was assessed according to EU Regulation No. 10/2011 using aqueous (10% ethanol), acidic (3% acetic acid), and fatty (50% ethanol) food simulants over 30 days. Total phenolic release was quantified using the Folin-Ciocalteu assay, and migration kinetics were modelled. CBO incorporation did not significantly ($p \geq 0.05$) affect film thickness or water solubility, indicating good compatibility with the PLA matrix. Films containing 30% CBO exhibited excellent UV-shielding performance, blocking more than 99% of UV radiation at key wavelengths. Antioxidant activity increased significantly ($p < 0.05$) with CBO concentration, with DPPH and ABTS scavenging activities exceeding 93% and 99%, respectively. Phenolic migration followed an initial rapid release followed by diffusion-controlled behaviour, best described by exponential models. Migration was strongly dependent on simulant polarity, with the highest release observed in fatty food simulants. Films containing 15% CBO maintained migration levels below regulatory limits in aqueous and acidic conditions, indicating food-contact safety. Overall, PLA/CBO films demonstrate controllable phenolic migration, strong antioxidant activity, and effective UV protection, supporting their potential use as sustainable active packaging materials. This approach contributes to food quality preservation, shelf-life extension, and food security while aligning with Sustainable Development Goals.

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POSTER PRESENTATION

THE CHARACTERIZATION OF FOOD COATING FORMULATIONS BASED ON CARRAGEENAN, GELATIN AND CHITOSAN WITH ADDITION OF NATURAL BIOACTIVES FROM PLANTS

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The development and application of edible food coatings have emerged as a critical, eco-friendly strategy to tackle global food waste and increase its shelf-life. Approaches for development of edible coatings varies from matrix structuring, mechanisms of action as well as methods for enriching matrices with natural active ingredients. The aim of this work was to investigate how the matrix composition influence the retention and functionality of natural biobased compounds, as well as from the environmental stresses like UV light and oxygen. The glycerol was added to enhance the flexibility and elasticity of films, important feature upon the application but also that influences matrix structure and its barrier behaviour. Biopolymer matrices were formed from carrageenan combined with gelatin, or chitosan, with or without the addition of glycerol as plasticizer. The aim was to evaluate the naturally present non-food competitive plant - halophyte *Crithmum maritimum* and its essential oil, and with aromatic plant *Rosmarinus officinalis*. Produced formulations, aimed to be used as fish coatings, were tested for barrier performance (oxygen, carbon dioxide, nitrogen, water vapour and UV-VIS light), mechanical properties, antioxidant activity and total phenolic content, aimed also to serve for estimation of the retained bioactive compounds. The antioxidant activity was determined using FRAP and DPPH method. The results have shown that the addition of plant extracts and oil showed important antioxidant activity. The total polyphenol content and antioxidant activity in films with rosemary extract was higher than in ones without extract (carrageenan and gelatin with rosemary extract 11.35 mgGAE/g film, and without extract 1.67 mgGAE/g film,). Also, the films with glycerol have shown better elasticity when stored in dry, while the plasticizing effect of water was evident for non-plasticized films when stored in humid conditions. The addition of oil improved the gas barrier of all films, while the addition of aqueous extracts did not have such influence. Films enriched with plant extracts and oil had better UV barrier performance compared to non-enriched blends. The obtained results serve as indicators for further application in choosing the appropriate formulation for application and shelf-life studies on fresh Adriatic sardines.

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POSTER PRESENTATION

SCREEN-PRINTED VOLATILE AMINE INDICATOR FOR SMART FISH PACKAGING

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The aim of this work was to develop a colorimetric indicator for volatile amines intended for smart fish packaging. The study focused on selecting a suitable printing method and materials. Printing enables scalable fabrication of indicators suitable for packaging, and the study confirms the indicator's response to ammonia vapours under laboratory conditions. The indicator ink was prepared by mixing the sensing compound with a polymer binder and solvent under continuous stirring until a homogeneous formulation was obtained. The ink was deposited onto a plastic foil by screen printing, dried in a hot air dryer and then overprinted with a water-insoluble polymer layer. The dried printed indicator was placed onto a standard white support and placed into a reaction chamber, where it was exposed to ammonia vapours. Reflectance and colorimetric values were measured in real time during exposure using a reflectance probe. Screen printing enabled successful deposition of the indicator layer onto a plastic foil. The resulting prints had high visual quality, with a homogeneous printed layer across the entire active area. Same method was subsequently used for overprinting the indicator with a water-insoluble polymer layer, successfully improving water resistance. The fabricated indicator demonstrated a clear and visually distinguishable colour change upon exposure to ammonia. Screen printing proved to be a reliable method for depositing a homogeneous indicator layer on plastic substrates. The printed indicator showed a clear colour response to ammonia, confirming its functionality and potential for scalable fabrication.

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POSTER PRESENTATION

DEVELOPMENT OF PBSA COMPOSITES WITH RED GRAPE POWDER

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This research aimed to develop and evaluate a bioplastic material, PBSA (poly(butylene succinate co-adipate)), with integrated bioactive fillers derived from agri-food waste to enhance the valorisation of red grape skin residues, decrease the amount of plastic, and develop an active material able to release bioactive substances, such as antioxidant or antimicrobial compounds, to potentially extend the shelf-life of food. For the experiments, a red grape skin powder was selected and characterised for moisture, colour, ash, proteins, carbohydrates, particle size distribution, dietary fibre, structural carbohydrates, total phenolic content, and antioxidant activity. The analyses showed a promising composition, and the powder was compounded with PBSA, obtaining films with different percentages of red grape skin incorporation. Analysis of the melting flow rate of the blends showed an increase in the viscosity with increasing percentage of red grape skin powder. The films were characterised for mechanical properties, revealing a decrease in mechanical properties due to grape skin powder incorporation. The films obtained were also subjected to global migration tests according to Reg. (EU) 10/2011, which confirmed compliance with the legislative limits regarding global migration with simulants ethanol 10%, acetic acid 3%, and vegetable oils, after 10 days at 40°C. In addition, tests were performed to evaluate antimicrobial activity, polyphenol release, and antioxidant capacity. The results showed significant antimicrobial activity and polyphenol release in the food simulants tested, but no effect against lipid oxidation, demonstrating the potential of these materials for food packaging applications.

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Innovative technologies for sustainability

POSTER PRESENTATION

OPTIMIZATION OF ULTRASOUND-ASSISTED EXTRACTION OF LYCOPENE FROM TOMATO BY-PRODUCTS

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The valorization of agro-industrial by-products represents a sustainable strategy for recovering high-value bioactive compounds. This study aimed to optimize the extraction of lycopene from tomato pomace (peel and seeds) using ultrasound-assisted extraction with water as a green solvent, targeting future nanoencapsulation and application in functional food products. The material was homogenized with water and subjected to different combinations of ultrasonic power and processing time according to a response surface methodology design. After treatment, samples were freeze-dried and lycopene content was quantified by high-performance liquid chromatography (HPLC). Statistical analysis was performed using a quadratic model and analysis of variance (ANOVA). The model was highly significant ($p<0.0001$), with a coefficient of determination (R^2) of 0.9612 and adjusted R^2 of 0.9473, demonstrating strong predictive ability. Ultrasonic power, the interaction between power and time, and quadratic terms significantly influenced lycopene extraction ($p<0.05$). The highest lycopene concentration was obtained at 220 W and 22 min. These findings demonstrate that ultrasound-assisted extraction is an effective and sustainable approach to recover lycopene from tomato by-products, providing a promising basis for nanoencapsulation and development of value-added functional foods.

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POSTER PRESENTATION

SUSTAINABILITY ASSESSMENT OF INNOVATIVE PHYTOBIOTIC-ENRICHED AQUAFEEDS THROUGH LIFE CYCLE ASSESSMENT (LCA)

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The transition toward sustainable aquaculture systems requires reducing antibiotic use while ensuring environmentally responsible feeding strategies. This study evaluates the sustainability performance and environmental footprint of innovative aquafeeds enriched with encapsulated phytobiotics as a natural alternative to conventional antibiotic additives.

The environmental assessment was conducted using Life Cycle Assessment (LCA) in accordance with ISO 14040:2006 and ISO 14044:2006 standards. The functional unit was defined as the production of 1 kg of farmed fish (live weight), allowing the environmental impacts to be quantified at the level of the final product rather than solely at the feed production stage. The analysis incorporated the Feed Conversion Ratio (FCR), directly linking feed consumption to biomass production and ensuring realistic system representation.

System boundaries were defined following a cradle-to-gate approach, including raw material production and transport, feed manufacturing processes, energy consumption, and waste management. Environmental impact assessment was performed using the ReCiPe 2016 method (Hierarchist perspective). System modelling was carried out in SimaPro 9.5 (PRé Sustainability), using background inventory data from Ecoinvent v3.9.1 (cut-off system model) to compile the Life Cycle Inventory (LCI).

Results indicate that replacing antibiotics with encapsulated phytobiotics does not increase the overall carbon footprint per kg of produced fish, while improvements are observed in selected impact categories related to toxicity and resource use. The integration of LCA at the feed design stage demonstrates its value as a decision-support tool for advancing sustainable aquaculture practices.

Acknowledgements

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References

[1] Gruber, C., Ocelova, V., Kesselring, J. C., & Wein, S. (2025). Phytogenic Feed Additives as a Sustainable Alternative to Antibiotics: Enhancing Growth and Disease Resistance in Nile Tilapia (*Oreochromis niloticus*). Animals, 15(3), 380. https://doi.org/10.3390/ani15030380.

[2] Okon, E., Iyobhebhe, M., Olatunji, P., Adeleke, M., Matekwe, N., & Okocha, R. (2025). Feed Additives in Aquaculture: Benefits, Risks, and the Need for Robust Regulatory Frameworks. Fishes, 10(9), 471. https://doi.org/10.3390/fishes10090471.

POSTER PRESENTATION

EMULSION-BASED GELATION OF MARINE-DERIVED PEPTIDES: PROCESS OPTIMIZATION AND CONTROLLED RELEASE FROM GELATIN-IN-OIL BEADS

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Marine biomass valorization through mild physical processing enables the development of structured delivery systems with controlled functionality. In this study, peptide-rich hydrolysates derived from the invasive marine species *Fistularia commersonii* were encapsulated using a gelatin-in-oil emulsion gelation system, with emphasis on process--structure--release relationships.

Gelatin solutions containing marine-derived peptides were dispersed in an oil phase under controlled agitation, forming a water-in-oil emulsion. Subsequent thermal-induced gelation of the dispersed aqueous phase led to the formation of structured gelatin beads. The influence of key process parameters (gelatin concentration, peptide loading, agitation speed, oil-to-water ratio, and cooling rate) on bead size distribution, morphology, and encapsulation efficiency was systematically investigated.

Particle size distribution and sphericity were evaluated using laser diffraction and microscopy, while swelling behaviour and mass variation were quantified under controlled hydration conditions. Release profiles were monitored in aqueous media simulating soil-moisture conditions, and kinetic data were fitted to diffusion-based and empirical models to determine the governing transport mechanisms.

Thermal stability and structural transitions were analyzed using Differential Scanning Calorimetry (DSC), while Dynamic Mechanical Analysis (DMA) provided insight into viscoelastic behaviour and network strength. The results demonstrate that emulsion-based gelation provides a tunable encapsulation platform in which process conditions directly determine structural integrity, swelling behaviour, and release kinetics.

This work contributes to the rational design of biodegradable marine-based delivery systems, integrating green extraction, structured gelation, and predictive transport modelling within a process engineering framework.

References

[1] Moya Moreira, T. F., Gonçalves, O. H., Leimann, F. V., & Ribeiro, R. P. (2023). Fish Protein Hydrolysates: Bioactive Properties, Encapsulation and New Technologies for Enhancing Peptides Bioavailability. Current Pharmaceutical Design, 29(11), 824--836. <https://doi.org/10.2174/1381612829666230110141 81.>

[2] Pérez-Pérez, V., Jiménez-Martínez, C., González-Escobar, J. L., & Corzo-Ríos, L. J. (2024). Exploring the impact of encapsulation on the stability and bioactivity of peptides extracted from botanical sources: trends and opportunities. Frontiers in Chemistry, 12. <https://doi.org/10.3389/fchem.2024.1423500.>

[3] Tadeo, X., López-Méndez, B., Castaño, D., Trigueros, T., & Millet, O. (2009). Protein Stabilization and the Hofmeister Effect: The Role of Hydrophobic 130 Solvation. Biophysical Journal, 97(9), 2595--2603. https://doi.org/10.1016/j.bpj.2009.08.029.

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POSTER PRESENTATION

SECUREFOOD: GOVERNANCE AND RESILIENCE FRAMEWORKS FOR SUSTAINABLE FOOD SYSTEMS

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Strengthening the resilience and sustainability of food systems requires integrated, system-level approaches that combine governance innovation with operational support tools. SecureFood addresses this need through the development of two complementary frameworks: an agency-based Resilience Governance Framework and a holistic Food Systems Resilience Management (FSRM) Framework. Together, these structures provide a systematic pathway for redesigning food systems toward coupled resilience and sustainability objectives in line with the Farm to Fork strategy and Food 2030 priorities. The governance framework fosters coordinated multi-actor collaboration across the food ecosystem, enhancing trust, clarifying roles, and enabling efficient uptake of project results beyond the project lifecycle. In parallel, the FSRM framework streamlines resilience assessment, preparedness, and adaptive capacity building at both national and food-actor levels, integrating considerations related to biodiversity, environmental resources, and risk management. By combining participatory governance principles with structured resilience management processes and supporting digital tools, SecureFood demonstrates how systemic innovation can support the transition toward more sustainable, inclusive, and resilient food systems.

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POSTER PRESENTATION

ADVANCED AGING STRATEGIES FOR PEAR BRANDY: IMPACT ON VOLATILE COMPOSITION AND PHENOLIC CHARACTERISTICS

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Traditional aging of fruit distillates is a time-intensive process, often requiring extended storage to achieve balanced aroma, color, and flavor. In response to growing demands for efficiency and sustainability, innovative approaches combining wood contact with physical treatments are being explored as alternatives to conventional maturation.

The objective of this study was to significantly shorten the aging period---from several months to less than one hour---by applying electric field treatments, while simultaneously improving the chemical composition and sensory potential of pear brandy. Distillate samples were treated under electric fields of 20, 35, and 50 V for 20, 45, and 60 minutes in the presence of different wood fragments. Chromatic parameters were evaluated and compared with untreated samples and with distillates matured for 3 days, using the same wood types but without electric-field application. The highest color intensity appeared in samples treated with mulberry wood at 20 V. This level was almost double that of the three-day control. In selected conditions with common oak, hue values approached those recorded for distillates of traditionally barrel-aged products. Analysis of volatile and phenolic compounds indicated enhanced extraction of wood during electric-field treatment, producing profiles that, in many cases, closely resembled those of conventionally aged spirits. Electric-field-assisted aging combined with wood fragments proved effective at reproducing key maturation characteristics within minutes. This technique enables precise control over extraction processes, reduces storage time and product losses, and supports more sustainable, cost-efficient production while preserving the overall quality of the distillate.

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POSTER PRESENTATION

TOWARDS INTELLIGENT SOLAR COOKING: INTEGRATING THERMAL MODELLING, AI AND FOOD QUALITY KINETICS

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The transition towards sustainable and low-carbon food systems requires innovative approaches that integrate renewable energy. Solar cooking, although recognised as a sustainable alternative, remains limited by process variability, lack of control, and insufficient understanding of its impact on food quality. The SUNRISE project has recently commenced, intending to develop intelligent solar cooking systems by integrating heat-transfer modelling, experimental data, and AI-based prediction tools. As a first step, the authors conducted a comprehensive review of solar cooking technologies, identifying key research gaps, particularly the lack of integration between thermal behaviour, environmental variability, and food quality evolution. Building on this foundation, the project is currently developing an instrumented solar box cooking system equipped with sensors to monitor temperature profiles, solar radiation, and ambient conditions to generate high-resolution datasets under real operating conditions. In parallel, modelling activities are being developed to describe heat-transfer mechanisms (conduction, convection, and radiation), combined with machine-learning approaches to enable predictive modelling of temperature evolution and cooking performance. This hybrid modelling strategy directly addresses challenges highlighted in our review, particularly the difficulty of predicting system behaviour under dynamic conditions. A complementary research axis focuses on food quality and safety. Ongoing experiments aim to evaluate the impact of solar cooking on selected food model systems, with emphasis on legumes. Kinetic modelling is applied to describe changes in quality attributes, addressing the limited availability of such studies in the literature. This project aims at advancing solar cooking as a controllable and predictive food-processing.

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POSTER PRESENTATION

N-FIXING BACTERIA ENHANCE QUALITY-RELATED PHYTOCHEMICALS IN BRASSICA OLERACEA L. VAR. CAPITATA

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There is limited knowledge regarding the impact of up-to-date sustainable fertilizers, primarily designed to reduce environmental impacts, on health-related food quality compounds. This study evaluated the effects of sustainable nitrogen (N) fertilizers on *Brassica oleracea* L. var. capitata, with a focus on the application of N-fixing bacteria and biochar. We analyzed the concentrations of flavonol glycosides and chlorogenic acid, as well as total glucosinolates (GSLs) levels, as these compounds play a key role in the nutritional and functional quality of Brassica vegetables. Plants fertilized with N-fixing bacteria showed similar chlorogenic acid and flavonol-glycosides compared to those observed in control plants stressed by lack of N fertilization, but significantly higher than those measured in plants receiving inorganic N fertilization. Likewise, the application of N-fixing bacteria exhibited the highest total GSL concentrations in cabbage compared to the other fertilization. Biochar application tended to increase the accumulation of these quality-related compounds, although statistical differences were less pronounced than those associated with the N fertilization treatments.

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POSTER PRESENTATION

DEVELOPMENT OF A HUMIDITY-SENSING LABEL IN INTELLIGENT PACKAGING

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In the contemporary food industry, intelligent packaging technology is a beneficial means for real-time monitoring of food quality, particularly through humidity sensors that track the relative humidity within a package or surrounding conditions. Humidity is a predominant factor for food quality; the accumulation of moisture causes chemical reactions, changes in physical properties, and a favorable environment for microbes and fungi, thus leading to a shorter shelf life of the product. Among those applications, there is a strong demand for monitoring and control of low humidity for products such as cereal, biscuits, chips, and popcorn. Carboxylated cellulose nanofibers (CNF) are characterized by a high specific surface area and abundant hydrophilic functional groups, such as hydroxyl and carboxyl groups, which form hydrogen bonds with water molecules to significantly enhance the label's sensitivity to moisture. This study developed a humidity sensor based on the pH-sensitive nature of crude purple sweet potato anthocyanins (PPA) extract and CNF as the moisture-absorbing substrate, and the label was formed in two parts, one for the moisture absorption zone and the other for the moisture movement to indicate the sorbed amount. The sensing label was formed using PPA/acid mix immobilized on CNF laminated on filter paper, and then dehydrated in an oven at 30°C/40% RH. In the initial formulation, acidic compounds, including ascorbic acid, boric acid (BA), and citric acid were evaluated. BA was selected because it greatly favored label readability, demonstrating a distinct coloration from light purple to deep purple after moisture absorption, and the △E values were greater than 5. In the analysis of sorption extent, the distance of the colored front line was significantly correlated with the absorbed moisture; as the absorption increased from 0.15 mL to 0.45 mL, the diffusion distance for the pH 6.5 basis label was 1.55±0.05 cm to 4.20±0.10 cm. In summary, this research successfully developed a smart label formula utilizing 0.75% BA and 0.05 M phosphate buffer, with pH 6.5 and pH 7.5, which demonstrated a good sensing ability to indicate the headspace relative humidity in the popcorn package after opening. Also, the color line was useful to the extent of texture loss of this moisture-sensitive product.

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POSTER PRESENTATION

BEER BYPRODUCT VALORIZATION AND INNOVATION

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Food and beverage production requires significant amounts of raw materials and feedstocks in industrial and full-scale production systems. In order to create production systems that are more sustainable as well as profitable there is a need to not only limit waste production through increases in process efficiency but also find uses and applications for streams that would otherwise be lost to waste. This is particularly true for fermentation-based food and beverage production, especially beer production. Within beer brewing processes, there are several byproducts that are traditionally considered waste -- namely spent brewer's grain, spent hops, and spent brewer's yeast. While spent brewer's grain has been largely adopted as a feed additive for livestock due to its nutritional value and abundance, spent hops and spent brewer's yeast have found less applications in this and food production fields due to the perceived bitterness imparted by the residual iso-alpha-acids. This study aims to investigate processes and methods for spent hops and yeast to extract valuable compounds for use as health supplements, as well as to find higher value applications in food production with or without debittering processes. Furthermore, the information gathered and products created will be used to gauge consumer interest and acceptance, and thus market viability. Viability of either standalone company development or adoption of methods by existing industry will be evaluated based on findings.

This work is part of the California Denmark Innovator Fellowship, a partnership between University of California Davis and Denmark Technical University.

POSTER PRESENTATION

MORPHOLOGICAL EFFECTS OF UV-C LED EXPOSURE ON EARLY STAGES OF SITOPHILUS SPP.

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Post-harvest losses in stored rice are largely driven by infestations of *Sitophilus* spp. which cause significant grain damage during storage1. Conventional control strategies rely mainly on chemical fumigants and insecticides, raising increasing concerns regarding environmental impact, human health and the development of resistance. A major challenge in pest management is the occurrence of hidden infestations, resulting from oviposition in the field and the subsequent insect development within stored grains2. Females of Sitophilus adults lay their eggs inside grains, sealing the oviposition hole, where larval and pupal stages develop concealed, making early detection and control difficult3. These limitations have encouraged research into sustainable alternatives, such as ultraviolet (UV-C) light4.

This study investigates the morphological effects of exposure to 280 nm UV-C light-emitting diodes (LEDs) on the larval and pupal stages of Sitophilus spp. Samples were exposed for 0 (control group), 1, 5, 7 and 10 minutes, corresponding to UV fluence doses of 46.4, 231.9, 324.7 and 463.8 mJ/cm2, respectively. Following exposure, larvae and pupae were examined using a magnifier to assess structural alterations and capture images to document morphological damage. Compared with controls, all exposed groups exhibited visible morphological injuries indicating a clear effect of UV-C exposure on immature insect stages.

These findings support the development of innovative, non-chemical technologies to reduce post-harvest losses while minimising environmental impact. The integration of UV-based treatments into stored-product protection strategies could provide an effective and eco-friendly alternative to conventional chemical control, aligning with global efforts to promote sustainability and innovation in food storage systems. Our findings indicate that UV-C light represents a promising approach for suppressing the development of Sitophilus spp. in stored grains. Further research is recommended to evaluate DNA damage in larvae and pupae, assess potential effects on rice quality and investigate scalability and industrial feasibility of this approach.

References

1. Mesterházy, Á., Oláh, J. & Popp, J. Losses in the Grain Supply Chain: Causes and Solutions. Sustainability 12, 2342 (2020).
2. Fan, X., Huang, R. & Chen, H. Application of ultraviolet C technology for surface decontamination of fresh produce. Trends Food Sci. Technol. 70, 9--19 (2017).
3. Hagstrum D. W., Subramanyam B. Fundamentals of Stored-Product Entomology [Internet]. AACC International; 2006. 15--28 p. Available from: https://www.sciencedirect.com/science/article/abs/pii/B9781891127502500077
4. Dittgen, C. L. et al. Chemical, physical, and sensory changes in rice subjected to UV-C radiation and its acceptability to rice weevil *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae) and humans. J. Stored Prod. Res. 90, 101760 (2021).

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POSTER PRESENTATION

MICROWAVE ASSISTED EXTRACTION OF BIOACTIVE COMPOUNDS FROM CAPSICUM SPP.

Ivan Karlo Cingesar[1], Marta Brkljačić[1], Ana Kocet[1], Marta Glavičić[1], Višnja Stulić[1], Zoran Herceg[1], Ana Jurinjak Tušek[1], Tomislava Vukušić Pavičić[1]

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Capsicum spp. represents one of Europe's most significant vegetable crops, valued for its diversity, high nutritional quality, and abundance of bioactive compounds such as phenolics and capsaicinoids. Increasing interest in efficient extraction techniques has driven the development of innovative, environmentally friendly technologies, including microwave-assisted extraction -- a method that enhances cell membrane permeability and promotes the release of intracellular constituents. The aim of this study was to investigate the influence of different extraction parameters: duration of extraction, temperature and solvent sample ratio. The influence of named parameters is characterized by analysis of total phenolic content, carotenoids content, capsaicinoids content, antioxidant acitivity analysed with electron paramagnetic resonance, and phyisco-chemical properties. Compared to nontreated sample, microwave assisted extraction yielded higher concentraction of phenolic content and capsaicinoids. There was no negative effect of microwave assisted extraction on physico-chemical properties.

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POSTER PRESENTATION

INNOVATIVE FLUORESCENCE-BASED TECHNOLOGIES FOR SUSTAINABLE VERIFICATION OF UV-C PROCESSING IN DAIRY SYSTEMS

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The transition toward sustainable and innovative food systems requires not only novel processing technologies but also rapid methods to verify their effectiveness. In the dairy sector, UV-C processing has emerged as a promising non-thermal, sustainable technology capable of inactivating spoilage and pathogenic microorganisms while preserving nutritional and sensory quality. Approved under Regulation (EC) No 258/97, UV-treated milk is considered safe, with EFSA authorising a post-pasteurisation dose of 1045 J/L, enabling shelf-life extension and increased vitamin D_3 content.

Despite these advantages, industrial verification of UV-C treatment currently relies solely on reactor process parameters, which may not detect failures such as lamp degradation, leading to increased operational risk, waste, and potential recalls. Therefore, a rapid verification method analogous to the alkaline phosphatase test used for pasteurisation is critically needed.

This research proposes a fluorescence-based verification approach that exploits UV-C--induced photo-oxidative changes in intrinsic milk chromophores (Figure 1) as dose-dependent optical fingerprints. UV-C exposure alters the fluorescence spectra of naturally fluorescent components such as proteins and vitamins, generating measurable, characteristic signals. Fluorescence spectroscopy enables rapid, non-destructive detection of these changes without reagents, sample preparation, or microbiological testing.

Representative fluorescence responses, including those of tryptophan (Figure 2), demonstrated systematic dose-dependent variations following UV-C exposure, confirming the feasibility of this approach as a reliable indicator of delivered UV-C dose. The method supports at-line or in-line implementation, enabling continuous process verification rather than retrospective testing. From a sustainability perspective, this verification strategy eliminates chemical and reagent waste, minimizes product losses through real-time monitoring, and supports low-energy processing with a reduced environmental footprint. In conclusion, fluorescence-based UV-C dose verification represents a critical enabling technology for the broader industrial adoption of UV-C as a standalone, sustainable dairy processing method.

References

1) Souroullas, K.; Manoli, A.; Itskos, G.; Apostolou, T.; Papademas, P. Fluorescence of Intrinsic Milk Chromophores as a Novel Verification Method of UV-C Treatment of Milk. Foods 2024, 13, 2887. https://doi.org/10.3390/foods13182887

2) Souroullas, K. and Papademas, P. (2025), Challenges in developing a Process Analytical Technology (PAT)-based verification of UV-C treatment of milk. Int J Dairy Technol, 78: e13168. https://doi.org/10.1111/1471-0307.13168

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POSTER PRESENTATION

NUTRITIONAL ENHANCEMENT OF CAROLINO RICE THROUGH NATURAL PIGMENTS AND MICROALGAE FORTIFICATION: A COMPARATIVE STUDY

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Rice is a major global staple and in Portugal its production is largely dominated by the Carolino variety (*Oryza sativa* ssp. japonica). The food industry increasingly seeks products that combine nutritional value, sensory quality, affordability, and consistency.

This study evaluated whether Carolino rice coloured-enriched with **Chlorella vulgaris** biomass or astaxanthin offers a superior nutritional profile compared with non-enriched rice. *Chlorella* is a sustainable microalga rich in protein, essential amino acids, fibre, polysaccharides, and polyunsaturated fatty acids. Astaxanthin, a red ketocarotenoid derived from the microalga **Haematococcus pluvialis**, functions as a natural colorant with strong antioxidant activity.

Proximate composition was determined using standard analytical methods. Fat content was higher in astaxanthin- and *Chlorella*-enriched rice than in the control (2.49±0.09%, 2.26±0.08%, and 1.13±0.06%, respectively). Protein was highest in *Chlorella* treated samples, followed by astaxanthin and control samples (9.04±0.06%, 8.06±0.07%, and 7.19±0.15%). Fibre content in rice samples was also greatest with *Chlorella* treatment (0.97±0.09 g/100 g) compared to the control (0.39±0.01 g/100 g) and to astaxanthin treatment (0.33±0.02 g/100 g). Moisture was lowest in astaxanthin treated samples, followed by *Chlorella* and control samples (11.28±0.04%, 12.49±0.21%, 13.60±0.07%). Carbohydrates were highest in astaxanthin samples, than in *Chlorella* and control samples (73.39±0.09%, 72.95±0.77%, 58.93±0.45%), while ash content was similar across formulations.

Overall, enrichment increased macronutrient density relative to conventional rice. *Chlorella* was particularly advantageous due to higher protein and fibre contents, whereas astaxanthin resulted in lower moisture and higher carbohydrates. The results highlight the potential of this enriched Carolino rice as a value-added product with improved nutritional quality.

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POSTER PRESENTATION

FUNCTIONALISATION OF PORTER BEER WITH PINE BARK EXTRACT: ENHANCED PHENOLIC PROFILE AND PROTECTION OF ANTIOXIDANT CAPACITY DURING FERMENTATION

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Maritime pine bark (*Pinus pinaster* subsp. atlantica) is an abundant forestry by-product recognised as a rich source of polyphenolic compounds with strong antioxidant potential. Its incorporation into fermented beverages represents a promising strategy for developing functional beers while supporting circular economy principles. This study evaluated the impact of pine bark extract (PBE) on the phenolic composition and antioxidant capacity of a Porter-style beer.

PBE was obtained by microwave-assisted extraction using a 48% (v/v) hydroethanolic solution (grape marc spirit). Two brewing conditions were established: a control beer and a beer supplemented with PBE at pitching. The supplementation level (36.5 mL/L) was defined following a prior toxicity assessment and was below the established safety threshold. Yeast viability assays confirmed that Saccharomyces growth under these brewing conditions was not impaired by PBE. Fermentation lasted 9 days, during which °Brix, biomass and pH were monitored, with no observable deviations between treatments. Samples collected before and after fermentation were analysed for total phenolic content (TPC), total flavonoids content (TFC), and antioxidant activity (DPPH, ABTS, ORAC and FRAP).

Before fermentation, PBE significantly enhanced the beer's bioactive profile ($p<0.05$), increasing TPC from 346±4 to 502±7 mg GAE/L and ORAC from 4.98±0.19 to 7.41±0.12 µmol TE/mL. After fermentation, PBE beer retained markedly higher phenolic and antioxidant levels than the control (TPC: 422±2 vs 297±3 mg GAE/L; ABTS: 1.382±0.038 vs 1.207±0.022 µmol TE/mL; FRAP: 1.030±0.022 vs 0.853±0.017 µmol TE/mL; $p<0.05$). Although fermentation reduced TPC, ABTS and TFC in both beers, ORAC decreased significantly only in the control ($p=0.041$) and remained stable in PBE beer ($p=0.656$), indicating preservation of overall antioxidant capacity, while DPPH showed no significant changes ($p>0.05$).

Overall, PBE fortification improved the functional profile of Porter beer without compromising yeast performance or fermentation behaviour. Ongoing work is exploring additional strategies, including post-fermentation PBE addition, to further optimise bioactive retention and technological performance.

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POSTER PRESENTATION

HYDROTHERMAL CARBONIZATION OF CORN COBS AND BIOMETHANE POTENTIAL OF PROCESS WATER

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Corn cobs were converted by hydrothermal carbonization (HTC) at 200 and 250 °C for 1 h to produce hydrochar and an organic-rich process water. Hydrochars were dried and characterised by CHN analysis, while process water was analysed for pH, conductivity, chemical oxygen demand (COD), biological oxygen demand (BOD5), total organic carbon (TOC) and selected anions. The biomethane potential of the liquid fraction was tested in 0.5 L Dreschel bottles at 37 °C using a water-displacement measurement system. Carbon dioxide was removed in an intermediate 3 M NaOH scrubber (phenolphthalein indicator), therefore the collected gas corresponded to methane. HTC increased hydrochar carbon content from 45.7% (raw cobs) to 52.4% at 200 °C and 64.0% at 250 °C, indicating progressive carbonisation at higher temperature. Process water was strongly acidic (pH ~3) and exhibited high organic strength (COD of 75,650 and 56,175 mg O2/L, TOC of 12,236 and 10,024 mg C/L for 200 and 250 °C, respectively). Net methane yields (mean) were 9.10 and 5.81 mL CH4/g fresh substrate for 200 and 250 °C, respectively, suggesting that milder HTC conditions generated a liquid phase more amenable to anaerobic conversion. The results support coupling HTC of wet lignocellulosic residues with anaerobic digestion of process water as an energy recovery route. Future work will evaluate hydrochars as sorbent for ammonium ions from digestate streams.

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POSTER PRESENTATION

USE OF PULLULAN COATING ON AVOCADO FOR QUALITY PRESERVATION AND SHELF LIFE EXTENSION

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Pullulan is a microbial exopolysaccharide produced by the fermentation of **Aureobasidium pullulans**. It exhibits excellent film-forming ability, transparency, and biocompatibility, and is characterized as GRAS by the US FDA, showing good potential for fruit and vegetable preservation and sustainable packaging. Postharvest fruits remain physiologically and metabolically active, undergoing continuous respiration and transpiration, leading to water loss and tissue softening during shipping and storage, accelerating fruit decay. Use of edible coatings is therefore an effective approach to maintain fruit quality and meet consumer demand for natural and safe preservation methods. In this study, a pullulan-based coating for avocado was developed, and its effect on shelf life was evaluated. The edible substance solution was prepared using pullulan, methyl cellulose (MC), and glycerol. Edible film was cast using a Teflon mold, and dried at 30 ºC/40% RH for 24 h. Transparency, color, microstructure, water vapor transmission, and viscosity were evaluated to assess feasibility. For fresh avocado application, the coating solution was applied and dried at 30 ºC/40% RH for 30 min. Fruit quality parameters, including respiration rate, color, weight loss, hardness, and preference, were monitored over a 13-day storage period at 25±3 ºC. Results showed that pullulan alone failed to form a uniform coating on the fruit peel, due to its low viscosity. With 1% MC in 2% pullulan solution, viscosity increased to 27.50±0.00 cP, enabling adhesion to the fruit peel. The pullulan/MC film showed good transparency with no color alteration, and WVTR was determined to be ca. 115 g/m^2^/day. Additionally, the SEM images showed that MC addition improved the structural properties of pullulan, producing a more uniform and dense morphological pattern. The application of coating onto avocado, results showed less peel browning and fewer black spots, indicating a ripening delay. Also, firmness decreased from ca. 95 N to 4.89 ± 0.45 N in the uncoated group, while coated fruits maintained 78.24 ± 3.70 N after 7d storage. These results demonstrate that the pullulan/MC coating delayed avocado ripening and extended shelf life.

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POSTER PRESENTATION

INFLUENCE OF BOTTLE STORAGE TIME ON PHENOLIC CONTENT AND ANTIOXIDANT ACTIVITY OF WINE SPIRITS AGED USING A SUSTAINABLE TECHNOLOGY

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The development of more eco-efficient processes is one of the strategies underlying the pillars of sustainability, with a focus on the use of new technologies, and increased awareness of environmental, economic and social challenges. In this context, the use of an alternative ageing technology (AAT), which combines wood staves with micro-oxygenation (MOX), applied to beverages stored in stainless steel tanks, aiming to reproduce the ageing stage in wooden barrels. It is worth noting that traditional ageing technology (TAT) has significant drawbacks, such as low production efficiency, high evaporation, high cost, and high demand for wood, a natural resource with limited availability, that contributes to a high environmental impact1. Thus, this study assessed whether the ageing characteristics obtained by AAT are retained during storage time (0, 12, 48 months) in bottle compared to those provided by TAT. The total polyphenol index (TPI) and antioxidant activity (DPPH assay) were analysed in the wine spirits (WS) aged with Limousin oak (**Quercus robur** L.) wood, using three modalities in 50 L glass demijohns (pilot scale) with wood staves and micro-oxygenation (MOX levels: O15, O30 and O60) of AAT; and using wooden barrels (TAT: B modality). The results show that after four years of storage in bottle, antioxidant activity (AA) decreased significantly in wine spirits from both technologies, with a greater decline in the B modality [average reduction: B (34%), O15 (21%), O30 (17%) and O60 (16%)]. Regarding the phenolic content (PC), a significant increase of TPI values in B modality (21%) was observed, whereas all modalities from AAT showed a slight increase (7%), but were not significantly different at the beginning of storage (t0). Comparing all results, the behaviour that involves the reduction of AA and an increase in TPI values in all modalities, can be attributed to oxidative depolymerization of polymeric phenolics (PP) into monomeric phenolics (MP), under different oxygen content resulting from ageing technologies combined with the action of factors ruling the storage in bottle (oxygen present in bottle's headspace, dissolved in aged WS and transfer through the cork). Hence, the mechanisms of AA are directly related to the total amount and configuration of their hydroxyl groups of PP and MP. Notably, the MP exhibit lower antioxidant activity than PP, presumably because of their valency effects, potentially explaining the reduction of AA2. In summary, the oxidation reactions are responsible for the changes in AA of aged WS during storage time in the bottle. According to the findings, all modalities from AAT preserved the phenolic content of aged WS, maintaining its quality, and might be the best alternative for wine spirit quality and ageing process sustainability.

References

1. Oliveira-Alves, S.; Lourenço, S.; Anjos, O.; Fernandes, T.A.; Caldeira, I.; Catarino, S.; Canas, S. Influence of the Storage in Bottle on the Antioxidant Activities and Related Chemical Characteristics of Wine Spirits Aged with Chestnut Staves and Micro-Oxygenation. Molecules 2022, 27, 106. https://doi.org/10.3390/molecules27010106
2. Pan, J.; Yin, D.; Ma, L.; Zhao, Y.; Zhao, J.; Guo, L. Dimer and Tetramer of Gallic Acid: Facile Synthesis, Antioxidant and Antiproliferative Activities. Lett. Drug Des. Discov. 2013, 11, 27--32. https://doi.org/10.2174/15701808113109990032

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POSTER PRESENTATION

EFFECT OF PULSED ELECTRIC FIELD (PEF) TREATMENT ON BOVINE MILK PROTEINS

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PEF technology was used in this study to evaluate its effect on the stability and conformation of bovine milk proteins. As a non-thermal pasteurization technique, PEF can maintain the original characteristics of some milk constituents, which can be an advantage over traditional heat processing. Therefore, PEF represents an attractive technology for milk processing, as it preserves not only safety but also several sensory, nutritional, and functional properties.

The main objective of the present study was to examine the impacts of PEFs on bovine proteins (caseins and non-caseins proteins) and to optimize processing parameters at the laboratory scale. This involved treating the milk with pulsed electric fields (PEFs, (EPULSUS®-LPM1A-10 for laboratory scale at 10 kVcm-1), using two conditions: c1 (40 µs pulses, 5 Hz) and c2 (10 µs pulses, 15 Hz) and measuring temperature and conductivity before and after each treatment to monitor any potential thermal contribution to the process. Commercially available UHT cow's milk was used for protein analyses (AOAC 991.20), casein content (AOAC 998.05) and protein by the Biuret method (Doumas et al. (1981).

The protein results obtained by the Biuret method in the PEF-treated samples-3.6% (c1) and 3.89% (c2) indicate only slight differences as compared to untreated milk samples (3,96%), mainly for longer pulses (40 µs), causing mild to moderate structural changes. Compared with the total protein content in untreated milk (3.63%) and after treatment c1 (3.58%) and c2 (3.57%), no significant changes occurred following PEF treatment, which were smaller than those observed with traditional thermal pasteurization. Concerning casein, the protein content before PEF (3.4%) was similar to the content after each treatment: 3.33% and 3.34% for c1 and c2, respectively. In conclusion, this study shows that PEF does not affect the total protein content. UREA-PAGE assays will be used to analyze the caseins profile before and after PEF treatment

References

Taha, A., Casanova, F., Talaikis, M., Stankevič, V., Žurauskienė, N., Šimonis, P., Pakštas, V., Jurkūnas, M., Gomaa, M. A. E., & Stirkė, A. (2023). Effects of pulsed electric field on the physicochemical and structural properties of micellar casein. Polymers, 15, 3311. https://doi.org/10.3390/polym15153311

POSTER PRESENTATION

QUALITY ASSESSMENT AND ANTI-LISTERIAL EFFICACY OF COLD PLASMA TREATMENT ON FRESH LETTUCE

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Ensuring microbial safety of fresh leafy vegetables while preserving quality remains a major challenge for the food industry, driving interest in non-thermal decontamination technologies. This study evaluates the potential of cold plasma as an alternative to heat-based processing for the decontamination of lettuce. Although thermal treatments are not conventionally applied to this product due to their detrimental effects on freshness, they were included here as a reference for antimicrobial efficacy. Lettuce leaves inoculated with *_Listeria innocua_* (surrogate for *_L. monocytogenes_*) were treated using gliding arc cold plasma for 5--30 s and compared with hot water blanching at 80 °C for equivalent durations. Treatment effects were evaluated through microbial reduction and quality parameters, including color (total color difference, chroma, browning index), pH, chlorophylls (a, b, total), and total phenolic content. Thermal treatment achieved complete *_L. innocua_* inactivation (~7-log reduction) within 5 s, whereas cold plasma resulted in a slower decline, reaching approximately 2-log reduction after 30 s. pH remained relatively stable (5.6--6.0) across treatments. Cold plasma better preserved color vividness, chlorophyll b, total chlorophyll, and phenolic content, maintaining phenolic levels at approximately 14--15 mg GAE/g (fresh weight), while thermal treatment caused significant reductions even from short exposure times. Although thermal processing ensured rapid decontamination, cold plasma demonstrated superior preservation of physicochemical quality, highlighting its potential as a non-thermal strategy for lettuce with low microbial loads, provided its antimicrobial efficacy can be further optimized.

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POSTER PRESENTATION

PULSED ELECTRIC FIELD--ASSISTED EXTRACTION OF C-PHYCOCYANIN FROM LIMNOSPIRA PLATENSIS: EFFECTS OF PULSE WIDTH AND REFRIGERATION STORAGE

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Pulsed electric field (PEF) treatment was investigated as a method to enhance the extraction of the water-soluble protein phycocyanin (C-PC) from pellet-form *Limnospira platensis*. Various PEF conditions were evaluated, including specific energy (100--200 kJ/kg), electric field strength (1.2--1.6 kV/cm), and pulse width (10--50 µs). The highest C-PC extraction yield was obtained under moderate specific energy (150 kJ/kg), the highest electric field strength (1.6 kV/cm), and the longest pulse width (50 µs). When specific energy and electric field strength were held constant, a reduction in pulse width alone resulted in significantly lower extraction yields, indicating the combined effect of PEF parameters.

Based on these preliminary results, the influence of refrigeration storage time (24-72h) on PEF-assisted extraction was further examined. Increasing storage time enhanced the effectiveness of PEF treatment, leading to higher C-PC yields, which were positively correlated with increased antioxidant capacity, total phenolic content, and soluble protein levels in the extracts. However, prolonged refrigeration storage reduced C-PC extraction selectivity after two days, resulting in increased chlorophyll and carotenoid contamination.

These findings demonstrate that PEF treatment effectively enhances C-PC extraction from *L. platensis*, with pulse width identified as a critical parameter. While refrigeration storage increases cell susceptibility to PEF and improves extraction efficiency, excessive storage leads to increased cell degradation and reduced pigment purity.

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POSTER PRESENTATION

INFLUENCE OF PULSED ELECTRIC FIELD PRETREATMENT ON BIOACTIVE COMPOUNDS AND PHYSICOCHEMICAL PROPERTIES OF PEPPER

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Capsicum spp. is one of the most important vegetable crops in Europe, valued for its diversity and high nutritional value, as well as its content of bioactive compounds such as phenolics and capsaicinoids. The growing demand for efficient extraction methods has encouraged the development of innovative technologies, including pulsed electric field (PEF) treatment, a non-thermal method that enhances cell membrane permeability and facilitates the release of intracellular compounds.

The aim of this study was to evaluate the effectiveness of PEF as a pretreatment for the extraction of bioactive compounds from different pepper varieties and to assess its influence on phenolic content, capsaicinoids, antioxidant activity, and physicochemical properties. The experimental design included electric field strengths of 2.0, 5.0, and 7.5 kV/cm for 1, 3, and 5 minutes.

The results showed that PEF treatment significantly enhanced the extraction of bioactive components, particularly phenolic compounds, compared to untreated samples. The highest phenolic yield (4.67 mg/g) was obtained in sweet pepper treated at 5 kV/cm for 1 minute, indicating that moderate electric field intensity and shorter treatment duration may be optimal for phenolic extraction. The highest antioxidant activity (93.90%) was observed in cayenne pepper treated at 5.0 kV/cm for 5 minutes. Furthermore, PEF treatment did not cause significant negative changes in physicochemical properties, confirming the advantages of non-thermal processing in preserving raw material quality while enhancing extraction efficiency.

Overall, the findings demonstrate that pulsed electric field treatment represents an effective and promising pretreatment method for improving the extraction of bioactive compounds from peppers.

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POSTER PRESENTATION

PROCESS INTENSIFICATION OF OSMOTIC MEMBRANE DISTILLATION VIA ULTRASONICATION: FLUX ENHANCEMENT AND QUALITY RETENTION ASSESSMENT IN ORANGE JUICE

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Osmotic Membrane Distillation (OMD) is a non-thermal membrane process driven by vapour pressure difference across a hydrophobic membrane and is suitable for concentrating thermally sensitive food systems. However, its industrial application is constrained by concentration polarization at the membrane surface, leading to reduced permeate flux and process efficiency. The primary objective of this study was to study the flux behaviour of OMD under ultrasonic process intensification and to evaluate its associated quality aspects during orange juice concentration. Previous studies on ultrasound-assisted membrane processes have predominantly employed ultrasonic bath systems, where acoustic energy is indirectly transmitted to the membrane module. In contrast, the present study introduces a modified configuration in which an ultrasonic transducer (28 kHz, 60 W) was directly integrated into a plate-and-frame membrane module of area 0.011m2 using a hydrophobic polytetrafluoroethylene (PTFE) membrane with a pore size of 0.45 µm. This direct coupling was designed to improve cavitation efficiency and boundary layer disruption at the membrane surface. Sodium chloride (NaCl) and calcium chloride dihydrate ($CaCl_2 \cdot 2H_2O$) at concentrations of 4, 5, and 6 M were used as osmotic agents. Experiments were conducted for 6 hours to compare OMD and ultrasonication-assisted OMD (US-OMD) performance. The US-OMD system achieved a maximum flux enhancement of 88% with an average flux of 1.96 LMH in US-OMD compared to 1.04 LMH in OMD using 5 M $CaCl_2 \cdot 2H_2O$. Orange juice quality was maintained, with Total Soluble Solids increasing to 14.5 °Brix, while density (1.05 g/cm^3) and titratable acidity (1.27 g/100 mL) remained the same. Higher retention of vitamin C (837 mg/L) and total polyphenols (912 mg/L) was observed under these conditions. The results demonstrate that direct ultrasonic integration offers enhanced mass transfer performance compared to OMD alone, while retaining key nutritional and physicochemical quality attributes of orange juice.

References

Chanukya, B. S., & Rastogi, N. K. (2017). Ultrasound assisted forward osmosis concentration of fruit juice and natural colorant. Ultrasonics sonochemistry, 34, 426-435.

Heikkinen, J., Kyllönen, H., Järvelä, E., Grönroos, A., & Tang, C. Y. (2017). Ultrasound-assisted forward osmosis for mitigating internal concentration polarization. Journal of Membrane Science, 528, 147-154.

Hou, D., Wang, Z., Li, G., Fan, H., Wang, J., & Huang, H. (2015). Ultrasonic assisted direct contact membrane distillation hybrid process for membrane scaling mitigation. Desalination, 375, 33-39.

Nandan, Y., Sandeep, G. D. S., Choudhary, N., Jan, N. M., & Raghavarao, K. S. M. S. (2025). Machine Learning Models for the Prediction of Transmembrane Flux in Ultrasonication Assisted Microfiltration of Pretreated Orange Juice. Journal of Food Process Engineering, 48(8), e70208.

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Bio-processing for innovation and sustainability

POSTER PRESENTATION

SEPARATION OF POLYOLS ON A CATION EXCHANGE RESIN: IMPLICATIONS FOR THE SUSTAINABLE PURIFICATION OF BIOPRODUCTS

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The growing demand for low-calorie sweeteners has intensified the need for efficient purification strategies of polyols such as L-arabitol and xylitol, which are increasingly produced via biotechnological routes. In food applications, high purity standards are required, making downstream separation a critical processing step. In this work, adsorption equilibrium isotherms of xylitol and L-arabitol onto strong acid cation exchange resin were obtained through single-component equilibrium experiments conducted at different temperatures. The adsorption equilibrium data was described using classical adsorption models to evaluate adsorption capacity and affinity behavior. The influence of temperature on the adsorption process was systematically assessed to provide insight into the energetic nature of the interactions between the polyols and the adsorbent. Adsorption fixed bed experiments were conducted using different operating conditions, validating the equilibrium previously obtained. The adsorption tests revealed distinct adsorption responses for each polyol, indicating differences in interaction strength with the resin and suggesting potential selectivity under appropriate operating conditions. Thermodynamic evaluation based on temperature-dependent equilibrium parameters was used to assess the spontaneity and feasibility of the adsorption process. The results highlight adsorption as a promising and resource-efficient approach for the purification of food-grade polyols and provide fundamental information to support the development of sustainable bioprocessing strategies for functional food ingredient production.

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POSTER PRESENTATION

PRODUCTION OF TANNASE BY ASPERGILLUS NIGER USING FRUIT POMACE AS A SUBSTRATE

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The study aimed to biosynthesize tannase by *Aspergillus niger* in a culture medium with fruit pomace to induce tannase biosynthesis. Tannase (E.C.3.1.1.20) hydrolyses ester and depside bonds of hydrolysable tannins. This reaction produces saccharide and gallic acid. Many microorganisms synthesize tannase, but due to the potential use of tannase preparations in the food industry, the most suitable species is *Aspergillus niger*, classified as GRAS. The increase in the consumption of fruit and vegetables, as well as juices, purées, and smoothies, is associated with the production of pomace, the utilisation of which is a significant problem in food processing. Numerous studies show that fruit pomace is a rich source of nutrients and minerals, and its use in biotechnological processes is in line with the development of the circular economy. Grape, pomegranate, cranberry, blueberry, and strawberry pomace are rich in tannins and can be a valuable raw material for tannase production. The optimisation of the composition of the medium and the culture conditions of *A. niger* from the point of view of maximising tannase activity was carried out using planned experiment methods. The experiment plan was determined using the STATISTICA programme. The optimal composition of the medium was determined as the maximum response surface using the MATLAB programme. Tannase was purified using traditional filtration, ultrafiltration, and precipitation with a cooled organic solvent and dried by freeze-drying. Tannase activity was determined using the Ibuchi method, and protein was determined using the Lowry method. The composition of hydrolysis of tannins -- using spectrophotometric method; molecular weight profile of enzyme preparation-- using SDS-PAGE electrophoresis. The results obtained confirm the assumption that fruit pomace used to induce tannase biosynthesis is a valuable raw material for obtaining tannase, and its use in biotechnological processes is in line with the development of the circular economy concept. In addition, the research allows for cultural conditions that ensure high tannase activity. It was important that the tannase preparation obtained in *Aspergillus niger* culture effectively hydrolyses tannins contained in the model juice.

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Food product development

POSTER PRESENTATION

PLANT PROTEIN ENRICHMENT IN HAZELNUT PASTE: IMPACT ON STABILITY AND RHEOLOGY

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The growing demand for plant-based and high-protein foods is promoting reformulation strategies for lipid-rich matrices with improved nutritional and technological performance. Hazelnut paste, widely used in confectionery and bakery products, is characterized by high fat content and susceptibility to oil separation and oxidative rancidity. This study aimed to develop high-protein hazelnut pastes achieving a double result in terms of both "high protein" claim (≥20% energy from protein) and increased stability against phase separation, which is a typical problem of nut pastes.

After some preliminary trials, two enriched formulations were prepared by incorporating protein isolate blends into a commercial 100 % non-stabilized hazelnut paste (NS), giving two recipes with approximately 25% total protein PMR (pea-almond-rice proteins) and SMR (soy-almond-rice proteins) . The NS paste and another commercial product stabilized with palm oil ((S) were used as reference samples. All the samples were characterized for color (CIELAB), water activity, oil separation (centrifugation at 4°C), oxidative stability (Oxitest), texture, viscous and visco-elastic behavior, and tribological behavior.

Protein enrichment significantly reduced oil separation compared to NS, reaching values comparable to or lower than the stabilized sample, indicating improved physical stability without the addition of saturated fats. Enriched samples showed increased hardness and consistency index and maintained pseudoplastic behavior (n<1). The visco-elastic properties revealed G' predominance over G'' and an extended linear viscoelastic region, suggesting weak gel-like structuring able to limit phase separation. Oxitest results showed comparable or slightly longer induction periods in the enriched samples, indicating that oxidative stability was not compromised by protein addition. Furthermore, the protein-enriched samples showed a more stable texture after cooking, to simulate a bakery application.

Plant protein incorporation represents, then, an effective strategy to produce high-protein hazelnut pastes with enhanced structural stability and maintained oxidative resistance, supporting the development of nutritionally improved and sustainable confectionery formulations.

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POSTER PRESENTATION

LACTIC ACID FERMENTATION ENHANCES THE GUT AND METABOLIC BENEFITS OF OSMOTICALLY DEHYDRATED ONION REDTIDE PREPARATIONS IN RATS

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This study aimed to evaluate the effectiveness of osmotic dehydration with a lactose solution, alone or combined with spontaneous lactic acid fermentation, in producing novel RedTide onion preparations with functional properties, and to assess their physiological effects in rats. Forty healthy male Wistar rats were randomly assigned to four dietary groups for a four-week feeding trial: a control diet and diets supplemented (2%, w/w) with one of three lyophilized RedTide onion preparations, i.e., untreated, osmotically dehydrated with lactose, or osmotically dehydrated followed by lactic acid fermentation. Dietary onion supplementation exerted moderate to large size effects on caecal digesta mass, pH, SCFA composition, and microbial enzyme activities, indicating enhanced gut fermentation and microbial functional capacity. Onion treatments modulated bile acid metabolism, particularly increasing primary and conjugated bile acids, while reducing potentially detrimental bile acid species. The osmotically dehydrated/fermented onion preparation produced the most pronounced systemic effects, including reduced hepatic fat and triglyceride accumulation, lower plasma triglycerides and atherogenic index, and favourable modulation of genes involved in lipid metabolism, bile acid synthesis, inflammation, and immune signaling. This group also showed enhanced expression of antioxidant- and immunity-related plasma proteins, and markers of improved haematological stability and reduced oxidative and inflammatory stress. In contrast, osmotic dehydration alone resulted in more limited metabolic and immunological effects, despite some modulation of gut microbial activity and bile acid profiles. In conclusion, dietary supplementation with RedTide onion preparations induced biologically relevant, processing-dependent effects on microbial gut fermentation, bile acid metabolism, and systemic metabolic and immune responses in rats. The combination of osmotic dehydration with lactose and lactic acid fermentation seems to be most favourable strategy, supporting the potential of fermented onion preparations as functional dietary ingredients.

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POSTER PRESENTATION

TECHNOLOGICAL VALORISATION AND UPCYCLING OF SURPLUS AND VISUALLY REJECTED PGI APPLES AND PDO PEARS: EFFECTS ON COLOUR STABILITY AND SENSORY PROPERTIES OF FRUIT PREPARATIONS

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Apple and pear production plays a significant role in the Portuguese agri-food sector; however, substantial quantities of fruit classified as industrial-grade or visually rejected are discarded annually due to apparent defects or reduced calibre.

In this study, fruit preparations were produced exclusively from surplus PGI (Protected Geographical Indication) Fuji and Gala apples and PDO (Protected Designation of Origin) Rocha pear, using whole fruit with peel, unlike most commercial fruit pulps, with the dual objective of increasing dietary fibre content and reducing processing waste. The study aimed to optimise processing conditions by assessing the effects of core removal, pasteurisation method, blanching and antioxidant addition on processing yield, colour stability and sensory acceptance. Different processing combinations were evaluated, including fruit processed with and without core, pasteurisation in a water bath or in a tubular pasteurisation system, and blanching treatments with and without antioxidant addition. Throughout one month storage, pH values remained relatively stable (approximately 3.8--4.5 SD ≤ 0.03), with lower variability observed in de-cored samples processed in the pasteurisation system.

Instrumental colour analysis (L*, a* and b*) demonstrated that the tubular pasteurisation improved colour stability and higher lightness, while water bath treatments, particularly those including the core, were more susceptible to browning. Apples generated lower core-related waste (approximately 16.9 ± 1.9%) and higher fruit yield (83.3 ± 1.9%) compared to Rocha pear (21 ± 1.0% waste; 78.4 ± 1.0% yield). Treatments without antioxidant addition led to higher pulp yields, whereas antioxidant application reduced final yield, especially in pear, likely due to leaching effects, despite improving visual attributes.

Quantitative Descriptive Analysis showed higher overall sensory acceptance for samples subjected to blanching combined with antioxidant treatment, associated with enhanced colour, brightness, texture and flavour balance. Overall, the combination of controlled pasteurisation, blanching and antioxidant application proved to be an effective strategy to obtain fibre-enriched PDO e PGI fruit preparations with improved technological and sensory quality.

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POSTER PRESENTATION

INNOVATIVE EDIBLE HYDROGELS AS FUNCTIONAL FOOD SYSTEMS FOR PROBIOTIC AND PLANT-BASED BIOACTIVES

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Interest in the development of innovative probiotic products with enhanced bioactive properties is steadily increasing, contributing both to the improvement of human health and to the transition toward sustainable food systems. Probiotics are defined as live microorganisms that confer health benefits to the host when administered in adequate amounts, such as lactic acid bacteria (LAB). This work explored the development of innovative edible hydrogel systems as functional food with bioactive compounds. Calcium alginate--based hydrogels were formulated into jelly-type confectionery products enriched with microalgae (*Chlorella*) and sustainable plant ingredients such as carob syrup (**Ceratonia siliqua**), aiming to enhance antioxidant potential, textural quality, and probiotic stability. Two types of jelly gums were prepared: one containing free probiotic cells (**L. acidophilus**) (free LAB-Jelly) and another containing probiotic cells encapsulated in sodium alginate (encapsulated LAB-Jelly). Encapsulation strategies were assessed for their ability to improve probiotic protection. Following packaging in a multilayer material (BOPP, MET-PET, LDPE) and storage at room temperature for one-month, microbiological analyses, texture profile analysis, determination of total phenolic content, and measurement of water activity (aw) were conducted. After one month of storage at 25°C, the encapsulated LAB-Jelly gums exhibited lower reduction of probiotic viability (21%) compared to the free LAB-Jelly (38%). Furthermore, total phenolic content of aqueous extracts of both samples exhibited a higher % reduction in free LAB-Jelly (32.6%) compared to encapsulated LAB-Jelly (10.9%), with final values of 3.1 mg GAE/g and 4.1 mg GAE/g, respectively. Texture profile analysis revealed that all measured parameters (hardness, elasticity, cohesiveness, and adhesiveness) were acceptable in both types of jelly gums. After one month of storage, the encapsulated LAB-Jelly demonstrated superior microbiological properties and bioactivity compared to the non-encapsulated formulation. Further research is needed for optimization of the product.

References

1. Altamirano-Ríos, A. V., Guadarrama-Lezama, A. Y., Arroyo-Maya, I. J., Hernández-Álvarez, A. J., & Orozco-Villafuerte, J. (2022). Effect of encapsulation methods and materials on the survival and viability of *Lactobacillus acidophilus*: A review. International Journal of Food Science and Technology, 57(7), 4027-4040.

2. Rodríguez-Solana, R., Romano, A., & Moreno-Rojas, J. M. (2021). Carob pulp: a nutritional and functional by-product worldwide spread in the formulation of different food products and beverages. A review. Processes, 9(7), 1146.

3. Pyrovolou, K., Panopoulou, E. C., Tsogka, C., Sklavou, A., Gogou, E., Strati, I. F., Konteles, S. J., & Batrinou, A. (2025). Development of Calcium Alginate Hydrogels with Chlorella, Carob (*Ceratonia siliqua* L.) and Encapsulated Probiotics in Edible Jelly-Gums with Enhanced Bioactivity. Gels, 12(1), 1. https://doi.org/10.3390/gels12010001

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POSTER PRESENTATION

MEDITERRANEAN PLANT-BASED KOMBUCHA BEVERAGES FERMENTED USING CAROB HONEY (CERATONIA SILIQUA, L.) AS AN ALTERNATIVE CARBON SOURCE

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The growing demand for functional beverages as well as the replacement of refined sucrose with sustainable alternative carbon sources in fermented beverages has gained increasing interest in the development of functional foods. In this study, kombucha beverages were prepared using carob honey (*Ceratonia siliqua*, L.*) as an alternative carbon source and fermented with a symbiotic culture of bacteria and yeast (SCOBY), in combination with selected Mediterranean medicinal plants and aromatic materials, including: St. John's Wort (*Hypericum perforatum*), sage (*Salvia officinalis*), Chios mastic tree (*Pistacia lentiscus* var. *chia*), and Greek mountain tea (*Sideritis* spp.). Herbal infusions were fermented using a symbiotic culture of bacteria and yeast (SCOBY) and the resulting beverages were assessed for their total phenolic content and organoleptic characteristics over a 35-day period. The results have shown that carob honey was a highly effective substrate for functional kombucha production and that the type of carbon source strongly influenced bioactive compound levels. Formulations prepared with carob honey showed significantly higher total phenolic content (on average 1257 mg GAE/L at the last day of fermentation) which was >4 times than those prepared with sucrose, both at the initial stage and throughout fermentation. Plant species and plant combinations also affected fermentation outcomes with St. John's Wort and sage based formulations showing particularly high bioactive profiles. Organoleptic evaluation indicated that kombucha beverages fermented with carob honey exhibited a balanced aroma and flavor profile with satisfactory overall acceptability. Overall, these findings confirm that kombucha fermentation, particularly when combined with sustainable Mediterranean medicinal plants and alternative sweeteners such as carob honey, is a promising strategy for the development of functional beverages with enhanced bioactive potential. The observed variability among plant matrices, sweeteners, and fermentation times highlights the importance of formulation optimization to maximize health-related properties.

References

1. Jayabalan R, Malbaša RV, Lončar ES, Vitas JS, Sathishkumar M. A Review on Kombucha Tea-Microbiology, Composition, Fermentation, Beneficial Effects, Toxicity, and Tea Fungus. Compr Rev Food Sci Food Saf. 2014 Jul;13(4):538-550. doi: 10.1111/1541-4337.12073. PMID: 33412713.

2. Onsun, B., Toprak, K. & Sanlier, N. Kombucha Tea: A Functional Beverage and All its Aspects. Curr Nutr Rep 14, 69 (2025). https://doi.org/10.1007/s13668-025-00658-9

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POSTER PRESENTATION

OPTIMIZATION OF KOMBUCHA FERMENTATION FROM WHITE MULBERRY LEAVES (MORUS ALBA L.) TO MAXIMIZE POLYPHENOL CONTENT

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Kombucha is a sparkling fermented drink that is gaining popularity. It is traditionally made from black tea. However, white mulberry leaves are a promising substitute. They are a source of polyphenols, making them an attractive raw material for kombucha-type fermented beverages. The study aimed to optimize the fermentation process of kombucha prepared from white mulberry leaves to maximize polyphenol content and characterize the kinetics of this process. The material used for the study was an infusion of white mulberry leaves, sweetened with white sugar and fermented with SCOBY starter culture. The experiment was planned using the Box-Behnken model for three independent variables: time (7-14-21 days), temperature (22-26-30°C), and sugar concentration (30-50-70 g/L), analyzing their impact on total polyphenol content. Analysis of the generated response surfaces showed saddle points at a constant sugar content of 45 g/L and at a constant fermentation duration of 15 days, indicating the need for verification tests at higher temperatures. At this stage, the process was carried out at 30°C and 37°C, with a constant sugar concentration of 45 g/L, and pH, biomass growth, total acid, sugar, and polyphenol content were monitored for 15 days. Analysis of the results showed differences in the course of fermentation depending on the temperature. In the process conducted at 30°C, the parameters changed continuously and evenly until the last day of the study. This resulted in an excessive accumulation of acetic acid (9.65 g/L) and a drop in pH to 2.71, thereby reducing the product quality. At 37°C, however, a rapid process was observed in the initial phase, followed by stabilization of the results. This indicates faster depletion of microorganisms' metabolic activity at higher temperatures. This variant allowed the highest polyphenol content (0.366 mg/mL) to be obtained as early as the 8th day of fermentation, exceeding the final result at 30°C (0.311 mg/mL) while maintaining a safer pH of 3.08. The most favorable parameters for white mulberry leaf kombucha production are a temperature of 37°C, a fermentation time of 8 days, and a sugar concentration of 45 g/L.

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POSTER PRESENTATION

FORMULATION AND DEVELOPMENT OF FUNCTIONAL PROBIOTIC BEVERAGES FROM WHEY PROTEIN CONCENTRATES OF DIFFERENT SPECIES

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Dairy products represent a key component of the human diet due to their high nutritional value. During cheese production, only about 10--20% of the processed milk is converted into cheese, while the remaining 80--90% results in whey as a by-product. Globally, approximately 200 million tons of whey are generated each year.

The disposal of whey poses significant environmental challenges because of its high biochemical oxygen demand (BOD) and chemical oxygen demand (COD). Nevertheless, whey also contains valuable bioactive compounds, high-quality aminoacids, lactose, vitamin B_{12}, and various galactooligosaccharides (GOSs), making it a promising raw material for valorisation into functional foods and nutraceuticals.

Currently, the primary routes for whey utilisation include its use in animal feed, whey-based food products, and biogas production. However, large-scale dairy plants in northwestern Europe have invested in advanced processing technologies for whey concentration and drying, as well as in the production of high-purity protein fractions used in premium applications such as medical nutrition, infant formulas, sports nutrition products and more.

In recent years, there has been a growing demand for goat and sheep cheeses due to their superior nutritional profiles and potential health benefits. In this context, the main objective of the present project was to enhance the circular economy within small and medium-sized dairy enterprises (SMEs) in Mediterranean countries through the implementation of innovative technologies and the development of new, high-value dairy products.

Within this framework, we aimed to develop functional probiotic beverages derived from various types of whey protein concentrates (WPCs). To develop the optimal product formulation, several pre-production trials were conducted using different ratios of WPC, starter cultures, colouring agents, and flavouring agents. Comprehensive analyses were subsequently performed to evaluate the physicochemical, microbiological, and sensory properties of the resulting beverages.

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New, alternative, and novel food sources and ingredients

POSTER PRESENTATION

INFLUENCE OF HEMP AND PEA PROTEIN ADDITION ON DOUGH RHEOLOGY AND QUALITY OF GLUTEN-FREE ENERGY SNACK

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This study investigated the effects of replacing rice starch with pea and hemp proteins at substitution levels of 20% and 40% in the formulation of energy snacks, with the aim of evaluating their impact on dough behavior and final product quality. The rheological properties of the dough were characterized using a lubricated squeeze flow test and texture profile analysis, while the mechanical properties of the energy snacks were assessed through penetration and three-point bending tests. The incorporation of plant-based proteins led to an increase in the elongational viscosity of the dough, particularly at the highest substitution level, indicating enhanced resistance to deformation during processing. Besides, significant changes were observed in textural parameters, including hardness, cohesiveness, and adhesiveness. Protein fortification also induced significant changes in the physical and textural characteristics of the energy snacks. Protein-enriched snacks exhibited lower lightness values and higher hue angle values compared to the rice starch control counterparts, indicating the influence of protein addition on the color of the snacks. Overall, these results indicate that incorporating plant proteins significantly affects the quality characteristics of snack products, thereby supporting the development of functional, protein-enriched snacks with improved technological properties.

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POSTER PRESENTATION

MONTADO-INSPIRED FUNCTIONAL BREAD: UNLOCKING THE POTENTIAL OF ACORN FLOUR AND ESSENTIAL OILS

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As one of the most widely consumed and ancient foods worldwide, bread holds a central place in many diets due to its accessibility. Increasing consumer awareness of health and nutrition has driven the development of functional foods through the incorporation of bioactive ingredients, such as essential oils (EOs) and probiotic microorganisms. In parallel, the growing interest in gluten-free alternatives highlights the potential of acorn flour, an underexploited resource from the Montado ecosystem.

In the Albread project, acorn flour is combined with essential oils extracted from medicinal and aromatic plants to develop an innovative functional bread [1]. Given their valuable bioactive properties and widespread use in food technology, it is essential to characterize these extracts, including the influence of extraction methods and geographical origin on their physicochemical properties and suitability for specific applications [2,3].

The EOs were analysed by GC--MS, revealing significant compositional variations. Among the tested oils, rosemary and thyme extracts were selected and incorporated into a standard bread formulation. The antioxidant capacity of the dough was measured before and after baking, showing a slight increase following the baking process.

Furthermore, essential oils with antifungal properties are being evaluated for their ability to inhibit mould growth in bread, with the aim of extending shelf life. The incorporation of acorn flour significantly enhanced the antioxidant potential but affected the dough structure due to its low gluten content. To address this limitation, several food-grade biopolymers and proteins are being tested, alongside a rheological characterization of the dough.

This study aims to improve the nutritional and functional profile of bread while promoting the economic valorisation of local bioresources, environmental sustainability, and the conservation of the Montado ecosystem.

References

[1] Zocchi, D.M.; Bondioli, C.; Hamzeh Hosseini, S.; Miara, M.D.; Musarella, C.M.; Mohammadi, D.; Khan Manduzai, A.; Dilawer Issa, K.; Sulaiman, N.; Khatib, C.; et al. Food Security beyond Cereals: A Cross-Geographical Comparative Study on Acorn Bread Heritage in the Mediterranean and the Middle East. Foods 2022, 11, 3898, doi:10.3390/foods11233898.
[2] Ribet, L.; Kassis, A.; Jacquier, E.; Monnet, C.; Durand-Dubief, M.; Bosco, N. The Nutritional Contribution and Relationship with Health of Bread Consumption: A Narrative Review. Critical Reviews in Food Science and Nutrition 0, 1--28, doi:10.1080/10408398.2024.2428593.
[3] Amoah, I.; Cairncross, C.; Osei, E.O.; Yeboah, J.A.; Cobbinah, J.C.; Rush, E. Bioactive Properties of Bread Formulated with Plant-Based Functional Ingredients Before Consumption and Possible Links with Health Outcomes After Consumption- A Review. Plant Foods Hum Nutr 2022, 77, 329--339, doi:10.1007/s11130-022-00993-0.

POSTER PRESENTATION

FROM MARINE CO-PRODUCTS TO FUNCTIONAL INGREDIENTS: RAW MATERIAL EFFECTS ON FISH PROTEIN HYDROLYSATES

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The sustainable valorisation of fish processing side-streams enables the production of tailored high-value ingredients. This study investigated fish protein hydrolysates (FPH) produced from two types of co-products: muscle-rich trimmings from Cape hake (CH) and Nile perch (NP), and bone-rich gilthead seabream heads and frames (GB). The objective was to assess how raw material type influences the bioactive and techno-functional properties of enzymatic hydrolysates. Hydrolysis was performed using Alcalase® and Protana® under previously described conditions [1].

Hydrolysis yields ranged from 12.0% (CH and NP) to 16.9% (GB), with protein yields around 80%. Degree of hydrolysis differed significantly among materials (44.3% CH, 37.7% GB and 25.6% NP), reflecting different hydrolysis extents and distinct peptide size distributions. All FPH had high protein content (FPH_CH = 76.9 and FPH_GB= 81.7%). FPH_GB retained higher lipid content (9.3%) and fatty acid profiles differed according to raw material, with FPH_GB dominated by MUFA, FPH_NP by SFA and FPH_CH by PUFA. Muscle-derived FPH showed higher mineral fraction (~12%), particularly Na, K and Mg, while heavy metals were below detection or quantification limits in all samples. Bioactive properties varied markedly: FPH_GB showed the strongest DPPH and ABTS radical scavenging activities, whereas FPH_CH showed the highest ACE inhibitory activity (82.9%, 5 mg/mL). Copper and Fe chelating activities were similar among FPH (EC50: 0.5-0.9 mg/mL and 2.5-2.9 mg/mL, respectively). Regarding functional properties, all FPH displayed high solubility (80.4--91.5%), with FPH_GB showing higher emulsifying and foaming capacity, while FPH_CH and FPH_NP formed more stable foams. FPH_CH exhibited higher water absorption (3.4 mL/g protein) but lower fat absorption capacity (2.3 g oil/g protein).

Overall, these results demonstrate that co-products selection strongly determines the bioactive and functional properties of FPH, enabling targeted production of differentiated ingredients for functional food and nutraceutical applications and supporting circular economy strategies.

References

[1] Sapatinha, M.; Camacho, C.; Pais-Costa, A.J.; Fernando, A.L.; Marques, A.; Pires, C. Enzymatic Hydrolysis Systems Enhance the Efficiency and Biological Properties of Hydrolysates from Frozen Fish Processing Co-Products. Mar. Drugs 2025, 23, 14. <https://doi.org/10.3390/md23010014>

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POSTER PRESENTATION

ANTIOXIDANT-BASED STABILISATION OF GILTHEAD SEABREAM COPRODUCTS TO PRODUCE BIOACTIVE AND FUNCTIONAL PROTEIN HYDROLYSATES

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Fish coproducts are valuable sources of bioactive peptides but are highly susceptible to lipid oxidation, which can compromise the quality and utilisation of fish protein hydrolysates (FPH). This work explores two antioxidant-based strategies to reduce lipid oxidation of gilthead seabream (**Sparus aurata**) coproducts and their FPH: antioxidant directly in the raw material and during the enzymatic hydrolysis.

Coproducts were stabilised with Duralox MANC® (0.5%, m/m) or left untreated and processed either fresh or after 3 months of frozen storage to produce FPH [1]. In both treatments, Trolox and EDTA were applied during hydrolysis. Coproducts were analysed for lipid oxidation, while FPH were assessed for physical, chemical, biological and functional properties.

Raw material stabilisation reduced initial lipid oxidation (50%) and enabled the production of FPH with TBA values up to tenfold lower than non-stabilised coproducts. Antioxidant addition during hydrolysis reduced lipid oxidation in FPH from non-stabilised coproducts but showed no additional benefits when applied to stabilised material. These trends persisted after 3 months of frozen storage of the coproducts and the corresponding FPH. All FPH presented a~w~ < 0.1; antioxidant strategies influenced colour, with stabilised coproducts producing darker FPH, while Trolox+EDTA resulted in lighter products. FPH showed high protein content (75--81% DW), lipid levels of 3.5--6.0% with the fatty acid profile MUFA

Overall, antioxidant stabilisation of fish coproducts, combined with Trolox and EDTA addition during hydrolysis, proved highly effective to control lipid oxidation and preserve bioactivity. The combined use of both strategies allows a balanced approach to producing bioactive FPH, supporting the sustainable valorisation of fish processing coproducts into functional ingredients.

References

[1] Sapatinha, M.; Camacho, C.; Pais-Costa, A.J.; Fernando, A.L.; Marques, A.; Pires, C. Enzymatic Hydrolysis Systems Enhance the Efficiency and Biological Properties of Hydrolysates from Frozen Fish Processing Co-Products. Mar. Drugs 2025, 23, 14. <https://doi.org/10.3390/md23010014>

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POSTER PRESENTATION

VALORIZATION OF PINTO BEAN POD AS A NOVEL, SUSTAINABLE PECTIN SOURCE: OPTIMIZATION OF HOT ACIDIC EXTRACTION AND CHARACTERIZATION OF TECHNO-FUNCTIONAL PROPERTIES

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The increasing interest in sustainable foods highlights the evaluation of agro-industrial wastes and by-products as potential high value-added functional additives and ingredients. The aim of this study was to valorize pinto bean pod, an underutilized agro-industrial waste, as a novel pectin source, and to characterize extracted pectin for its molecular and techno-functional properties for the first time. Pectin was extracted from pinto bean pod using hot organic acidic extraction optimized by using a Box--Behnken experimental design. The extraction was studied to evaluate the effects of temperature (55--75--95 °C), extraction time (30--60--90 min), and citric acid (CA) concentration (3--6--9%). The optimization data were collected by monitoring extraction yield (Y), galacturonic acid content (GA), and degree of esterification (DE) for pectin extracts obtained at different conditions. According to the verified experimental design, the optimal extraction condition giving most acceptable parameters (Y: 20%, GA: 30%, DE: 29%) were reached by treating waste for 30 min with 6% CA at 95°C. The techno-functional properties of the pinto bean pectin were characterized by determining its water holding capacity (WHC), oil holding capacity (OHC), foaming capacity (FC), and emulsifying capacity (EC). The pectin extracted exhibited a WHC of 3.71 g/g and an OHC of 1.61 g/g. The pectin showed poor FC that was destabilized in 3h. In contrast, it showed a good EC with a moderate emulsion stability. This research revealed that the pinto bean pods are one of the most promising waste as a pectin source. In fact, a literature survey suggested that pinto bean pods are better pectin source than banana, pomegranate, carrot, apple, and melon processing wastes that pectin yields varied between 2.9 and 15.8%. Further studies are ongoing to discover gelation and edible film forming properties of pinto bean pectin.

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POSTER PRESENTATION

UTILIZATION OF PREMATURE BANANA FLOURS AS EMULSION STABILIZER AND FAT SUBSTITUTE IN REDUCED OIL AQUAFABA MAYONNAISE: A COMPARATIVE STUDY WITH PULP, PEEL AND WHOLE FRUIT FLOURS

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Turkey is a major producer of banana fruit in the Mediterranean, however, due to lack of suitable climate conditions in late autumn and winter, high rate of premature bananas originates as one of the greatest problems of farmers. The premature bananas are rich source of resistant starch, pectin and polyphenols distributed at different amounts in fruit pulp and peel depending on maturity level. This study aimed to investigate possible utilization of their flours obtained from pulp (PU), peel (PL) and whole fruits (WF) of wasted premature bananas as a novel ingredient in reduced oil (70%) aquafaba vegan mayonnaise. The optimal oil content of aquafaba mayonnaise for essential creamy texture, firmness and emulsion stability is 80% while lowering oil-content causes dramatic reductions in quality parameters due to loose packing of emulsified oil droplets. Thus, to prevent loss of quality attributes of reduced-oil mayonnaise, the formulations were enriched with 1 % (w/v) of PE, PU and WF; and their effects on emulsion stability, colour and textural/rheological properties were investigated.

Due to its high polyphenol content PE yielded dark-yellow coloured mayonnaise while PU and WF formulations were light coloured as desired for mayonnaise. Back extrusion tests showed that PU mayonnaise was almost 2-fold firmer (1.04 N) and it had 2-fold higher consistency index (8.04 N•s) than PE and WF mayonnaises. Although PU mayonnaise showed the highest initial firmness, the WF sample exhibited the highest stability over 7-day storage at 10oC. The mayonnaises rheological properties were characterized by thixotropic loop measurement and fitting flow characteristics by Herschel-Bulkley model (R2 ≥ 0.949). All samples followed shear thinning behaviour and showed thixotropic properties, but only PU and BL samples had yield stress (Yo) values (PU: Yo=50 Pa; BL: Yo=10 Pa) that is characteristic for commercial mayonnaises. Additionally, their apparent viscosities (μ) at 100 s-1 for PU, WF, PE and control (ϕ=80%) were 0.87, 0.73, 0.68 and 0.50 Pa.s, respectively.

In conclusion, PU mayonnaise used as a fat-substitute, mimicked the colour, texture and rheology of conventional aquafaba mayonnaise. This work is promising for application of waste valorisation and circular economy approaches in Turkish banana farming.

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POSTER PRESENTATION

OPTIMISATION OF THE FERMENTATION PROCESS OF SOUR WHEY AS A BASE FOR THE DEVELOPMENT OF A BIODEGRADABLE COMPOUND THAT PREVENT THE FORMATION OF BIOFILM BY LISTERIA MONOCYTOGENES OR DEGRADES THE FORMED BIOFILM

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Raw milk in dairy processing is a vector for the transmission of *Listeria monocytogenes* to dairy products. Proper cleaning and disinfection processes that prevent the development of resistance to chemical disinfectants are essential for reducing the risk of food contamination and makes it possible to meet food safety criteria. L. monocytogenes has developed adaptive abilities in the environment, including growth at -2°C, low pH ≤ 4.4 and aw ≤ 0.92 and the ability to form biofilms. The aim of this study is to develop a biodegradable disinfectant compound based on acid whey that prevents the formation of bacterial biofilms on abiotic surfaces.

The study used 27 samples of acid whey obtained from dairies in various regions of Poland. The whey samples were delivered to the laboratory in sterile packaging, maintaining the cold chain. The whey was fermented by microflora naturally present in whey. The fermentation process was carried out for 1-30 days at 30°C, with pH measurements taken every 6-7 days using a pH meter (Orion Star A211, Thermo). Then the whey samples were sterilized (121°C/15 min) and stored in a refrigerator.

A polystyrene model surface and two strains of L. monocytogenes - Lm 19111 serotype 1/2a isolated from poultry and Lm 7644 isolated from humans - were used to evaluate biofilm formation. Revitalized strains with a density of 1-9x103 cfu/mL were used for the analyses. The assessment of biofilm formation on the control surface and the tested surface (after rinsing with whey) was carried out at various temperatures in the range of 5-30°C for 2, 7, 15, and 30 hours using a staining method and measuring the optical density at a wavelength of 600 nm (SpectraMax iD3, Syngen Biotech) relative to the blind sample.

The post-fermentation process resulted in a decrease in pH value. The lowest pH value in the range of 3.26-3.28 was obtained in the third week of fermentation for samples L/14 and L/19. In 13 samples (48%), pH values less than or equal to 3.40 were found, which means that they can be used as a basis for the development of a biodegradable preparation as an alternative to chemical rinsing and disinfecting preparations. The assessment of biofilm formation at different temperatures on a model surface rinsed with selected whey showed no biofilm formation within 2 hours. The strength of the biofilm forming on the surface depended on time, temperature and the type of acid whey. Based on the research conducted, it can be concluded that sour whey can be used as a base for a biodegradable disinfectant that prevents the formation of bacterial biofilm on abiotic surfaces.

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References

1. Hu L., Dong Q., Li Z., Ma Y., Aslam M. Z., Liu, Y., 2022. Modelling the adhesion and biofilm formation boundary of *Listeria monocytogenes* ST9. Foods, 11, 1-11.

2. Dimakopoulou-Papazoglou D., Lianou A., Koutsoumanis K. P., Modelling biofilm formation of *Salmonella enterica* ser. Newport as a function of pH and water activity. Food Microbiology 2016, 53, s. 76-81.

3. Muskalska K., B., Szymczak B. 2015. Postępy badań nad bakteriami rodzaju Listeria, Postępy Mikrobiologgii,54 (2), 123--132.

4. Gupta T. B., Mowat E., Brightwell G., Flint S.H., Biofilm formation and genetic characterization of New Zealand Cronobacter isolates, Journal of Food Safety 2017, 38, s. 1-13

POSTER PRESENTATION

MORINGABIOFACTORY: PRELIMINAY PHENOLOGICAL AND PHYTOCHEMICAL CHARACTERIZATION OF PLANT MATERIAL

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Moringa oleifera Lam is a species native to the southern foothills of the Himalayas in northwestern India, cultivated since ancient times for its nutritional and medicinal properties. Currently, M. oleifera grows naturally and is cultivated in more than 80 countries in tropical and subtropical regions worldwide, primarily for its leaves, although fruit production for seed harvesting is becoming increasingly important. Its excellent qualities as a functional food and its adaptation to drought make it a potentially resilient crop that can effectively contribute to the FAO's Sustainable Development Goals. The MORINGABIOFACTORY project comprises the agronomic and nutritional study of three varieties of M. oleifera (PKM-1, OCD-3 and MX3) in the semi-arid subtropical Mediterranean (BSh-Csa) climate conditions of southeastern Spain. These varieties were intentionally selected for their cultivation properties and production parameters, as well as for the use and quality of their products. During the first year of the Project, a total population of 353 individuals (young trees and seedlings in initial growth stages) of the three varieties of M. oleifera has been generated from seeds, which are currently cultivated in the CEBAS-CSIC Experimental Fields, located in Santomera (Murcia, Spain). A preliminary phenological study according to the extended BBCH scale was carried out during the nursery stage, in a growth chamber at CEBAS-CSIC and in a shade house at the CAID facilities of the University of Murcia. Although seed germination percentages were above 80% in all cases, there were differences between the three varieties for the vegetative phenophases studied, from sowing to the principal growth stage 3. These differences did not affect plant survival or acclimation after transplanting. Identifiying vegetative and reproductive phenophases, sub-stages, and key stages, in coming seasons will provide key data for characterization of ecotypes of M. oleifera, and harvest schedules for full valorization of the tree (leaves, flowers, fruits and seeds) as source of health-promoting bioactives: glucomoringin (4-[(α-L-rhamnosyloxy)-benzyl]-glucosinolate), and related isomers, glycosilated flavonols, and cinnamic derivatives.

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POSTER PRESENTATION

DEVELOPMENT OF PLANT-BASED ICE CREAM USING ETHYLCELLULOSE-STRUCTURED VEGETABLE OIL OLEOGELS

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The development of plant-based ice cream alternatives requires effective strategies to replace conventional solid fats while maintaining desirable structural and sensory properties. This study investigated ethylcellulose (EC) oleogels as novel fat systems for plant-based ice cream formulation. EC, a cellulose derivative with affinity for oil, was employed as the structuring polysaccharide, enabling oleogel formation and stabilization in the frozen product. Oleogels were prepared using sunflower, soybean, and linseed oils as lipid phases, structured with ethylcellulose at 2, 6, and 10% (w/w). The oleogels were characterized for color, molecular interactions by Fourier-transform infrared spectroscopy (FTIR), and thermal behavior using differential scanning calorimetry (DSC) to assess the effects of oil type and EC concentration on their physicochemical properties. Ice cream mixes formulated with the different EC oleogels were evaluated for rheological properties to assess flow behavior and structural development prior to freezing. The final ice cream products were analyzed for color, texture, and sensory characteristics, allowing assessment of the impact of fat replacement on product quality. Comparisons among formulations provided insight into the influence of lipid source and EC level on oleogel performance within a complex frozen dessert matrix. Overall, the results demonstrated that ethylcellulose oleogels based on different vegetable oils can be successfully incorporated into plant-based ice cream, modulating both processing behavior and final product quality. This study highlights the potential of EC oleogels as a versatile approach for structuring liquid vegetable oils, supporting the development of sustainable, plant-based frozen desserts with tailored physicochemical and sensory properties.

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POSTER PRESENTATION

ETHYLCELLULOSE-STRUCTURED VEGETABLE OIL OLEOGELS AS FAT SUBSTITUTES IN GLUTEN-FREE MILLET MUFFINS ENRICHED WITH TOMATO POMACE POWDER

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Current trends in gluten-free product development emphasize the need for functional fat alternatives and the incorporation of value-added ingredients to improve product quality and sustainability. In this study, ethylcellulose-based oleogels were investigated as alternative fat sources for gluten-free muffins. Oleogels were formulated using sunflower oil and soybean oil as lipid phases, with ethylcellulose incorporated at concentrations of 2, 6, and 10% (w/w). The physicochemical properties of the resulting oleogels were characterized in terms of color parameters, Fourier transform infrared (FTIR) spectroscopy, and thermal behavior assessed by differential scanning calorimetry (DSC), in order to evaluate the structural organization and stability of the oleogel systems. Gluten-free muffins were prepared using millet flour as the base ingredient, with the partial substitution of flour by tomato pomace powder at levels of 5, 10, and 15% (w/w), aiming to enhance the nutritional profile and promote the capitalization of agro-industrial by-products. The formulated oleogels were used as fat sources in the muffin formulations, replacing conventional solid fats. The muffins were analyzed for color, textural properties, and sensory attributes to assess the impact of oleogel type, ethylcellulose concentration, and tomato pomace addition on product quality and consumer perception. The combined evaluation of oleogel characteristics and muffin quality parameters provides insight into the interactions between oleogel structure, flour matrix, and fiber-rich ingredients in gluten-free bakery systems. Overall, the results highlight the potential of ethylcellulose oleogels as functional fat alternatives and tomato pomace powder as a value-added ingredient in gluten-free muffins, contributing to the development of bakery products with potential nutritional benefits, while supporting innovation and sustainability in gluten-free food formulation.

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POSTER PRESENTATION

FERMENTATES AS PROMISING MICROBIAL SOLUTIONS TO ENHANCE THE SHELF LIFE OF SLICED MEAT ANALOGUES

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Consumer demand for alternative proteins has been increasing, driven by health-related motivations, including concerns about animal-associated diseases and the search for foods with lower fat and caloric content. Nevertheless, important challenges remain, particularly regarding sensory quality and product safety, namely in relation to ingredient functionality, allergen management, and microbial stability.

This study aimed to develop and characterize six prototypes of sliced meat analogues (n = 3): one control (prototype C), formulated with a synthetic chemical preservative, and five experimental prototypes (A, B, D, E, and F), in which the preservative was replaced by a fermentate (A and B -- buffered vinegars; D, E, and F -- cultured dextrose). Samples were stored at 4 °C and evaluated over 28 days (typical shelf life for this product category) and 60 days. Microbiological analyses included total viable counts (TVC) and lactic acid bacteria (LAB), while physicochemical parameters comprised pH and water activity (aw). A sensory evaluation (difference-from-control test) was conducted on day 0 to assess appearance and overall quality.

Over the 60-day storage period, pH and aw values showed a slight decrease but did not differ among prototypes. Microbiologically, on day 0, TVC and LAB counts were close to the detection limit (1 log CFU/g). Between days 7 and 28, all prototypes except D remained below the established microbiological limit of 7 log CFU/g for TVC. At day 60, only prototype A maintained counts below this threshold. Regarding LAB, the control and prototypes A and B remained below 7 log CFU/g throughout the 60 days of storage. Sensory analysis revealed that prototype D differed most from the control and presented the lowest median scores for flavour, odour, and texture.

These findings suggest that fermentates can enhance the microbial stability of sliced meat analogues while maintaining sensory and technological quality, supporting their use as promising solutions for shelf life extension and food waste reduction.

References

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POSTER PRESENTATION

SIMULTANEOUS HESPERIDIN DEGLYCOSYLATION AND PROBIOTIC FERMENTATION OF ORANGE JUICE

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Orange juice can serve as a substrate for the growth of probiotic bacteria. Lactic fermentation of fruit juice produces "functional food" rich in bioactive compounds and beneficial bacteria that support intestinal microflora1. Orange juice is a rich source of flavonoids, particularly hesperidin2. However, flavonoid bioavailability is often limited due to low solubility, which can be improved by enzymatic deglycosylation. Glycosylation significantly influences the biochemical properties and biological activity of flavonoids, with the specific type of sugar residue playing a crucial role. For example, Glycosylation strongly affects flavonoid properties; glucosylation generally enhances solubility, whereas rhamnosylation may reduce it3. Hesperidin can be hydrolyzed by naringinase, an enzyme complex containing α-L-rhamnosidase and β-D-glucosidase, first to rhamnose and hesperetin-7-O-glucoside (Hes-7-G), and then to glucose and hesperetin4.

This study aimed to develop a simultaneous process to enhance hesperidin solubility and produce probiotic orange juice via combined fermentation with naringinase and probiotic bacteria.

Freshly squeezed orange juice (55 mL, pH 4.04) was enriched with a naringinase preparation from *Aspergillus niger* (2.8 mL, 1 mg mL^{-1}) and inoculated with a monoculture of *Lactobacillus casei* subsp. rhamnosus (3 mg). The mixture was incubated at 30 °C in a conical flask. Samples were taken at 0, 24, 48, and 72 hours. The concentrations of hesperidin and its hydrolysis products (organic acids), pH values, Lactobacillus cell counts, and antioxidant activity (DPPH assay) were measured at each time point.

After 72 hours of fermentation, approximately 85% of the hesperidin content was hydrolyzed into hesperetin-7-O-glucoside (Hes-7-G) and hesperetin. Lactobacillus cell counts increased significantly, reaching approximately 2×10^8 CFU/mL, indicating successful probiotic growth. The antioxidant activity of the juice decreased slightly, but the change was not statistically significant.

The combined use of naringinase and probiotic bacteria enabled efficient hesperidin hydrolysis while supporting probiotic viability, demonstrating a promising strategy for producing functional probiotic beverages with enhanced flavonoid bioavailability.

References

1. Perricone, M.; Bevilacqua, A.; Altieri, C.; Sinigaglia, M.; Corbo, M.R. Challenges for the Production of Probiotic Fruit Juices. Beverages 2015, 1, 95--103.

2. Mazzaferro, L.S.; Breccia, J.D. Quantification of hesperidin in citrus-based foods using a fungal diglycosidase. Food Chemistry. 2012, 134, 2338--2344

3. Slámová, K.; Kapešová, J.; Valentová, K. "Sweet flavonoids": Glycosidase-catalyzed modifications. International Journal of Molecular Science 2018, 19, 2126.

4. Bodakowska-Boczniewicz, Joanna, and Zbigniew Garncarek. "Use of Naringinase to Modify the Sensory Quality of Foods and Increase the Bioavailability of Flavonoids: A Systematic Review." Molecules 2025, 30.11, 2376.

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POSTER PRESENTATION

SELECTIVE INACTIVATION OF Β-D-GLUCOSIDASE IN THE NARINGINASE COMPLEX FOR TARGETED PRODUCTION OF HESPERETIN 7-O-GLUCOSIDE

Joanna Bodakowska-Boczniewicz[1], **Katarzyna Górska**[1], **Zbigniew Garncarek**[1], **Joanna Harasym**[1]

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Naringinase is an enzyme complex composed of α-L-rhamnosidase and β-D-glucosidase, capable of deglycosylating flavonoids such as hesperidin. α-L-Rhamnosidase hydrolyzes hesperidin to rhamnose and hesperetin 7-O-glucoside (Hes-7-G), while β-D-glucosidase further converts Hes-7-G to hesperetin1. Selective inactivation of β-D-glucosidase allows accumulation of Hes-7-G, a compound with superior water solubility and bioavailability compared to hesperidin and hesperetin, making it attractive for biotechnological and food applications2.

The study aimed to identify conditions enabling selective inhibition of β-D-glucosidase activity within the naringinase complex while preserving maximal α-L-rhamnosidase activity, thereby enabling selective production of Hes-7-G from hesperidin.

Enzymatic activities were measured spectrophotometrically using p-nitrophenyl-α-L-rhamnopyranoside and p-nitrophenyl-β-D-glucopyranoside. HPLC quantified Hesperidin, Hes-7-G, and hesperetin concentrations. The effects of pH, temperature, and incubation time were evaluated to optimize selective inactivation of β-D-glucosidase. In addition, the influence of polyols and sugars -including inositol, sucrose, glycerol, xylose, erythritol, xylitol, and sorbitol-on α-L-rhamnosidase thermostability was assessed. Special focus was placed on evaluating the effect of erythritol concentration, reaction temperature, and incubation time on β-D-glucosidase deactivation and concurrent stabilization of α-L-rhamnosidase.

Incubation at pH 10 for 1 h retained over 70% α-L-rhamnosidase activity while reducing β-D-glucosidase activity to ~11%. Erythritol markedly enhanced α-L-rhamnosidase thermostability. Optimal selectivity was achieved by incubating the enzyme in 2.8 M erythritol at 70 °C for 10 min, resulting in ~5% residual β-D-glucosidase activity and over 58% α-L-rhamnosidase activity. Under these conditions, α-L-rhamnosidase activity exceeded β-D-glucosidase activity by more than 70-fold.

Selective thermal inactivation of β-D-glucosidase in the presence of erythritol enables efficient production of Hes-7-G from hesperidin, providing a practical strategy to enhance flavonoid bioavailability.

References

1. Bodakowska-Boczniewicz, Joanna, and Zbigniew Garncarek. "Use of Naringinase to Modify the Sensory Quality of Foods and Increase the Bioavailability of Flavonoids: A Systematic Review." Molecules 2025, 30.11, 2376.

2. Sun, J.; Li, W.; Li, H.; Li, L.; Ni, H.; Chen, F.; Li, Q. Adding sorbitol improves the thermostability of α-L-rhamnosidase from *Aspergillus niger* and increases the conversion of hesperidin, Journal of Food Biochemistry. 2021, 46, e14055.

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POSTER PRESENTATION

COMPARISON OF SELECTED PHYSICOCHEMICAL PARAMETERS AND MICROBIOLOGICAL QUALITY OF ACID WHEY FROM POLAND

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Whey is considered a by-product in most dairies. Sustainable whey management focuses on its biotechnological and food applications in order to develop new value-added products. Therefore, it is crucial to assess the quality of whey. The aim of the study was to compare the quality of acid whey obtained from milk processing plants in Poland, in terms of physicochemical parameters and microbiological safety, across seasons. A total of 50 samples were analysed: 25 from winter and 25 from summer. Each sample was analysed in three replicates. Physicochemical parameters as basic composition, pH, °SH, colour in the L*a*b* system were assessed according to the PN-78/A-86030/Az2 standard. Microbiological tests for total microbial count (TVC), lactic acid bacteria (LAB), yeast and mould (Y&M) and pathogenic bacteria (Enterobacteriaceae, Salmonella spp., *Listeria monocytogenes*, *Staphylococcus aureus*) were carried out in accordance with the PN-EN ISO 7218:2008 standard. Analysis of the L*, a* and b* colour parameters of whey showed slight differences between samples obtained in winter and summer. The winter samples had similar acidity (27.2-43.7 °SH), pH values in the range of 3.6-4.5 and water activity of approximately 0.92-0.97. Samples from the summer period were characterised by lower acidity of 27.3-34.5 °SH, pH values in the range of 4.3-4.7 and water activity of approximately 0.92-1.00. Statistically significant differences in the total number of microorganisms between winter and summer samples were observed in 14 of the tested acid whey samples. No growth or presence of pathogenic microorganisms (St. aureus, L. monocytogenes, Salmonella ssp.) was observed in any of the acid whey samples tested, regardless of the season. The studies indicate differences in the microbiological and physicochemical quality of whey produced by Polish dairies, across seasons. Although the quality differences are minor, this may indicate the need to standardize the raw material for further processing.

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References

1. Arshad, U.E.T.; Hassan, A.; Ahmad, T.; Naeem, M.; Chaudhary, M.T.; Abbas, S.Q.; Randhawa, M.; Colombo Pimentel, T.; da Cruz, A.G.; Aadil, R.M. A recent glance on the valorisation of cheese whey for industrial prerogative: High-value-added products development and integrated reutilising strategies. Int. J. Food Sci. Technol. 2023, 58, 2001--2013.

2. Del Toro-Barbosa, M.; Uribe-Velazquez, T.; Hurtado-Romero, A.; Rosales-De la Cruz, M.F.; Carrillo-Nieves, D.; Garcia-Amezquita, L.E.; Garcia-Cayuela, T. Evaluation of GABA-Producing Fermented Whey Formulations: From Strain Selection to Raspberry- Enriched Beverages with Psychobiotic Potential. Foods. 2025, 14, 2762.

3. Menchik, P., T. Zuber, A. Zuber, and C. I. Moraru. 2019. Short communication: Composition of coproduct streams from dairy processing: Acid whey and milk permeate. J. Dairy Sci. 102:3978--3984.

4. Mukherjee, P.; Raj, N.; Sivaprakasam, S. Harnessing Valorization Potential of Whey Permeate for D-Lactic Acid Production Using Lactic Acid Bacteria. Biomass Convers. Biorefinery. 2023, 13, 15639--15658.

5. Pires, A.F.; Marnotes, N.G.; Rubio, O.D.; Garcia, A.C.; Pereira, C.D. Dairy By-Products: A Review on the Valorization of Whey and Second Cheese Whey. Foods. 2021, 10, 1067.

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POSTER PRESENTATION

EVALUATION OF SOLVENT EFFICIENCY FOR ULTRASOUND-ASSISTED EXTRACTION OF BIOACTIVE COMPOUNDS FROM SPRUCE SPROUTS

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Spruce sprouts of Norway spruce (Picea abies (L.) H. Karst.) have recently attracted interest as a promising natural source of bioactive compounds, particularly phenolic constituents and antioxidants. This study aimed to quantitatively assess the phenolic constituents and antiradical activity of fresh spruce sprouts using spectrophotometric techniques following ultrasound-assisted extraction for 5 minutes at 60 °C with different solvents (96%, 80%, 70%, 50%, and 25% ethanol, as well as pure water). The extracts were analysed for total phenolic, flavonoid, and total tannin content, as well as antiradical activity using the DPPH assay and antioxidant capacity using the ABTS+ method. To identify the most effective solvent for extraction, a multicriteria decision analysis approach (TOPSIS) was applied. The highest total phenolic content was observed in the 50% ethanol extract (3.06 ± 0.19 g GAE 100 g^{-1} DW), but the lowest in pure water extract (1.23 ± 0.33 g GAE 100 g-1 DW). The lowest total flavonoid content was observed in the pure water extract (1.09 ± 0.14 g CAE 100 g^{-1} DW), whereas the other extracts showed values approximately 0.16-0.61 higher. The highest tannin content was obtained with 96% ethanol (1.18 ± 0.03 g TA 100 g^{-1} DW), while water extract showed considerably lower tannin levels. Based on the TOPSIS analysis of all measured parameters, 50% and 70% ethanol showed the highest overall extraction efficiency from spruce sprouts using ultrasound-assisted extraction. These findings suggest that moderate ethanol concentrations, combined with ultrasound-assisted extraction, are effective for maximising the yield of bioactive compounds from fresh spruce sprouts, providing a promising approach for natural extract production.

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POSTER PRESENTATION

FRACTIONATION OF INULA SALICINA L. PRESSURIZED HYDROETHANOLIC EXTRACT: IN VITRO ANTIOXIDANT AND ENZYME INHIBITORY POTENTIAL

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*_Inula salicina_* L. is widely used in folk medicine. This study focused on the fractionation and phytochemical evaluation of a PLE--EtOH/H_2O *_I. salicina_* extract, with particular emphasis on chlorogenic acid, owing to its well-documented medicinal potential and diverse therapeutic effects. The crude extract was obtained by pressurized liquid extraction (PLE) using an EtOH/H_2O mixture as a green solvent system to ensure efficient recovery of polar and moderately polar phenolic compounds. Fractionation was applied as a rational strategy to separate compounds according to polarity, enabling enrichment of phenolic constituents and a clearer assessment of their contribution to biological activity.

The crude extract was dissolved in water and sequentially partitioned with hexane and ethyl acetate. The ethyl acetate and water fractions exhibited substantially higher total phenolic content (TPC) and *in vitro* antioxidant capacity than the hexane fraction, which mainly removed non-polar pigments. Fraction yields were 2.4, 17.4, and 79.9 g/100 g extract for the hexane, ethyl acetate, and water fractions, respectively. TPC values increased from 0.7 mg GAE/g E (hexane) to 80.5 mg GAE/g E (ethyl acetate) and 136.8 mg GAE/g E (water). A similar trend was observed for antioxidant activity, with TEAC~CUPRAC~ values of 4.7, 360.4, and 1146.6 mg TE/g E and TEAC~ABTS~ values of 1.43, 600.9, and 522.0 mg TE/g E, respectively. Both the ethyl acetate and water fractions showed strong superoxide scavenging activity (1801.4 and 366.9 mg TE/g E), pronounced antiglycation activity (IC~50~ = 0.08 and 0.17 mg/mL), and inhibitory effects against α-amylase, α-glucosidase, and pancreatic lipase, indicating potential relevance for reducing inflammation, oxidative stress, and metabolic dysfunction.

HPLC--MS/MS analysis confirmed the presence of phenolic acids and flavonoids, including chlorogenic acid, predominantly in the water fraction. The marked decrease in enzyme-inhibitory activity after removal of the ethyl acetate fraction highlights the key role of medium-polarity phenolics and demonstrates the value of fractionation for concentrating bioactive compounds.

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POSTER PRESENTATION

IS WHEY A BY-PRODUCT OR WASTE? A COMPARISON OF THE QUALITY AND SAFETY OF ACID WHEY FROM POLAND

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Acid whey is a major by-product of the dairy industry, generated in large volumes during the production of fermented dairy products, particularly cottage cheese and curd. Due to insufficient utilization, it is often concerned as waste, despite its significant nutritional and technological potential. This study aimed to assess whether acid whey from Poland should be classified as waste or as a valuable by-product, based on a comprehensive evaluation of its quality and safety. A total of 50 acid whey samples were collected from 25 dairy processing plants across Poland during winter and summer seasons. The samples were analyzed for microbiological safety, antibiotic resistance of environmental microflora, and physicochemical quality, including pH, titratable acidity, water activity, colour parameters, basic composition, and protein profile. No pathogenic microorganisms, including Salmonella spp., *Listeria monocytogenes*, or *Staphylococcus aureus*, were detected in any of the samples, regardless of season. Although relatively high total microbial counts were observed in some cases, they were mainly associated with lactic acid bacteria, indicating natural fermentation processes rather than contamination. Enterobacteriaceae were detected only sporadically. Acid whey samples showed low acidic pH (3.6--4.7), moderate titratable acidity, and high water activity, confirming their physicochemical stability. The protein content ranged from 0.22 to 1.39%, depending on region and season, demonstrating nutritional variability but consistently retaining biologically valuable whey protein fractions. The presence of antibiotic-resistant microorganisms was observed in selected samples, highlighting the need for routine monitoring rather than disqualification of the raw material. The results indicate that acid whey produced in Poland is microbiologically safe and nutritionally valuable, supporting its classification as a by-product rather than waste. Proper quality control and targeted valorisation strategies may enable its effective use within food processing and circular economy systems.

References

Buchanan, D.; Martindale, W.; Romeih, E.; Hebishy, E. Recent advances in whey processing and valorisation: Technological and environmental perspectives. Int. J. Dairy Technol. 2023, 76, 291--312.

Lindsay, M.J.; Walker, T.W.; Dumesic, J.A.; Rankin, S.A.; Huber, G.W. Production of monosaccharides and whey protein from acid whey waste streams in the dairy industry. Green Chem. 2018, 20, 1824--1834.

Menchik, P.; Zuber, T.; Zuber, A.; Moraru, C.I. Short communication: Composition of coproduct streams from dairy processing: Acid whey and milk permeate. J. Dairy Sci. 2019, 102, 3978--3984.

Pal, P.; Nayak, J. Development and analysis of a sustainable technology in manufacturing acetic acid and whey protein from waste cheese whey. J. Clean. Prod. 2016, 112, 59--70.

Pillai, A., T.; Morya, S.; & Kasankala, L., M. Emerging Trends in Bioavailability and Pharma-Nutraceutical Potential of Whey Bioactives. Journal of Nutrition and Metabolism.2024 <https://doi.org/10.1155/2024/8455666>

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POSTER PRESENTATION

INTERACTION BETWEEN DIETARY FIBRE AND (POLY)PHENOLS IN ORANGE AND ORANGE JUICE

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The aim of this study was to evaluate the effect of food matrix and the interaction between dietary fibre (DF) and (poly)phenols (PPs) in the nutritional properties of orange and orange juice. Oranges were peeled and homogenised whereas the juice was obtained by pressing, filtration, and heat treatment and was elaborated in the Pilot Plant of the IFAPA (Córdoba, Spain). The samples were subjected to a solid-liquid aqueous-ethanolic extractions to obtain three different DF-rich fractions: Insoluble Fraction (IF), Soluble Fraction (SF) and Total Fraction (TF), which were freeze-dried and homogenised. The IF and TF were characterised in terms of their proximate composition and content of total, soluble and insoluble DF (TDF, SDF and IDF), their techno-functional properties [1] and the antioxidant capacity was determined by FRAP, ORAC, and DPPH. In all DF-fractions obtained (IF, SF, and TF) the composition and structure of the non-starch polysaccharides were estimated by analysis of neutral sugars (GC-FID) and uronic acids [2]. Subsequently, the extractable (EPP) and non-extractable (NEPP) (poly)phenols were analysed by HPLC-QqQ-MS/MS [3]. IFs of both samples (orange and juice) showed the highest contents of TDF, whereas the amount of SDF was consistently higher in TFs, enhancing some of the techno-functional properties. The main polysaccharide was pectin, accounting for 95% of SFs and 73% of IFs. Flavanones and cinnamic acids were the main PPs detected in the DF-rich fractions. In fractions obtained from orange, the IF showed a mean total PP concentration of 162 µmol/100 g d.w., while the SF contained 48 µmol/100 g d.w. In contrast, in orange juice fractions, SF showed a higher PP concentration (108 µmol/100 d.w) than IF (94 µmol/100 g d.w). The study demonstrated that orange juice processing treatment resulted in a decreased percentage of IDF, modifying its interaction with PP and potentially impacting their bioaccesibility and bioavailability.

References

[1] Núñez-Gómez, V., González-Barrio, R., Baenas, N., Moreno, D. A., & Periago, M. J. (2022). Dietary-Fibre-Rich Fractions Isolated from Broccoli Stalks as a Potential Functional Ingredient with Phenolic Compounds and Glucosinolates. International Journal of Molecular Sciences, 23(21). https://doi.org/10.3390/IJMS232113309

[2] Englyst, H. N., Quigley, M. E., Hudson, G. J., & Cummings, J. H. (1992b). Determination of dietary fibre as non-starch polysaccharides by gas-liquid chromatography. The Analyst, 117(11), 1707--1714. https://doi.org/10.1039/AN9921701707

[3] Núñez-Gómez, V., Jesús Periago, M., Luis Ordóñez-Díaz, J., Pereira-Caro, G., Manuel Moreno-Rojas, J., & González-Barrio, R. (2024). Dietary fibre fractions rich in (poly)phenols from orange by-products and their metabolisation by in vitro digestion and colonic fermentation. Food research international (Ottawa, Ont.),177, 113718. https://doi.org/10.1016/J.FOODRES.2023.113718

POSTER PRESENTATION

ZEIN--POLYSACCHARIDE MAILLARD CONJUGATES AND THEIR PREBIOTIC POTENTIAL

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Zein is an abundant cost-effective corn-derived protein, yet its application is limited by its pronounced hydrophobic nature. To address this limitation, chemical modification via nonenzymatic Maillard glycosylation between proteins and polysaccharides has been proposed. In addition, glycated proteins have been reported to have higher resistance to gastric digestion, suggesting their potential as prebiotics to simultaneously supply carbon and extra nitrogen to the gut microbiota. Therefore, the aim was to produce Maillard zein and inulin (Z-In) or citrus pectin (Z-CP) conjugates evaluating their prebiotic effect on lactic acid bacteria (LAB) and the associated physicochemical changes in protein.

Zein-polysaccharides conjugates were produced under alkaline pH (8), at 80°C for 24 h. Reaction performance was evaluated by FT-IR, X-ray diffraction (XRD), degree of glycation (DG), and protein solubility changes. Prebiotic index (PI) was assessed by growing *Lacticaseibacillus paracasei* and *Limosilactobacillus fermentum* in modified media containing the conjugates. The INFOGEST 2.0 static in vitro digestion protocol was used to evaluate the conjugates' protective effect on LAB survivability during digestion.

FT-IR and XRD analyses confirmed conjugate formation by marked changes in the intensity and wavenumber of zein's main absorption bands. DG analysis showed that reaction pH and polymer ratio significantly affected glycation, with higher pH increasing DG to 32-44 % in Z--CP formulations. Maillard-type conjugation improved zein's aqueous solubility, especially in Z--CP, where higher pH and DG yielded the most hydrophilic conjugates. PI measurements indicated that all conjugates had a positive prebiotic effect, by supporting LAB growth. Z--In conjugates displayed the highest PI values, 0.74-1.01 for L. fermentum and 1.31-1.53 for L. paracasei, surpassing inulin (PI = 0.11). In static in vitro digestion, Z--In and inulin provided the greatest protection, best preserving L. paracasei viability during simulated gastrointestinal transit, whereas the bacteria alone experienced the largest viability loss.

These results suggest that conjugation can improve plant protein hydrophilicity and prebiotic potential, though further studies on protein digestibility and gut microbiota effects are needed.

References

Kutzli, I., Weiss, J., & Gibis, M. (2021). Glycation of Plant Proteins Via Maillard Reaction: Reaction Chemistry, Technofunctional Properties, and Potential Food Application. Foods, 10(2), 376. https://doi.org/10.3390/FOODS10020376

Li, Y., Wan, Z., Zhao, S., Lu, H., McClements, D. J., Liu, X., & Liu, F. (2024). Development of zein-based complexes and conjugates with enhanced surface hydrophilicity: Structure, emulsifying, foaming, and antioxidant properties. Food Hydrocolloids, 154. https://doi.org/10.1016/J.FOODHYD.2024.110064

Urango, A. C. M., Meireles, M. A. A., & Silva, E. K. (2024). Maillard conjugates produced from proteins and prebiotic dietary fibers: Technological properties, health benefits and challenges. Trends in Food Science & Technology, 147, 104438. https://doi.org/10.1016/J.TIFS.2024.104438

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POSTER PRESENTATION

LACTIC ACID FERMENTATION OF PROTEIN-LIPID EXTRACT FROM MILK THISTLE ENDOSPERM AND ITS INFLUENCE ON THE QUALITY OF OBTAINED BEVERAGES

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The endosperm of milk thistle (**Silybum marianum** (L.) Gaertner) is a by-product generated during the production of silymarin. From the perspective of the pharmaceutical industry, only the milk thistle seed hull is considered the functionally valuable part, as it is the source of the aforementioned flavonolignan complex. The remaining endosperm---rich in protein, fat, and calcium---is directed to the animal feed market.

This study aimed to verify the suitability of milk thistle endosperm for producing fermented, probiotic, and sensorially appealing beverages rich in protein and unsaturated fatty acids. The crude extract was obtained by simultaneous extraction of proteins and oleosomes from the raw material under alkaline conditions (pH 8.5; T = 37°C; t = 20 min). The extract was adjusted to pH 6.8 (1M HCl), enriched with glucose (20 g/L), pasteurized (T = 85°C; t = 20 min), and inoculated with probiotic LAB (mono- and multistrain preparations, including ***B. lactis, B. bifidum, B. longum, L. lactis, L. brevis, L. casei, L. acidophilus, L. salivarius, L. paracasei, L. plantarum, L. helveticus**). The fermentation process took place under aerobic conditions for 24 and 48 hours at 36 °C.

The protein (Kjeldahl method), amino acid profile (HPLC), sugar and organic acid profile (HPLC), color parameters, and aroma profile (e-nose) were determined for the unfermented and fermented extracts (beverages).

Milk thistle extract provided a good substrate for the growth of lactic acid bacteria. After 24 hours of fermentation, the pH decreased from an initial value of approximately 6.80 to 3.96-4.50, ultimately reaching a range of 4.14 to 3.58 after 48 hours, depending on the probiotic preparation used. Considering the sensory profile, all tested fermented extracts contained, among others, sulfur-organic compounds, broad-methane compounds, and sulfur-chloride compounds, and the color significantly improved under the influence of LAB activity. Milk thistle extract showed a partially deficient amino acid profile. However, this could be improved through lactic acid fermentation.

References

Teleszko, M.; Zając, A.; Krzos, G.P. 444467 Fermented Protein Extract from Milk Thistle and Method of Obtaining It; Polish Patent Office: Warszawa, Poland, 2023. (In Polish)

Teleszko, M., Haraf, G., Zając, A., Garncarek, Z., Górska, K., Krzos, G., ... & Kotecki, P. (2024). Use of Directed Lactic Fermentation to Obtain Plant-Based, Upcycled Beverage from Milk Thistle Endosperm. Sustainability, 16(13), 5342.

Teleszko, M., Haraf, G., Zając, A., & Krzos, G. (2023). Milk Thistle (*Silybum marianum* (L.) Gaertner) Endosperm as an Alternative Protein Source for a Sustainable Food System (SFS)---Pilot Studies. Sustainability, 15(19), 14411.

Ozgolet, M., Cakmak, Z. H. T., Bozkurt, F., Sagdic, O., & Karasu, S. (2024). Optimization of extraction parameters of protein isolate from milk thistle seed: Physicochemical and functional characteristics. Food Science & Nutrition, 12(5), 3346-3359.

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POSTER PRESENTATION

IMPROVEMENT OF THE TECHNO-FUNCTIONALITY OF RICE PROTEIN AND ITS COMBINATION WITH PORK SPLEEN THROUGH PH-SHIFT AND ULTRASOUND

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There is an urgent need for sustainable protein sources that can meet the growing food demands of an expanding global population without causing environmental harm. Rice proteins (RP) represent a promising plant-based alternative, as they are derived from one of the world's most widely cultivated crops, are recognized as hypoallergenic, and are rich in essential amino acids. Moreover, RP reportedly exhibit higher digestibility and nutritional value compared to proteins from other major cereals. However, their low solubility and poor surface activity under neutral conditions remain significant limitations. Enhancing these techno-functional properties is therefore essential to fully unlock the potential of RP. Combining RP with upgraded animal proteins, such as porcine spleen proteins (SP), can help enhance these properties while supporting circular economic strategies. Currently, the utilization of slaughterhouse by-products remains far from optimal, leading to significant surpluses that could be better recovered. Developing systems that render these materials profitable as sources of high-quality proteins with technological functionality is therefore of great interest. This study aimed to assess the individual and combined effects of pH shifting (PS) and ultrasound (US) on the functional properties of RP concentrates, SP, and their binary mixture. Protein dispersions at 10% (w/w) of RP, SP, and a 1:1 mixture were prepared and subjected to PS (pH 10 → pH 7), US (40% amplitude, 15 s on/off cycles for 15 min), or the PS+US combination. In total, 12 different samples were analysed in three individual batches. Solubility, emulsifying properties (activity and stability indices, EAI and ESI), and particle size and distribution were determined in protein dispersions and emulsions. US and the combination of PS+ US were treatments that reduced the particle size the most in RP and RP: SP protein dispersions. However, SP set of treatments, specifically those treated by US and PS+US showed a big wide distribution which included a variety of particle sizes. However, those results observed in dispersions did not have a great impact in the droplet size of emulsions, which did not show an important reduction in D[4,3], which varied from 40 to 31 μm within all treatments applied. Regarding solubility, US was the treatment that produced the best results in all samples. In the group of RP samples, solubility increased about 200% by applying US, although final solubility remained very low. When RP was mixed with SP, the final solubility with the US treatment increased by 100%, reaching values that rose from 16% in RP: SP to 32%. The EAI and ESI values increased with US and PS-US, highlighting the effectiveness of the mixture, which presented greater stability (ESI ≈ 80 min) compared to the untreated mixture (ESI ≈ 41 min). Overall, the RP: SP combination treated with US enhanced interfacial functionality and emulsion stability compared to the individual RP, positioning SP as a revalued functional ingredient.

References

Amagliani, L., O'Regan, J., Kelly, A. L., & O'Mahony, J. A. (2017). The composition, extraction, functionality and applications of rice proteins: A review. Trends in Food Science and Technology, 64, 1--12.

Anzani, C., Boukid, F., Drummond, L., Mullen, A. M., & Alvarez, C. (2020). Optimising the use of proteins from rich meat co-products and non-meat alternatives: Nutritional, technological and allergenicity challenges. Food Research International, 137, 109575.

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POSTER PRESENTATION

LOW-ALCOHOL FERMENTED CLOUDY PEAR AND PLUM JUICES: INFLUENCE OF LACTIPLANTIBACILLUS PLANTARUM AND LACHANCEA YEASTS ON BIOACTIVE COMPOSITION AND SENSORY QUALITY

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The food market is looking for new natural products that offer the highest possible health-promoting value and sensory properties that consumers will find acceptable. Such products may be fruit juices fermented with various microorganisms (without added salt), containing microbiological metabolites and living microbial cells, as well as components derived from plant material, such as polyphenols, organic acids and volatile compounds.

For our study, we used cloudy pear and plum juices, widely consumed in various parts of the world in their natural state, as well as lactic acid bacteria and yeasts derived from plant fermentation. This study aimed to determine the effect of different microorganisms conducting lactic acid fermentation on the chemical composition and bioactive component content of naturally cloudy, fermented pear and plum juices. The process involved using **Lactiplantibacillus plantarum** K7 bacteria, which were isolated during sauerkraut fermentation, as well as **L. thermotolerans** PYCC6375 and **L. fermentati** PYCC5883 yeasts, which have poor ethanol fermentation capabilities. We analysed the pH, acidity, sugars (HPLC), free amino nitrogen, selected organic acids (HPLC), colour (CIELAB), polyphenols (HPLC), volatiles (GC-MS), aroma-active volatiles (GC-MS-O) and sensory characteristics.

The fermented juices obtained were rich in organic acids (of plant and microbial origin) and polyphenols, and had reduced sugar content (polyols replacing glucose and fructose) and a low alcohol content (<0.2%). At the same time, all three microorganisms significantly enhanced the fruity aroma of the juices. **Lachancea** yeasts proved to be a viable alternative to lactic acid bacteria for producing fermented juices, particularly plum juices. The highest polyphenol content and consumer preference rating were obtained with plum juices fermented with **L. fermentati** yeast.

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POSTER PRESENTATION

ENHANCING BIOACTIVE COMPOUNDS IN PARSLEY (PETROSELINUM CRISPUM) AND CORIANDER (CORIANDRUM SATIVUM) VIA OPTIMIZED THERMAL DRYING

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Drying is a key preservation technique for aromatic herbs like parsley (*Petroselinum crispum* L.) and coriander (*Coriandrum sativum* L.), widely used in food industry. However, elevated drying temperatures can degrade bioactive compounds and antioxidant activity, impacting both nutritional quality and sensory attributes.

This study investigates how convective drying at 40 °C and 60 °C can be optimized to enhance bioactive compounds and antioxidant capacities in parsley and coriander, focusing on total phenolic content (TPC), total flavonoid content (TFC), and antioxidant activity assessed by FRAP, DPPH, and ABTS assays.

Fresh herb samples were dried in a convective oven to constant weight, ground, and extracted with 80 % methanol. At 40 °C, coriander exhibited higher FRAP (15.30 ± 0.95 mg TE/g) and TFC (0.65 ± 0.02 mg CE/g) than parsley (FRAP: 10.87 ± 0.34 mg TE/g; TFC: 0.10 ± 0.01 mg CE/g). Increasing the drying temperature to 60 °C enhanced parsley's FRAP (12.62 ± 0.49 mg TE/g) and TFC (0.12 ± 0.01 mg CE/g), while coriander showed a slight increase (FRAP: 14.16 ± 0.29 mg TE/g; TFC: 0.68 ± 0.03 mg CE/g). TPC values were 3.82 ± 0.08 mg GAE/g (parsley 40°C) and 3.85 ± 0.19 mg GAE/g (parsley 60 °C), with coriander at 1.87 ± 0.19 mg GAE/g (40°C) and 2.47 ± 0.24 mg GAE/g (60°C). DPPH scavenging activity increased with temperature for both herbs (parsley 60°C: 0.0500 ± 0.0002 mg TE/g; coriander 60°C: 0.0507 ± 0.0002 mg TE/g), together with ABTS values rising to 0.0736 ± 0.0001 mg TE/g at 60°C.

These results demonstrate that optimized thermal drying at 60 °C can enhance bioactive compounds and antioxidant capacity, particularly in parsley, with minimal flavonoid loss and improved radical scavenging. While coriander retains superior inherent antioxidant potential under both conditions. Lower temperature (40 °C) preserves higher coriander bioactive but may extend processing time. Overall, this study highlights the potential of temperature-optimized drying to maximize the functional properties of aromatic herbs, supporting sustainable and efficient processing for food industry applications.

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POSTER PRESENTATION

THE INFLUENCE OF THE SEASON ON THE BASIC COMPOSITION AND NUTRITIONAL VALUE OF ACID WHEY FROM SELECTED MILK PLANTS IN POLAND

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Whey is a liquid by-product generated during casein coagulation in the production of cheese and related fermented dairy products. It contains several valuable micro- and macronutrients that exhibit high biological value and unique techno-functional and bioactive properties. The composition of whey is influenced by multiple factors, including the season of milk collection, the type of processed dairy product, and post-milking storage conditions. The aim of this study was to evaluate the basic chemical composition and nutritional value of whey obtained during the summer and winter seasons from different milk plants in Poland. The results presented here come from five milk plants located in the Masovian, Pomorskie, Podlaskie, Wielkopolska, and Podkarpackie Voivodeships. The content of protein, dietary fibre, total sugars, saturated fatty acids, total ash, sodium, salt, dry matter, total fat, energy value, and digestible carbohydrates was analysed. Significant seasonal differences in those parameters were observed. The conducted research confirms the thesis that the nutritional value of acid whey varies depending on the region of origin, the source of milk, or the season. The biological value of acid whey is primarily determined by its protein content, including albumin and globulin. In general, protein content was higher in the winter season. The highest values were detected in samples from south-eastern Poland. The content of digestible carbohydrates also varied among samples, with higher values observed in the summer season. These findings are promising for the reuse of acid whey in different food matrices as an ingredient to enhance nutrient density.

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POSTER PRESENTATION

INNOVATION IN CHEESEMAKING: MICROBIAL DYNAMICS OF FRESH CHEESE USING FIG LEAF RENNET

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Investing in the valorization of by-products of food production, within the context of the circular economy, could serve as a starting point to introduce innovation into dairy industry.

Based on this premise, preliminary studies were conducted with the aim of studying and validating the use of fig leaf extract as rennet in cheese production. These studies demonstrated that a high quantity (10%) of extract (obtained at room temperature for 30 minutes) was necessary to achieve the desired coagulating capacity.

Following these studies, fresh cheeses were produced using the rennet in the optimized proportion. Subsequently, a set of microbiological analyses was carried out to quantify the most relevant microbial groups (total aerobes, lactic acid bacteria, and fungi) and to monitor the evolution of these microbial groups over a one-week period, as well as to investigate the presence of pathogenic microorganisms (*_Listeria monocytogenes_*, *_Staphylococcus aureus_* e *Salmonella* sp.). Chemical parameters (moisture, pH, titratable acidity, ash, and fat) were also determined in order to relate microbial evolution with these chemical aspects.

For this purpose, cheeses were analyzed at the end of production (t0) and after one week of refrigerated storage (t1).

It was observed that all quantified groups showed higher values after one week, as expected, and based on the results obtained, the predominance of lactic acid bacteria throughout the studied period was confirmed. No pathogenic microorganisms were detected. Regarding the chemical parameters, moisture, ash, and fat showed no significant changes between t0 and t1. A decrease in pH (from 6.28 ± 0,02 to 6.20 ± 0.02) and an increase in titratable acidity (0.21±0,01 to 0.28 ±0,01%) were observed, although the latter parameter showed values slightly lower than reference values.

Under the conditions of the trials, the evaluated parameters were within the expected and considered safe values, according to the established criteria. However, further study is needed to relate the behavior of the microbiota of these cheeses to physicochemical and organoleptic parameters more robustly, as well as to assess product acceptability among consumers through sensory evaluation tests.

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POSTER PRESENTATION

VALORISATION OF BERRY-DERIVED DIETARY FIBER FRACTIONS AS SUSTAINABLE FUNCTIONAL FOOD INGREDIENTS

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The agri-food sector is increasingly focused on the development of sustainable ingredients obtained through green and efficient processes. Berries are rich sources of dietary fiber and (poly)phenols, compounds with high added value that are often underexploited when embedded in complex food matrices. In this study, two dietary fiber-rich fractions, insoluble (IFF) and soluble (SFF), were obtained from freeze-dried mixed berries using water-based extraction followed by ethanol precipitation (SFF). The fractions were comprehensively characterized in terms of dietary fiber content and composition, hydration properties, (poly)phenol profile and antioxidant capacity. The extraction process increased total dietary fiber by up to 1.7-2.4-fold, reaching 65.1% in IFF and 47.4% in SFF, compared to whole berries, generating fractions with distinct physicochemical properties. IFF was characterized by a high proportion of insoluble fiber, (87% of total fiber), enriched in cellulose and hemicellulose, while SFF contained predominantly soluble fiber (95% of total fiber) and pectins (≈93% of polysaccharide fraction), exhibiting significantly higher hydration properties. In particular, SFF showed water retention and swelling capacities of 4.8 g water/g and 12.9 mL/g, respectively, markedly higher than those of whole berries. Both fractions retained substantial amounts of non-extractable (poly)phenols, mainly ellagic acid derivatives, contributing to antioxidant capacities of up to 53.6 μmol TE/g (FRAP) and 249.8 μmol TE/g (ORAC). These results demonstrate that berry-derived fiber fractions obtained through sustainable processing represent promising multifunctional ingredients, combining technological functionality, bioactive compound retention and potential applications in food product development and food waste valorisation strategies.

References

(1) Bilawal, A.; Ishfaq, M.; Gantumur, M. A.; Qayum, A.; Shi, R.; Fazilani, S. A.; Anwar, A.; Jiang, Z.; Hou, J. A Review of the Bioactive Ingredients of Berries and Their Applications in Curing Diseases. Food Biosci 2021, 44, 101407. https://doi.org/10.1016/J.FBIO.2021.101407. (2) Inada, K. O. P.; Leite, I. B.; Martins, A. B. N.; Fialho, E.; Tomás-Barberán, F. A.; Perrone, D.; Monteiro, M. Jaboticaba Berry: A Comprehensive Review on Its Polyphenol Composition, Health Effects, Metabolism, and the Development of Food Products. Food Research International 2021, 147, 110518. https://doi.org/10.1016/J.FOODRES.2021.110518.

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Food waste recovery and valorization

POSTER PRESENTATION

PROTEIN QUALITY OF YEAST BIOMASS GROWN ON ACID WHEY

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The development of sustainable protein sources from dairy sidestreams requires evidence that they support yeast biomass with nutritionally relevant amino acid composition. Acid whey, in particular, provides a nutritionally rich medium for yeast growth, thereby influencing protein nutritional value.

This study evaluates the quality of the protein in yeast biomass produced from acid whey permeate. Two lactose-assimilating yeast strains (**Kluyveromyces marxianus** MSCL 79 and **Cyberlindnera jadinii** MSCL 87, obtained from Microbial Strain Collection of Latvia) were cultivated in partially concentrated acid whey permeate (hydrolyzed and non-hydrolyzed) in batch-type bioreactors for 72 h at 30 °C with the pH adjusted to 5.0. Supplementation with $(NH_4)_2HPO_4$, KH_2PO_4 and $MgSO_4 \cdot 7H_2O$ was applied to assess its effects on protein content and amino acid composition. Biomass samples were analyzed for protein content by the Kjeldahl method and amino acid composition by LC--MS/MS.

Both strains produced biomass proteins containing the full spectrum of essential amino acids; however, the amino acid scores differed markedly. Methionine and cysteine were the primary limiting amino acids, with combined score reaching ~1 % of FAO reference values in **C. jadinii** (27.17% protein) and ~10.8 % in **K. marxianus** biomass (25.17% protein). The highest total amino acid concentration was observed in **K. marxianus** biomass cultivated on hydrolyzed substrate supplemented with $(NH_4)_2HPO_4$, KH_2PO_4 and $MgSO_4 \cdot 7H_2O$. This biomass contained 46.44% protein and reached 6331.91 mg 100 g^{-1} total amino acids. Essential amino acids comprised 40.63 % of total amino acids, while total free amino acids reached 481.94 mg 100 g^{-1}. This sample also exhibited higher proportions of free amino acids (9.62 % vs 7.07 %), indicating larger pools of available essential amino acids.

These results demonstrate that protein quality in yeast biomass derived from acid whey should not be evaluated based solely on crude protein content, but also on amino acid composition. The quantitative amino acid balance reflected yeast physiology. These findings highlight the importance of amino acid profiling when assessing yeast biomass for sustainable food systems.

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POSTER PRESENTATION

COMPARISON OF BIOMASS HYDROLYSATE DETOXIFICATION METHODS: ENABLING COCOA POD HUSK VALORIZATION

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The largest portion of the cocoa fruit (cocoa pod husk -- CPH) is considered a residue in processing. An alternative to the underutilization of CPH, adding value to this byproduct, is the transformation of xylose and arabinose, belonging to the hemicellulosic fraction, into polyols through yeast fermentation. The limiting factor is the presence of organic acids, furanic compounds, phenolics, and proteins, which inhibit the action of microorganisms. This study evaluated detoxification methods for CPH hemicellulosic hydrolysate (HH) by pH alteration (overliming). HH was subjected to pH increase (7, 8.5, or 10) using CaO or NaOH, followed by a pH decrease to 5.5 with H~2~SO~4~ or H~3~PO~4~, with centrifugation and precipitate removal between stages. Composition was evaluated by HPLC-RI. Results showed that reaching pH 8.5 or 10.0 were most effective. Also, samples that differed only by the acid used for neutralization showed similar results. Calcium-based alkali proved to be an efficient remover of inhibitors: >50% of acetic/formic acids, 60-90% of HMF and furfural, 90% of phenolics, 70% of proteins, and 70-95% of sulfate. However, it also removed 40-70% of glucose, xylose, and arabinose mass. Alternatively, sodium hydroxide -- a well-established methodology for sugarcane bagasse -- was less efficient to remove CPH inhibitors: 10-30% removal of acetic acid, 70-80% of furfural, 30-50% of HMF, 70% of phenolics, 25% of sulfate, but no removal of formic acid or proteins, and yet sugar mass was mostly maintained. Even though removal of acetic acid and furans was not maximized, the concentration stayed within yeast (**Candida tropicalis**) tolerance. Therefore, the study provides essential information for the use and valorization of CPH, indicating that the use of NaOH-pH 10-H~3~PO~4~ is more efficient to detoxify without compromising the sugar content and future fermentation performance.

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POSTER PRESENTATION

NATURAL COLORANTS WITH ANTIOXIDANT ACTIVITY FROM FRUIT AND VEGETABLE PROCESSING BY-PRODUCTS

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Large amounts of fruit and vegetable by-products are generated during food processing, yet they represent a valuable and still underutilized source of bioactive molecules, particularly natural pigments with pronounced antioxidant properties. The aim of this study was to determine the content of total anthocyanins, chlorophylls and carotenoids, as well as antioxidant capacity using FRAP and DPPH assays, in selected fruit and vegetable by-products. Peels of purple sweet potato, pomegranate, and citrus fruits were subjected to ultrasound-assisted extraction using various solvents: 15% citric acid in 30% ethanol or 24% citric acid in 70% ethanol for the extraction of anthocyanins, and 96% ethanol or acetone for the extraction of chlorophylls and carotenoids. The results demonstrated that the type of by-product had a significant effect ($p<0.001$) on pigment content and antioxidant capacity. Purple sweet potato peel contained significantly higher anthocyanin content (120.69 mg/100 g dw) compared to pomegranate peel (17.29 mg/100 g dw), whereas pomegranate peel exhibited higher antioxidant capacity (FRAP 60.75 mmol TE/100 g dw, DPPH 15.84 mmol TE/100 g dw). For chlorophylls in lime peel, the extraction solvent did not significantly affect pigment content or FRAP values, while a significant difference was observed using the DPPH assay ($p=0.002$). The highest carotenoid contents were recorded in orange and mandarin peels, whereas red grapefruit peel showed the lowest carotenoid levels and antioxidant capacity. No significant influence of solvent type on carotenoid extraction efficiency or antioxidant activity was observed. In conclusion, the studied fruit and vegetable by-products represent a rich source of natural pigments and antioxidants. This highlights their potential for valorization in the food, pharmaceutical, and cosmetic industries, as well as for supporting sustainable, circular bioeconomy approaches.

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POSTER PRESENTATION

IMPACT OF ENCAPSULATED OLIVE LEAVES EXTRACT ON SPONGE CAKE QUALITY

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Bakery products, particularly cake, are among the most consuming food items around the world. Due to the increasing health concerns, demand for functional foods has increased . In recent years, various food products have been developed through the incorporation of natural bioactive compounds, such as phenolics, which have gained attention as a result of their antioxidant properties (Ciont et al., 2023). However, the direct addition of polyphenolic compounds in baked products is limited due to their thermal instability. The incorporation of their encapsulated forms is a promising approach to enhancing their stability and functionality in food products (Kalajahi et al., 2025; Karambakhsh et al., 2024). Secondary metabolites have been extracted from several plant materials and recently from agro-industrial wastes. Olive leaves, a main byproduct of olive oil production, and their extracts have been proposed as food additives due to their high content of phenolics compounds such as hydroxytyrosol, tyrosol and oleuropein (Paciulli et al., 2023). This study aimed to evaluate the effects of different levels of encapsulated olive leaves extract on the properties of sponge cakes. The presence of phenolics compounds seemed to influence the physiochemical and functional properties of the sponge cakes. The proposed methodology resulted in the development of functional cakes through the utilization of agro-industrial by - products.

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References

Ciont, C., Difonzo, G., Pasqualone, A., Chis, M. S., Ranga, F., Szabo, K., Simon, E., Naghiu, A., Barbu-Tudoran, L., Caponio, F., Lelia Pop, O., & Cristian Vodnar, D. (2023). Phenolic profile of micro- and nano-encapsulated olive leaf extract in biscuits during in vitro gastrointestinal digestion. Food Chemistry, 428. https://doi.org/10.1016/j.foodchem.2023.136778

Kalajahi, S. E. M., Mohammadi, M., Soofi, M., Ghandiha, S., Sabzichi, M., & Hamishehkar, H. (2025). Application of encapsulated phenolic compounds from *Hibiscus sabdariffa* L. extract using maltodextrin, inulin, and quince seed mucilage to enhance stability and bioavailability in sponge cake. Carbohydrate Polymer Technologies and Applications, 11. https://doi.org/10.1016/j.carpta.2025.100897

Karambakhsh, G., Golmakani, M. T., Houshmandi, P., Farahnaky, A., & Majzoobi, M. (2024). Upcycling date juice waste: Impact of date press cake on sponge cake quality. Food Chemistry: X, 24. https://doi.org/10.1016/j.fochx.2024.102029

Paciulli, M., Grimaldi, M., Rinaldi, M., Cavazza, A., Flamminii, F., Mattia, C. Di, Gennari, M., & Chiavaro, E. (2023). Microencapsulated olive leaf extract enhances physicochemical stability of biscuits. Future Foods, 7. https://doi.org/10.1016/j.fufo.2022.100209

POSTER PRESENTATION

OPTIMIZATION OF SOLID--LIQUID EXTRACTION OF BIOACTIVE COMPOUNDS FROM FOOD PROCESSING WASTES

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The valorization of food processing by-products is an effective strategy to enhance sustainability and reduce economic losses. Rather than being discarded, these by-products can provide valuable bioactive compounds with health-promoting properties. This study focused on the recovery of high value-added compounds from olive leaves, grape pomace, and tomato processing residues, optimizing extraction conditions for each. Solvent ratio, temperature, and time were selected as independent variables for all extractions and evaluated using Central Composite Design (CCD) and Response Surface Methodology (RSM) with Design-Expert software.

Olive leaves, a major by-product of olive production, are rich in phenolic compounds and antioxidants. Optimum extraction with 40% ethanol--water (v/v) at 30°C for 180 minutes yielded an antioxidant capacity of 1,205.9 mg Trolox/kg dry matter and a total phenolic content of 29.68 mg GAE/g.

Grape pomace, the residue from winemaking, contains high levels of anthocyanins, which contribute to antioxidant activity and natural color. Extraction using 70% ethanol acidified with 0.1% HCl at 60°C for 120 minutes produced 659 mg/100 g dry matter of total monomeric anthocyanins.

Tomato processing residues, rich in carotenoids such as lycopene, were extracted with 25% acetone--hexane at 45°C for 45 minutes, achieving a lycopene content of 4.5 mg/100 g dry matter. Solvent polarity and temperature influenced carotenoid and phenolic extraction differently, highlighting the need for compound-specific optimization.

These results demonstrate that olive leaves, grape pomace, and tomato residues can be effectively converted into bioactive-rich extracts through tailored extraction processes. The obtained extracts, abundant in antioxidants, phenolics, anthocyanins, and carotenoids, have potential applications in functional beverages and dietary supplements. Utilizing these by-products not only reduces food industry waste but also enables the development of innovative, health-promoting products, supporting both sustainability and economic valorization of agri-food residues.

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POSTER PRESENTATION

EFFECT OF FERMENTATION ON THE BIOACTIVE COMPOUND CONTENT OF RED AND BLACK CURRANT POMACE

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Red and black currants (**Ribes rubrum** and **Ribes nigrum**) are berry fruits rich in bioactive compounds. Their processing generates a high-value pomace that represents an important source of phenolic compounds, particularly anthocyanins, which contribute to strong antioxidant activity. Due to its compositional and functional properties, currant pomace shows considerable potential for further valorization in the food and pharmaceutical industries. To enhance the recovery of these bioactive constituents, various processing approaches have been explored, among which fermentation has gained increasing attention.

Microbial fermentation can modify the composition of pomace, thereby enhancing its nutritional and biological properties and improving the extraction efficiency of bioactive compounds. Accordingly, this study aimed to evaluate the effect of optimal fermentation conditions on the content of biologically active compounds in red and black currant pomace. Preliminary research determined that the selected microorganism was **Lactobacillus plantarum** (1%, initial number 10^9 CFU/mL), with the addition of yeast extract as a nitrogen source (2%) and a fermentation time of 24 hours at 32 °C. After fermentation, pomace supernatants were analyzed for pH, total acidity, chromatic parameters according to the CIELab system, total phenolic content, total anthocyanins, and antioxidant activity, and the results were compared with those obtained from non-fermented pomace samples.

The supernatants of fermented pomace exhibited higher levels of total phenolics and anthocyanins, which corresponded to increased antioxidant activity. Fermentation also led to a reduction in pH and total acidity. The color of the fermented pomace became lighter with a more pronounced red hue, likely reflecting the release of anthocyanins. Among the two types of pomaces, black currant pomace contained higher concentrations of bioactive compounds. Overall, these findings underscore the effectiveness of fermentation in enhancing the value of berry fruit pomace and highlight its potential applications in the food and pharmaceutical industries.

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POSTER PRESENTATION

ENHANCED RECOVERY OF ANTIOXIDANTS FROM ORANGE PEEL WASTE USING SUSTAINABLE SOLVENTS: A COMPARATIVE ANALYSIS OF SOLVENT SYSTEMS AND OPERATIONAL CONDITIONS EFFICIENCY

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With the growing demand for natural antioxidants and sustainable practices, agri-food by-products such as orange peel waste (OPW) have emerged as promising, low-cost, and underutilized sources of polyphenols. In this study, the antioxidant potential of OPW was investigated as influenced by the type of extraction solvents (six conventional, two green, and four deep eutectic solvents, DESs) and operational conditions (40 °C/30 min vs. 60 °C/20 min). The extracted bioactive compounds were analyzed for their total phenolic content (TPC) using the Folin-Ciocalteu method, while their polyphenol composition and quantification were determined by Ultra High Performance Liquid Chromatography (UHPLC). The antioxidant capacity was assessed via DPPH and ABTS assays. Results showed that deep eutectic solvents (DESs) significantly outperformed both green (GS) and conventional solvents (CS) ($p < 0.05$), with $ZnCl_2$:Glucose (DES2) emerging as the most effective formulation. At 60 °C/20 min (optimal condition), DES2 yielded the highest TPC (160.90 ± 0.16 mg GAE/g extract), DPPH (92.26 ± 0.01 %), and ABTS (74.23 ± 0.21 %) values. Among CS and GS, ethanol and ethyl lactate were most effective, respectively. Temperature had a significant ($p < 0.05$) effect on extraction efficiency, with consistently higher values obtained at 60 °C. UHPLC analysis revealed hesperidin as the most abundant compound, followed by quercetin, naringin and caffeic acid derivatives. These findings highlight the potential of DESs, particularly $ZnCl_2$:Glucose, as sustainable and efficient alternatives for extracting high-value antioxidants from citrus by-products, contributing to waste valorization and supporting circular bioeconomy strategies.

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POSTER PRESENTATION

PURIFICATION AND CHARACTERIZATION OF TRANSGLUTAMINASE ISOLATED FROM SARDINE (SARDINA PILCHARDUS) FLESH WASTE

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Transglutaminase (TGase) is an enzyme that catalyzes acyl transfer reactions by creating covalent cross-links between protein molecules and has been used to improve the physical and functional properties of protein-based foods. The objectives of this study were the extraction, purification, and biochemical characterization of TGase from sardine (*Sardina pilchardus*) flesh in order to provide a suitable TGase enzyme for food industry applications. The results showed a specific activity, yield, and purification fold of 357.14 U/mg protein, 36.74%, and 183.15, respectively. The enzyme exhibited maximal activity at 40 ◦C and pH 8.0, with a molecular weight of around 57 kDa. The effect of time on TGase thermal stability at 40 °C showed a gradual decrease in its catalytic activity during the incubation time until the enzyme was completely inactivated at 60 min. Additionally, the sardine TGase was found to be calcium-dependent. However, Mg2+ and Ba2+ ions were found to be effective in its activation to some extent and a total inhibition was shown by Zn2+ and Sr2+ ions. The TGase activity was affected markedly by NaCl and EDTA, and lost, respectively, about 80.7% and 36.49% from its activity by increasing the concentration (1.5 M NaCl and 20 mM EDTA). Based on the surface hydrophobicity and solubility results, the cross-linking of natural actomyosin mediated by TGase increased to a greater extent. The results revealed that sardine TGase possessed attractive qualities, making it a potential alternative to other TGase sources for food industry applications.

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POSTER PRESENTATION

CHARACTERISATION OF HIGH-DIETARY-FIBRE INGREDIENTS DERIVED FROM BROCCOLI BY-PRODUCTS

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The valorisation of agri-food by-products is gaining increasing relevance within Food Science and Technology. This study evaluated the potential of broccoli stems---commonly discarded yet naturally rich in dietary fibre---to produce functional ingredients with high total dietary fibre (TDF) content and enhanced soluble-to-insoluble fibre ratios. Broccoli stems were subjected to enzymatic treatments (cellulase, pectinase, xylanase and their combination), followed by ethanol extraction, centrifugation and low-temperature drying. The resulting ingredients were analysed for TDF and its soluble (SDF) and insoluble (IDF) fractions, as well as for their functional and antioxidant properties. Combined enzymatic treatment yielded the highest fibre extraction, achieving up to 60% TDF. The control ingredient, despite its slightly lower TDF content (55%), exhibited the highest SDF content (17%) and the greatest SDF/IDF ratio. All broccoli-derived ingredients displayed low carotenoid (<100 µg/100 g) and total phenolic contents (<100 mg GAE/100 g). Overall, the control ingredient showed the most favourable characteristics, including higher soluble fibre content, greater antioxidant capacity and superior swelling and water-holding capacities, while also avoiding the need for enzymatic processing. These findings highlight broccoli stems as a promising raw material for developing fibre-rich functional ingredients through cost-efficient valorisation strategies.

References

MAPA. 2020. "Las Pérdidas y El Desperdicio Alimentario En La Industria Agroalimentaria Española: Situación Actual y Retos de Futuro." Ministerio de Agricultura Alimentación y Medio Ambiente. 2020.

Mudgil Deepak, Barak Sheweta (2019). Chapter 2 - Classification, Technological Properties, and Sustainable Sources. Editor(s): Charis M. Galanakis. Dietary Fiber: Properties, Recovery, and Applications. Academic Press, 2019, Pages 27-58, ISBN 9780128164952, <https://doi.org/10.1016/B978-0-12-816495-2.000022.>

Núñez-Gómez, V., González-Barrio, R., & Periago, M. J. (2023). Interaction between Dietary Fibre and Bioactive Compounds in Plant By-Products: Impact on Bioaccessibility and Bioavailability. Antioxidants (Basel, Switzerland), 12(4), 976. https://doi.org/10.3390/antiox12040976

Núñez-Gómez, Vanesa, Rocío González-Barrio, Nieves Baenas, Diego A. Moreno, and Ma Jesús Periago. 2022. "Dietary-Fibre-Rich Fractions Isolated from Broccoli Stalks as a Potential Functional Ingredient with Phenolic Compounds and Glucosinolates." International Journal of Molecular Sciences 23 (21): 13309. https://doi.org/10.3390/ijms232113309

POSTER PRESENTATION

MODULATION OF GUT MICROBIOTA METABOLISM BY HIGH-DIETARY-FIBRE INGREDIENTS DERIVED FROM BROCCOLI BY-PRODUCTS

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The valorisation of broccoli by-products represents a sustainable strategy to reduce agri-food waste while generating fibre-rich functional ingredients. This study aimed to evaluate the modulatory effects of ingredients obtained from broccoli stems on the fermentation profile of human faeces. Broccoli stem fibre was extracted in ethanol following enzymatic treatments with cellulase, pectinase, xylanase or their combination, and subsequently dried at low temperature (40 °C). Gut microbiota activity was assessed through *in vitro* gastrointestinal digestion and 24-h incubation with human faecal inoculum, followed by GLC-FID analysis of short-chain fatty acids (SCFAs) and bacterial enumeration.

Enzymatic treatments altered the dietary fibre composition, yielding ingredients containing 55--60% total dietary fibre. Notably, the untreated control ingredient exhibited a more favourable soluble/insoluble fibre (SDF/IDF) ratio and higher proportions of branched rhamnogalacturonan I (RG-I). This composition slightly enhanced SCFA production in faecal batch cultures (approximately +10%) compared with enzyme-treated ingredients. No significant differences were observed in total anaerobes or *Bifidobacteriaceae* counts. However, *Enterobacteriaceae* levels were reduced following incubation with cellulase-, pectinase-treated and control ingredients. Moreover, cellulase- and pectinase-derived ingredients significantly promoted *Lactobacillus* growth.

Overall, these findings indicate that broccoli stems are a promising raw material for the development of fibre-rich ingredients with potential beneficial effects on gut microbiota function and, consequently, gut health.

References

Jian, C., Sorensen, N., Lutter, R., Albers, R., de Vos, W., Salonen, A., & Mercenier, A. (2024). The impact of daily supplementation with rhamnogalacturonan-I on the gut microbiota in healthy adults: A randomized controlled trial. Biomedicine & Pharmacotherapy, 174, 116561. https://doi.org/10.1016/j.biopha.2024.116561

Liu, M., Zhang, L., Ser, S. L., Cumming, J. R., & Ku, K. M. (2018). Comparative phytonutrient analysis of broccoli by-products: The potentials for broccoli by-product utilization. Molecules, 23(4), 900. https://www.mdpi.com/1420-3049/23/4/900

Núñez-Gómez, V., González-Barrio, R., Baenas, N., Moreno, D. A., & Periago, M. J. (2022). Dietary-fibre-rich fractions isolated from broccoli stalks as a potential functional ingredient with phenolic compounds and glucosinolates. International Journal of Molecular Sciences, 23(21), 13309. https://www.mdpi.com/1422-0067/23/21/13309

Rivas, M. Á., Benito, M. J., Martín, A., Córdoba, M. de G., Ruíz-Moyano, S., & Casquete, R. (2022). Improve the functional properties of dietary fibre isolated from broccoli by-products by using different technologies. Innovative Food Science and Emerging Technologies, 80. https://doi.org/10.1016/j.ifset.2022.103053

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POSTER PRESENTATION

COMPARATIVE CHARACTERIZATION OF REJECTED GALA, FUJI (PGI), AND ROCHA PEARS (PDO): FROM WASTE TO HIGH-VALUE FOOD MATRICES

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Food waste at the post-harvest stage represents one of the greatest challenges for the sustainability of the agri-food chain, often driven by aesthetic standards rather than safety or nutritional failures. This study demonstrates that apples with PGI (Protected Geographical Indication) status (Gala and Fuji) and Rocha pears with PDO (Protected Designation of Origin) status classified as "rejected" are excluded based on commercial grading criteria rather than any deterioration of their intrinsic quality. Food safety is confirmed by the absence of *Salmonella* spp. and *E. coli* in all samples, debunking the microbiological risk associated with disposal. The physico-chemical characterization reveals distinct technological potentials for each matrix. Fuji apples stand out for their high soluble solids (13.96 ± 2.24%) and total sugars (61.30 ± 2.99%), making them ideal for processed products with high sensory impact. In contrast, Rocha pear reveals a superior functional profile, with total dietary fiber (22.46 ± 1.11%) and cellulose (5.28 ± 0.31%) levels significantly higher than those of apples, in addition to a mineral content (ash) of 6.90 ± 0.06%. Although the pear's higher pH (4.82 ± 0.62) and water activity (0.958 ± 0.001) require more rigorous stabilization processes, these by-products do not constitute depreciated material, but rather nutrient-rich sources. The targeted valorization of these flows, adjusted to the specificities of each cultivar, allows for the transformation of a structural surplus into a strategic opportunity for innovation and responsible production, aligning food science with the principles of the circular economy.

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POSTER PRESENTATION

FROM FOOD WASTE TO FOODBORNE RISK: ASSESSING THE SAFETY OF ORGANIC COMPOST

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Organic composting is increasingly adopted in both organic and conventional farming. Although guidelines for good composting practices exist, this seldom reaches small farmers, and compost quality is rarely subject to systematic control[1]. As compost is directly applied to food-producing soils, its microbiological safety is critical within a food safety framework.

In this work, composts considered "mature" by farmers were collected from 10 urban farms (UF) in Porto, Portugal, and their microbiological quality was evaluated. Most farms used 1 m^3^ closed composters; two used 10 m^3^ open pile composters, and one relied on a shared community composter. A commercially available organic compost was included as control. Microbiological analyses included enumeration of total viable counts (TVC), lactic acid bacteria (LAB), *B. cereus*, *Enterobacteriaceae*, *E. coli*, as well as the detection of *L. monocytogenes*, *Salmonella* spp., and sulphite-reducing clostridia (SRC) spores.

Bacterial counts were generally high, with significant inter- and intra-farm variation. TVC ranged from 6.7 to 8.4 CFU/g, reflecting the microbial activity required for organic matter degradation. LAB levels varied significantly (3.1--7.4 log CFU/g). As this group produces antibacterial compounds, such variability suggests that pathogen suppression may not be consistent throughout farms. Of concern, *E. coli* and *Enterobacteriaceae* levels ranged from 1.4 to 4.6, and 3.8 and 5.3 log CFU/g, respectively, suggesting faecal contamination. These values were comparable to those reported in sewage sludges, fertilizers commonly characterized by high microbial loads and potential pathogen presence[2].

Salmonella spp. was not detected, all composts tested positive for SRC spores. **L. monocytogenes** was found in composts from 9 of the 10 farms, with an overall incidence of 53%. The relevance of this pathogen to food safety associated with the observed farming practices, such as continuous crop rotation, planting and seeding near to ready-to-harvest crops and lack of regulatory oversight, highlights potential foodborne illness risks associated with urban farming.

These findings underscore the need for improved guidance, monitoring and regulation of composting practices to safeguard food safety in urban farming systems.

References

1. Azim K, Soudi B, Boukhari S, Perissol C, Roussos S, Thami Alami I. Composting parameters and compost quality: a literature review. Organic Agriculture. 2017;8(2):141-158. doi:10.1007/S13165-017-0180-Z

2. Wójcik-Fatla A, Farian E, Kowalczyk K, et al. *Enterobacteriaceae* in Sewage Sludge and Digestate Intended for Soil Fertilization. Pathogens. 2024;13(12). doi:10.3390/pathogens13121056

POSTER PRESENTATION

GOAT CHEESE WHEY IN BAKERY PRODUCTION: A CIRCULAR ECONOMY STRATEGY

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At the National University of La Plata dairy farm, goat cheese is produced, and 50 L/week of whey are discarded, representing a residue that causes environmental damage. In this context, the possibility arises to reintroduce this by-product into the food production chain to provide its nutrients, reduce environmental impact, and generate added value. The objective of this work was to use goat cheese whey in bread making. Breads were formulated using 000 wheat flour, dry yeast, sugar, salt, and water for the control breads (PC) or cheese whey for the whey breads (PS). Viscoelasticity was evaluated on unleavened doughs, and the optimal fermentation time at 30°C was determined for leavened doughs. The breads were baked in an electric oven (180°C, 20 min). Bread quality was evaluated: specific volume (Vs), texture (TPA), and crust color; physicochemical properties: moisture (105°C in oven) and water activity (Aqualab); and nutritional composition: lipids (Soxhlet), carbohydrates (Anthrone), proteins (Kjeldahl), and ash (muffle calcination). The doughs showed no differences in viscoelastic behavior. After 60 min of fermentation and baking, breads with similar Vs were obtained (~ 2 cm^3/g). PS showed lower moisture (39±1 PS vs 42.05±0.04 PC), higher hardness (16 N PS vs 9 N PC), and greater crust color development. The aw of both breads was similar (0.94), and a higher protein percentage was observed in PS compared to PC (8.78±0.35 PS vs 7.38±0.57 PC). Therefore, it was possible to use the cheese-making by-product in the production of breads that maintained their textural characteristics and improved their nutritional profile.

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POSTER PRESENTATION

EVALUATION OF SOLVENT-DEPENDENT EXTRACTION OF FERULIC ACID FROM WHEAT BRAN USING NIR SPECTROSCOPY

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Detection of ferulic acid represents an analytical challenge when using near-infrared (NIR) spectroscopy due to its low concentration relative to dominant matrix constituents such as carbohydrates, proteins, lipids, and water. However, the presence of aromatic and carboxylic functional groups, provides distinctive vibrational features that allow its detection in complex matrices such as wheat bran extracts. The objective of this study was to evaluate whether NIR spectral characteristics could serve as indicators of solvent effectiveness in ferulic acid extraction from wheat bran. Six solvents were used: 1 M NaOH, pure ethyl acetate, 80 % (w/w) ethanol, 70 % methanol, 50 % acetone, and 50 % hexane. Ultrasound-assisted extraction was performed for 30 min at 60 °C with a 1:10 solid-to-liquid ratio. Due to excessive foaming, acetone and hexane treatments were conducted at 40 °C. NIR spectra were recorded (900--2500 nm) using an AvaSpec-NIR-2.5-HSC-EVO spectrophotometer (Avantes, The Netherlands). For each solvent, measurements were repeated five times. Spectral data were further processed using The Unscrambler software (Camo Software, Norway), focusing on identifying wavelength regions associated with ferulic acid. The key spectral regions associated with ferulic acid were linked to phenolic hydroxyl (O--H) and aliphatic/aromatic (C--H) groups in the first overtone region (1100-1250 nm) and the combination bands (1450-2000 nm). Aromatic ring--specific overtones (1650-1800 nm) also exhibited distinct differences in peak intensities, with the highest observed in the 1 M NaOH extract, followed by methanol, ethanol, hexane, acetone, and ethyl acetate extracts. These findings suggest that alkaline extraction, as well as polar solvents, are more effective in releasing ferulic acid from the wheat bran matrix, which is consistent with the predominantly ester-bound nature of ferulic acid in cereal cell walls. The results also demonstrate the complexity of interpreting NIR spectra in multicomponent biological systems where contributions from other constituents (sugars, proteins, lipids, and water) are evident and may overlap with ferulic acid signals. Therefore, further research is necessary to establish a highly specific spectral fingerprint for ferulic acid detection in cereal by-products.

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POSTER PRESENTATION

SOLID FORMULATIONS OF VITAMIN A PROTECTED AT THE MOLECULAR LEVEL BY THE WHEY PROTEIN Β-LACTOGLOBULIN

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Milk whey protein, once considered a by-product in the dairy industry, is now seen as a promising resource given its natural role as a nutrient carrier.[1] β-lactoglobulin (β-LG), the main whey protein in milk, has been shown to bind and decelerate the decomposition of a variety of bioactive compounds, including polyphenols and vitamins.[2] Vitamin A is an essential micronutrient, but its use in food supplementation is limited by its poor solubility and high sensitivity to light, heat, moisture and oxygen. [3]

In this work, solid whey protein scaffolds were developed for the encapsulation of vitamin A. Taking advantage of the unique binding properties of β-LG, β-LG:vitamin A complexes were formed and then dried into a solid powder. Fluorescence quenching and X-ray crystallography demonstrated that vitamin A remains bound within the hydrophobic pocket of β-LG after drying and subsequent rehydration. Through mass spectrometry (MS), we showed that encapsulation within β-LG scaffolds protects vitamin A at the molecular level. The integrity of vitamin A was retained during extended storage (>5 months), confirming the effectiveness of the encapsulation method. These results further indicate that whey protein scaffolds may be used to encapsulate other highly sensitive bioactive compounds, supporting the valorization of whey into high-value food supplements.

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References

[1] Y. D. Livney, "Milk proteins as vehicles for bioactives," Curr. Opin. Colloid Interface Sci., vol. 15, no. 1--2, pp. 73--83, 2010, doi: 10.1016/j.cocis.2009.11.002.

[2] M. Figueiredo, Z. Sárkány, F. Rocha, and P. M. Martins, "Challenges and Advances in the Encapsulation of Bioactive Ingredients Using Whey Proteins," Foods, vol. 14, no. 4, p. 691, Feb. 2025, doi: 10.3390/foods14040691.

[3] S. Zhang, H. Yin, S. Yuan, Z. Chen, and Q. Zhang, "Study on Photodegradation Mechanism and Kinetics of Vitamin A and Derivatives under Ultraviolet Irradiation," ACS Food Sci. Technol., vol. 5, pp. 1990--1998, 2025, doi: 10.1021/acsfoodscitech.5c00243.

POSTER PRESENTATION

FEASIBILITY OF BETA-GALACTOSIDASE PRODUCTION BY KLUYVEROMYCES MARXIANUS FROM PRETREATED SPENT COFFEE GROUNDS

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The increasing generation of agro-industrial residues has driven the development of sustainable strategies for their valorization into high-value products. In this study beta-galactosidase production from spent coffee grounds (SCG) was investigated using **Kluyveromyces marxianus** under submerged fermentation in pretreated **Coffea robusta** residues. SCG were subjected to an alkaline-ultrasound assisted pretreatment (90 min, 50 °C) to increase fermentable sugars in the substrate. Fermentation of pretreated SCG was carried out for 48 h; during which microbial growth kinetic was registered. The ONPG assay was used to determine specific beta-galactosidase activity, while total protein concentration was quantified by the Bradford method after 32 h and 48 h. Native polyacrylamide gel electrophoresis was used to compare protein profiles between the fermentation extract and a commercial beta-galactosidase reference (Lactaid®). The estimated lag phase (10.96 h) indicates a relatively short adaptation period, suggesting that the ultrasound pretreatment applied increased effectively the substrate accessibility and reduced the inhibitory effects commonly associated with untreated coffee residues. Higher beta-galactosidase activity was observed at 48 h (4.08 ± 0.05 U/mg), compared to 32 h (2.36 ± 0.32 U/mg), indicating that enzyme production increased during the late stationary phase. The commercial reference showed an activity of 11.12 U/mg. Comparable electrophoretic protein bands between the enzyme crude extract from SCG and the commercial reference supported the presence of beta-galactosidase. These results indicate that the ultrasound-assisted alkaline pretreated SCG can be used as a substrate for beta-galactosidase production, demonstrating its feasibility for enzyme production from food processing residues.

References

Mussatto, S. I., Machado, E. M. S., Martins, S., & Teixeira, J. A. (2011). Production, composition, and application of coffee and its industrial residues. Food and Bioprocess Technology, 4(5), 661--672. https://doi.org/10.1007/s11947-011-0565-z

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POSTER PRESENTATION

MAXIMIZING ANTIOXIDANTS WITH MICROWAVES: A DESIGN OF EXPERIMENTS APPROACH

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Olive leaves (OL) are a rich source of phenolic antioxidants, but efficient and sustainable extraction requires optimized processing conditions. Microwave assisted extraction (MAE) offers significant advantages over conventional methods by enabling rapid heating, reduced solvent consumption and improved mass transfer, making it a suitable technique for valorizing agro industrial by products [1, 2].

This study aimed to optimize MAE conditions to maximize both mass yield and antioxidant capacity of olive leaves extracts (OLE) through a statistically guided design of experiments. A face centered central composite design was applied to evaluate the combined effects of ethanol percentage (0--100% v/v), temperature (35--70 °C) and solid--liquid ratio (0.020--0.066g~dry OL~/mL~solvent~). Extraction time remained constant (12 mins). Responses included extraction mass yield and antioxidant capacity (AC). Experimental data were modelled using response surface methodology using MODDE®.

Ethanol percentage exhibited opposite effects, decreasing mass yield while enhancing AC. Temperature positively influenced both outputs, whereas solid--liquid ratio showed moderate, response dependent effects. Optimized conditions were identified as 66.2% ethanol, 70 °C and a solid--liquid ratio of 0.044 g~dry OL~/mL~solvent~. Under these conditions, the experimental mass yield (26.7 g~dry OLE~/100 g~OL~) closely matched model predictions, while antioxidant capacity reached 2405 µmol~TEAC~/g~dry OLE~. Chemical profiling confirmed a total phenolic content (TPC) of 56.65 mg~GAE~/g~dry OLE~ and the presence of key phenolics, dominated by oleuropein (44.46 mg~oleuropein~/g~dry OLE~). Moreover, a scale up of the optimized MAE process from 0.8 g to 20 g of OL was performed. The mass yield improved slightly (33.72 g~dry OLE~/100 g~dry OL~) and the antioxidant capacity remained similar (2356.90 µmol~TEAC~/g~dry OLE~). Phenolic recovery also increased substantially at large scale, with higher TPC (78.59 mg~GAE~/g~dry OLE~) and elevated oleuropein levels (71.43 mg~oleuropein~/g~dry OLE~).

MAE enabled fast, high yield extraction, and its scale up remained efficient and reproducible, preserving antioxidant activity while boosting phenolic recovery for larger volume production.

References

Vinatoru M, Mason TJ, Calinescu I (2017) Ultrasonically assisted extraction (UAE) and microwave assisted extraction (MAE) of functional compounds from plant materials. TrAC Trends in Analytical Chemistry 97:159--178. https://doi.org/10.1016/j.trac.2017.09.002

López-Salazar H, Camacho-Díaz BH, Ocampo MLA, Jiménez-Aparicio AR (2023) Microwave-assisted extraction of functional compounds from plants: A Review. Bioresources 18:6614--6638. https://doi.org/10.15376/biores.18.3.Lopez-Salazar

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POSTER PRESENTATION

FRUIT WASTE PATTERNS AS A LEVER FOR SUSTAINABLE COLLECTIVE CATERING SYSTEMS

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Fruit waste generated in collective catering systems poses significant sustainability challenges while also representing an underexplored opportunity for resource recovery and valorisation. This study aimed to quantify and characterize fruit waste generated during the preparation stage in collective catering units, using an integrated framework, combining operational, economic and environmental indicators.

Fruit waste was directly measured in five units of a large Portuguese foodservice company -- ITAU (Instituto Tecnológico de Alimentação Humana), using standardized weighing procedures. Waste percentages, along with associated costs, carbon, and water footprints, were calculated by fruit and unit type to identify emerging patterns. Procurement data were used to contextualize waste profiles and multivariate patterns were explored using Principal Component Analysis. Fruit-specific waste rates were subsequently extrapolated using real purchasing data from more than 200 units to estimate potential annual impacts at the corporate level.

Results showed that stage fruit waste ranges from approximately 5-17% across units and 3-30% by fruit types, with certain fruits contributing disproportionately to total economic and environmental impacts due to high purchase volumes. Two independent dimensions were identified, reflecting absolute waste magnitude and relative utilization inefficiency.

These findings highlight preparation-stage fruit waste as a critical leverage point for improving resource efficiency in institutional foodservices. Overall, fruit waste generation was shown to be driven by both intrinsic fruit characteristics and unit-specific operational practices, with fruits presenting large non-edible fractions and units lacking standardized procedures exhibiting greater inefficiencies. The results show that even small, targeted improvements in procurement planning, food preparation practices and by-product valorisation, particularly for high-impact fruits and specific units, can generate significant economic and environmental benefits. These findings highlight the importance of context-specific strategies for sustainable foodservice operations, such as the development of effective fruit by-product valorisation pathways within sustainable food systems.

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POSTER PRESENTATION

ENVIRONMENTAL AND ECONOMIC ASSESSMENT OF PIQUANT EXTRACT PRODUCTION: PRELIMINARY LIFE CYCLE ASSESSMENT AND TECHNO ECONOMIC ANALYSIS

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The food industry is increasingly focused on circularity and resource efficiency, particularly in plant-based sauces and condiments. This study evaluates the environmental and economic performance of producing a piquant extract, with a focus on the by-products generated during extract manufacturing for piri-piri sauce production. These by-products including stems, seeds, pulp, and peels are often underutilized despite containing valuable compounds that can be recovered and valorized within food systems. An integrated cradle-to-gate life cycle assessment (LCA) and techno-economic analysis (TEA) was conducted to evaluate the piquant extract production process. The system comprises raw pepper washing, mechanical grinding using a Voran machine, salt addition, fermentation, acidification with a water--vinegar mixture, and filtration. Filtration separates the piquant extract from solid residues, which are subsequently valorized as co-products for piri-piri condiment production. This integrated LCA--TEA approach enables the identification of environmental hotspots and key cost drivers while assessing the potential for emission reduction and economic optimization. Primary data were collected from an industrial production facility operating at an average batch size of 850 kg, defined as the functional unit. Facility-specific data on material and energy flows were complemented with background data from the Ecoinvent v3.9.1 database. Preliminary LCA results indicate a carbon footprint of approximately 180 kg CO_2-eq per functional unit, with pepper cultivation and sourcing identified as the main contributor, followed by the vinegar and water mixture used during the acidification stage.The TEA is conducted using SuperPro Designer in parallel to assess capital and operational expenditures, production costs per kilogram of extract, and economic feasibility under different valorization scenarios. This study contributes to sustainable food ingredient processing by demonstrating the benefits of by-product valorization and integrated environmental--economic assessment. Future work will complete the TEA, explore alternative allocation approaches, and assess process improvements such as renewable energy integration, and enhanced circular economy strategies.

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POSTER PRESENTATION

CALIBRATION OF FERULIC ACID IN AGRO-FOOD WASTE EXTRACTS USING NEAR INFRARED SPECTROSCOPY (NIRS)

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The agri-food industry generates substantial quantities of lignocellulosic waste, including cereal bran, fruit peels, and sugar beet pulp, all of which are abundant in bioactive compounds such as ferulic acid (FA). Ferulic acid is highly valued for its antioxidant, anti-inflammatory, and antimicrobial properties, and serves as a primary precursor for natural vanillin production. While efficient extraction from lignocellulosic matrices often depends on alkaline-mediated hydrolysis, green extraction technologies, such as ultrasound-assisted (UAE), microwave-assisted (MAE), and enzyme-assisted (EAE) extraction, have emerged as sustainable alternatives to reduce the environmental footprint and energy consumption. A critical challenge in these processes is the requirement for rapid, non-invasive analytical tools to optimize extraction yields. Therefore, the aim of this study was to develop a spectroscopic method for the quantification of FA isolated from agro-food waste, using NIRS in combination with chemometrics. A calibration set (0.1--10.0 mg/mL) was developed using FA standards dissolved in 80 % ethanol to ensure complete solubility. NIR spectra were recorded in the wavelength range of 1000 nm to 2500 nm using an AvaSpec-NIR-2,5-HSC-EVO NIR spectrophotometer (Avantes, The Netherlands). For each concentration, measurements were repeated five times. Spectral data were further processed using the software Statistica 14.0 (TIBCO Statistica, USA). The predictive performance of Artificial Neural Networks (ANNs) was evaluated based on the determination coefficient (R2pred), the Root Mean Square Error of Prediction (RMSEP), the Ratio of Performance to Deviation (RPD) and the Ratio of the Error Range (RER). Preliminary results indicate that the ANN model provides superior accuracy in handling non-linearities and potential chemical interferences (R2pred = 0.9612, RMSEP = 0.7200, RPD = 4.3840, RER = 13.7502). The developed model facilitates real-time monitoring of ferulic acid isolation, significantly reducing solvent consumption and analysis time.

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POSTER PRESENTATION

COMPARATIVE STUDY OF SOLVENT EFFECTS IN ULTRASOUND-ASSISTED EXTRACTION OF FERULIC ACID FROM WHEAT BRAN

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Wheat bran, a major by-product of cereal processing, is an abundant and low-cost source of bioactive compounds, particularly phenolic acids. Ferulic acid, the predominant hydroxycinnamic acid in wheat bran, is mainly esterified to arabinoxylans within the cell wall matrix. Due to its antioxidant, antimicrobial, anti-inflammatory, and health-promoting properties, ferulic acid is of interest for applications in functional foods, nutraceuticals, cosmetics, and pharmaceuticals. However, its bound form limits bioavailability and reduces extraction efficiency using conventional methods, highlighting the need for sustainable extraction strategies. Ultrasound-assisted extraction (UAE) enhances mass transfer through acoustic cavitation, promoting cell wall disruption and improved solvent penetration. In this study, UAE (30 min; 40 and 60 °C; solid-to-liquid ratio 1 g/10 mL) was applied to extract ferulic acid from wheat bran using solvents of different polarities: 80 % ethanol, 70 % methanol, ethyl acetate, 50 % hexane, 50 % acetone, and 1 M NaOH. Extracts were analyzed for ferulic acid concentration and physicochemical properties. Solvent type significantly influenced extraction efficiency. The highest ferulic acid concentration was obtained with 80 % ethanol (179.34 µg/mL), followed by 70 % methanol (145.33 µg/mL) and 50 % acetone (143.33 µg/mL). Lower yields were observed with 50 % hexane (127.09 µg/mL), 1 M NaOH (101.59 µg/mL), and ethyl acetate (93.14 µg/mL). Despite its ability to release bound phenolics, NaOH was less effective under the applied ultrasonic conditions. Results indicate that solvent polarity and compatibility with ultrasound are decisive factors. Ethanol, a polar and food-grade solvent, most effectively enhanced ferulic acid recovery. Overall, UAE combined with ethanol represents an efficient and sustainable strategy for wheat bran valorization.

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POSTER PRESENTATION

SUSTAINABLE RECOVERY OF CAROTENOIDS FROM TOMATO PROCESSING WASTE: A COMPARATIVE STUDY OF CONVENTIONAL AND MICROWAVE-ASSISTED EXTRACTION USING DEEP EUTECTIC SOLVENTS

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In recent years, considerable research efforts have focused on the valorization of agro-industrial waste and by-products as a strategy to lower management costs and convert materials rich in natural bioactive compounds into value-added ingredients for applications in the food, cosmetic, and pharmaceutical industries. Tomato processing waste (TPW), composed primarily of peels, seeds, and small amounts of pulp, represents a significant disposal challenge for the food industry. Most commonly it is used as animal feed, composted, or discarded in landfills, all of which impose significant environmental burdens. It is a valuable source of bioactive compounds, especially carotenoids, which are the predominant bioactive constituents. These lipid-soluble natural pigments, synthesized by plants and microorganisms, accumulate during ripening in chloroplasts and chromoplasts, particularly in the outer peel layer. Within their native plant matrix, carotenoids are relatively stable in the environment in which they are synthesized. Lycopene is the most abundant carotenoid in tomatoes, followed by β-carotene. Their levels are influenced by geographical origin, cultivar, maturity stage, seasonal factors, and processing conditions. However, once isolated, they become highly unstable and are prone to rapid degradation. Exposure to light and oxygen accelerates oxidative reactions and structural changes, leading to significant losses in stability and biological activity.

Conventional carotenoid extraction methods typically utilize large volumes of organic solvents such as hexane, acetone, or ethyl acetate. These conventional solvents present significant concerns regarding human health and environmental safety, thereby driving the need for more sustainable and environmentally benign alternatives. Consequently, recent studies have increasingly explored green solvent systems, particularly deep eutectic solvents (DES), as promising and sustainable extraction media. The aim of this study was to optimize and compare conventional carotenoid extraction with microwave-assisted extraction (MAE) from tomato waste using eutectic solvents. Based on a comprehensive review of the available literature, several solvent systems demonstrating high stability and extraction potential were selected: menthol and thymol in a 1:1 molar ratio; menthol and lactic acid in a 4:1 molar ratio; and capric acid and lauric acid in a 2:1 molar ratio.

Conventional extraction was performed on a magnetic stirrer (550 rpm, 30 min), at room temperature in the dark, and the samples were prepared with a solid-to-solvent ratio of 1:20, After the extraction, samples were centrifuged and saponified to remove impurities, particularly fats, to minimize the matrix effect during carotenoid quantification by HPLC. The obtained results showed that the mixture of capric and lauric acid demonstrated the highest extraction efficiency for both lycopene and β-carotene, compared to the other two mixtures employed. Accordingly, this solvent system was selected for further optimization of the microwave-assisted extraction process. The influence of key extraction parameters, including microwave power, extraction time, and solvent-to-solid ratio, was evaluated in order to maximize carotenoid yield while minimizing degradation.

Initially, the effect of two different MAE conditions was evaluated: lower power with longer extraction time (120 W, 20 min) and higher power with shorter extraction time (450 W, 1 min). The results indicated that extraction at 120 W for 20 minutes yielded slightly higher carotenoid recoveries compared to 450 W for 1 minute. However, considering overall energy consumption, the condition of 450 W for 1 minute, although associated with marginally lower yields, required substantially less energy input.

For this reason, the condition of 450 W for 1 minute was selected for further investigation of the effect of different solid-to-solvent ratios (1:10, 1:20, and 1:30, w/v). Since all tested ratios resulted in very similar carotenoid yields, the 1:20 ratio was chosen for subsequent optimization.

Based on an experimental design approach, additional trials were conducted under various combinations of extraction times (1--13 min) and microwave power levels (100--1900 W). The results demonstrated that extraction performed at higher microwave power and shorter exposure times provided the highest yields of both lycopene and β-carotene, highlighting the efficiency of intensified, short-duration microwave treatment for carotenoid recovery from tomato waste.

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POSTER PRESENTATION

BETALAIN RECOVERY FROM BEETROOT: OPTIMIZATION OF EXTRACTION CONDITIONS

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The characteristic red color of beetroot (**Beta vulgaris** L.) is attributed to betalains, water-soluble nitrogen-containing pigments divided into red-purple betacyanins and yellow-orange betaxanthins. Betalains have strong antioxidant and anti-inflammatory activities and are associated with potential protective effects on cardiovascular health and oxidative stress. Because of their pronounced bioactivity, betalains are increasingly used as functional ingredients and natural food colorants. However, their extraction requires a careful selection of conditions, especially the choice of solvent and pH.

The aim of this study was to optimize extraction conditions for the recovery of betalains from beetroot powder and to determine the antioxidant activity of the resulting extracts. The parameters varied included solvent type (water, 10% and 20% ethanol), solvent pH value (4, 5 and 6), and extraction time (10 and 30 min). Extraction was performed in an ultrasonic bath and obtained extracts were spectrophotometrically analyzed for total betalain content (TBC) and antioxidant capacity (FRAP and DPPH). TBC in the samples ranged from 4.39 to 6.64 mg/g dry weight (dw); antioxidant capacity measured by the FRAP method ranged from 31.37 to 83.30 μmol/g dw, and by the DPPH method from 36.68 to 82.33 μmol/g dw.

According to statistical analysis, the optimal conditions for obtaining an extract with the best properties were using water as the solvent, at pH 6, with an extraction time of 30 min. In conclusion, this study demonstrated that extraction conditions significantly influence the recovery of betalains and the antioxidant capacity of beetroot powder extracts. These findings highlight the importance of optimizing extraction parameters to obtain betalain-rich beetroot extracts and support their potential application as natural colorants and functional ingredients in food and nutraceutical products.

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POSTER PRESENTATION

DEVELOPMENT OF ATLANTIC HORSE MACKEREL (TRACHURUS TRACHURUS) BURGER INCORPORATED WITH PROTEIN HYDROLYSATES FROM COD FISH BY-PRODUCTS

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Fish is a food of high nutritional value, being an important source of proteins, fat, vitamins, and essential minerals. Atlantic horse mackerel is also rich in polyunsaturated fatty acids (PUFAs), recognized for their benefits to cardiovascular and neurological health. However, this composition also makes it highly susceptible to lipid oxidation, reducing its shelf life. Oxidation is accelerated by high water activity and near-neutral pH, conditions common in fish and processed products such as fish burgers. This work aimed to develop fish burger incorporated with bioactive extracts (protein hydrolysates -- PH, or green tea extract -- GTE) and study their shelf life. The PH were recovered from cod bones using subcritical water extraction, and GTE with hydro-alcoholic extraction. The fish burgers were prepared using minced fish meat incorporated with 1% (w/w) of active compounds, in four formulations: i) containing 1% (w/w) of PH; ii) containing 1% (w/w) of GTE; iii) containing a combination of both extracts at 0.5% (w/w) each, and iv) control without active compounds. The samples were stored in refrigerated conditions (5 ºC) and evaluated over 6 days in terms of physical-chemical (pH, TBARs, total volatile basic nitrogen, and color) and microbiological analysis. Compared to control, samples with only GTE or the combined GTE+PH presented delay in the oxidation (50% less in TBARs) and microbiological deterioration (reduction of 0.5 Log CFU/g in total mesophilic microorganisms). No significant changes were observed in the fish burgers incorporated with only the PH. The results demonstrate that the incorporation of bioactive extracts has potential in reducing oxidative degradation and improving microbiological stability in fish-based products, however superior doses must be used. Moreover, the use of natural extracts aligns with current consumer demand for clean-label and functional foods.

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POSTER PRESENTATION

PHYTOCHEMICAL COMPOSITION AND BIOACTIVITIES OF HIBISCUS SABDARIFFA LEAF EXTRACTS: A CASE STUDY OF VARIETIES 'TAITUNG NO. 6' AND 'TAITUNG NO. 3' IN TAIWAN

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Hibiscus sabdariffa L. leaves, often considered agricultural by-products, possess significant potential for functional foods. This study evaluated the bioactive compounds and pharmacological activities of leaf extracts from two Taiwanese varieties, Taitung No. 6 (HS-6) and Taitung No. 3 (HS-3), using 50% ethanol, acidified 50% ethanol, and *n*-hexane extraction. Analysis via LC-MS/MS and GC-MS revealed that HS-6 50% ethanol extract and acidified 50% ethanol extract contained significantly higher levels of anthocyanins (delphinidin-3-*O*-sambubioside and cyanidin-3-*O*-sambubioside) compared to HS-3 extracts. Distinct varietal differences were also noted in phenolic acids (neochlorogenic and gallic acid) and flavonoids (quercetin-3-*O*-glucoside and rutin). While HS-3 *n*-hexane extract accumulated more lipophilic antioxidants like vitamin E, HS-6 *n*-hexane extract were richer in squalene and phytol. Functionality assays showed that HS-6 acidified 50% ethanol extract exhibited the strongest DPPH radical scavenging and alpha-glucosidase inhibitory activities. Furthermore, in a macrophage-based anti-inflammatory model, HS-6 50% ethanol extract demonstrated a significant suppression of IL-6, whereas HS-3 acidified 50% ethanol extract showed the strongest TNF-alpha inhibition. Overall, the bioactivities of acidified extract were found to be superior to those of non-acidified extract. In antiproliferation tests, HS-6 50% ethanol extract exhibited potent inhibitory effects against BxPC-3 (pancreatic cancer) and A549 (lung cancer) cells. Additionally, HS-6 50% ethanol extract significantly promoted glucose analog uptake in insulin resistance assays, with the most pronounced effect observed at 250 mcg/mL. In conclusion, Taitung No. 6 leaves demonstrate superior functional composition and efficacy over Taitung No. 3, highlighting Taiwanese Roselle leaves as promising natural sources for antioxidant, anti-diabetic, and anti-inflammatory ingredients in functional food development.

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Innovation and consumer acceptance

POSTER PRESENTATION

INNOVATIONS FOR FOOD WASTE PREVENTION TO SUPPORT EU CLIMATE TARGETS: A SYSTEMATIC REVIEW OF THEIR EFFICACY

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This contribution emerges as a result of the WASTEWISE project, which aims to develop robust and evidence-based scenarios for food loss and waste prevention in support of EU climate and environmental targets. With the aim to inform the design of credible and consensus-driven food waste reduction scenarios on selected supply chains, we carry out a systematic review of scientific evidence on innovations that have been empirically tested to prevent food waste. The methodology follows a PRISMA framework and uses keywords to draw records on Scopus and EU project databases (CORDIS). After a first screening to remove irrelevant records, an eligibility assessment is conducted based on predefined inclusion criteria. Only records focused on prevention of food waste, and providing an empirical assessment of the efficacy of innovations, are retained. Selected records are analysed and classified by innovation type, stage of the supply chain, food category addressed, and measurement methods applied. The result is a database of tested innovations against food waste, which will be used to support the development of achievable food waste reduction scenarios at the EU level.

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POSTER PRESENTATION

YOUNG ADULTS' ACCEPTANCE OF MEDITERRANEAN-INSPIRED RECIPES: PORTUGUESE RESULTS FROM A MULTICOUNTRY CO-CREATION STUDY (MOREMEDDIET)

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Despite its well-documented health and environmental benefits, adherence to the Mediterranean diet among younger populations continues to decline, reinforcing the need for targeted strategies such as the MoreMedDiet project to promote its acceptance and adoption.

Within the MoreMedDiet project, co-creation sessions were carried out to assess the acceptability of ten Mediterranean-inspired recipes across five countries (Portugal, Spain, Italy, France and Turkey). This study reports the Portuguese results. Twenty-five young adults aged 18--30 years evaluated eleven recipes using an 11-item questionnaire based on a 7-point hedonic scale, where 7 represents the highest score and 1 the lowest. To ensure methodological consistency with ordinal data, recipe selection was based on the percentage of top-box responses (scores 6--7) for overall liking, supported by median values. Willingness to eat again and purchase intention were analysed to validate selection.

The results achieved showed that the highest "overall opinion" top-box scores were observed for Vegetable cream (64%), followed by Hummus (48%) and Fish à Brás (48%), Meatballs (36%) and Lamb salad (35%). Vegetable cream additionally showed strong behavioural intention outcomes, as 68% of participants expressed willingness to consume it again and 60% to buy it in a ready-to-eat format, while perceptions of healthiness and sustainability were high (76%). Fish à Brás demonstrated high repurchase and family-cooking intention (with 56% and 52%, respectively), suggesting cultural alignment with the gastronomic traditions in Portugal. In contrast, although Bruschetta and Carrot cream showed high visual appeal and perceived healthiness, they did not achieve high overall liking in the Portuguese sample.

At consortium level, 5 recipes were selected: Bruschetta, Hummus, Carrot cream, Vegetable cream and Lamb salad. Comparison with the Portuguese results showed partial overlap, with Vegetable cream, Hummus and Lamb salad consistently preferred, suggesting cross-cultural acceptability. Differences in the remaining selections indicate country-specific sensory preferences. These findings highlight the influence of cultural context on recipe acceptance and support the value of local co-creation in optimising Mediterranean-inspired dishes.

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POSTER PRESENTATION

MICROBIOLOGICAL AND SENSORY EVALUATION OF VACUUM-PACKED FRESH MARINATED BEEF

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Meat quality is primarily assessed through sensory attributes such as color, odor, texture, and flavor, which influence consumer acceptance. This study was carried out at a meat processing company, Carnes Campicarn, S.A., to assess the microbiological safety, sensory quality, and shelf life of vacuum-packed fresh marinated beef.

Cuts from young cattle: topside, rump, and tri-tip (20 samples of each), were frozen (Merino International) and mechanically sliced (Treif Falcon Hybrid) to 8-mm thickness before applying a dry lemon-thyme marinade. Whole chuck cuts (10 samples) were marinated using a a paprika- and onion-based liquid marinade, according to the cooking method (roasting). Two formulations were tested (25 g compound /kg product dissolved in 80 g or 100 g of water) to improve the sensory quality, culinary properties, and shelf life. All products were thermoformed vacuum-packed (SUPERVAC/GK852B/2020086) and analyzed by an accredited external laboratory three days after production to determine shelf life. Microbiological analysis included detection of Salmonella in 25 g (AFNOR BRD07/11-12/05 Rapid Salmonella); enumeration of positive-glucuronidase *E. coli* (ISO 16649-2:2001); total viable count (TVC) at 30 °C (ISO 4833-1:2013 Amd1:2022); coagulase-positive staphylococci count (ISO 6888-2:2021/Amd.1:2023); and *Listeria monocytogenes* count (Compass Listeria Agar AFNOR -- BKR23/05-12/07). An internal sensory test with 5--6 panelists evaluated organoleptic characteristics of the products raw (color, appearance, odor) and after cooking.

Results showed absence of Salmonella spp in 25 g; *E. coli*, coagulase-positive staphylococci, and *Listeria monocytogenes*: $< 1.0 \times 10^1$ CFU/g; and TVC 4.1×10^6 CFU/g. All parameters complied with Regulation (EC) Nº 2073/2005 and the company criteria, ensuring a 15-day shelf life with acceptable sensory attributes. The lemon-thyme marinade showed low flavor perception, suggesting reformulation.

The higher-water formulation improved marinade distribution and visual uniformity of grilled samples while maintaining flavor. Future work will assess physicochemical (pH, CIE Lab*, Warner--Bratzler shear force, lipid oxidation), microbiological, and sensory parameters in beef from animals of different ages to support the commercial valorization of cow meat

References

Marinades Based on Natural Ingredients as a Way to Improve the Quality and Shelf Life of Meat: A Review https://www.mdpi.com/2304-8158/12/19/3638

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New trends in food nutrition and health

POSTER PRESENTATION

PHYTOSOME-IN-CHITOSAN MATRICES AS A FOOD-GRADE ORAL DELIVERY SYSTEM FOR CRANBERRY AND GRIFFONIA BIOACTIVE COMPOUNDS

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Chitosan is a bioactive polysaccharide derived from chitin and is increasingly explored as a multifunctional raw material for dietary supplements and functional foods, where it can act as a structuring biopolymer and a carrier for sensitive phytochemicals. In parallel, lipid--phytochemical complexes such as phytosomes are attractive for improving dispersion and protecting plant bioactive compounds during processing and storage. However, conventional vesicle/phytosome preparation often relies on organic solvents or processing steps that complicate food-grade scale-up.

In this study, phytosomes loaded with cranberry and Griffonia extracts were produced using a novel heating-based approach in which glycerol served as an environmentally friendly medium to dissolve soy lecithin, enabling a simple and potentially scalable, solvent-free process suitable for food-oriented formulations. The resulting phytosomes exhibited a mean hydrodynamic diameter of ~100 nm as determined by Nanoparticle Tracking Analysis (NTA), confirming the formation of nanoscale vesicles. Encapsulation efficiency and phytochemical content were evaluated by HPLC.

To translate these nanosystems into usable oral formats, the phytosomes were incorporated into chitosan-based nanocomposite matrices, yielding uniform, transparent, and flexible structures. The formed matrices were assessed for mechanical performance (tensile strength and elasticity) and moisture absorption behavior, parameters directly linked to handling stability and robustness in supplement and food applications (e.g., orally dissolving films/strips, chewable or rehydratable formats, and functional food carriers).Overall, the combination of glycerol-assisted phytosome production with chitosan-based nanocomposite matrices offers a promising route toward next-generation, food-compatible delivery platforms for botanical extracts. The approach supports efficient processing and structural stability, warranting further investigation of bioactive protection, release behavior, sensory performance, and functional efficacy in relevant supplement and functional food prototypes.

References

1. Detsi, A., Kavetsou, E., Kostopoulou, I., Pitterou, I., Pontillo, A. R. N., Tzani, A., Christodoulou, P., Siliachli, A., & Zoumpoulakis, P. (2020). Nanosystems for the encapsulation of natural products: The case of chitosan biopolymer as a matrix. Pharmaceutics, 12(7), 669. https://doi.org/10.3390/pharmaceutics12070669

2. Pivetta, T. P., Simões, S., Araújo, M. B., & Carvalho, R. A. (2020). Development of food-grade lipid-based delivery systems for bioactive compounds. Trends in Food Science & Technology, 98, 1--13. https://doi.org/10.1016/j.tifs.2020.01.017

POSTER PRESENTATION

IMPACT OF OSMOTIC DEHYDRATION AND LACTIC ACID FERMENTATION ON THE PHYSIOLOGICAL EFFECTS OF DIETARY ONION IN RATS

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This study investigated the effects of four different onion (SG44) preparations on body composition, metabolic parameters, hepatic gene expression, and gut microbial activity in healthy male Wistar rats. Fifty rats were randomly assigned to five dietary groups and fed semi-purified diets for four weeks: control, untreated onion, osmotically dehydrated onion, and dehydrated onion further subjected to lactic acid fermentation with strains 944 or P27. Body weight, feed intake, and body composition were monitored, and blood, liver, and caecal samples were collected for biochemical, enzymatic, bile acid, short-chain fatty acid, and gene expression analyses. Dietary onion preparations reduced hepatic expression of lipogenic genes Hif1a, Scd1, and Acly, indicating anti-lipogenic effects. Osmotic dehydration with glucose-fructose syrup enhanced these benefits by decreasing inflammatory and lipogenic genes (Nfkb1, Srebf1, Tlr4) and improving plasma markers of liver function and lipid metabolism. Fermentation had a preparation-specific impact on liver genes that regulate fatty acid oxidation, bile acid metabolism, and inflammation. The percentage of lean tissue decreased in dehydrated onion-fed rats, yet there were no changes in overall body weight, and fermentation did not further impact body composition. Caecal enzyme activities and bile acid profiles were modulated, reflecting favorable gut microbial activity. These findings demonstrate that dietary onion, particularly when processed via osmotic dehydration and selective fermentation, can beneficially modulate hepatic gene expression, plasma biochemistry, and gut microbial function, supporting its potential as a functional dietary component to promote metabolic health.

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ETHICS: The animal study was approved by Local Animal Care and Use Committee in Olsztyn, Poland (Approval No. 41/2022; Olsztyn, Poland, 15.06.2022).

POSTER PRESENTATION

INVESTIGATION OF THE CHANGES IN DIGESTIBLE STARCH FRACTIONS AND GLYCEMIC INDEX OF WHEAT DURING SPROUTING

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Sprouting is a well-known bioprocess that enhances the nutritional value of cereals. The sprouting process also induces physicochemical alterations in grains, potentially leading to elevated hydrolytic amylase activity and increased starch digestibility. The effect of wheat sprouting for 0, 24, 36, 48, 60, and 72 h at 20 °C and 95 % relative humidity was investigated in this study through the analysis of free sugar content, different starch fractions (rapidly digestible starch and slowly digestible starch), and estimated glycemic indexes. As sprouting progressed, the total free glucose content in wheat gradually increased, reaching a peak of 54.11 ± 3.66 g/kg after 72 h of sprouting. The wheat samples sprouted for 36 h exhibited the highest rapidly digestible starch content (97.9 g/100 g). However, due to the extended sprouting process, the rapidly digestible starch content gradually decreased to 57.85 g/100 g by 72 h. A similar pattern was observed in estimated glycemic index of sprouted wheats. While the estimated glycemic index increased from 98 ± 13 to 179 ± 8 after 36 h of sprouting, it subsequently decreased to 107 ± 5 by 72 h of sprouting. These findings point out the changes in nutritional value of wheat upon sprouting and highlight the significance of sprouting time in determining the digestible starch fractions and the estimated glycemic index.

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POSTER PRESENTATION

MUSHROOM-DERIVED BIOACTIVES TARGETING THE GUT MICROBIOME--BRAIN AXIS: INSIGHTS FROM PLEUROTUS CITRINOPILEATUS

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Edible mushrooms are increasingly explored as sources of immunoactive and neuroprotective metabolites with relevance for host homeostasis. Within this group, **Pleurotus citrinopileatus** stands out for its nutritional profile and a growing body of evidence supporting multi-target biological effects [1]. Here, we investigated whether an aqueous extract of **P. citrinopileatus** can modulate processes linked to cholinergic signaling by inhibiting acetylcholinesterase (AChE), the enzyme that hydrolyzes acetylcholine. Beyond neurotransmission, acetylcholine is a central mediator of gut--brain communication and participates in the control of intestinal motility, epithelial barrier function, and immune responsiveness, thereby contributing to immune homeostasis across the gut--brain axis [2,3].

The extract was chemically screened for total phenolics using the Folin--Ciocalteu assay, revealing relevant phenolic levels that were consistent with its antioxidant behavior in the ABTS•+ radical scavenging test. Functionally, AChE inhibition assays demonstrated a measurable inhibitory effect, indicating that **P. citrinopileatus** aqueous extract may help preserve acetylcholine availability and mitigate cholinergic dysfunction.

Overall, the combination of radical-scavenging capacity and AChE inhibition supports a dual, convergent mode of action with potential relevance for neurotransmitter regulation at the gut--brain--immune interface. These findings position **P. citrinopileatus** as a promising nutraceutical resource for future applications in neuroprotection, immune modulation, and maintenance of gut--brain axis balance.

References

[1] B. Drzewiecka, et al., Biomedicines, 12 (2024) 1483.

[2] J.C. Park, et al., Cell. Mol. Immunol., 22 (2025) 1001.

[3] S. Vaknine, H. Soreq, Neuropharmacology, 168 (2020) 108020.

POSTER PRESENTATION

PLANT-BASED FERMENTED BEVERAGE: CHEMICAL PROPERTIES OF GRAPE (VITIS VINIFERA L.) JUICE WATER KEFIR

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No-dairy kefir (water kefir) is an essential source of probiotics and nutrients for vegans and people who are intolerant to dairy products. Its probiotic effect is characterized by the association of different microorganisms in symbiosis (lactic acid bacteria, acetic acid bacteria and yeasts) in the gastrointestinal mucosa, which can promote anti-inflammatory and gastroprotective activities when ingested in adequate amounts1. Although fermentation provides health benefits, using overripe fruits to produce plant-based fermented beverages is one of the upcycling strategies to reduce post-harvest losses and incorporate nutrients and bioactive compounds. The objective of this study is to investigate the fermentation properties using two water kefir grains (GC and GI) combined with juice from lyophilized overripe grapes (*_Vitis vinifera_* L.). The microbial, total phenolic content (TPC) and physicochemical properties of water kefirs (KGC and KGI) were evaluated to determine the impact during fermentation. The results showed that the fermentation period (24h) significantly affect the lactic acid bacteria (LAB) and yeast counts, organic acids, pH and phenolic contents of water kefirs (KGC and KGI). Yeast and LAB counts in water kefirs were changed within the range 7.00--7.40 log CFU/mL and 7.30--7.50 log CFU/mL, respectively. Lactic and acetic acids concentrations increased during fermentation up to 0.49 g/L and 0.56 g/L, respectively. The pH range of kefirs was 3.93-4.02. The ethanol concentration in kefirs is within the regulatory limitation for fermented and non-alcoholic beverages (0.5--1.20% ABV). Overall TPC increased during 16 h of fermentation (1391.36 ± 18.05 mg GAE/L) and decreased after 24 h (1037.26 ± 29.50 mg GAE/L) compared to the beginning of fermentation (1369.68 ± 37.54 mg GAE/L). The rise in overall TPC during fermentation could be attributed to LAB hydrolases that convert polymeric phenolic compounds to other compounds with lower molecular weight (LMW). However, after 24 h a significant loss of TPC can have occurred due to factors like oxidation, adsorption with proteins and polymerization of LMW compounds. According to the finding, juice from lyophilized overripe grapes can be fermented with water kefir grains to produce non-dairy and functional beverages as a upcycled product for consumers.

References

1. Cufaoglu, G., & Erdinc, A. N. (2023). An alternative source of probiotics: Water kefir. Food Frontiers, 4, 21--31. https://doi.org/10.1002/fft2.200

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POSTER PRESENTATION

DETERMINATION OF CHEMICAL PROFILES, BIOLOGICAL ACTIVITIES, AND ANTIDIABETIC ACTIVITY OF RIENG (ALPINIA GALANGA (L.) WILLD) AND DIEP CA (HOUTTUYNIA CORDATA THUNB.) EXTRACTS FROM VIETNAM

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Rieng (*Alpinia galanga* (L.) Willd) and Diep Ca (*Houttuynia cordata* Thunb.) are two aromatic plants widely used as spices in Vietnamese cuisine. Numerous studies have reported that these plants exhibit various significant bioactivities, including antibacterial, antioxidant, anti-inflammatory and antidiabetic properties. This study compared the chemical profiles and biological activities of extracts obtained from Rieng and Diep Ca using four extraction techniques: traditional methods; ultrasound; microwave; and enzyme-ultrasound-assisted methods. Analysis of the chemical composition revealed that extracts of Rieng and Diep Ca are both rich in valuable bioactive compounds, including phenolic and flavonoid acids. A comparative evaluation of the extraction methods showed that the enzyme--ultrasound-assisted technique was the most efficient at extracting these compounds. This resulted in superior biological activity (antioxidant, antibacterial, anti-inflammatory and antidiabetic) compared to the other extracts. These findings open up new possibilities for using Rieng and Diep Ca in Vietnam to develop functional foods and treat certain chronic diseases.

References

Ansari, P., Choudhury, S. T., Seidel, V., Rahman, A. B., Aziz, Md. A., Richi, A. E., Rahman, A., Jafrin, U. H., Hannan, J. M. A., & Abdel-Wahab, Y. H. A. (2022). Therapeutic Potential of Quercetin in the Management of Type-2 Diabetes Mellitus. Life, 12(8), 1146. <https://doi.org/10.3390/life12081146>

Aware, C. B., Patil, D. N., Suryawanshi, S. S., Mali, P. R., Rane, M. R., Gurav, R. G., & Jadhav, J. P. (2022). Natural bioactive products as promising therapeutics: A review of natural product-based drug development. South African Journal of Botany, 151, 512--528.

Belury, M. A., Cole, R. M., Snoke, D. B., Banh, T., & Angelotti, A. (2018). Linoleic acid, glycemic control and Type 2 diabetes. Prostaglandins, Leukotrienes and Essential Fatty Acids, 132, 30--33. <https://doi.org/10.1016/j.plefa.2018.03.001>

Biswas, T., Behera, B. K., & Madhu, N. R. (2023). Technology in the Management of Type 1 and Type 2 Diabetes Mellitus: Recent Status and Future Prospects. Advances in Diabetes Research and Management, 111--136.

Bouyahya, A., El Omari, N., Elmenyiy, N., Guaouguaou, F.-E., Balahbib, A., Belmehdi, O., Salhi, N., Imtara, H., Mrabti, H. N., El-Shazly, M., & Bakri, Y. (2021). Moroccan antidiabetic medicinal plants: Ethnobotanical studies, phytochemical bioactive compounds, preclinical investigations, toxicological validations and clinical evidences; challenges, guidance and perspectives for future management of diabetes worldwide. Trends in Food Science & Technology, 115, 147--254. <https://doi.org/10.1016/j.tifs.2021.03.032>

Hazra, P., Hazra, S., Acharya, B., Dutta, S., Saha, S., Mahapatra, P., Pradeepkumar, P., Pal, H., Chattopadhyay, A., Chakraborty, I., Jambhulkar, S., Chatterjee, S., & Ghosh, S. K. (2022). Diversity of nutrient and nutraceutical contents in the fruits and its relationship to morphological traits in bitter gourd (*Momordica charantia* L.). Scientia Horticulturae, 305, 111414. <https://doi.org/10.1016/j.scienta.2022.111414>

IDF Diabetes Atlas | Tenth Edition. (n.d.). Retrieved March 21, 2023, from <https://diabetesatlas.org/>

Nguyen, M. T. T., Nguyen, N. T., Nguyen, H. X., Huynh, T. N. N., & Min, B. S. (2012). Screening of α-Glucosidase Inhibitory Activity of Vietnamese Medicinal Plants: Isolation of Active Principles from *Oroxylum indicum*. Natural Product Sciences, 18(1), 47--51.

Sudhakar, K., Mishra, V., Hemani, V., Verma, A., Jain, A., Jain, S., & Charyulu, R. N. (2021). Reverse pharmacology of phytoconstituents of food and plant in the management of diabetes: Current status and perspectives. Trends in Food Science & Technology, 110, 594--610. https://doi.org/10.1016/j.tifs.2020.10.024

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Role of Food Technology/engineering in sustainable and green food systems

POSTER PRESENTATION

FORMULATION AND CHARACTERIZATION OF SUSTAINABLE MICROALGA-BASED BIOCOMPOSITES

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Plastics are extensively used across multiple sectors, with the packaging industry being the largest consumer, accounting for approximately 40% of global plastic production. An estimated 320 million tons of plastics are used annually for food packaging alone. These synthetic polymers are highly durable but non-biodegradable and are frequently discarded after single use, leading to severe environmental pollution and landfill accumulation. The increasing demand for biodegradable alternatives underscores the urgent need for sustainable bioplastics and innovative production strategies. This study aims to contribute a sustainable approach to the production of value-added microalgae-based biocomposites by determining the optimal formulation of MAH-PBS blended with Chlorella, with a focus on their thermal, mechanical, and morphological properties. PBS-MAH/alga composite formulations were prepared by varying the PBS, glycerol, and water contents. The biocomposite films were produced using laboratory-cultivated *Chlorella vulgaris* (Lab_CV). Biocomposite films prepared with LAB_CV exhibited up to a 6.3-fold increase in elongation at break (4.88 ± 0.26% for 5% PBS-MAH) compared to films containing commercial C. vulgaris (COM_CV) (0.77 ± 0.07%). The highest tensile strength (4.85 ± 1.29 kPa) was obtained for LAB_CV films with 10% PBS-MAH, representing a 3.5-fold improvement over films produced with COM_CV (1.35 ± 0.30 kPa). Increasing PBS content enhanced structural integrity and reduced film porosity. Under identical plasticizer and microalgae contents, tensile strength increased with higher PBS-MAH concentrations, indicating a positive correlation between PBS-MAH content and the mechanical performance of C. vulgaris-based biocomposites. In addition, films produced with LAB_CV exhibited sharper melting peaks, indicating greater homogeneity and thermal stability, while films made with COM_CV showed broader peaks and lower elongation at break, reflecting reduced uniformity.

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Food and Nutrition nexus

POSTER PRESENTATION

ASSESSING THE IMPACT OF THE NUTRI-SCORE FRONT-OF-PACK LABEL ON CONSUMER CHOICE: A CASE STUDY OF PASTEURISED NATURAL ORANGE JUICE

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Front-of-pack nutrition labelling (FoPNL) aims to support informed choices, yet effects may depend on product category and information context. Aim: to assess the impact of the Nutri-Score on consumers' perceptions and preferences for pasteurised natural orange juice (bag-in-box), relative to other extrinsic packaging cues. A multimethod design with interviews and an online survey. After an attention check, the survey included a free word association task, a beverage food-frequency questionnaire, an attitude semantic differential scale and the Food Choice Questionnaire to capture food-choice motives; stated preferences were estimated via conjoint analysis (n=88), manipulating Nutri-Score (C vs absent), pack size (1,5 L vs 3 L) and on-pack nutrition statement ("Vitamin C" vs "Sugars"). Representations were ambivalent (naturalness/benefit vs processing/sugars). FCQ motives were highest for Natural content (M=6.2±1.4) and Sensory appeal (M=6.1±1.2). In EDS, the Nutri-Score presence was associated with an evaluative recalibration, increasing perceived naturalness (3.5±1.6 to 4.8±1.8) and healthiness (3.3±1.7 to 4.9±1.8; both $p<0.001$), with marked heterogeneity across consumers. In conjoint analysis, the on-pack nutrition statement showed the largest utility range (0.290), exceeding Nutri-Score (±0.082) and pack size (±0.043). The highest-ranked profile was "no Nutri-Score/3 L/vitamin C" (predicted utility 6.810; observed rating 6.682). Five preference segments emerged: Indifferent (n=48), Functional--Convenient (n=10), Traditional (n=9), Functional--Moderate (n=13) and Nutri-sceptic (n=8). The Nutri-Score effects appear contextual and segmented, varying with packaging configuration and individual characteristics, with implications for food literacy and nutrition communication.

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POSTER PRESENTATION

CHARACTERIZATION OF THE FUNCTIONAL COMPONENTS IN ANTHOCYANIN-RICH FOOD MATERIALS PRODUCED IN TAIWAN

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Anthocyanins are plant-derived pigments with antioxidant and health-promoting properties. The sustainable utilization of locally produced anthocyanin-rich crops offers opportunities to reduce food waste, lower carbon footprints, and enhance agricultural value while supporting the development of functional foods and natural colorants. This study compared ten anthocyanin-rich food materials produced in Taiwan---roselle, butterfly pea flower, black rice, mulberry, purple napiergrass, purple corn kernels, purple sweet potato, purple potato, red potato, and red cabbage---using acidified 50% ethanol and acidified water at a solid-to-liquid ratio of 1:10 (w/v). Extraction yield, total anthocyanin content, total phenolic content, total flavonoid content, and antioxidant activity were determined using spectrophotometric methods, with antioxidant capacity evaluated by DPPH radical scavenging activity. The results showed that acidified water generally produced higher extraction yields, particularly for red cabbage, butterfly pea flower, mulberry, and roselle, which consistently exhibited high yields under both extraction conditions. In contrast, acidified 50% ethanol extracts exhibited higher total anthocyanin contents for most materials, with roselle showing consistently high anthocyanin levels regardless of solvent type. Total phenolic and flavonoid contents were also generally higher in acidified 50% ethanol extracts, with purple napiergrass, roselle, and mulberry exhibiting superior functional component profiles. Antioxidant activity followed a similar trend, as most acidified 50% ethanol extracts demonstrated stronger DPPH radical scavenging activity. Among all materials, purple napiergrass and roselle consistently showed the highest antioxidant capacity. Overall, acidified water favored extraction yield, whereas acidified 50% ethanol was more effective for recovering anthocyanins and related phenolic compounds. Roselle and purple napiergrass demonstrated the most favorable overall performance, highlighting their potential for application in functional foods, natural colorants, and value-added food ingredients.

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Food waste: societal and policy aspects

POSTER PRESENTATION

POST-CONSUMPTION SUSTAINABILITY IN ONLINE FOOD DELIVERY: A KNOWLEDGE-BASED THEORY OF PLANNED BEHAVIOR APPROACH

Ana Luiza Camargo Mascarin Cunha[1], Victoria Brucieri Zutin[1,2,3], Maria Teresa de Alvarenga Freire[1,2,3], Gessuir Pigatto[4,5,3], Vivian Lara Silva[1,2,3]

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Food waste and post-consumption waste management are growing challenges in digitally mediated food systems, particularly within online food delivery (OFD). While these services enhance convenience and accessibility, they also intensify over-ordering, impulsive consumption, and limited portion control, contributing simultaneously to food waste and increased post-consumption residues. Addressing these challenges requires closer attention to how knowledge and education shape consumer cognition, behavioral intentions, and consumption practices.

Grounded in the Theory of Planned Behavior (TPB), this study proposes a framework to examine food waste and waste management behaviors in OFD contexts. Although TPB has been widely applied in sustainability research, studies often address these behaviors separately and underexplore the educational dimension shaping attitudes and perceived behavioral control. In digital food environments, knowledge is crucial for translating awareness into intentional behavior.

To address this gap, the study extends TPB by incorporating knowledge related to the environmental, social, and economic impacts of food waste and waste management. These knowledge dimensions are conceptualized as educational resources that foster responsibility, critical reflection, and more sustainable consumption and disposal practices. The framework also accounts for infrastructural conditions, such as access to selective collection and recycling systems, as contextual factors that interact with knowledge to enable or constrain behavior. Expected results suggest that higher levels of knowledge and environmental education strengthen pro-environmental intentions and improve both food waste reduction and waste separation behaviors. By foregrounding knowledge and education within an extended TPB framework, this study contributes to a more comprehensive understanding of sustainable post-consumption practices and offers practical insights for educational strategies, digital interventions, and policy design in online food delivery systems.

References

Aydin, A.E., Yildirim, P. 2021. Understanding food waste behavior: the role of morals, habits and knowledge. Journal of Cleaner Production 280: 124250. https://doi.org/10.1016/j.jclepro.2020.124250

Burlea-Schiopoiu, A., Ogarca, R.F., Barbu, C.M., Craciun, L., Baloi, I.C., Mihai, L.S. 2021. The impact of COVID-19 pandemic on food waste behaviour of young people. Journal of Cleaner Production 294: 126333. https://doi.org/10.1016/j.jclepro.2021.126333

Chen, M.-F., Tung, P.-J. 2010. The moderating effect of perceived lack of facilities on consumers' recycling intentions. Environment and Behavior 42(6): 824--844.

Francis, J.; Eccles, M.P.; Johnston, M.; Walker, A.; Grimshaw, J.M.; Foy, R.; Kaner, E.F.S.; Smith, L.; Bonetti, D. 2004. Constructing questionnaires based on the theory of planned behaviour: a manual for health services researchers. Centre for Health Services Research, University of Newcastle upon Tyne.

Ioannou, T., Zampetakis, L. A., & Lasaridi, K. 2013. Psychological determinants of household recycling intention in the context of the theory of planned behaviour. Fresenius Environmental Bulletin, 22(7): 2035--2041.

Islam, S. A., Jones, R. P., Akhi, A. A., & Talukder, M. S. 2024. Do food delivery apps influence food waste generation? A stimulus--organism--behavior--consequence (SOBC) exploration. British Food Journal, 126, 879--897. https://doi.org/10.1108/BFJ-07-2023-0648

Jarjusey, F., Chamhuri, N. 2017. Consumers' awareness and knowledge about food waste in Selangor, Malaysia. International Journal of Business and Economic Affairs 2: 1--10. https://doi.org/10.24088/ijbea-2017-22002

Kristia, K., Kovács, S., & László, E. 2023. Food delivery platform and food waste: Deciphering the role of promotions, knowledge, and subjective norms among Indonesian Generation Z. Cleaner and Responsible Consumption, 11, 100152. https://doi.org/10.1016/j.clrc.2023.100152

Li, C., Bremer, P., Jowett, T., Lee, M. S. W., Parker, K., Gaugler, E. C., & Mirosa, M. 2024. What influences consumer food waste behaviour when ordering food online? An application of the extended theory of planned behaviour. Cogent Food & Agriculture, 10, 2330728. https://doi.org/10.1080/23311932.2024.2330728

Liao, C.; Zhao, D.; Zhang, S. 2018. Psychological and conditional factors influencing staff's takeaway waste separation intention: an application of the extended theory of planned behavior. Sustainable Cities and Society 41: 186--194. https://doi.org/10.1016/j.scs.2018.05.046

Shankar, A., Dhir, A., Talwar, S., Islam, N., & Sharma, P. 2022. Balancing food waste and sustainability goals in online food delivery: Towards a comprehensive conceptual framework. Technovation, 117, 102606. https://doi.org/10.1016/j.technovation.2022.102606

Stancu, V.; Haugaard, P.; Lähteenmäki, L. 2016. Determinants of consumer food waste behaviour: two routes to food waste. Appetite, 96: 7--17. https://doi.org/10.1016/j.appet.2015.08.025

Stoeva, K., Alriksson, S. 2017. Influence of recycling programmes on waste separation behaviour. Waste Management 68: 732--741. https://doi.org/10.1016/j.wasman.2017.06.005

Talwar, S., Kaur, P., Ahmed, U., Bilgihan, A., & Dhir, A. 2023. The dark side of convenience: How to reduce food waste induced by food delivery apps. British Food Journal, 125, 205--225. https://doi.org/10.1108/BFJ-02-2021-0204

Tonglet, M., Phillips, P. S., Read, A. D. 2004. Using the theory of planned behaviour to investigate the determinants of recycling behaviour: A case study from Brixworth, UK. Resources, Conservation and Recycling, 41(3): 191--214. https://doi.org/10.1016/j.resconrec.2003.11.001

Wan, C., Cheung, R., & Shen, Q. G. 2012. Recycling attitude and behaviour in university campus: A case study in Hong Kong. Facilities, 30, (13--14): 630--646. https://doi.org/10.1108/02632771211280 74

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POSTER PRESENTATION

HEALTH STUDENTS' PERCEPTIONS OF FOOD WASTE IN CAMPUS FOOD SERVICES: A STUDY IN YOGYAKARTA

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Institutional food service, particularly in educational settings, contributes a proportion of food waste where awareness and behavioral changes of the students need to be encouraged. Objective: This study investigated health students' perceptions about food waste in campus food service in Yogyakarta, examining differences across gender, educational level, and field of study. A cross-sectional survey using an online form platform was conducted in February 2026 in Yogyakarta. 105 participants aged 18 years and above from a variety of study levels were involved in this survey. Data were analyzed using Mann-Whitney U test, Chi-square test, and Spearman correlation. Most students (54.3%) agreed that the younger generation wastes more food, while 81.9% supported the idea of discounted pricing for surplus food in the canteen and cafeteria. Although 57.1% acknowledged existing waste-reduction efforts, 99.1% emphasized the need for greater student awareness to reduce food waste. Convenience and proximity (56.2%) were the main reasons for purchasing food from campus food services. The majority of students agreed that food waste was mainly due to taste preferences (44.8%), lack of awareness (27.6%), and overbuying (23.8%). Surplus food storage facilities in the campus area (36.2%), educational campaigns (24.8%), and menu modifications (22.9%) are the main strategies that have been effectively implemented to reduce food waste, according to the students. Significant differences in perceptions were found only between medicine and public health students ($p<0.01$). No significant associations were identified between perceptions and gender, educational level, study program, or age. While students recognize food waste issues and existing strategies for food waste prevention and reduction, there is a strong consensus on the necessity for improved awareness programs and practical interventions in health faculty food services.

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POSTER PRESENTATION

CONSUMER KNOWLEDGE OF BEST BEFORE AND USE BY DATE LABELS: A SYSTEMATIC REVIEW OF FOOD QUALITY PERCEPTIONS, FOOD SAFETY RISKS AND FOOD WASTE IMPLICATIONS

Marveen Nafula[1], **Widya Satya Nugraha**[1,2], **Gyula Kasza**[1,3]
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Consumer-related food waste in middle- to high-income countries constitutes a major sustainability challenge, contributing substantially to the environmental footprint of agricultural production, particularly in terms of greenhouse gas emissions. Despite the clear legal distinction between best before and use by food labels in the European Union, consumer confusion remains a leading cause of avoidable household food waste. This study evaluated the current level of consumer literacy regarding date labels, mapped the behavioral consequences of label interpretation for waste and safety, and identified policy interventions to improve consumer decision-making. To achieve this goal, the study employed a systematic literature review and bibliometric analysis to identify critical knowledge gaps and the efficacy of current policy interventions. Scopus database was searched resulting in 516 relevant papers. Using the PRISMA method, a total of 36 articles were screened and selected for the study. Evidence indicates that consumers frequently misinterpret both use by and best before dates, leading to premature disposal of edible food. Food waste is further driven by disgust sensitivity towards products past the best before date, risk averse safety perceptions and impulsive purchasing behaviors that result in household overstocking. Shelf life varies across similar batches due to differences in storage temperature and handling, making the effectiveness of safety-based date labelling dependent on consumer interpretation and risk perception. While products beyond the best before date are typically safe, reputational risks and logistical constraints limit food donation practices. This review underscores the need for clearer and more descriptive language on food labels, promotions for food close to its best before date or reuse options of damaged food, proper handling of foods at retail and consumer level, consumer education on shelf life interpretation and sensory evaluation, retail handling improvements and evidence-based donation policies restricted to best before products. Strengthening charitable infrastructure and promoting near-date sales strategies may further mitigate avoidable waste while safeguarding public health.

Author Index

Numbers refer to page numbers in this volume. To generate the index, right-click below and choose Update Field.

A

ISBN: 978-989-9244-58-0

B

C

D

E

F

L

M

N

O

P

T

U

V

W

X

Y

Z

ISEKI-Food Association establishes and maintains a network among universities, research institutions and companies across the food chain, working to ensure food studies are of high quality. The International ISEKI-Food Conference brings together academics, students, researchers, industry professionals and policymakers to discuss the future of food research, education and industry.

The topic of the 8th ISEKI-Food Conference was “Innovation in Research and Education for the transition to sustainable food systems”. Held at the University of Algarve, Faro, Portugal, on 1–3 June 2026, the Conference focused on three interconnected areas: Education and Training; Research; and Responsible food production and consumption.

There were 242 abstracts presented in this Conference. Among them, 9 keynotes, 68 were selected for oral presentations and 168 for poster presentations. The abstracts of the oral and poster presentations can be found in this Book of Abstracts.

ISEKI CONFERENCES

1st ISEKI-Food Conference	10 - 12 September, 2008, Porto, Portugal
2nd ISEKI-Food Conference	31 August - 2 September, 2011, Milan, Italy
3rd ISEKI-Food Conference	21 - 23 May, 2014, Athens, Greece
4th ISEKI-Food Conference	6 - 8 July, 2016, Vienna, Austria
5th ISEKI-Food Conference	3 - 5 July, 2018, Stuttgart, Germany
6th ISEKI-Food Conference	23 - 25 June, 2021, Online
7th ISEKI-Food Conference	5 - 7 July, 2023, Paris, France
8th ISEKI-Food Conference	1 - 3 June, 2026, Faro, Portugal

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