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Latvia University of Life Sciences and Technologies
Faculty of Agriculture and Food Technology

FOODBALT 2026
19th Baltic Conference
on Food Science and Technology

"RESILIENT FOOD SYSTEMS: FROM PRIMARY PRODUCTION TO CONSUMPTION"

Abstract Book

Jelgava
May 14–15, 2026

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Conference Organizers

Editors-in-chief and responsible
compilers of Abstract book – **Ruta Galoburda and Evita Straumite**

Welcome to the FOODBALT2026 conference!

I am proud and honoured that 19th Baltic Conference on Food Science and Technology “Resilient food systems: from primary production to consumption” takes place from 14th to 15th May, 2026 again at the Latvia University of Life Sciences and Technologies.

This event is a unique opportunity for food scientists, nutritionists, doctoral and master's students, and experts to com togather, share knowledge, and shape the future of food science and technology.

Under the theme “Resilient Food Systems,” the conference will feature a comprehensive programme addressing key innovations in food science and technology, from sustainable practices, technological advancements to market trends and nutritional science.

On behalf of the Organising Committee, I warmly welcome you to the FOODBALT2026 conference. I believe that this event will provide a venue for scientific discussion, exchange of the information, the development of new ideas, and the initiation of cooperation activities among researchers, experts, and doctoral students.

Together, we can drive innovation, sustainability and growth for a better future.

professor Inga Ciprovica
FOODBALT2026 conference chair

Foodbalt 2026 keyword cloud

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FOODBALT 2026
19th Baltic Conference on Food Science and Technology
"RESILIENT FOOD SYSTEMS: FROM PRIMARY PRODUCTION TO CONSUMPTION"

PRE-CONFERENCE – Student day
May 13, 2026

Session *Room 182, 1st floor, LBTU main building*

13^{00}-13^{20} KEY LECTURE **Asnate Elizabete Universa** *Latvia University of Life Sciences and Technologies (Latvia)* ***Innovation path for students: LBTU ecosystem - from idea to funding***

13^{20}-16^{00} **STUDENT PRESENTATIONS**

May 14, 2026

8^{30}-9^{30} **Registration.** ***Hall of Aula, LBTU main building***

Session I *Room Aula, LBTU main building*
Functional Ingredients and Alternative Proteins: Composition, Processing, and Applications

Moderators: Jose Martin Ramos-Diaz Food and Bioproducts, Natural Resources Institute Finland (Luke), Finland
Inga Ciproviča, Latvia University of Life Sciences and Technologies, Latvia

9^{30}-9^{45} **OPENING.** Vice-Rector for Science at Latvia University of Life Sciences and Technologies (LBTU) **Gatis Vītols**, Dean of the Faculty of Agriculture and Food Technology **Dace Siliņa,** Director of Food Institute **Inga Ciproviča**

9^{45}-10^{25} KEY LECTURE **Jose Martin Ramos-Diaz** *Food and Bioproducts, Natural Resources Institute Finland (Luke) (Finland)* ***Innovative extrusion technologies: Redefining structure and functionality***

10^{25}-10^{40} **O1** – **Liene Jansone,** Zanda Kruma ***Mineral composition of apple vinegars***

10^{40}-10^{55} **O2** – **Ernesta Tolpeznikaite,** Vadims Bartkevics, Anna Skrastina, Romans Pavlenko, Modestas Ruzauskas, Vytaute Starkute, Dovile Klupsaite, Ernestas Mockus, Elena Bartkiene ***Functional ingredient synthesis from spirulina (Arthrospira platensis)***

10^{55}-11^{10} **O3** – **Vittoria Latrofa,** Kärt Saarniit, Aleksei Kaleda, Maarja Maasikmets, Sirli Rosenvald ***Suitability of different faba bean varieties in the development of high-protein ingredients***

11^{10}-11^{25} **O4** – **Alina Bogomolova,** Ernestas Mockus, Vytaute Starkute, Dovile Klupsaite, Romas Ruibys, Elena Bartkiene ***Amino acid and fatty acid changes in ultrasound-treated Acheta domesticus and Tenebrio molitor biomass***

11^{25}-11^{40} **O5** – **Alina Sivacova,** Inga Ciprovica ***Yeast-driven bioconversion of acid whey permeate into mycoprotein***

11^{40}-12^{00} **Pitch presentations**

P1 – Patryk Słota, **Szymon Juchniewicz,** Joanna Harasym ***Kuzu as a natural starch substitute: functional and rheological characterization***

P2 – Edite Ziemele, Inga Ciprovica ***Nitrogen bioacessibility of Acheta domesticus powders and protein isolates during in vitro digestion***

P3 – Tõnu Püssa, Jüri Ruut**,** Aleksander Sünter, Dea Anton, Linda Rusalepp, Kadrin Meremäe, Mihkel Mäesaar, Piret Raudsepp**,** Terje Elias, Mati Roasto ***Hazardous oxidation products in plant-based alternatives. Malondialdehyde as a convenient measure of fatty acid oxidation levels***

P4 – Aleksei Kaleda, **Monica Nabil Gayed Ibrahim**, Karel Talvistu, Martti Tamm, Kadi Jakobson ***Characterisation of plant-based burger produced with pea and oat protein isolates***

12^{00}-12^{45} LUNCH

Parallel Session II *Room 182, 1st floor, LBTU main building*

Food By-Products and Side Streams: Valorisation and Sustainable Processing

Moderators: Ernesta Tolpeznikaite, Lithuanian University of Health Sciences, Lithuania
Tatjana Ķince, Latvia University of Life Sciences and Technologies, Latvia

12^{45}-13^{00} **O6 – Adriana S. Franca** ***Coffee by-products: the many roads towards sustainable development in the food industry***

13^{00}-13^{15} **O7 – Renate Ruska,** Sandra Muizniece-Brasava, Ilze Laukaleja-Broka ***Management practices and valorisation potential of coffee production byproducts in the Baltic states***

13^{15}-13^{30} **O8 – Danija Lazdiņa,** Dalija Segliņa, Inga Ciprovič**a** ***Soy sauce analogue production using Japanese quince (Chaenomeles japonica) seeds***

13^{30}-14^{15} **Pitch presentations**

P5 – Sanita Sazonova, Sintija Vetra, Ilze Gramatina ***Extraction of fish oil from processing waste: A review of conventional and alternative methods***

P6 – Daniela Dreslere, Ilze Gramatina ***Valorization of fish processing by-products for protein hydrolysate recovery***

P7 – Lolita Tomsone, Ruta Galoburda, Zanda Kruma ***Comparative evaluation of bioactive compounds in fresh and freeze-dried horseradish (Armoracia rusticana) root and leaf juice***

P8 – Ilze Beitane, Martins Sabovics, Gita Krumina-Zemture, Sandra Iriste, Janis Jenzis, Elina Zelmene ***Assessment of food losses in the production processes of Latvian food companies***

P9 – Asnate Elizabete Universa, Andrejs Banis, Tatjana Kince, Zanda Kruma, Ilona Dabina-Bicka ***Nutritional characterization of brewer's spent grains depending on brewery scale and beer technology***

P10 – Andrejs Banis, Tatjana Kince, ***Submerged fermentation as a biological pretreatment for protein recovery from brewery spent grain***

P11 – Marta Czarnowska-Kujawska, Beata Paszczyk, Joanna Klepacka ***Buckwheat husk as an addition to yoghurts – analysis of mineral content and sensory characteristics***

P12 – **Jelena Pisarjonoka,** Anete Keke ***Enzymatic and ultrasound-assisted extraction of chlorophyll from food production by-products***

Parallel Session III *Room Silver Hall, LBTU main building*

Nutrition and Food Quality: From Composition to Public Health Perspectives

Moderators: Elena Bartkiene, Lithuanian University of Health Sciences, Lithuania
Asnate Ķirse-Ozoliņa, Latvia University of Life Sciences and Technologies, Latvia

12^{45}-13^{00} **O9** – **Elena Bartkiene,** Vytaute Starkute, Dovile Klupsaite, Ernestas Mockus, Erika Mozuriene, Ernesta Tolpeznikaite ***Contribution of fermentation to food quality - multifaceted approach***

13^{00}-13^{15} **O10 – Svetlana Aleksejeva,** Vitalijs Radenkovs, Maksims Zolovs, Laila Meija, Inga Ciprovica ***Compositional dynamics of polar lipids in dairy products across processing***

13^{15}-13^{30} **O11** – **Maija Gertsone**, Asnate Kirse-Ozolina ***Selenium in muesli: Nutritional content, consumer awareness, and public health implications in Latvia***

13^{30}-13^{45} **O12** – **Chrysoula Kapartziani,** Vaso Karantzavelou, Nikos Symvoulidis, Eleni Tsatsaroni, Nikolina Tsoukala, Dimitra Barkouta, Periklis Vardakas, Stathis Arapostathis ***Beyond the algorithm: Engineering human-centric resilience in digital nutrition through intermittent fasting systems***

13^{45}-14^{15} **Pitch presentations**

P13 – Asnate Kirse-Ozolina, Tatjana Kince, Klinta Karklina, Renate Ruska, Onega Circene, **Sandra Muizniece-Brasava** ***Suitability of locally sourced raw materials for the development of food rations for emergency situations***

P14 – Klinta Madara Greiliha, Elizabete Beate Komarova**, Asnate Kirse-Ozolina** ***Investigation of commercial and home-made fermented beverages in Latvia: kombucha and water kefir***

P15 – Anna Murniece, **Asnate Kirse-Ozolina** ***Nutritional analysis of food products intended for children in Latvia***

P16 – Elina Kila, Asnate Kirse-Ozolina, Liva Aumeistere ***Evaluation of commercial infant foods in Latvia using the WHO nutrient and promotion profile model***

P17 – Elena Bartkiene, Dovile Klupsaite, Ernestas Mockus, Erika Mozuriene, Darius Cernauskas, Ernesta Tolpeznikaite, Patricija Dvaranauskaite, Saule Golubovaite, Ignas Pranckevicius, Adele Asmonaite, Gerda Vaitkeviciute, Jonas Lenciauskas, Meta Varnelyte, Saida Stankeviciute, **Vytaute Starkute** ***Whole wheat bread: more sustainable, safe, and smarter solution***

P18 – Elena Bartkiene, Dovile Klupsaite, Ernestas Mockus, Erika Mozuriene, Darius Cernauskas, Ernesta Tolpeznikaite, Patricija Dvaranauskaite, Saule Golubovaite, Ignas Pranckevicius, Adele Asmonaite, Gerda Vaitkeviciute, Jonas Lenciauskas, Meta Varnelyte, Jolanta Dzemydiene, Vytaute Starkute ***Application of different sourdoughs in whole rye bread production: effects on quality attributes and acrylamide content***

14^{15}-14^{45} COFFEE BREAK

Key Lecture *Room Aula, LBTU main building*

14^{45}-15^{25} **KEY LECTURE Mikelis Grivins** *Riga Stradins University (Latvia)* ***The chessboard of food system change: Who moves and what works***

Parallel Session IV *Room 182, 1st floor, LBTU main building*
Functional Bioactives and Structured Food Systems: Design, Delivery, and Stability

Moderators: Aušra Šipailienė, Kaunas University of Technology, Lithuania
Zanda Krūma, Latvia University of Life Sciences and Technologies, Latvia

15^{30}-15^{45} **O13 – Marius Užupis,** Michail Syrpas, Joanna Topolska, Petras Rimantas Venskutonis, Małgorzata Starowicz, Vaida Kitrytė-Syrpa ***Optimized pressurized liquid extraction enhances the recovery of antioxidant-rich fractions with enzyme inhibitory activity from Gnaphalium uliginosum L.***

15^{45}-16^{00} **O14 – Vidmantė Minelgaitė,** Sigita Jeznienė, Evren Gölge, Aušra Šipailienė ***Maillard reaction–derived conjugates of dietary polysaccharides and plant proteins as protein-enriched prebiotics***

16^{00}-16^{15} **O15 – Gintarė Dyglė,** Viktorija Eisinaitė, Daiva Leskauskaitė ***Impact of high-pressure homogenization on the long-term stability and aging behavior of agar-collagen fluid gels***

16^{15}-16^{30} **O16 – Szymon Juchniewicz,** Joanna Harasym ***Hydrogel or emulgel? The influence of the natural lipid fraction of hemp protein on the properties of composite gelatin gels***

16^{30}-17^{00} **Pitch presentations**

P19 – Oliwia Paroń, **Szymon Juchniewicz,** Joanna Harasym ***Structure under control: The effect of composition and homogenization on the properties of oleogels***

P20 – Sigita Jeznienė, Ina Jasutienė, Milda Keršienė, Rita Badariavičiūtė, Laurita Varnaitė-Kapočė, Ieva Bartkuvienė, Vida Audra Budrienė, Arūnas Jonušas, **Vidmantė Minelgaitė,** Daiva Leskauskaitė, Aušra Šipailienė ***Application of double emulsion gel for encapsulation of probiotics and cannabidiol in functional food and their impact on gut microbiota***

P21 – Zanda Kruma, Baiba Tikuma, Irina Sivicka, Sigmar Naudi, Reet Karise, Inese Tupreine ***Protecting honeybee health with nectar plant extracts: cross-border solutions for Varroa mite control and biodiversity preservation***

P22 – Kamilla Ujvari, Karolina Matejczuk, Piotr Szweda ***Antimicrobial and antioxidant potential of honeys produced in Polish apiaries***

P23 – Julia Czaplis, Karolina Matejczuk ***Bacillus velezensis PY2.3 isolated from bee pollen as biocontrol agent against American foulbrood***

P24 – Jakub Dziadosz, Karolina Matejczuk ***Prebiotic functionality of bee bread: Modulation of Lactoplantibacillus plantarum***

Parallel Session V *Room Silver Hall, LBTU main building*
Fermentation and Food Quality

Moderators: **Erkan Yalçin**, Bolu Abant İzzet Baysal University, Turkey
Jeļena Zagorska, Latvia University of Life Sciences and Technologies, Latvia

15^{30}-15^{45} **O17 – Stefanija Steinweg,** Asnate Kirse-Ozolina, Anete Keke, Zanda Kruma, Jelena Zagorska, Inga Ciprovica ***Relationship between antimicrobial activity, organic acids, and lactic acid bacteria counts in fermented milk***

15^{45}-16^{00} **O18 – Valerija Illarionova,** Jelena Zagorska, Asnate Kirse-Ozolina, Kristine Majore, Vitalijs Radenkovs, Inga Ciprovica ***Proteolytic potential of mesophilic lactic acid bacteria in fermented milk***

16^{00}-16^{15} **O19 – Vytaute Starkute,** Ernestas Mockus, Dovile Klupsaite, Saulius Tusas, Ramute Miseikiene, Elena Bartkiene ***Lacto-fermentation of bovine colostrum: changes in amino acid, biogenic amine, and fatty acid profiles***

16^{15}-16^{30} **O20 – Daina Eglīte-Antona,** Kristīne Majore, Inga Ciproviča ***Early fermentation kinetics of buckwheat substrates using single and multiple strain cultures: Growth dynamics and acidification***

16^{30}-16^{45} **O21 – Davide Falotico**, Davide De Angelis, Erica Pontonio, Federico Rametta, Lorenzo Ciraldo, Giuseppe Perri, Giuseppe Natrella, Antonella Pasqualone, Giacomo Squeo, Francesco Caponio ***Alcalase hydrolysis to enhance techno-functional properties of dry-fractionated pea protein***

16^{45}-17^{10} **Pitch presentations**

P25 – Erkan Yalçin, Ayşenur Arslan ***Reducing anti-nutritional compounds of buckwheat by malting and using buckwheat malt flour in gluten-free bread***

P26 – Laura Elīza Freimane, Stefanija Steinweg, Asnate Kirse-Ozolina, Kristine Majore, Anete Keke, Inga Ciprovica, Jelena Zagorska ***Antimicrobial properties of thermophilic lactic acid bacteria in fermented milk***

P27 – Tijana Bjelogrlic, Natalja Part, Aleksei Kaleda ***Curd formation in hybrid milk-plant protein systems: Effect of protein substitution and calcium chloride addition on rennet-induced gelation***

P28 – Waldemar Gustaw, Dominik Szwajgier ***The effect of barley malt addition on the physicochemical and nutritional properties of set yogurt made from skimmed milk***

18^{30}–22^{00} CONFERENCE DINNER

May 15, 2026

Parallel Session VI *Room 182, 1st floor, LBTU main building*
Innovation for Food Quality, Safety, and Sustainability

Moderators: **Michał Świeca**, University of Life Sciences, Lublin, Poland
Evita Straumīte, Latvia University of Life Sciences and Technologies, Latvia

9^{00}-9^{15} **O22 – Michał Świeca,** Agata Michalska, Ireneusz Kapusta, Waldemar Gustaw, Małgorzata Sierocka, Natalia Żurek ***Microencapsulated extracts of Artist's Bracket and Red-belted Bracket: Antioxidant and anti-inflammatory properties***

9^{15}-9^{30} **O23** – **Laura Augustinaitytė,** Joanna Oracz, Gabriela Kowalska, Milda Pukalskienė ***Application of multi-step conventional and innovative extraction techniques for the recovery of functional compounds from blackcurrant pomace***

9^{30}-9^{45} **O24** – **Liene Ozola,** Undīne Hofmane ***Quality assessment of wheatgrass (Triticum aestivum) and optimisation of cultivation technologies for food applications***

9^{45}-10^{00} **O25 – Dovile Klupsaite,** Elena Bartkiene, Vytaute Starkute, Ernestas Mockus, Darius Cernauskas, Zilvinas Liatukas, Vytautas Ruzgas ***Bioprocessing of black and winter wheat flour with Lacticaseibacillus paracasei LUHS244 for cookie formulation***

10^{00}-10^{15} **O26 –** Layla T.O. Alves, Noemi P. Almeida, Luiza L. Pimenta, **Leandro S. Oliveira,** Adriana S. Franca ***Pequi (Caryocar brasiliense Camb.) peel extract as a functional additive in green starch-based polymers: a circular economy approach for sustainable food packaging***

10^{15}-10^{45} **Pitch presentations**

P29 – Noemi P. Almeida, Barbara L.S. Freitas, Layla T.O. Alves**, Leandro S. Oliveira** ***Potential of pequi (Caryocar Brasiliense Camb.) pectin as a substitute for commercial pectin in protein-based biodegradable films***

P30 – **Anita Avena,** Liene Ozola, Anete Ķeķe ***Effect of ultrasound and pasteurisation on structure and visual quality of black elderberry juice***

P31 – **Krista Juliāna Cīrule-Imbovica**, Ilona Dabiņa-Bicka, Zanda Kruma ***The potential of inulin addition for enhancing the nutritional value and quality of non-alcoholic beer***

P32 – Zanda Krūma, Ilze Beitāne, **Nameda Vilciņa,** Pāvels Zubkovs ***Characterization of secondary lipid oxidation compounds in beverages fortified with microencapsulated fish and algae oils***

P33 – **Sanita Reidzane,** Ruta Murniece, Linda Legzdina, Dace Klava ***Sourdough fermentation for organic wheat–barley bread production***

P34 – Liis Lutter, Gristel Toomsalu, Mirjam Vallas, Epp Songisepp ***Assessment of biocide susceptibility of sanitation-indicator microorganisms in bakery industry biofilms***

Parallel Session VII *Room Silver Hall, LBTU main building*
Consumer Behaviour and Sustainable Food Systems: Economic and Social Dimensions

Moderators: Dulmini Nanayakkara Sapugahawatte, Estonian University of Life Sciences, Estonia
Dace Kļava, Latvia University of Life Sciences and Technologies, Latvia

9^{00}-9^{15} **O27** – **Ayomide Igbaroola,** Katarzyna Woźniak-Jasińska, Agnieszka Sapa ***How does affordability shape behavioral intentions of consumers to purchase low water footprint food products? The Polish context***

9^{15}-9^{30} **O28** – **Widya Satya Nugraha,** Gyula Kasza, Miklós Süth, Dávid Szakos ***Food sustainability label in Hungary: Understanding awareness, trust, and consumer intentions***

9^{30}-9^{45} **O29** – **Dulmini Nanayakkara Sapugahawatte,** Mati Roasto, Tiina Mandel, Kadrin Meremäe, Mihkel Mäesaar, Terje Elias, Tõnu Püssa ***Microbiological safety and quality of plant-based alternative foods at the retail level in Estonia***

9^{45}-10^{00} **O30** – **Andra Dubrovska**, Evita Straumite ***Nutritional and technological challenges in emergency and crisis food production***

10^{00}-10^{15} **O31** – **Kim Yeonkwang**, Kim Yookyung ***Valorisation of mealworm larvae through jeotgal fermentation and probiotic properties of insect-derived lactic acid bacteria***

10^{15}-10^{45} **Pitch presentations**

P35 – **Kristína Predanócyová,** Peter Šedík, Eva Ivanišová, Ivona Jančo ***Generation Z and walnut consumption: Insights into preferences, factors shaping consumption patterns, and product perspectives***

P36 – **Elizabete Mūrniece,** Elīna Ciekure, Ilva Lazda, Santa Sibule, Inese Siksna ***Nutritional value of dairy and meat substitutes on the Latvian market***

P37 – **Lāsma Plociņa**, Ilze Beitāne ***Sensory acceptance evaluation of pea protein isolate beverage in patients with mental disorders***

P38 – **Dace Klava,** Sanita Reidzane, Evita Straumite, Ilze Gramatina, Aleksei Kaleda, Kadi Jakobson, Marta Rutina-Rutenberga ***Influence of fiber enrichment on the textural characteristics of a meat analogue***

P39 – **Tetiana Harbovska,** Ina Alsina, Laila Dubova, Serhii Kondratenko, Mara Duma ***Changes in the chemical composition of Cucurbita spp. fruits under conditions of interspecies hybridization***

P40 – Alo Tänavots, Marek Tepper, **Kristi Kerner** ***Lipid composition and antioxidant status of the semitendinosus muscle of organic Hereford bulls reared on cultural coastal grasslands***

10^{45}-11^{20} COFFEE BREAK

Session VIII *Room Silver Hall, LBTU main building*

Food Safety and Functionality: Effects of Origin, Raw Materials, and Processing

Moderators: Monica Nabil Gayed Ibrahim, TFTAK AS, Estonia
Ruta Galoburda, Latvia University of Life Sciences and Technologies, Latvia

11^{20}-12^{00} **KEY LECTURE** **Ilva Nakurte** *Institute for Environmental Solutions (Latvia)* ***Medicinal and aromatic plant diversity in the context of traceability, chemical variability, and cultivation potential***

12^{00}-12^{15} **O32** – Vytaute Starkute, Elena Bartkiene, Ernestas Mockus, João Miguel Rocha, Darius Cernauskas**, Erika Mozuriene,** Romas Ruibys, Gul Ebru Orhun, Dovile Klupsaite ***The impact of green lentils on wheat bread quality parameters and acrylamide formation***

12^{15}-12^{30} **O33** – **Klinta Karklina**, Liene Ozola ***Comparative quality assessment of the spring and autumn – harvest spruce sprouts***

12^{30}-12^{45} **O34** – **Ieva Miķelsone**, Paweł Górnaś ***Antioxidants in fruits of the Cucurbitaceae family: evaluation of tocochromanols and carotenoids***

12^{45}-13^{00} **O35** – **Monica Nabil Gayed Ibrahim,** Helena Andreson, Sana Ben-Othman, Ivi Jõudu ***Impact of oat drink processing interval time with neutral and acidic protease on its nutritional composition***

13^{00}-13^{25} **Pitch presentations**

P41 – Eva Ivanišová, **Ivona Jančo,** Kristína Predanócyová, Miroslava Kačániová, Adriana Kolesárová ***Antioxidant and antimicrobial activity of fermented kombucha black and green tea***

P42 – Joanna Klepacka, Ryszard Rafałowski, Marta Czarnowska-Kujawska ***Effect of rosemary extract on storage stability of butter***

P43 – **Daniela Linkevica,** Asnate Kirse-Ozolina ***Quality parameters of lacto-fermented onion***

P44 – **Marks Kiselovs,** Ilze Gramatina ***Impact of cattle-raising methods on the quality of dry-aged meat***

P45 – Layla T.O. Alves, Noemi P. Almeida, Geraldo C. Brandão, Leandro S. Oliveira, **Adriana S. Franca** ***Sustainable starch-based active polymeric films enriched with pequi peel polyphenols for antioxidant active food packaging applications***

13^{25}-13^{45} CLOSING OF CONFERENCE

SESSION I
FUNCTIONAL INGREDIENTS AND ALTERNATIVE PROTEINS: COMPOSITION, PROCESSING, AND APPLICATIONS

INNOVATIVE EXTRUSION TECHNOLOGIES: REDEFINING STRUCTURE AND FUNCTIONALITY

Jose Martin Ramos-Diaz

Food and Bioproducts, Natural Resources Institute Finland (Luke), FI-31600 Jokioinen, Finland

Extrusion has been a cornerstone technology in the food industry for nearly 90 years and, despite its considerable modifications to accommodate new ingredients and produce novel structures, its basic principles—based on versatility, zero side-streams and continuous flow—have remained pivotal to this day. However, the rise of complementary technologies involving biomodification has challenged the use of extrusion due to the sensitive nature of associated ingredients. To address this, Luke is proposing an integrated system for additive introduction. This system could bridge distant technologies into a processing unit that can set a new level of matrix complexity by relying on basic extrusion principles, a key feature for its scalability potential. In this presentation, key features of this integrated system—and corresponding method for additive introduction—will be described as well as the foundational results linked to this innovation.

Keywords: extrusion, additive introduction, structure, sensitive ingredients, functionality

Acknowledgments. This study was supported by Luke Innovation Center.

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MINERAL COMPOSITION OF APPLE VINEGARS

Liene Jansone, Zanda Kruma

Food Institute, Faculty of Agriculture and Food Technology, Latvia University of Life Sciences and Technologies, Jelgava, Latvia

Apples are among the most widely used fruits in food production, serving as raw materials for a broad range of products. Apple vinegar has been produced through fermentation and has been consumed worldwide as a traditional health remedy for centuries. However, apple processing generates substantial amounts of residues that remain underutilised. This study evaluated the mineral composition of vinegar produced from apple residues (AVR) and compared it with that of commercially available apple vinegars (AVC).

All analysed minerals were detected at levels comparable to those reported in previous studies on apple vinegar. Potassium (K) was the most abundant mineral (19.7–48.2 mg 100 g^{-1}), with higher variability detected in AVC samples. Calcium (Ca) concentrations ranged from 1.97 to 5.84 mg 100 g^{-1} in AVC and from 2.41 to 4.04 mg 100 g^{-1} in AVR, while magnesium (Mg) concentrations ranged from 16.7 to 24.3 mg 100 g^{-1} in AVC and from 15.8 to 24.0 mg 100 g^{-1} in AVR, suggesting effective mineral retention during fermentation of apple residues. Iron (Fe) and sodium (Na) levels were low in both vinegar types, whereas selenium (Se) was below the limit of quantification in all samples.

Overall, the results demonstrate that vinegar produced from apple residues exhibits a mineral profile comparable to that of commercially available apple vinegars. These findings highlight the potential of residue-based fermentation as a sustainable approach for producing nutritionally relevant vinegar while supporting by-product valorisation and circular economy principles.

Keywords: fermentation, residue, pomace, by-product valorisation, food waste

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O2

FUNCTIONAL INGREDIENTS SYNTHESIS FROM SPIRULINA *(ARTHROSPIRA PLATENSIS)*

Ernesta Tolpeznikaite[1], Vadims Bartkevics[2], Anna Skrastina[2], Romans Pavlenko[2], Modestas Ruzauskas[3], Vytaute Starkute[1,4], Dovile Klupsaite[1], Ernestas Mockus[1], Elena Bartkiene[1,4]

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Biotechnological valorisation of spirulina (*Arthrospira platensis*) enables its conversion into biofunctional ingredients for sustainable food systems. This study evaluated changes in the physical chemical characteristics of spirulina subjected to submerged (SMF) and solid-state fermentation (SSF). Ten lactic acid bacteria (LAB) strains (*Lactiplantibacillus plantarum* No. 122; *Lacticaseibacillus casei* No. 210; *Lcb. paracasei* No. 244; *Lactobacillus curvatus* No. 51; *Lactobacillus coryniformis* No. 71; *Levilactobacillus brevis* No. 173; *Pediococcus pentosaceus* No. 183; *Pediococcus acidilactici* No. 29; *Liquorilactobacillus uvarum* No. 245; *Leuconostoc mesenteroides* No. 225) were used as starter cultures for fermentation. Samples were inoculated with 3% (v/w) LAB and analyzed after 24 and 48 h. pH was measured directly, while L-glutamic acid, gamma-aminobutyric acid (GABA), and biogenic amines (BA's) were quantified by HPLC-MS, and fatty acid (FA) profiles by GC-FID. Fermentation conditions (SMF, SSF) significantly affected pH ($p=0.042$). After 48 h of SSF, samples fermented with *L. paracasei* No. 244 reached the highest GABA concentration (2395.9 mg/kg), while *L. brevis* No. 173 achieved the lowest pH (4.10). FA profiling revealed the predominance of methyl palmitate (C16:0), methyl linoleate (C18:2), and *γ*-linolenic acid methyl ester (C18:3*γ*). A significant correlation was observed between GABA and BA putrescine ($r = 0.309$) as well as spermidine content ($r = 0.211$), suggesting shared decarboxylation pathways of amino acids. While the process increases beneficial metabolites, the simultaneous formation of BAs necessitates precise optimization to ensure safety. These findings demonstrate that controlled LAB fermentation is a suitable approach for producing high-value spirulina-based ingredients, contributing to modern food system diversification.

Keywords: fermentation, GABA, lactic acid bacteria, biogenic amines, fatty acids

Acknowledgments. This work builds upon COST Action 18101 SOURDOMICS. Author Elena Bartkiene is the Vice-Chair and leader of the working group 6 "Project design and development innovative prototypes of products and small-scale processing technologies".

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SUITABILITY OF DIFFERENT FABA BEAN VARIETIES FOR THE DEVELOPMENT OF HIGH-PROTEIN INGREDIENTS

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The increasing global demand for sustainable and ethically produced protein sources has intensified interest in plant-based ingredients, particularly legumes, as alternatives to animal-derived proteins. Among these, faba bean (*Vicia faba* L.) is a promising crop due to its high protein content, favourable amino acid profile, and agronomic advantages. However, the presence of off-flavours and antinutritional compounds may negatively affect consumer acceptance and limit the use in novel protein-rich foods. These sensory-related attributes are mainly associated with volatile compounds, but also with non-volatile compounds, some of which act antinutritional factors, including saponins, tannins, vicine, and convicine. The concentrations of volatile compounds and antinutrients vary considerably across cultivars.

In this study, ten faba bean cultivars were evaluated to investigate their compositional variability and its impact on sensory-related properties relevant to plant protein ingredient production. The cultivars were characterized in terms of protein content and key compounds associated with bitterness, astringency, and beany flavour. The results highlighted considerable differences among cultivars. Bioro had the most favourable sensory-related profile, followed by Alexia and LG Hawk, whereas Jõgeva showed the least favourable characteristics, including pronounced green odour and high lipoxygenase activity. The findings confirmed that cultivar selection plays a crucial role in determining the suitability of faba beans for food applications.

Overall, this work highlights the importance of cultivar selection as a strategic factor in the development of acceptable and sustainable faba bean-based protein ingredients, supporting the advancement of novel plant-based food products.

Keywords: plant-based ingredients, antinutritional factors, sensory

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O4

AMINO ACID AND FATTY ACID CHANGES IN ULTRASOUND-TREATED *ACHETA DOMESTICUS* AND *TENEBRIO MOLITOR* BIOMASS

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Insects are a sustainable source of high-quality proteins and lipids for food applications. Their nutritional profiles may be modified by ultrasonication, a non-thermal and eco-friendly processing method. The aim of this study was to investigate the effect of low-frequency ultrasonication on free amino acid (FAA) and fatty acid (FA) characteristics of *Acheta domesticus* and *Tenebrio molitor* biomass. Ultrasonic treatment (UT) was applied at 37 kHz and 160 W at 40 °C for 0, 15, 30, 45, and 60 minutes. FAA and FA profiles were determined using gas chromatography coupled with mass spectrometry (GC-MS). It was established that UT significantly influenced FAA profiles in both insect species. Also, analysed factors (species - and treatment duration) were significant on most of the FAA content in samples. Changes were particularly evident for valine, methionine, tryptophan, serine, and tyrosine, suggesting UT-induced modifications of protein structures. Distinct responses between species were observed, indicating matrix-specific susceptibility to UT. FA composition was also affected by UT. Linoleic acid was the predominant FA in *A. domesticus*, whereas *T. molitor* biomass was characterized by higher levels of oleic acid alongside linoleic acid. UT altered the relative proportions of individual FAs, highlighting its potential to modulate lipid profiles depending on both analysed factors: UT duration and insect species. Overall, low-frequency UT induces measurable changes in FAA and FA composition of insect biomass. These findings emphasize the importance of optimizing UT parameters to preserve nutritional quality of insect-based ingredients for food and feed applications.

Keywords: insects, proteomic profile, lipidomic profile, nutritional quality

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O5

YEAST-DRIVEN BIOCONVERSION OF ACID WHEY PERMEATE INTO MYCOPROTEIN

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Acid whey is a challenging dairy side-stream due to its high organic load and limited valorisation routes, particularly in context of increasing demand for sustainable protein sources. This study evaluates yeast-driven bioconversion of acid whey permeate into mycoprotein.

Two lactose-assimilating yeasts, *Kluyveromyces marxianus* MSCL 79 and *Cyberlindnera jadinii* MSCL 87 (Microbial Strain Collection of Latvia), were cultivated in batch-type bioreactors on partly concentrated acid whey permeate with 13% and 20% solids. The effects of lactose hydrolysis, supplementation with $(NH_4)_2HPO_4$, KH_2PO_4, $MgSO_4 \cdot 7H_2O$ and active biomass addition after 24 h of fermentation were evaluated over 72 h at 30 °C under continuously adjusted pH 5.0 to assess yeast growth kinetics, wet biomass yield and protein concentration. Both yeasts efficiently utilised acid whey permeate as a carbon source. Increasing total solids from 13% to 20% enhanced wet biomass formation while reducing protein concentration (ANOVA, $p = 0.002$). Lactose hydrolysis shortened the lag phase and improved growth kinetics, particularly for *C. jadinii*, where viable counts increased from 7.62 to 8.18 $\log_{10}$ CFU mL^{-1} at 13% solids. Simultaneous supplementation with $(NH_4)_2HPO_4$, KH_2PO_4, $MgSO_4 \cdot 7H_2O$ increased protein concentration across tested conditions, reaching 42.51% in *K. marxianus* and 40.63% in *C. jadinii* fermented substrates. *K. marxianus* achieved the highest biomass yield (58.95 g L^{-1}) with active biomass addition at 20% total solids, whereas *C. jadinii* produced lower yields (up to ~31 g L^{-1}).

The results demonstrate that acid whey permeate can be converted into mycoprotein through yeast-driven bioconversion, enabling sustainable protein production and circular dairy processing.

Keywords: acid whey, mycoprotein, yeast fermentation, dairy waste-stream, biomass

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KUZU AS A NATURAL STARCH SUBSTITUTE: FUNCTIONAL AND RHEOLOGICAL CHARACTERIZATION

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The aim of the study was to comprehensively characterize kuzu as a potential starch substitute, with particular emphasis on its physicochemical, functional, rheological, pasting, and textural properties.

Kuzu was characterized by a moisture content of 14.95% and moderate emulsifying activity (EA = 0.26%) and emulsion stability (ES = 6.04%), indicating limited but measurable emulsifying properties. High water-holding capacity (WHC = 1.70 g H_2O/g DM; water-absorption capacity WAC = 2.35 g H_2O/g DM; water absorption index WAI = 10.46 g H_2O/g DM) and swelling capacity (SP = 11.69 g/g DM) confirm the functionality of kuzu in systems requiring water retention. Color parameters ($L^* \approx 100$ $a^* \approx -0.65$, $b^* \approx 3.68$) indicate a very light material with a neutral shade, which is beneficial for food applications. Analysis of the pasting properties showed high maximum viscosity (Peak = 2958.5 mPa·s) and a gelatinization temperature of 77.6 °C, typical for starch with good thermal stability. Rheological tests confirmed the dominance of elasticity ($G' > G''$; $\tan \delta \approx 0.12$), while TPA analysis showed moderate hardness and high elasticity of the gel structure. The results confirm the suitability of kuzu as a functional starch substitute in food formulations, particularly for products requiring high water-binding capacity, resistance to viscosity changes, and a light color.

Keywords: kuzu, starch substitute, functional properties, rheological properties, texture profile analysis

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NITROGEN BIOACESSIBILITY OF *ACHETA DOMESTICUS* POWDERS AND PROTEIN ISOLATES DURING *IN VITRO* DIGESTION

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Edible insects in Europe are increasingly used as protein ingredients rather than whole foods, making protein digestibility and bioaccessibility as critical parameters for nutritional assesment. This study assessed nitrogen bioaccessibility of processed house crickets (*Acheta domesticus*) powders and protein isolates derived from these powders during *in vitro* gastrointestinal digestion.

House crickets were processed either by oven drying at 100 °C until constant weight or freeze drying under reduced pressure for 24 h, followed by milling into powders. Protein isolates were produced from powders by alkaline solubilisation at pH 10.0 using 1 M NaOH, followed by isoelectric precipitation of solubilised proteins at pH 4.3 using 1 M HCl. The precipitates were washed twice with distilled water, freeze dried, and milled. Samples were subjected to an *in vitro* gastrointestinal digestion (Minekus, 2014). Nitrogen was quantified using the Kjeldahl method and expressed as bioaccessible nitrogen relative to the initial nitrogen content of the sample.

Protein isolates exhibited significantly higher nitrogen bioaccessibility than the corresponding whole insect powders, irrespective of drying method (Welch two-sample *t*-test, $p = 8.68 \times 10^{-5}$). Isolates obtained from freeze-dried and oven-dried crickets showed high nitrogen bioaccessibility (89.79 ± 1.41% and 91.23 ± 0.56%, respectively), whereas the corresponding powders displayed lower values (73.11 ± 2.14% and 64.16 ± 1.43%).

The results indicate that protein isolation via alkaline extraction at pH 10 enhances nitrogen bioaccessibility irrespective of drying method, while drying history influences nitrogen bioaccessibility in non-isolated insect protein powders.

Keywords: *Acheta domesticus*, protein isolation, alkaline extraction, nitrogen bioaccessibility, *in vitro* digestion

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HAZARDOUS OXIDATION PRODUCTS IN PLANT-BASED ALTERNATIVES: MALONDIALDEHYDE AS A CONVENIENT MEASURE OF FATTY ACID OXIDATION LEVELS

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In plant-based alternatives (PBAs), the enzymatic and free radical oxidation of polyunsaturated fatty acids (PUFA) and cholesterol can generate a range of oxidation products with varying levels of toxicity. Malondialdehyde (MDA), a secondary lipid oxidation product, is an important compound formed during this process. The EFSA Scientific Committee recommends that the daily intake of MDA should not exceed 30 µg/kg body weight (bw), other experts have proposed a limit of 0.5 mg/kg for concentrations in food.

The aim of this study was to assess the formation and levels of MDA in PBAs sold in Tartu supermarkets. As of October 2025, 179 samples of PBAs were analysed at the "best before" or "use by" dates. Determination of MDA was performed by in-house methods by spectrophotometry or by liquid chromatography (UV-VIS DAD, 532 nm), using TBARS assay.

Among the samples analysed, 75 samples (41.9%) had MDA levels below 0.5 mg kg^{-1}, 38 samples (21.2%) had concentration between 0.5 and 1 mg kg^{-1}, 41 samples (22.9%) between 1 and 2 mg kg^{-1}, 15 samples (8.4%) between 2 and 3 mg kg^{-1}, 6 samples (3.4%) between 3 and 4 mg kg^{-1}. In 4 samples (2.2%) the MDA concentration exceeded 4 mg kg^{-1}. The highest MDA level detected was 4.87 mg kg^{-1}. Overall, 58.1% samples exceeded the proposed limit concentration of 0.5 mg kg^{-1}.

The study results show that for many PBAs the periods up to the "use by" date should be shortened and the oxidation level of the product is an important determinant for “best before” or “use by” dates for PBAs.

Keywords: plant-based alternative products, polyunsaturated fatty acids, oxidation, malondialdehyde, food shelf-life

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CHARACTERISATION OF PLANT-BASED BURGER PRODUCED WITH PEA AND OAT PROTEIN ISOLATES

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The objective of the present research is to evaluate the binding potential of oat and pea proteins for plant-based burger (PBB) production and to assess their effects on burger properties. For PBBs preparation, pea and oat proteins (82.4 and 83.7 g protein/100 g dry matter, respectively) have been used, along with other dry ingredients, oils, water, and Textured Vegetable Protein (TVP). Six different recipes were compared, in which part of the dry matter was replaced by adding 1.5% or 3% protein. Three variants were tested: oat protein only, pea protein only and their combination (50:50). The PBBs were evaluated for their cooking losses, texture profile analysis (TPA), and sensory properties using a 5-point hedonic scale. Increasing protein concentration from 1.5% to 3% in PBBs generally reduced cooking loss by about 1%. The lowest cooking loss was observed in pea burgers (13–14%), compared to burgers containing oat protein (16–18%). TPA analysis showed that pea burgers were softer and more elastic than those containing oat protein, which had a firmer, chewier texture. Sensory evaluation confirmed the TPA and cooking loss results, where recipes containing pea protein were perceived as juicier, while oat burgers were dry and chewy. Pea burgers were more neutral in taste, while oat burgers exhibited umami and a slight bitterness aftertaste. To sum up, pea protein had better potential as a binding ingredient in PBB recipes, providing a pleasant taste, texture and higher consumer acceptance. Oat protein could be tested in other meat-alternative applications with firmer texture and more intense flavour.

Keywords: pea protein isolate, oat protein isolate, plant-based burger, functional properties, sensory criteria

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SESSION II
FOOD BY-PRODUCTS AND SIDE STREAMS: VALORISATION AND SUSTAINABLE PROCESSING

COFFEE BY-PRODUCTS: THE MANY ROADS TOWARDS SUSTAINABLE DEVELOPMENT IN THE FOOD INDUSTRY

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Coffee is one of the most widely consumed beverages worldwide, being quite a relevant food commodity from both health and economic standpoints. It has been established that moderate daily consumption of coffee is associated with positive health effects, including protective effects on cardiovascular, nervous and immune systems, among others. Also, both green and roasted coffee extracts were shown to present inverse correlation with many diseases such as Alzheimer's, depression, diabetes, Parkinson's, and cancer. These health-related benefits are attributed to coffee's rich phytochemistry, including many biologically active compounds such as caffeine, polyphenols and others. Along the coffee production chain (from the coffee fruit to the resulting beverage), many by-products are generated in significant amounts, including coffee husks and pulp, parchment husks, chaff (silverskin), and spent coffee ground (SCGs). These by-products are normally discarded, being inappropriately destined for landfills, or used in low-cost applications, such as animal feed, soil composting or feedstock for in-farm combustion systems, despite their high potential value. Such by-products present a distinct and rich chemical makeup, being suitable for further profitable exploitation. Therefore, this discussion focuses on finding sustainable and eco-friendly strategies for valorising coffee by-products, particularly in food-related applications. Examples include recovery of bioactive compounds, and their potential uses as food additives or ingredients; and the potential use components in the manufacture of composite materials that can be employed for food packaging.

Keywords: carbohydrates, coffee antioxidants, coffee husks, spent coffee grounds

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MANAGEMENT PRACTICES AND VALORISATION POTENTIAL OF COFFEE PRODUCTION BYPRODUCTS IN THE BALTIC STATES

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Byproduct valorisation has become a strategic priority within the food industry as sustainability and circular economy principles gain increasing importance. The coffee sector represents a significant yet underexploited source of value-added byproducts. In the Baltic States, the coffee production sector generates substantial quantities of residues that are predominantly directed to biodegradable waste streams, resulting in downcycling and loss of potential economic value. While spent coffee grounds from beverage preparation have been studied, other, for example, post-roasting byproducts, such as silverskin, a byproduct collected during green coffee bean roasting, remain insufficiently studied.

This study examines the current management practices and valorisation potential of coffee production byproducts within Baltic States coffee roasting enterprises. Surveys and semi-structured interviews were conducted with coffee roasters to assess byproduct handling, perceived risks, and technological constraints. The findings reveal growing awareness among producers regarding the potential of coffee production byproducts as food-grade materials, particularly due to their antioxidant properties. Although elevated moisture content, resulting from post-roasting water spraying applied to mitigate flammability risks, poses microbial stability challenges, producers express a strong interest in developing improved processing and stabilisation solutions.

The results indicate opportunities to transform coffee production byproducts from an underutilised residue into a food-grade material. By addressing moisture-related safety constraints, the Baltic State coffee sector can enhance resource efficiency, create added value, and strengthen its contribution to sustainable and circular bioeconomy development.

Keywords: byproducts, coffee, silverskin, valorisation

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SOY SAUCE ANALOGUE PRODUCTION USING JAPANESE QUINCE (*CHAENOMELES JAPONICA*) SEEDS

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The study explored soy sauce analogue production using Japanese quince seeds (JQS) as a partial or complete replacement for soy beans, representing a protein-based fruit processing by-product valorisation strategy. Soy bean + wheat (SW), soy bean + wheat + JQS (SWJ), and JQS + wheat (JW) mixtures were inoculated with *Aspergillus sojae*, and solid-state fermented for 48 hours at 30°C. Afterwards, the mixture was submerged in 15% brine, and fermented in closed jars for 6 months at ambient temperature, monitoring pH and soluble solids. Free amino acids, sugars and organic acids were analysed using HPLC-MS and HPLC-RID, respectively, and volatile compounds were analysed using GC-MS.

The addition of JQS to the substrate resulted in lower pH and soluble solids (p<0.05) than the traditional recipe. Similarly, free amino acid (especially bitter) content was lower in sauces using JQS in the substrate (p<0.05). The sugars and acids in the sauces were glucose, galactose, and lactic acid and acetic acid, their contents were similar between samples (p>0.05). The SW samples had higher fermented aroma-associated peak area, while JW had higher waxy and floral aroma-associated compound area. SJW and JW had higher peak areas of compounds associated with creamy, minty and acidic aroma. Volatile compounds mainly belonged to alcohols, esters and organic acids.

While the addition of JQS resulted in a distinctly different product, they can be used as a partial or complete replacement for soy beans in savoury fermented sauce production.

Keywords: microbial hydrolysis, valorization, by-products

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EXTRACTION OF FISH OIL FROM PROCESSING WASTE: A REVIEW OF CONVENTIONAL AND ALTERNATIVE METHODS

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The fish processing industry generates various by-products, including bones, skin, fat, which are still valuable and could be further used in the food industry. Fish contains on average 30% fat and approximately 50% of a fish body weight ends up as waste or unused by-products. Fish waste is a valuable source of fish oil, making its extraction an important step in valorization. The aim of this review was to compare different methods for extracting fish oil from fish by-products and to identify the main differences between them. In particular, traditional extraction methods were compared with green extraction methods, enzymatic extraction methods, and chemical extraction methods.

The review provides a detailed analysis of the mentioned methods, which are mostly compared with the most widely used traditional extraction technique – the wet reduction method. Scientists indicate in their studies that the highest percentage of oil yield is achieved by enzymatic extraction methods (approximately 59%) and traditional extraction methods (approx. 49%), while chemical and green extraction methods have the lowest percentage yield (approx. 37%). Also, the oil yield depends on the type of the fish. Higher fat content in the fish, the greater oil yield. Studies show that oil obtained using chemical methods still contains the solvent that were used to extract the oil. Oils extracted using traditional, enzymatic or green methods are generally considered safer for consumption than those obtained by chemical methods.

Several studies report that enzymatic extraction, microwave-assisted extraction, and supercritical fluid extraction can significantly reduce oil extraction time, thereby enabling production optimization. However, the application of new green methods can increase extraction costs.

Keywords: fish oil, extraction method, traditional method, green method, enzymatic method

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VALORIZATION OF FISH PROCESSING BY-PRODUCTS FOR PROTEIN HYDROLYSATE RECOVERY

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To ensure the maximal valorization of by-products generated by fish-processing industries – such as heads, frames, skin, trimmings, and viscera from fish, which collectively account for 40–60% of the total biomass, it is essential to retain these materials within the food chain in accordance with the principles of a sustainable circular economy through the production of high-value biomolecules. Fish by-products can be converted into high-value-added products like fish protein hydrolysates (FPHs), which have high nutritional value and are rich in bioactive peptides with health benefits. Protein hydrolysates are defined as proteins that are chemically or enzymatically broken down into smaller free amino acids and peptides which can improve the functional and nutritional properties of food protein. Enzymatic hydrolysis is a widely used method for recovering proteins from waste, enhancing their functional and nutritional properties of proteins. The aim of the study is to compare the effects of different enzymes during the hydrolysis process and to evaluate the nutritional value of the resulting hydrolysate. Raw materials derived from Atlantic salmon (*Salmo salar*) used for the production of FPHs include bones, skin, frames and head. Fish protein hydrolysates (FPHs) are produced by treating fish by-products with proteases, such as pepsin or microbial endopeptidases, under carefully controlled pH and temperature conditions. Enzyme type affected the yield of the protein concentrate obtained. In order to obtain a protein hydrolysate with a high protein content, it is essential to select the most suitable type of enzyme and the correct parameters for enzymatic hydrolysis.

Keywords: fish by-products, protein hydrolysate, enzyme

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COMPARATIVE EVALUATION OF BIOACTIVE COMPOUNDS IN FRESH AND FREEZE-DRIED HORSERADISH (*ARMORACIA RUSTICANA*) ROOT AND LEAF JUICE

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Horseradish remains an underutilized plant material despite its potential as a source of natural bioactive compounds. Understanding how freeze-drying affects phenolic stability and antioxidant activity in different plant matrices is essential for developing value-added functional ingredients and optimizing processing strategies for sustainable food production.

This study had two objectives. First, to assess the impact of plant matrix and freeze-drying on the preservation of phenolic compounds and antioxidant potential in horseradish (*Armoracia rusticana*) juices. Second, to evaluate the leaves as a potentially underutilized source of natural antioxidants.

Juice was extracted from horseradish roots and leaves prior to freeze-drying. Phenolic compounds and antioxidant activity were studied. Fresh juice was used as a control for comparison.

The obtained results showed that the content of bioactive compounds is matrix dependent. Freeze-drying reduced total phenolic content, most phenolic substances (excluding flavonols) and antioxidant activity in horseradish root juice, while these parameters increased in leaf juices. It should be noted that total flavonols showed the opposite trend.

The results suggest that horseradish leaves have promising potential as a source of natural antioxidants and freeze-drying is an effective processing method.

Keywords: plant matrix, total phenolic content, antioxidant activity, processing induced changes

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ASSESSMENT OF FOOD LOSSES IN THE PRODUCTION PROCESSES OF LATVIAN FOOD COMPANIES

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Food loss poses a significant challenge to sustainable food systems, yet empirical evidence at company level remains scarce. This study aims to identify the volume and characteristics of food losses in Latvian food companies, as well as to assess existing challenges and solutions in food resource management. The research was conducted in two stages: (1) an analysis of sustainability-related information disclosed on the websites of 80 food companies and (2) a survey of 32 companies examining the volume and causes of food loss.

The website analysis revealed that information availability and transparency (18%) and economic responsibility (16%) were the most frequently reported sustainability aspects, whereas only 2% of cases addressed sustainability structure and management. Furthermore, only 26% of companies provided quantified data on sustainability performance, including independent audits or certifications. The survey results indicate that 91% of companies are aware of the problem of food loss, with 81% reporting food losses of up to 5%. Food losses most commonly occurred during processing (47%), followed by raw material handling (22%) and packaging (16%). These losses were primarily attributed to human error, equipment malfunction, and quality control rejections.

To mitigate food loss, companies most frequently applied process optimisation, employee training, technological innovation, and waste reuse or recycling. Measures to reduce environmental impact included monitoring water use (44%), recovering energy from waste (16%), and assessing the carbon footprint (12%). Additionally, surplus production was commonly managed through donation to charitable organisations or recycling.

Keywords: sustainability, recycling, carbon footprint

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NUTRITIONAL CHARACTERIZATION OF BREWER'S SPENT GRAINS DEPENDING ON BREWERY SCALE AND BEER TECHNOLOGY

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Brewer's spent grains (BSG) represent the predominant by-product of beer production, accounting for approximately 85% of total brewing waste, with over 15 million kilograms generated annually in Latvia. Despite their substantial nutritional potential, BSG utilization remains predominantly confined to low-value applications. This study systematically characterizes the compositional variability of BSG across eleven samples from Latvian breweries of diverse production scales and beer types. BSG samples from small, medium, and large-scale breweries producing light and dark beers were collected. Comprehensive analyses included macronutrient profiling, complete amino acid characterization, phenolic compound determination, and antioxidant activity. Results revealed considerable compositional heterogeneity directly influenced by brewery parameters. Moisture content ranged from 71.9% to 83.9%, while crude protein varied substantially (17.8–30.83% dry weight), with large-scale dark beer operations yielding the highest levels. Lipid content ranged from 0.68% to 5.44%, and dietary fiber consistently exceeded 59.61% dry weight, reaching 71.64% in small-scale operations. All samples contained a complete essential amino acid profile, with glutamic acid (0.43–0.95 g/100 g protein) exhibiting the highest concentrations and greatest variability. Dark beer BSG demonstrated up to 1.6 times higher total phenolic content (1.055 mg GAE/g DW) compared to light beer samples (0.232–0.750 mg GAE/g DW). This elevated phenolic content, combined with the complete amino acid profile, positions dark beer BSG as a potentially promising candidate for protein extraction and functional ingredient development. These findings underscore the impact of brewery scale and beer production technology on BSG nutritional values.

Keywords: brewer's spent grains, compositional analysis, antioxidant activity, phenolic compounds, amino acid profile, circular bioeconomy

Acknowledgments: This study was conducted within the framework of the GreenAgroRes project (VPP-ZM-VRIIILA-2024/1-0002), with support from participating breweries.

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SUBMERGED FERMENTATION AS A BIOLOGICAL PRETREATMENT FOR PROTEIN RECOVERY FROM BREWERY SPENT GRAIN

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The increasing focus on sustainable food production continues to emphasise the valorisation of agri-food by-products such as brewery spent grain (BSG), a lignocellulosic residue rich in proteins and dietary fibre. As a continuation of previous research on enzyme-assisted protein extraction, the present study investigates microbial fermentation as a biological pretreatment strategy to further improve protein recovery from Brewery spent grain. The present study aims to evaluate changes in protein solubility, degree of matrix degradation, and the functional properties of the obtained protein fractions, including water and oil-holding capacity, foaming ability, and protein molecular weight, using submerged fermentation in comparison to enzymatic hydrolysis. Dark lager BSG (protein content 30.83 ± 0.25 g 100 g^{-1} DW) was used as raw material. Submerged fermentation was performed for 96 h using selected lactic acid bacteria strains *Lacticaseibacillus paracasei* and *Lactiplantibacillus plantarum*. Both strains are active within a temperature range of 15–37 °C and were inoculated at 0.01 g per 100 g substrate (approximately 10^7 CFU g^{-1}) using MRS medium. Fermentation was applied to promote structural modification of the lignocellulosic matrix through microbial enzymatic activity and organic acid production, thereby improving protein solubilisation. Additionally, fermentation using *Rhizopus oligosporus* was used in order to find a cost-effective fermentation way for potential large-scale application. After 4 days of fermentation, the biomass was centrifuged, and the supernatant was collected for further analysis and protein concentrate recovery. The approach supports circular bioeconomy principles because this technology will help to reuse discarded raw material into value-added protein ingredients suitable for food applications.

Keywords: protein recovery, side stream product processing, fermentation, circular valorisation, plant protein concentrate

Acknowledgments. This research has been partly conducted within the project VP46 Research-based solutions for sustainable agri-food system addressed to the European Green Deal objectives (GreenAgroRes), No. VPP-ZM-VRIIILA-2024/1-0002.

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P11

BUCKWHEAT HUSK AS AN ADDITION TO YOGHURTS – ANALYSIS OF MINERAL CONTENT AND SENSORY CHARACTERISTICS

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The aim of the study was to evaluate sensory properties and mineral content of yoghurts enriched with buckwheat husk, which is an innovative and fully gluten-free component. Husk is a by-product of buckwheat groats production and is rich in dietary fibre, vitamins and minerals. The research material consisted of yoghurts with varying contents (1%, 2.5%, 4%) of ground buckwheat husk purchased from an online store. The analysed yoghurts were compared to the standard quality, yoghurt without added husks. The content of minerals in tested yoghurts was determined using atomic absorption spectrometry technique. Sensory analysis was conducted using a bipolar linear scales. Analysis of the mineral content in yoghurts with buckwheat husk showed a significant ($P<0.05$) increase in the content of magnesium, copper and manganese compared to the standard. However, in all tested variants a significant ($P<0.05$) decrease in calcium content was also observed, as well as zinc decrease in yoghurts with the highest husk content (4%), which may be due to the presence of insoluble fibre in the husk which reduced their availability. Sensory evaluation of yoghurts showed that as the amount of buckwheat husk increased, the colour of the yoghurts and the smell of the husk became more intense, and the consistency became thicker. In contrast, the smell of natural yoghurt was less noticeable compared to the standard. Furthermore, it was found that yoghurts with a low buckwheat husk content (1%, 2.5%) were the most preferred among respondents, mainly due to husk lower perceptibility in the product as well as a relatively small change in the taste and aroma of these yoghurts compared to the standard. The conducted research highlights the potential of husk as an attractive additive to yoghurt, capable of modifying mineral content - an aspect that warrants careful monitoring and also imparting new, appealing sensory characteristics.

Keywords: milk products, buckwheat husk, minerals, sensory properties

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ENZYMATIC AND ULTRASOUND-ASSISTED EXTRACTION OF CHLOROPHYLL FROM FOOD PRODUCTION BY-PRODUCTS

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Food processing yields a large amount of plant-based by-products, such as vegetable leaves and peels. Although they`re often classified as waste, they contain valuable bioactive compounds, such as chlorophyll and other pigments. Plant pigments are important group of biologically active compounds with a wide range of applications in food industry. Chlorophyll and its derivatives are used as natural food colourants. Chlorophyll extraction methods are often based on the use of harmful organic solvents and processing, which can be energy-intensive and environmentally detrimental. Therefore, there is increasing interest in developing more sustainable extraction approaches. The aim of the study was to extract chlorophyll from food products and production by-products using enzymatic and ultrasound-assisted extraction.

In the study, chlorophyll was extracted using fresh and blanched spinach leaves, zucchini, and cucumber peels. The efficiency of chlorophyll extraction was evaluated using experimental matrices to determine the effects of enzymatic and ultrasonic-assisted extraction parameters. Enzyme-assisted extraction of chlorophyll was carried out using an enzyme complex, which consisted of cellulase, xylanase and pectinase. The experimental data showed that an ultrasound-assisted extraction gave better chlorophyll yield than enzyme-assisted extraction. The highest content of chlorophyll was determined in blanched spinach leaves (83.41±0.04 mg mL^{-1}), which were treated with ultrasonic amplitude of 30% for 5 minutes at 40±2 °C temperature. However, it was determined that enzyme-assisted extraction was more suitable for blanched zucchini peels. The chlorophyll content in the peels was 31.61±0.01 mg mL^{-1}. The optimum conditions for an enzyme-assisted extraction were 30 U g^{-1} of enzyme complex, 25±2 °C temperature and 5 hours, adding 100 ppm Zn^{2+}. The results showed that both methods can be used as an effective approach for extracting chlorophyll from plant-based by-products.

Keywords: chlorophyll, ultrasound-assisted extraction, enzyme-assisted extraction, by-products

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SESSION III
NUTRITION AND FOOD QUALITY: FROM COMPOSITION TO PUBLIC HEALTH PERSPECTIVES

O9

CONTRIBUTION OF FERMENTATION TO FOOD QUALITY – MULTIFACETED APPROACH

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Fermentation-based foods constitute an important segment of functional nutrition, owing to the ability of controlled microbial metabolism to alter food composition, bioavailability of nutrients, and product stability. Advances in fermentation science have enabled the targeted selection and application of microbial strains, particularly lactic acid bacteria, to achieve specific technological and functional outcomes in food systems. These microorganisms contribute to acidification, synthesis of bioactive compounds, and inhibition of spoilage microbes, supporting both product quality and shelf life. Nevertheless, the incorporation of live microorganisms into food products necessitates stringent process control to mitigate safety risks associated with uncontrolled microbial growth and metabolic by-products. Current research efforts focus on optimizing fermentation parameters, such as substrate composition, temperature, pH, and microbial interactions, to regulate metabolic fluxes and minimize undesirable biochemical transformations. Furthermore, comprehensive *in vivo* assessments are essential for evaluating microbial functionality beyond the food matrix. Recent studies indicate that although beneficial microorganisms can survive food processing and gastrointestinal transit at high concentrations, excessive dominance of specific microbial taxa may reduce the diversity of the host microbiota, which is undesirable from several perspectives. These observations have driven a paradigm shift toward alternative functional ingredients derived from microbial cells or their metabolites. In this context, parabiotics and postbiotics have gained attention as stable, well-defined bioactive components that offer health benefits without the risks associated with viable microorganisms, enabling more predictable and safer applications in functional food development. Finally, deeper discussion is needed to indicate further directions of the microbe application for food matrices conversion.

Keywords: lactic acid bacteria, endotoxins, exotoxins, generally recognized as safe status, food safety

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O10

COMPOSITIONAL DYNAMICS OF POLAR LIPIDS IN DAIRY PRODUCTS ACROSS PROCESSING

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This study investigated the influence of processing on the concentration of selected polar lipid (PL) classes, including phosphatidylcholine (PC), phosphatidyl-ethanolamine (PE), and sphingomyelin (SM), in various dairy products. Quantitative analysis was performed using a selective and sensitive LC-ESI-MRM-TQ-MS/MS method following chloroform-methanol extraction and external calibration with molecular phospholipid standards. The results demonstrated that total phospholipid content increased proportionally with fat concentration within dairy matrices. The highest PL contents were observed in butter, cream, buttermilk, raw milk, and skimmed milk, corresponding to 135.34 ± 4.57, 110.51 ± 1.53, 48.08 ± 3.71, 20.13 ± 0.09, and 11.40 ± 1.00 mg 100 g^{-1}, respectively. Statistical analysis revealed significant differences between butter and skimmed milk ($p = 0.012$) and between cream and skimmed milk ($p = 0.015$). Among individual phospholipid classes, PE and PC were the dominant classes, particularly in fat-rich products. PE (16:0/18:2) and PE (16:0/18:1) were the most abundant molecular species, while PC (16:0/18:1) and PC (18:1/18:1) increased in cream and butter, indicating preferential enrichment of unsaturated PC species in milk fat globule membrane rich fractions. SM species, SM (d18:1/16:0) and SM (d18:1/18:0), were present at lower concentrations but exhibited a gradual increase from skimmed milk (1.02 ± 0.36 mg 100 g^{-1}) to cream (3.94 ± 2.15 mg 100 g^{-1}). Skimmed milk showed the lowest concentrations of all analysed PL species.

Dairy processing significantly alters polar lipid concentrations in the studied dairy products, and changes in the PC, SM, and PE composition highlight their potential influence on nutritional and functional properties.

Keywords: polar lipids, processing, fat globule membrane

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SELENIUM IN MUESLI: NUTRITIONAL CONTENT, CONSUMER AWARENESS, AND PUBLIC HEALTH IMPLICATIONS IN LATVIA

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Selenium (Se) is an essential trace element involved in antioxidant defense, thyroid function, and immune health; however, dietary intake in Latvia remains insufficient due to low selenium levels in the soil. This study evaluated the selenium content of muesli products available in Latvia and assessed consumer awareness and attitudes toward selenium and related health claims to support the development of consumer-approved high-selenium muesli. Of the 102 muesli products initially identified, 28 met the inclusion criteria and were included in the final analysis, with selenium content estimated based on ingredient lists per 100 g and per 30 g serving. Selenium levels ranged from 5.5 to 11.2 µg/100 g, contributing only 3–7% of the recommended daily intake per serving, and no products contained Brazil nuts (*Bertholletia excelsa*), the richest dietary source of selenium. A strong negative association was observed between selenium content and total sugars (ρ = –0.604, p = 0.000672). A cross-sectional online survey of 1,729 respondents revealed that although 60.1% were aware of selenium-deficient soils in Latvia, many had limited knowledge of selenium-related health claims (n = 246), and most were unaware of their own selenium status (n = 1376). A considerable share of participants (37.3%) was unable to name any foods rich in selenium, highlighting a clear gap in public awareness regarding dietary sources of this essential micronutrient. These findings highlight both the nutritional limitations of current muesli products and opportunities for selenium-fortified formulations and targeted consumer education to improve dietary selenium intake.

Keywords: selenium; muesli; consumer awareness; health claims

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BEYOND THE ALGORITHM: ENGINEERING HUMAN-CENTRIC RESILIENCE IN DIGITAL NUTRITION THROUGH INTERMITTENT FASTING SYSTEMS

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This study aims to investigate the critical requirements for developing a resilient digital nutrition system through the Metaboost project. Utilizing qualitative data from focus groups involving shift workers, patients with metabolic syndromes, and diverse cultural groups, the research explores the intersection of algorithmic authority and user autonomy. Results demonstrate that technological resilience in nutrition depends on three primary factors. First, temporal adaptability is essential for users with non-standard work cycles who face unique metabolic challenges. Second, systems must exhibit cultural intelligence to integrate religious fasting rituals (e.g., Ramadan) without imposing rigid western-centric biological norms. Third, interfaces must mitigate "medicalization anxiety," as constant data monitoring can induce stress in patients with chronic conditions. Furthermore, professional feedback from dietitians highlights the necessity of preventing obsessive behaviors and maintaining a synergistic relationship between technology and healthcare specialists. The research concludes by proposing a Resilience Framework for Digital Nutrition (RFDN) based on academic credibility. This framework positions university-backed validation as the central mechanism for user trust and promoting sustained behavioral adherence within the digital food system.

Keywords: digital nutrition, intermittent fasting, resilience, health, user-centric design

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SUITABILITY OF LOCALLY SOURCED RAW MATERIALS FOR THE DEVELOPMENT OF FOOD RATIONS FOR EMERGENCY SITUATIONS

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Global geopolitical and economic instability, together with the increasing risks posed by climate change, have underscored the critical importance of safe and reliable emergency food supplies. In Europe, food security has become a strategic priority in the context of the war in Ukraine, and residents of Latvia are advised to prepare 72-hour food reserves. Currently, most emergency food kits available on the market contain rations produced abroad, highlighting a significant gap in locally manufactured, sustainable, nutritionally balanced, and compact products. Latvian producers lack experience in the development of long-shelf-life food rations, and farmers have limited strategies for converting the locally grown raw materials into high-value-added products. The aim of this research was to assess the suitability of raw materials of Latvian origin for development of functional food rations. Oats (*Avena sativa*) are rich in microelements (Fe, Mg, Zn), antioxidant compounds and soluble fibre, especially β-glucan, which is associated with improved glycemic control and cardiovascular health compared with wheat. Gluten-free varieties broaden formulation possibilities. Buckwheat (*Fagopyrum esculentum*) is a gluten-free pseudocereal with high-quality protein containing all essential amino acids; it is also rich in rutin and quercetin, which exhibit antioxidant and vascular-protective effects. Nettle (*Urtica dioica*) is a mineral-rich leafy green containing significant levels of vitamins and polyphenols. Rowanberries (*Sorbus aucuparia*) are high in vitamin C, carotenoids and naturally occurring sugar alcohol sorbitol. Honey contains trace amounts of enzymes, organic acids and phenolic compounds that contribute to its antioxidant and antimicrobial properties.

Keywords: food security, emergency food rations, sustainable functional food, bioactive compounds, value-added products

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INVESTIGATION OF COMMERCIAL AND HOME-MADE FERMENTED BEVERAGES IN LATVIA: KOMBUCHA AND WATER KEFIR

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Kombucha and water kefir are naturally carbonated fermented beverages with a sweet-and-sour flavour, produced using a symbiotic consortium of lactic acid bacteria, acetic acid bacteria, and yeasts embedded in a polysaccharide matrix (cellulose in kombucha, dextran in water kefir). Microbial activity of these beverages reflects their functionality and quality, particiularly with regard to their potential probiotic effect. This study aimed to analyse the microbiological composition and quality of commercially available kombucha and water kefir in Latvia, in comparison with home-made beverages.

Counts of lactic acid bacteria (LAB) and yeasts were determined on MRS and MEA media, respectively, in commercial kombucha (n=18), home-made kombucha (n=1) and water kefir (n=1) samples. Isolated colonies were identified using API CHL 50 and API ID 32C systems (bioMérieux, France).

Yeast count ranged from 10^3 to 10^6 CFU mL^{-1} in nine samples. However, LAB were detected in significant amounts (>10^6 CFU mL^{-1}) in only three commercial samples and in home-made kombucha. Neither LAB nor yeasts were detected in eight commercial kombucha samples. Water kefir contained high levels of yeast (2.0×10^7 CFU mL^{-1}) and no detectable LAB (<1 CFU mL^{-1}).

In kombucha samples, *Pediococcus damnosus* and *Lactiplantibacillus plantarum* were found. The yeasts identified in commercial kombucha included *Zygosaccharomyces* spp., *Candida valida*, and *Candida krusei*, whereas water kefir contained *Saccharomyces cerevisiae*, *Zygosaccharomyces* spp., *Saccharomyces kluyverii* and *Kloeckera japonica*.

The results indicate that the presence of LAB is highly dependent on the starter culture used which is consistent with findings reported in the literature.

Keywords: fermented drink, lactic acid bacteria, yeasts, microbiological quality

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NUTRITIONAL ANALYSIS OF FOOD PRODUCTS INTENDED FOR CHILDREN IN LATVIA

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Many products available in the retail network include the label "for children" on the packaging or feature visual elements clearly targeting children, such as colorful illustrations of animals or cartoon characters. However, in Latvia there is no specific regulation governing food products marketed to children over the age of three. The study aimed to analyze differences in the nutritional value of child-targeted food products compared to products for general population.

The study compared 38 child-targeted food products with 38 identical or similar food products not intended for a specific target group across 12 food categories, each including two child-targeted products and two non-specialized products.

Only three food products were eligible for the Nordic Keyhole label, all of which were intended for general population. A Nutri-Score “A” rating was assigned to more products intended for general population (n=9) than to child-targeted products (n=5). Traffic light label analysis revealed that a higher proportion of child-targeted products contained elevated levels of total fat, saturated fat, sugar and salt.

When comparing identical products of the same manufacturer, child-targeted versions of pasta, strawberry yogurt, cheese snacks and butter cookies demonstrated higher nutritional quality (lower sugar, saturated fat and/or salt; higher protein and fiber content). In contrast, child-targeted sausage, chicken nuggets, tomato ketchup, cocoa breakfast cereal, dumplings and frozen potatoes exhibited lower nutritional quality (higher sugar, saturated fat and/or salt; lower protein and fiber content).

The results suggest a need for stronger government regulation, as children represent a particularly vulnerable consumer group exposed to food marketing.

Keywords: child-targeted foods, nutritional quality, food labelling, food regulation

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EVALUATION OF COMMERCIAL INFANT FOODS IN LATVIA USING THE WHO NUTRIENT AND PROMOTION PROFILE MODEL

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Exclusive breastfeeding for the first 6 months is recommended by the World Health Organization (WHO) as optimal for infant growth, immune development, and long-term health outcomes. However, in Latvia, exclusive breastfeeding rates remain low (only 16–17% at 6 months), partly due to the early introduction of complementary foods labelled as suitable for infants from 4 or 5 months. Compared to breast milk, these products are often low in energy but high in natural sugars. The WHO Nutrient and Promotion Profile Model (NPPM) was used to assess the appropriateness of 38 commercial infant foods in Latvia (labelled for use from 4+ and 5+ months, primarily as fruit-containing purées, desserts, smoothies, and porridges). The assessment revealed a substantial non-compliance with NPPM criteria. All evaluated products (100%) failed the minimal age criterion (6 months). Only 58% (n = 22) met the minimum energy requirement of 60 kcal per 100 grams. Almost all products (97%, n = 37) had a high sugar content (≥ 30% of total energy). Around one third of products exceeded sodium thresholds (i.e., 50 mg per 100 kcal). Additionally, all products lacked appropriate breastfeeding protection statements, and the majority included marketing claims potentially suggesting suitability for early complementary feeding.

These findings demonstrate significant gaps between national dietary recommendations and commercially available products marketed for infants, highlighting the need for stronger regulatory alignment, reformulation strategies, and improved breastfeeding protection policies in Latvia.

Keywords: exclusive breastfeeding, infant foods, NPPM, nutritional profiling, Latvia

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WHOLE WHEAT BREAD: MORE SUSTAINABLE, SAFE, AND SMARTER SOLUTION

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Wheat bran is the principal by-product of wheat milling. Although it is a rich source of bioactive compounds, its incorporation into bread remains limited due to its detrimental effects on overall product quality. The aim of this study was to select the most suitable lactic acid bacteria (LAB) cultures for the production of whole wheat (*Triticum aestivum*) bread (WWB). Nine LAB strains (*Lactobacillus paracasei*, *Lb. casei*, *Lb. brevis*, *Lb. plantarum*, *Lb. curvatus*, *Lb. uvarum*, *Pediococcus pentosaceus*, *P. acidilactici*, and *Leuconostoc mesenteroides*) were evaluated for sourdough preparation. The WWB formulation consisted of whole-grain wheat flour, salt (1.5%), and yeast (3.0%). The amount of water was adjusted to obtain dough with appropriate mechanical properties. Control WWB was prepared using non-fermented flour, whereas experimental WWB was produced by replacing 50% of the flour in the formulation with sourdough. The average pH, total titratable acidity (TTA), and LAB count of the sourdoughs were 4.30, 8.19 °N, 8.08 $\log_{10}$ CFU g^{-1}, respectively. Most WWBs prepared with sourdough exhibited higher specific volume, porosity, TTA, and overall sensory acceptability compared with the control. Moreover, sourdough incorporation significantly reduced acrylamide formation, with concentrations 1.75–6.70 times lower than in the control. Finally, the selection of appropriate LAB starters and the incorporation of 50% sourdough into the main WWB formulation resulted in improved bread quality and provided a more sustainable, safe, and value-added approach to bread production through the use of whole grains.

Keywords: wheat bran, acrylamide, sourdough, sustainability

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APPLICATION OF DIFFERENT SOURDOUGHS IN WHOLE RYE BREAD PRODUCTION: EFFECTS ON QUALITY ATTRIBUTES AND ACRYLAMIDE CONTENT

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Bread production in Northern and Eastern Europe has traditionally relied on rye (*Secale cereale* L.) as a major cereal grain. Dough acidification is a critical step in rye breadmaking, as it ensures proper product quality. The aim of this study was to identify the most suitable lactic acid bacteria (LAB) for the production of whole rye bread (WRB). Nine LAB strains (*Lactobacillus paracasei*, *Lb. casei*, *Lb. brevis*, *Lb. uvarum*, *Lb. plantarum*, *Lb. curvatus*, *Pediococcus pentosaceus*, *P. acidilactici*, *Leuconostoc mesenteroides*) were evaluated for rye sourdough preparation. The WRB formulation consisted of whole-grain rye flour, salt (1.5%), and yeast (3.0%), while the water content was adjusted to obtain dough with suitable mechanical properties. Control WRB was prepared using non-fermented flour, whereas experimental breads were produced by replacing 50% of the flour in the formulation with sourdough prepared using the above-mentioned LAB strains. The average pH, total titratable acidity (TTA), and LAB counts of the sourdoughs were 4.41, 8.23°N, and 8.32 $\log_{10}$ CFU g^{-1}, respectively. Most sourdough WRB exhibited increased specific volume, porosity, TTA, and overall sensory acceptability, along with reduced moisture content and significantly lower acrylamide levels (1.55–2.89-fold reduction) compared with the control. Overall, the selection of appropriate LAB for sourdough fermentation improved WRB quality and contributed to acrylamide mitigation in WRB.

Keywords: lactic acid bacteria, fermentation, safety

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SESSION IV
FUNCTIONAL BIOACTIVES AND STRUCTURED FOOD SYSTEMS: DESIGN, DELIVERY, AND STABILITY

THE CHESSBOARD OF FOOD SYSTEM CHANGE: WHO MOVES AND WHAT WORKS

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For decades, there have been concerted efforts to steer global food systems toward more sustainable and equitable models. However, progress has been uneven and often frustratingly slow. Despite growing awareness, numerous initiatives, and substantial financial investments, structural barriers, entrenched interests, cultural expectations, and fragmented approaches have limited the pace and scale of transformation. Yet, the need for change is becoming ever more urgent – both to ensure that existing systems become more resilient in the face of mounting global pressures, and to enable them to shift from contributing to global challenges to becoming part of their solution.

This lecture takes a twofold approach to understanding how meaningful transformation can be accelerated. First, it examines where change is most likely to manifest by focusing on the key actors capable of driving it (science, consumers, enterprises, and policymakers) and the distinct as well as overlapping roles they play in reshaping food systems. Second, it explores the most promising directions that should be pursued to facilitate this change, including emerging innovations, policy pathways, and collaborative models. By bringing these perspectives together and by critically reexamining the available evidence, the lecture offers a more nuanced and sensitised understanding of how pathways for change may differ across geographical contexts, particularly within Europe, thereby providing a clearer roadmap for navigating and advancing systemic transformation.

Keywords: innovations, transitions in food systems, permacrisis, resilience

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O13

OPTIMIZED PRESSURIZED LIQUID EXTRACTION ENHANCES THE RECOVERY OF ANTIOXIDANT-RICH FRACTIONS WITH ENZYME INHIBITORY ACTIVITY FROM *GNAPHALIUM ULIGINOSUM* L.

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Gnaphalium uliginosum L. is a traditional medicinal plant from the *Asteraceae* family containing caffeoylquinic acids and flavonoids. However, its extraction parameters for obtaining bioactive fractions and enzyme inhibitory potential remain understudied. This work aimed to optimize pressurized liquid extraction (PLE) using hydroethanolic mixtures (PLE-EtOH/H_2O) to maximize extraction yield and recovery of antioxidant-rich fractions, as well as to evaluate their enzyme inhibitory potential. A central composite design combined with response surface methodology was applied to assess the effects of three independent variables (T: 40–100 °C, τ: 15–45 min, EtOH/H_2O ratio: 20–80% v/v) on five response factors. PLE at various conditions increased extract yield from 20.3 to 31.3 g/100 g plant material (PM), surpassing ethanolic Soxhlet extraction, and resulted in higher phenolic content (64.9–104.6 mg GAE g^{-1} extract (E)) and antioxidant activity (473.0–664.0 mg TE g^{-1} E) in a significantly shorter time. The obtained extract under the optimal PLE conditions (80 °C, 15 min, 50:50 EtOH/H_2O v/v) demonstrated a strong superoxide scavenging ability in the PCL assay (351.8 mg TE g^{-1} E) and *in vitro* photoprotective effects, with SPF increasing from 8 to ~50 across the 0.1–1.0 mg mL^{-1} concentration range. Additionally, the extract had potent antiglycation activity (IC_{50} = 0.5 mg mL^{-1}) and inhibitory effects against α-amylase (IC_{50} = 0.99 mg mL^{-1}), α-glucosidase (IC_{50} = 3.61 mg mL^{-1}), pancreatic lipase (IC_{50} = 1.63 mg mL^{-1}) and acetylcholinesterase (AChE); IC_{50} = 0.84 mg mL^{-1}), together with moderate angiotensin-converting enzyme (ACE) inhibition (IC_{50} = 24.35 mg mL^{-1}), indicating extract's potential relevance to anti-inflammatory and healthy-aging mechanisms. Various phenolic acids and flavonoids identified by HPLC–MS/MS contribute to antioxidant and anti-inflammatory functionality relevant to food product development. Overall, this study provides an alternative approach to obtaining higher added-value fractions from the *G. uliginosum* plant suitable for nutraceutical and pharmaceutical applications.

Keywords: *Gnaphalium uliginosum*, pressurized liquid extraction, optimization

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O14

MAILLARD REACTION–DERIVED CONJUGATES OF POLYSACCHARIDES AND PLANT PROTEIN AS PROTEIN-ENRICHED PREBIOTICS

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Dietary proteins are usually absorbed in the small intestine, with limited portion reaching large intestine; therefore, gut microorganisms compete for nitrogen. Maillard-type glycoconjugation between proteins and polysaccharide can increase resistance to gastrointestinal proteolysis, supplying more nitrogen to colon and potentially exerting a prebiotic effect. We therefore produced Maillard conjugates from zein and inulin (Z-In) or citrus pectin (Z-CP) and evaluated their physicochemical and prebiotic properties.

Conjugates were produced by wet heating at 80 °C for 24 h under alkaline pH, then ultrafiltered and freeze-dried. Conjugation was confirmed by FT-IR, X-ray diffraction (XRD), and glycation degree (DG) analysis. Protein solubility was measured by the Biuret method, and prebiotic index (PI) was evaluated by cultivating *Lacticaseibacillus paracasei* and *Limosilactobacillus fermentum* in modified broths. Glycoconjugation was confirmed by FT-IR and XRD, with detection of notable changes in intensity and position of the main zein absorption bands. DG showed that reaction pH and polymer ratio influenced glycation efficiency; Z-CP conjugation at higher pH promoted greater DG (32–44%). Although native zein has limited water solublity, conjugation improved solubility, particularly in Z-CP, where higher pH and DG yielded the most hydrophilic conjugates. PI analysis indicated that all conjugates had positive prebiotic activity, supporting the growth of both strains; Z-In conjugates gave the highest PI of 1.23–1.49 for *L. paracasei* and 1.59 for *L. fermentum*, outperforming inulin (0.107-0.111).

These preliminary results suggest that such conjugation can increase plant proteins' hydrophilicity and create a new prebiotic, but further research is needed on protein digestibility and gut microbiota effects.

Keywords: Maillard conjugates, plant protein, solubility, prebiotic

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O15

IMPACT OF HIGH-PRESSURE HOMOGENIZATION ON THE LONG-TERM STABILITY AND AGING BEHAVIOR OF AGAR-COLLAGEN FLUID GELS

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Fluid gels are suspensions of gel particles whose rheology, structure, and lubrication can be tailored, making them highly promising for food industry applications. More research is focusing on how to change their morphology during production. However, the potential of post-processing treatments to modify fluid gels' properties and improve stability remains largely unexplored.
To address this gap, this study assessed the long-term stability (four weeks) and aging behavior of agar-collagen fluid gels that were additionally homogenized after processing using high-pressure homogenization (HPH) at 20, 40, and 60 MPa.
All formulations demonstrated high stability, with no significant changes in particle size distribution observed after storage. Span index values ranged from 1.996 (60 MPa) to 2.981 (control), indicating no aggregation of agar hairy structure domains. These results aligned with viscosity measurements, showing no changes in consistency classification, as all samples remained within the nectar-like range. Control, 20 MPa, and 40 MPa samples were classified as mildly thick, while the 60 MPa sample was moderately thick according to International Dysphagia Diet Standartisation Initiative tets. A slight increase in apparent viscosity at 50 s^{-1} was noted, most evident in the control and minimal in the 60 MPa sample. Additionally, the aging behavior of the systems was evaluated, revealing differences in structural reorganization and rheological modifications.
Overall, the systems maintained high shear recovery, low yield stress (<2.5 Pa), and stable viscoelastic properties (G’ and G”), confirming excellent structural integrity over time and demonstrating that HPH is a valuable tool for reducing particle size without adversely affecting fluid-gel stability.

Keywords: fluid gels, dysphagia food, high-pressure homogenization

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HYDROGEL OR EMULGEL? THE INFLUENCE OF THE NATURAL LIPID FRACTION OF HEMP PROTEIN ISOLATE ON THE PROPERTIES OF COMPOSITE GELATIN GELS

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Plant protein isolates are increasingly used as modifiers of protein gel structure, but their complex chemical composition, which includes not only the protein fraction but also naturally occurring lipids, challenges the classic interpretation of such materials as hydrogels only. The aim of this study was to assess whether gelatin-hemp protein isolate systems can be treated as hydrogels or rather as emulsified or hybrid multiphase systems.

Composite gels were prepared with a constant gelatin content (5% w/w) and increasing amounts of hemp protein (HPI) (0–20% w/w), containing approx. 10% of raw material. The structural and functional properties were analyzed using oscillatory rheology, texture profile analysis, water-holding capacity measurements, antioxidant activity assays, and FTIR spectroscopy.

With an increase in the proportion of HPI, a gradual transition was observed from a classic, thermoreversible gelatin hydrogel to systems with increased stiffness and mechanical resistance, maintaining structural continuity above the melting point of gelatin. FTIR analysis indicated a reorganization of the hydrogen bond network and an increasing proportion of hydrophobic interactions associated with the presence of lipids. At the same time, the antioxidant activity of the tested materials increased significantly.

The results suggest that gelatin-HPI gels cannot be classified solely as hydrogels but instead form emulgel or quasi-bigel systems, where characteristics of a protein network coexist with structures that stabilize the lipid phase.

Keywords: gelatin, hemp protein isolate, emulgels, hydrogels, rheology

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STRUCTURE UNDER CONTROL: THE EFFECT OF COMPOSITION AND HOMOGENIZATION ON THE PROPERTIES OF OLEOGELS

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The aim of the study was to evaluate the influence of composition (agarose and oil content) and homogenization conditions on the rheological and textural properties of oleogels with different formulations. The analysis was performed using response surface methodology (RSM), including dynamic measurements (G', G'', tan δ, intersection point G'=G'') and TPA analysis (hardness, cohesiviness, elasticity, gumminess, resilience).

The results indicate that the key factors determining the structure of oleogels were the oil and agarose content. An increase in the agarose content significantly increased the storage modulus G' and textural parameters related to mechanical resistance, especially hardness and gumminess. In turn, an increase in oil content led to a decrease in the stiffness of the system (decrease in G') and a marked reduction in the hardness and elasticity of the structure. The tan δ analysis showed that variation in composition modulated the balance between elastic and viscous characteristics, although the elastic component remained dominant in most systems. TPA measurements confirmed a close correlation between rheological behavior and gel mechanical integrity.

The models obtained were characterized by a high fit (R^2 up to 0.92), which confirms their usefulness in the design of oleogel structures. The study showed that by controlling the proportions of ingredients and process parameters, it is possible to precisely shape the mechanical and rheological properties, which is important in the development of functional substitutes for solid fats.

Keywords: oleogels, response surface methodology (RSM), rheological properties, texture profile analysis (TPA), fat substitutes

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P20

APPLICATION OF DOUBLE EMULSION GEL FOR ENCAPSULATION OF PROBIOTICS AND CANNABIDIOL IN FUNCTIONAL FOOD AND THEIR IMPACT ON GUT MICROBIOTA

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This research investigates the use of a double emulsion gel system for the delivery and release of encapsulated cannabidiol (CBD) and the probiotic strain *Lactiplantibacillus plantarum* DSM 24624. We utilised a dynamic Simulator of the Human Intestinal Microbial Ecosystem (SHIME®) to mimic human gastrointestinal environments, enabling comprehensive analysis of the interactions between probiotic bacteria *L. plantarum*, CBD, and the diverse microbial populations inhabiting the gastrointestinal tract. The analysis concentrated on the delivery of CBD and probiotics and examined the impact of the system on microbiota, diversity, and metabolic activity during digestion. This was accomplished using 16S rRNA gene sequencing and digital PCR techniques. Analysis of microbiota demonstrated notable alterations in both mucosal and luminal microbiota after SHIME® supplementation with double emulsion gel containing probiotics and CBD. Diversity assessments indicated a temporary increase in alpha diversity within the mucin layer and a reduction in the lumen, along with significant modifications in beta diversity observed throughout the experimental stages. The findings indicate that double emulsion gels may serve as effective vehicles for delivering probiotics and CBD to the gastrointestinal tract. Furthermore, novel formulations combining CBD and probiotics have the potential to favourably influence gut microbiota composition and metabolic function.

Keywords: double emulsion gel, probiotics, cannabidiol, delivery, microbiota

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PROTECTING HONEYBEE HEALTH WITH NECTAR PLANT EXTRACTS: CROSS-BORDER SOLUTIONS FOR *VARROA* MITE CONTROL AND BIODIVERSITY PRESERVATION

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Sustainable beekeeping and pollinator protection require environmentally friendly alternatives to synthetic treatments used against *Varroa destructor*. Within the Cross-Bee project, cross-border research activities in Latvia and Estonia include the evaluation of various nectar plant species, their chemical composition, and bioactive potential. Different plant species are cultivated, analysed, and screened to identify promising candidates for further research and application. Based on these preliminary studies, selected plants are advanced to the next research phase focusing on extract development and testing.

The main focus of the study is the development and optimisation of sustainable extraction approaches for obtaining bioactive compounds from nectar plants. Extraction methods are evaluated with the aim of ensuring high recovery of biologically active substances while maintaining environmental sustainability and scalability for practical use. Parameters such as extraction technique, processing conditions, and pretreatment methods are assessed to improve yield and preserve compound quality. Chemical characterisation of extracts enables the identification of compounds with potential activity against *Varroa destructor*, supporting the development of plant-based alternatives for beekeeping applications.

The results demonstrate that selected nectar plants provide promising sources of bioactive extracts. The most effective extracts will be further tested for efficacy and safety in subsequent research stages, contributing to sustainable *Varroa* management and improved pollinator health.

Keywords: nectar plants, extracts, *Varroa* mites, sustainable beekeeping

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ANTIMICROBIAL AND ANTIOXIDANT POTENTIAL OF HONEYS PRODUCED IN POLISH APIARIES

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Honey, now widely regarded as a popular functional food, has long been used as a traditional remedy to treat various health disorders. The aim of this study was to evaluate the physicochemical characteristics, antioxidant and antimicrobial properties of honey samples, with particular emphasis on differences between apiary-sourced and commercially available products, and to identify samples with the highest pharmacological potential.

A total of 68 honey samples obtained directly from Northern Poland apiaries and 22 store-bought honeys were analyzed. The samples represented different botanical origins, including multifloral, rapeseed, buckwheat, linden, and forest. Bactericidal and bacteriostatic activities were measured against *Staphylococcus aureus* (ATCC 25923; ATCC 29213) and *Escherichia coli* (ATCC 25922). Antioxidant capacity was evaluated via FRAP, DPPH and total phenolic content spectrophotometric assays. Diastase activity was measured as an indicator of freshness and potential heat treatment. Physicochemical characterization included determination of pH, electrical conductivity, and water content.

Buckwheat and forest honeys exhibited significantly higher antioxidant activity compared to multifloral and rapeseed honeys. Several samples demonstrated strong anti-staphylococcal activity, with minimal inhibitory concentration (MIC) values as low as 1.56% (v/v). Notably, certain commercially available honeys showed complete loss of diastase activity, suggesting heat treatment and potential processing-related degradation. In contrast, apiary-sourced samples generally retained higher enzymatic activity and were richer sources of microorganisms.

These findings highlight the considerable antimicrobial and antioxidant potential of Polish honeys and support their further investigation as natural therapeutic agents.

Keywords: honey, apiaries, antibacterial activity, MIC, antioxidants

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P23

BACILLUS VELEZENSIS PY2.3 ISOLATED FROM BEE POLLEN AS BIOCONTROL AGENT AGAINST AMERICAN FOULBROOD

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American foulbrood (AFB), caused by *Paenibacillus larvae*, remains one of the most devastating bacterial diseases affecting honeybee colonies worldwide. The aim of this study was to evaluate the antibacterial activity and potential mechanisms of action of metabolites produced by a *Bacillus velezensis* PY2.3 strain isolated from bee pollen against *P. larvae*.

Initial screening revealed distinct growth-inhibition zones surrounding *B. velezensis* PY2.3 colonies, indicating strong antagonistic activity toward *reference P. larvae* strains. To enhance metabolite production, culture conditions were optimized using five different media, with Tryptic Soy Broth (TSB) yielding the highest levels of active compounds. Bioactive fractions were isolated from TSB cultures through cold 96% ethanol precipitation followed by solvent evaporation. Fraction diluted in 30% ethanol at a concentration of 500 mg mL^{-1}were used for further analyses.

The TSB-derived fraction exhibited clear antibacterial activity in diffusion assays against *P. larvae* strains, confirming the presence of inhibitory metabolites. Tricine SDS-PAGE analysis demonstrated a rich profile of proteinaceous compounds, consistent with previous genomic predictions for *B. velezensis* PY2.3. To investigate potential mechanisms of action, anti-motility assays and membrane permeabilization tests were performed. The metabolites impaired bacterial motility and compromised membrane integrity, suggesting a multifactorial antibacterial mode of action.

Overall, the study demonstrates that metabolites produced by *B. velezensis* PY2.3 exhibit strong inhibitory effects against *P. larvae* and may support the development of natural, bee-derived strategies for the control of American foulbrood.

Keywords: *Bacillus*, antimicrobials, *Paenibacillus larvae,* American foulbrood, bee health

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PREBIOTIC FUNCTIONALITY OF BEE BREAD: MODULATION OF *LACTOPLANTIBACILLUS PLANTARUM*

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Interest in the gut microbiota has intensified due to its essential role in maintaining systemic homeostasis, driving the search for nutritional and therapeutic strategies capable of modulating intestinal microbial balance. Bee bread, a naturally fermented bee product, rich in proteins, amino acids, vitamins, minerals, and polyphenolic compounds, has emerged as a promising candidate for prebiotic applications. The aim of this study was to evaluate the ability of bee bread to stimulate the growth and functional activity of the probiotic strain *Lactoplantibacillus plantarum*.

To address this objective, several assays were performed, including assessment of bacterial survivability in simulated gastric and intestinal juices, evaluation of antimicrobial activity against selected foodborne pathogens, analysis of cell adhesion to hydrocarbons, and determination of enzymatic profile changes following bee bread supplementation. Supplementation with 1% bee bread markedly improved the survival of *L. plantarum* under artificial gastrointestinal conditions and hydrophobicity, as well as enhanced the production of antimicrobial compounds capable of inhibiting *Salmonella enterica*, *Staphylococcus aureus*, and *Escherichia coli*. Furthermore, bee bread induced β-glucosidase activity while suppressing leucine- and valine-arylamidase activities, indicating a metabolic shift toward the utilization of carbohydrate-rich substrates and reduced catabolism of branched-chain amino acids. Overall, the results demonstrate that bee bread exerts a multifaceted modulatory effect on *L. plantarum*, improving its stress tolerance, hydrophobicity, antimicrobial potential, and metabolic adaptability. These findings support the conclusion that bee bread may function as a selective prebiotic factor, enhancing both the functional performance and ecological fitness of probiotic bacteria.

Keywords: nutrition, prebiotics, probiotics, bee bread, functional food

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SESSION V
FERMENTATION AND FOOD QUALITY

O17

RELATIONSHIP BETWEEN ANTIMICROBIAL ACTIVITY, ORGANIC ACIDS, AND LACTIC ACID BACTERIA COUNTS IN FERMENTED MILK

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Lactic acid bacteria (LAB) used in the production of fermented milk release different bioactive compounds, which possess the ability to inhibit pathogenic microorganisms, contributing to food safety and human health. Antimicrobial activity (AA) may vary depending on the produced organic acids, bioactive peptides and other antimicrobial substances produced during fermentation. The study evaluated the correlation between the concentration of produced organic acids and lactic acid bacteria counts and the AA in fermented milk. AA was assessed against foodborne clinical pathogens – *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Listeria monocytogenes*, and *Salmonella enterica* (Faculty of Veterinary Medicine, LBTU), using disk diffusion method (inhibition zones, mm). The analysis was performed for fermented milk samples prepared with starter cultures TCC-20, YF-L811, and YF-L902 (Chr. Hansen, Denmark), as well as for their cell-free supernatant, after 1 and 7 days of cold storage (n=132). Antioxidant activity (DPPH assay), organic acids – lactic, acetic, formic, succinic, citric, and propionic (by HPLC), and LAB colony forming units (CFU) were determined by pour-plate method. All starters showed a significant increase in AA during the storage, and a more pronounced inhibition in outdoor season. Antioxidant activity varied among cultures (highest in TCC-20 on Day 1), and showed a significant decrease over the storage time. AA was not strongly associated ($r<0.3$) with LAB counts or organic acid concentrations, indicating that antimicrobial activity of the samples was driven by other fermentation-related components rather than individual tested metabolites (organic acids) or bacterial CFU in fermented samples.

Keywords: organic acids, lactic acid bacteria, antioxidant activity, organic products, fermented dairy

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O18

PROTEOLYTIC POTENTIAL OF MESOPHILIC LACTIC ACID BACTERIA IN FERMENTED MILK

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Despite the extensive characterisation of thermophilic lactic acid bacteria (LAB), the proteolytic profile of mesophilic strains remains comparatively underexplored. Therefore, research on the proteolytic activity of starter cultures is particularly relevant, as proteolysis contributes to the increase of potential biological value of the final product. The study aimed to characterize the proteolytic activity of selected mesophilic lactic acid bacteria (LAB) starters in fermented milk by evaluating changes in milk protein fractions during fermentation and storage. Fermented milk samples were prepared from pasteurized milk using five commercial mesophilic starter cultures (MO10, MO11, MEG1, MEG2, and LM) and fermented at 30 ± 1 °C to pH 4.65 ± 0.05. Analyses were performed after 24 h of maturation (day 1) and after 7 days of storage at 4 ± 1 °C. The pH, viable LAB count (using MRS and M17 media), non-protein nitrogen (Kjeldahl method), protein fractions (microfluidic chip electrophoresis) were assessed. All cultures exhibited slow acidification, final pH was reached in 8–11 h, while LAB viability in FM samples remained high (>8.3 log10 CFU·mL^{-1}) even after 7 days of storage. Fermentation caused a marked reduction in protein fractions, particularly κ-casein (52–85% decrease), and the degree of proteolysis depended significantly on the starter culture; the most pronounced proteolytic effect was observed in the homofermentative cultures MO10 and MO11, whereas the weakest effect was observed in the heterofermentative culture LM. Overall, selecting mesophilic starter cultures enables targeted modulation of proteolysis intensity and the potential nutritional value of fermented milk.

Keywords: protein fractions, mesophilic starter cultures, non-protein nitrogen

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O19

LACTO-FERMENTATION OF BOVINE COLOSTRUM: CHANGES IN AMINO ACID, BIOGENIC AMINE, AND FATTY ACID PROFILES

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Bovine colostrum (BC) contains a wide range of functional ingredients; however, optimizing its industrial application requires more detailed knowledge of the compositional changes during processing. This study aimed to evaluate the influence of lactic acid fermentation with *Lactiplantibacillus plantarum* (No. 135) and *Lacticaseibacillus paracasei* (No. 244) strains on the amino acid (AA), biogenic amine (BA), and fatty acid (FA) profiles of BC collected from different dairy farms. BC samples were fermented for 24 h at 30 °C; AA and BA profiles were determined by HPLC-UV/MS, while FA composition was analyzed using GC-MS. Results showed that fermentation significantly reduced BC pH by an average of 30.2–30.6% ($p < 0.001$), with LAB counts averaging 8.21 $\log_{10}$ CFU mL^{-1}. The dairy farm and LAB strain significantly influenced most AAs, such as lysine, methionine, and phenylalanine. Additionally, positive moderate correlations were found between BC pH and alanine ($r = 0.409$) as well as glycine ($r = 0.422$) content. Opposite effects were found for BA formation: fermentation either increased total BA content (up to 85.7%) or decreased it (up to 49.5%), depending on the BC source. Lipid analysis showed significant differences in Omega-3, 6, and 9 contents. Omega-9 was predominant, ranging from 27.2% to 28.1% of total fat. In conclusion, the dairy farm and LAB strain were the main factors influencing the detected AA, BA, and FA profiles. Thus, animal rearing and primary production stages should be considered in colostrum processing technologies to ensure high-quality applications in the food and nutraceutical industries.

Keywords: colostrum, lactic acid bacteria, proteomic profiles, lipidomic profiles, bioactive metabolites

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O20

EARLY FERMENTATION KINETICS OF BUCKWHEAT SUBSTRATES USING SINGLE AND MULTIPLE STRAIN CULTURES: GROWTH DYNAMICS AND ACIDIFICATION

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Buckwheat is a promising substrate for lactic acid fermentation; however, the fermentation performance strongly depends on both the starter and substrate composition. This study compared the fermentation of buckwheat substrates containing 8% and 10% solids using single-strain cultures (*Lactiplantibacillus plantarum* subsp. *plantarum* (LBP), *Lactobacillus acidophilus* (LA), *Lacticaseibacillus paracasei* subsp. *paracasei* (LCP), and *Lacticaseibacillus rhamnosus* (LCR), as well as strain combinations, to evaluate growth dynamics, pH development, and sugar utilisation. Fermentations were conducted at 37 °C with sampling at 2, 4, 8, and 10 h. LAB growth was determined by plate counting and pH by potentiometric measurements.

In all fermentations, LAB growth was accompanied by a decrease in pH and changes in sugar profiles. A significant decrease in pH was observed during the first 4 h of fermentation ($p < 0.05$). Single-strain cultures significantly acidified the substrate, reducing the pH from 7.44 to 4.35 (LBP) and to 4.55 (LA and LCP), while the slowest pH decrease was observed for LCR (pH 5.00) at both solid concentrations. Simultaneously, LAB counts increased from 5.06 $\log_{10}$ CFU mL^{-1} to 8.59 and 8.84 $\log_{10}$ CFU mL^{-1}, respectively, with the lowest value observed for LA (8.54 $\log_{10}$ CFU mL^{-1}). The LBP + LCP combination showed rapid growth and comparable acidification, reaching pH 4.30 and 9.06 $\log_{10}$ CFU mL^{-1} within the same time frame. In contrast, the LA + LCR combination showed weaker acidification (pH 5.38) and lower LAB growth (7.40 $\log_{10}$ CFU mL^{-1}). Overall, selected multi-strain cultures enhanced early fermentation kinetics, indicating that starter culture composition significantly influences fermentation performance.

Keywords: buckwheat, fermentation, Lactic acid bacteria, multistrain cultures, fermentation kinetics

Acknowledgments. This study was supported by the LBTU internal research project LPTF (Topic DG3): "Comparative Analysis of Plant-Based Raw Material Fermentation in Functional Products."

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O21

ALCALASE HYDROLYSIS TO ENHANCE TECHNO-FUNCTIONAL PROPERTIES OF DRY-FRACTIONATED PEA PROTEIN

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Shifting toward plant-based diets represents a key approach on environmental footprint mitigation. Recently, dry-fractionation has gained attention as a sustainable method to obtain plant-based proteins. However, these ingredients often exhibit poor functionality in terms of solubility, and unpleasant sensory properties, which limit their application in plant-based product development. Enzymatic hydrolysis represents a promising strategy to address and overcome these challenges. This study investigated the impact of Alcalase hydrolysis on key techno-functional properties of dry-fractionated yellow pea protein. A protein suspension was hydrolysed at 60 °C and samples were collected at different times. Degree of hydrolysis (DH), water and oil absorption capacity (WAC & OAC), water absorption and solubility index (WAI & WSI), foaming capacity and stability after 20 min (FC & FS20), and hexanal concentration were measured. High DH was achieved, even after 15 min of treatment, with progressive increase over time. Hydrolysis reduced WAC and WAI while significantly increasing the solubility. Conversely, OAC slightly declined. An initial improvement and subsequent decline were observed for FC, while FS decreased sharply, particularly FS20. Hexanal, responsible for characteristic legume off-notes, markedly decreased after treatment. In conclusion, Alcalase hydrolysis modified the functionality of dry-fractionated pea protein. The changes in techno-functional properties likely reflect the formation of smaller, more soluble peptides with reduced hydrophobic surface area. This technology is promising for food applications requiring high solubility, such as protein-based beverages, and sauces.

Keywords: plant-based proteins, enzymatic hydrolysis, Alcalase, techno-functional

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REDUCING ANTI-NUTRITIONAL COMPOUNDS OF BUCKWHEAT BY MALTING AND USING BUCKWHEAT MALT FLOUR IN GLUTEN-FREE BREAD

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The aim of this research was to investigate the reduction of anti-nutritional compounds – phytic acid (PA), condensed tannins (CT), total saponins (TS), trypsin inhibitor activity (TIA), and chymotrypsin inhibitor activity (CIA) – in buckwheat through malting. Native buckwheat cultivar was malted at two different conditions. Under the first malting condition (M1), the contents of CT and TS were reduced to the highest extent, under the second malting condition (M2), the highest reductions were observed in PA, TIA, and CIA contents.

Buckwheat malt flours produced under M1 and M2 conditions were incorporated into gluten-free bread formulations at the levels of 10% (M110, M210), 25% (M125, M225) and 50% (M150, M250). The lowest moisture and cooking loss was found in M150 bread, however, this sample also showed the lowest volume and specific volume. In contrast, the highest volume and specific volume were determined for M210 bread, which also exhibited the highest cooking loss.

Hardness generally increased and springiness decreased by increasing of buckwheat malt flour incorporations. The total flavonoid and protein contents of gluten-free breads increased with increasing levels of buckwheat malt flour, whereas starch digestibility decreased considerably. The reduction in starch digestibility was most pronounced in M150 bread.

Protein molecular weight profiles of buckwheat malt flours determined by sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE) were similar to those of wholegrain buckwheat flour. Buckwheat malt flour appears to be a promising additive for gluten-free bread formulations, as it can enhance antioxidant activity due to increased flavonoid contents and potentially lower glycemic index of gluten-free breads.

Keywords: buckwheat, malting, anti-nutritional compounds, gluten-free bread, SDS-PAGE

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ANTIMICROBIAL PROPERTIES OF THERMOPHILIC LACTIC ACID BACTERIA IN FERMENTED MILK

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The functional properties of fermented milk are the result of lactic acid bacteria (LAB) metabolism, producing bioactive compounds that can enhance antibacterial properties against food-borne pathogens. The aim of the study was to compare antibacterial activity (AA) of organic (ORG) and conventional (CON) fermented milk (FM), using comercial starter cultures (SC), after maturation and 7 days of storage. ORG and CON pasteurized milk were inoculated with SC: YF-L811, YF-L902, and TCC-20 (Chr. Hansen, Denmark). Colony forming units (CFU) of LAB were determined by pour-plate method on MRS and M17 media, AA was determined using disc diffusion assay, indicator pathogens were activated in Mueller-Hintonbroth, result zone diameter of growth inhibition were presented as inhibition zones (mm). A significantly higher AA was observed on day 7 compared to day 1, suggesting continued production and/or accumulation of bioactive compounds in FM. Among the pathogens, *L. monocytogenes* showed the highest sensitivity, followed by *E. coli* and *S. aureus*, whereas *S. enterica* and *P. aeruginosa* were more resistant. No significant differences were observed between ORG and CON milk, while SC showed moderate variations in AA. YF-L811 showed slightly higher AA, particularly in supernatants, suggesting greater production of water-soluble antibacterial compounds. TCC-20 and YF-L902 demonstrated comparable, but lower AA, mainly against *L. monocytogenes* and *S. aureus*. The findings suggest that concentration of antibacterial compounds in FM increase during storage and inhibit *L. monocytogenes* growth, independent of milk production system.

Keywords: antibacterial activity, organic acids, food-borne pathogens

Acknowledgments. This research was funded by the project “Strengthening the Institutional Capacity of LBTU for Excellence in Studies and Research” (ANM1, AF21), funded by the Recovery and Resilience Facility, project No. 5.2.1.1.i.0/2/24/I/CFLA/002.

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P27

CURD FORMATION IN HYBRID MILK-PLANT PROTEIN SYSTEMS: EFFECT OF PROTEIN SUBSTITUTION AND CALCIUM CHLORIDE ADDITION ON RENNET-INDUCED GELATION

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Dairy-plant protein systems are increasingly explored to develop sustainable hybrid products that combine the desirable taste and texture of dairy with the sustainability benefits of plant proteins. Casein plays a key role in creating the characteristic structure and mouthfeel of dairy products such as cheese and yogurt. By partially replacing dairy proteins with plant proteins, hybrid products aim to maintain these sensory qualities while reducing reliance on animal-derived ingredients. Such products also align with the growing flexitarian consumer trend, for individuals who seek to reduce animal product consumption without sacrificing familiar taste and texture. The current study investigates the effects of plant protein addition and calcium chloride concentration on rennet-induced gel formation in milk-plant protein matrices. Various plant proteins and their combinations are incorporated into skim milk at substitution levels of 20% and 40% (w/w). Calcium chloride is added at concentrations between 0.61 and 6 mM to evaluate its influence on coagulation behavior. Gelation is initiated using rennet and monitored through oscillatory rheology to determine gel onset time and the development of the elastic modulus (G') throughout the time. The results indicate that the type and proportion of plant protein had a greater impact on gelation behavior than the calcium chloride concentration. Increasing plant protein substitution generally altered gel onset time and reduced the elastic modulus of the resulting hybrid gels. Although calcium addition supported gel formation, its effect on the gel strength within the tested range was less pronounced. Overall, the study highlights the importance of thorough selection of plant protein when optimizing coagulation conditions and designing hybrid dairy products.

Keywords: hybrid curd, plant proteins, rennet gelation, calcium chloride, rheology

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P28

THE EFFECT OF BARLEY MALT ADDITION ON THE PHYSICOCHEMICAL AND NUTRITIONAL PROPERTIES OF SET YOGURT MADE FROM SKIMMED MILK

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Yogurt is one of the most widely consumed fermented dairy products worldwide and is traditionally regarded as a food of high nutritional value, particularly as a rich source of viable bacteria with health-promoting properties. Currently, a wide range of yogurt products are being developed through the incorporation of functional ingredients such as dietary fiber, vitamins, unsaturated fatty acids, and phytosterols. The primary objective of this study was to enhance the in vivo antioxidant potential of yogurt by increasing its phenolic content through fortification with brewery barley malts. The effect of different types of barley malt on the physicochemical properties and phenolic acid content of yogurt was investigated. Yogurt was prepared from skim milk powder (13% w/v) supplemented with barley malt at concentrations of 1%, 3%, and 5% (w/v). Fermentation was carried out at 43 ± 1 °C for approximately 3.5 hours. Subsequently, the yogurt samples were stored at 5 ± 0.5 °C for 24 hours prior to texture profile analysis (TPA) and syneresis determination. pH measurements were conducted before and after fermentation. The phenolic acid content was analyzed after 24 hours and again after three weeks of refrigerated storage. During fermentation, the pH decreased from 6.07–6.70 to 4.40–4.84, depending on the type and concentration of malt added. In general, yogurts supplemented with barley malt exhibited lower pH values compared to the control sample. Significant differences were observed among yogurt samples containing different types of barley malt with respect to firmness adhesiveness, cohesiveness, and springiness. The most abundant phenolic acids identified in the analyzed yogurts included caffeic, 2-hydroxycinnamic, chlorogenic, p-coumaric, ferulic, sinapic, and protocatechuic acids. The content of phenolic acids increased with increasing concentrations of added malt, whereas a decrease in polyphenol content was observed during refrigerated storage of the yogurts.

Keywords: texture, phenolic acids, syneresis, rheology

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SESSION VI
INNOVATION FOR FOOD QUALITY, SAFETY, AND SUSTAINABILITY

O22

MICROENCAPSULATED EXTRACTS OF *ARTIST'S BRACKET* AND *RED-BELTED BRACKET*: ANTIOXIDANT AND ANTI-INFLAMMATORY PROPERTIES

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Red-belted Bracket (*Fomitopsis pinicola*) and Artist's Bracket (*Ganoderma applanatum*) carry numerous bioactive secondary metabolites, which may mitigate oxidative stress and inflammation. The study characterises antioxidant and anti-inflammatory properties of the potentially bioaccessible fractions of inulin-based microcapsules containing the ethanolic extracts (standardised on terpenoids) from these mushrooms. A special emphasis is placed on the interactions between active constituents and resulting changes in biactivity. Red-belted Bracket (RBB) microcapsules contained mainly phenolic acids (e.g. vanillic and chebulic acids) and terpenoids (e.g. forpinic and formipinic acids), while in Artist's Bracket (AB), ganoderic and ganoderenic acids dominated. The ABTS radicals were effectively scavenged by RBB capsules; however, the highest activity was observed in capsules containing RBB and AB at a 3:1 ratio (4.6-fold increase, synergistic action). The highest reducing power was found in microcapsules with AB (1.4 mg TE g^{-1}). Interestingly, in the mixed capsule (ratio 1:1 and 1:3), components acted antagonistically. The highest inhibition of lipoxygenase (LOX) and xanthine oxidase (XO) activity was found in the AB microcapsules (216 kU g^{-1} and 26 mU g^{-1}, respectively), while those containing RBB extract were less active. Importantly, a combination of RBB and AB (3:1 and 1:3) demonstrated that LOX inhibitors acted synergistically, while XO inhibitors acted antagonistically. Finally, the antiglycation properties are possessed only by extracts from capsules containing a combination of RBB and AB (in a ratio of 3:1 and 1:3). RBB and AB-based microcapsules are valuable sources of potentially bioaccessible antioxidants and anti-inflammatory compounds; however, their activity is strongly influenced by interactions among the active components and matrix (carrier).

Keywords: antioxidants, inflammation, microencapsulation, mushrooms

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O23

APPLICATION OF MULTI-STEP CONVENTIONAL AND INNOVATIVE EXTRACTION TECHNIQUES FOR THE RECOVERY OF FUNCTIONAL COMPOUNDS FROM BLACKCURRANT POMACE

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Juice processing generates a large amount of blackcurrant pomace that is a potentially valuable source of functional ingredients. The aim of this study was to extract valuable components from blackcurrant pomace using multi-step conventional and innovative extraction methods, and to evaluate the in vitro biological activity of the obtained extracts, including total phenolic content (TPC), antioxidant capacity (DPPH, ABTS assays) and anti-inflammatory activity by measuring the inhibition of pro-inflammatory enzymes such as lipoxygenase (LOX), hyaluronidase, and cyclooxygenase (COX). Additionally, the study aimed to optimize by Response Surface Methodology (RSM) the parameters of pectin extraction in order to achieve the highest yield and degree of esterification (DE). The obtained results demonstrated that the application of multi-step extraction led to the highest yields when ethanol was used as a solvent. Both conventional and innovative extraction methods resulted in yields of 30.5 and 39.8 g 100 g^{-1}, respectively. The obtained extracts exhibited high antioxidant activity, ranging from 101.9 to 511.3 mg TE g^{-1} extract, as determined by the ABTS assay, and from 57.2 to 494.9 mg GAE g^{-1} extract, as determined by the total phenolic content (TPC) method. The evaluation of anti-inflammatory activity also revealed a strong potential of the investigated extracts. Results of optimization revealed that enzyme-assisted extraction method were effective in optimizing extraction yield, where the highest yield was 6.5% under the extraction conditions of a pomace-liquid ratio of 1:20, an extraction time of 3 h and an enzyme activity of 106 U. The results demonstrate that blackcurrant pomace is a promising source for the development of novel, naturally-derived cosmetic products, warranting further investigation.

Keywords: pro-inflammatory enzymes, optimization, pectin, degree of esterification, black currant pomace

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O24

QUALITY ASSESMENT OF WHEATGRASS (*TRITICUM AESTIVUM*) AND OPTIMISATION OF CULTIVATION TECHNOLOGIES FOR FOOD APPLICATIONS

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Wheatgrass (*Triticum aestivum*) has gained significant popularity as a functional food due to its high nutritional value and diverse bioactive compounds, including chlorophyll, vitamins, minerals, and antioxidants. This study aimed to evaluate the quality of wheatgrass grown using different cultivation technologies to optimise its use in food applications.

The research utilised two wheat quality classes (Food-grade EXTRA and feed-grade) and analysed the impact of ozone technology as a pre-treatment method. Wheatgrass was grown for 10 days in a controlled hydroponic environment under LED lighting (16 h light/8 h dark). The study compared two consecutive harvests from the same grains and processed the highest-quality samples into powder via lyophilisation to preserve heat-sensitive compounds.

Results indicated that both cultivation technology and raw material treatment significantly influenced nutritional parameters. Ozone treatment acted as a 'green technology' that improved seed germination and increased the average plant height by 8.7%. An integrated assessment identified the Food-grade EXTRA wheat treated with ozone (first harvest) as the most suitable for commercial food production. The sample exhibited the highest levels of vitamin C, total carotenoids and total flavonoids. The resulting wheatgrass powder demonstrated a high nutritional profile, with protein content ranging from 30.9 to 32.4 g 100 g^{-1} and fibre content ranging from 56.4 to 60.8 g 100 g^{-1}.

The study concludes that the nutritional value of wheatgrass can be effectively enhanced through the deliberate selection of grain quality, appropriate pre-treatment method, like ozonation, and optimised cultivation conditions.

Keywords: ozone technology, hydroponics, lyophilisation, bioactive compounds

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O25

BIOPROCESSING OF BLACK AND WINTER WHEAT FLOUR WITH *LACTICASEIBACILLUS PARACASEI* LUHS244 FOR COOKIE FORMULATION

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This study assessed the impact of fermentation with *Lacticaseibacillus paracasei* LUHS244 on characteristics (lactic acid bacteria (LAB) viable count, acidity, free amino acid (FAA) profile, gamma-aminobutyric acid (GABA), and biogenic amine (BA) content) of the new breed line of black (No. 8472-5) (BWF) and winter wheat "Silva" (WWF) flours. Fermented (48 h) wholemeal flour was added in addition to refined wheat flour in the base wheat cookie formulation at levels of 25–125% (w/w, flour basis) relative to the refined flour. Cookies were evaluated for overall acceptability (OA), acrylamide content, and volatile compound (VOC) profiles. Findings indicated that LAB counts were similar between BWF and SWF after the same duration of fermentation. Only several BAs (putrescine and spermidine) were identified in BWF and SWF at varying concentrations. Content of most FAA mainly increased after 24 h fermentation in BWF and WWF. GABA gradually increased in WWF during 48 h fermentation, while BWF had the highest GABA (2.88 μmol g^{-1}) after 24 h fermentation. Cookies containing BWF and WWF exhibit similar core VOCs, including vanillin, D-limonene. However, differences in the degree of variability and in the abundance of compounds were mainly influenced by fermentation. Significant reduction in acrylamide concentration was observed in most formulations with BWF and several with WWF compared to control samples (without wholemeal) ($p \leq 0.05$). OA decreased progressively with increasing BWF or WWF levels in the formulations, with the lowest scores observed following the inclusion of fermented wholemeal flours at higher levels. To maintain optimal levels of OA and acrylamide, cookie formulations with 25, 50, and 75% of non-fermented BWF, as well as 100 or 125% (flour basis) of non-fermented WWF, can be suggested.

Keywords: fermentation, colored wheat, baked goods, acrylamide

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O26

PEQUI (*CARYOCAR BRASILIENSE CAMB.*) PEEL EXTRACT AS A FUNCTIONAL ADDITIVE IN GREEN STARCH-BASED POLYMERS: A CIRCULAR ECONOMY APPROACH FOR SUSTAINABLE FOOD PACKAGING

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The growing demand for green and sustainable polymers has driven the valorization of agri-food waste as a renewable and low-cost source for the development of biodegradable and functional packaging materials. In this context, both sweet potato peel, an abundant byproduct rich in starch, and waste from a native fruit of the Brazilian Cerrado, pequi (*Caryocar brasiliense Camb.*), represent important opportunities within circular economy strategies. In this study, biodegradable films based on starch extracted from sweet potato peel were developed and incorporated with different concentrations of ethanolic extract from pequi peel, aiming at their potential application as sustainable food packaging. The films were produced by the casting method with progressive incorporation of the plant extract into the polymer matrix. Compared to the control film (without extract), the tensile strength decreased with the addition of the extract, while elongation at break increased 15 times, indicating a pronounced plasticizing effect. Water vapor permeability (WVP) was smaller for all the prepared films in comparison to the control one, indicating that the incorporation of the extract did not compromise the water vapor barrier performance. Oxygen permeability increased with the addition of the extract, and all films showed complete biodegradation in 15 days. These effects are associated with the diverse metabolic composition of the ethanolic extract of pequi peel, rich in phenolic compounds and other secondary metabolites, capable interacting with the starch matrix and modulating the functionality of the film. Overall, this work highlights the potential of combining starch extracted from sweet potato peel and bioactive extracts from Cerrado fruit waste to produce functional bioplastics, reinforcing the principles of circular economy and reducing dependence on fossil-based polymers.

Keywords: agri-food waste valorization, biodegradable films, food packaging

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POTENTIAL OF PEQUI (*CARYOCAR BRASILIENSE CAMB.*) PECTIN AS A SUBSTITUTE FOR COMMERCIAL PECTIN IN PROTEIN-BASED BIODEGRADABLE FILMS

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Plastic materials commonly used for food packaging are known as significant sources of greenhouse gas emissions and contamination of terrestrial and aquatic environments. In this sense, alternatives such as the development of biopolymer films from agro-industrial waste are being studied to mitigate the impacts of petroleum-derived plastic pollution. This study aimed to extract pectin from pequi (*Caryocar brasiliense* Camb.) peels (PEQ) using microwave-assisted methodology and evaluate it as replacement for commercial pectin (CPEC) as a strategy to enhance the sustainability of biopolymeric films. The extracted pectin was used pure and conjugated with isolated sunflower seed protein (SSP) to produce films with enhanced barrier and mechanical properties. The extracted pectin exhibited a degree of esterification comparable to that of CPEC. Substitution in conjugated films did not result in differences in the mechanical and pysico-chemical properties in comparison with the films prepared with commercial pectin. However, pure pectin films presented differences in terms of water barrier properties. Significant differences were also observed in the mechanical properties: the blend with commercial pectin, SSP80-CPEC20, had higher tensile strength, elongation at break and elastic modulus in comparison to pequi-based pectin. All blends and pure pequi pectin films degraded completely within 10 days of soil exposure demonstrating the sustainability of the packaging. It was concluded that it is feasible to extract pectin from pequi mesocarp and use it to produce films, pure and conjugated with sunflower seed protein, representing a sustainable alternative to conventional plastic packaging.

Keywords: biopolymeric film, pectin, pequi, isolated sunflower seed proteins

Acknowledgments. This study was supported by Brazilian Government Agencies CAPES and CNPq.

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EFFECT OF ULTRASOUND AND PASTEURISATION ON STRUCTURE AND VISUAL QUALITY OF BLACK ELDERBERRY JUICE

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Black elderberry (*Sambucus nigra)* juice is rich in polyphenols but frequently forms a turbid, unappealing sediment, which may discourage consumers. This study aimed to evaluate how high-intensity ultrasound combined with lower-temperature pasteurisation affects the particle size distribution, turbidity, centrifugal sedimentation rate, viscosity and colour of black elderberry juice. Ultrasound treatment alone decreased particle mean diameter ($D_{4,3}$) values, indicating deagglomeration of cell clusters and the formation of finer particles, while only slightly reducing centrifugal sedimentation. After ultrasound treatment (UT) and pasteurisation at 60–70 °C, particle size and centrifugal sedimentation rate increased. Turbidity decreased to approximately 40 NTU, yielding clarified juice with large, dense aggregates that settled.

In contrast, prolonged UT combined with pasteurisation at 60–70 °C significantly reduced $D_{4,3}$ and increased turbidity to 425 NTU, indicating a fine, stable colloidal cloud. Colour analysis showed that UT followed by pasteurisation at 60 °C enhanced redness and chromatic hue. In contrast, prolonged UT and 70 °C temperature pasteurisation produced darker, less vivid red tones, consistent with partial pigment degradation. The results reveal two technological pathways within the same juice matrix: a clarification pathway (ultrasound + pasteurisation) and a cloud stabilisation pathway (extended ultrasound + pasteurisation), offering a tool for developing elderberry juices with the desired visual outcome.

Keywords: *Sambucus nigra*, sonication, thermosonication, turbidity, sedimentation, colloidal stability

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THE POTENTIAL OF INULIN ADDITION FOR ENHANCING THE NUTRITIONAL VALUE AND QUALITY OF NON-ALCOHOLIC BEER

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Increasing consumer interest in a healthy lifestyle promotes the development of functional beverages and non-alcoholic alternatives. The sensory properties of non-alcoholic beer often differ from those of conventional beer, as the product may lack body and mouthfeel fullness due to the low ethanol concentration. The addition of dietary fibre, including inulin, may improve sensory characteristics and nutritional value.

The aim of this study is to evaluate the effect of inulin from different sources on the sensory and physicochemical properties, as well as the energy value, of non-alcoholic beer. Three types of inulin were added: Jerusalem artichoke (*Helianthus tuberosus*), chicory (*Cichorium intybus*), agave (*Agave* spp.). Inulin concentrations were selected in accordance with European Union regulations to enable the use of the nutrition claims “high fibre” or “source of fibre.” Physicochemical parameters were determined and visual assessment was performed.

Alcohol content and pH values did not change significantly regardless of inulin type or concentration. Compared to the control sample (relative density 1.0249), all inulin-enriched samples showed a statistically significant ($p < 0.001$) increase in relative density ranging from 0.18% to 0.41%, proportional to inulin concentration. The highest values were observed in Jerusalem artichoke samples, followed by chicory and agave. Sediment formation was most evident in Jerusalem artichoke samples, moderate in chicory samples, and absent in agave samples.

Further analyses will assess aroma compounds, dietary fibre, carbohydrate content along with sensory evaluation and storage stability assessment. The results provide a scientific basis for the development of functional non-alcoholic beer with improved sensory properties.

Keywords: non-alcoholic beer, inulin, functional beverages, dietary fibre, mouthfeel

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CHARACTERIZATION OF SECONDARY LIPID OXIDATION COMPOUNDS IN BEVERAGES FORTIFIED WITH MICROENCAPSULATED FISH AND ALGAE OILS

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Incorporation of PUFAS derived from fish and algae into functional foods has gained increasing attention as a strategy to improve dietary intake. However, due to their structure, these fatty acids are highly susceptible to lipid oxidation, which negatively affects sensory quality and shelf life. Microencapsulation is commonly used to improve oxidative stability by protecting the oils from environmental factors. The aim of this study is to identify and characterize key secondary lipid oxidation compounds in beverages fortified with microencapsulated fish and algae oils. Two different methods were used to assess the oxidation of beverages formulated with microencapsulated algal oil powder and three types of fish oil powders. All samples were subjected to accelerated oxidation test by heating up to 60 ℃ for 48 h. Secondary lipid oxidation compounds were analysed using solid-phase microextraction (SPME) coupled with gas chromatography (GC). Based on the obtained results, thermal treatment promoted oxidation of PUFAs, mainly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), which resulted in the formation of characteristic secondary oxidation products. The comparison of volatile compound profiles between the four samples demonstrated clear differences in oxidative stability. 2,4-heptadienal (E,E) and hexanal, both recognized as secondary oxidation compounds dominted in all samples. Samples containing fish oil without additional stabilizing components showed a more pronounced increase in aldehydes associated with omega-3 oxidation, indicating a higher degree of lipid degradation. These results indicate that the formulation provided improved protection against omega-3 oxidation and maintained better stability under accelerated oxidation conditions compared to the other tested samples

Keywords: omega, microencapsulation, oxidation, beverage

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P33

SOURDOUGH FERMENTATION FOR ORGANIC WHEAT–BARLEY BREAD PRODUCTION

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In the food industry, greater emphasis is placed on developing technologies and raw materials to enable the production of biologically valuable foods. In breadmaking, sourdough fermentation improves product quality by affecting dough rheology and the bread's structural, sensory, and nutritional characteristics. The new organic hull-less barley variety 'Gunika', bred in Latvia and characterised by high nutritional value (β-glucan 6.2 g 100 g^{-1}, protein 12.6 g 100 g^{-1}), is a promising raw material for bread production. This study aimed to evaluate the effect of sourdough fermentation on wheat bread quality by partially substituting organic wheat flour with 10%, 20%, and 30% barley flour, thereby assessing the potential application of barley flour in bread production. During the experiment, a spontaneous sourdough was prepared for the fermentation of wheat–barley doughs. The results showed that replacing wheat flour with barley flour increased dough water absorption from 58.7% to 65%, 70%, and 73%, respectively. Furthermore, the incorporation of narley flour improved dough stability, reduced dough softening, and extended dough development time. Crumb firmness was greater in sourdough-fermented bread (19.8 N) compared with yeast-leavened bread (12 N). However, the incorporation of barley flour reduced the crumb firmness of sourdough bread to 14.2 N. The addition of 10% and 20% barley flour did not significantly affect loaf volume in sourdough bread. Increased water absorption contributed to higher dough yield. Barley flour additions up to 20% had a positive effect on the quality of sourdough bread. Due to its more intense crumb colour, barley flour is suitable for use in various composite flour blends for bread production.

Keywords: rye sourdough, organic hull-less barley, dough fermentation

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ASSESSMENT OF BIOCIDE SUSCEPTIBILITY OF SANITATION-INDICATOR MICROORGANISMS IN BAKERY INDUSTRY BIOFILMS

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Biofilm formation on food industry equipment and surfaces represents a persistent hygiene challenge, promoting microbial contamination and elevating the risk of product spoilage. Although biofilm structure and development are well characterized, the biocide susceptibility of associated microbial communities remains underexplored. Understanding these susceptibility patterns is essential for developing targeted sanitation strategies. This study characterized the microbial composition of bakery biofilms and assessed the susceptibility of microbial isolates to three biocides (EtOH, NaOH+HNO_3, P3-oxysan ZS). Hygiene, product, and raw material samples from an Estonian bakery were analyzed, and isolates were identified using MALDI-TOF MS. Selected isolates (n=42) were used to form biofilms in microtiter plates. Biomass was quantified with the crystal violet assay and metabolic activity with 2,3,5-triphenyltetrazolium chloride. Biocide-induced reductions in biomass and metabolic activity were measured spectrophotometrically. The biofilms were predominantly composed of species from families *Bacillaceae*, *Moraxellaceae*, and *Staphylococcaceae*. The most frequent species were *Bacillus cereus*, *Acinetobacter baumannii* and *Lactiplantibacillus plantarum*. Biocide susceptibility varied among species and strains. EtOH showed the weakest reduction of biofilm biomass, with significantly lower activity than NaOH+HNO_3 ($p=0.0002$) and P3-oxysan ZS ($p=0.029$). The strongest suppression of metabolic activity was achieved by NaOH+HNO_3, which was significantly more effective than P3-oxysan ZS ($p=0.017$) and EtOH ($p=0.005$). P3-oxysan ZS and EtOH did not differ significantly in their effects ($p=0.919$), indicating comparable biocidal performance. Overall, these findings underscore the need to tailor sanitation strategies and develop standardized methods for evaluating biocide susceptibility that account for the specific characteristics and behaviour of biofilms.

Keywords: biofilm resistance, food safety, food quality, microplate reader

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SESSION VII
CONSUMER BEHAVIOUR AND SUSTAINABLE FOOD SYSTEMS: ECONOMIC AND SOCIAL DIMENSIONS

O27

HOW DOES AFFORDABILITY SHAPE BEHAVIORAL INTENTIONS OF CONSUMERS TO PURCHASE LOW WATER FOOTPRINT FOOD PRODUCTS? THE POLISH CONTEXT

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Policy debates and recent studies have renewed interest in water footprint labeling, particularly for food products. However, the continued low uptake of labeled products may be linked to higher prices and consumer affordability perceptions. This study surveyed 999 residents in a major net exporter of virtual water with limited domestic water resources. Using multi-stage sampling, data were analyzed with descriptive statistics, partial least squares structural equation modeling, and Monte Carlo sensitivity analysis to examine how affordability (AF) shapes consumers' intentions to purchase low water footprint food products (LWFP) using an extension of the theory of planned behaviour. The results show that AF has a strong direct positive effect on purchasing intentions (PI), alongside a small but significant negative moderation effect on perceived behavioral control (PBC). AF also indirectly influences PI through attitudes (ATT), subjective norms (SN), and PBC, with ATT emerging as the strongest mediating pathway. Among affordability dimensions, perceived value, reflected in the belief that LWFP are "worth the extra price", exerts the greatest influence, followed by price comparisons and personal income considerations. Pricing strategies and policy incentives should ensure AF, while awareness campaigns emphasize value-for-money and long-term environmental benefits of LWFP to reinforce ATT, SN, and PBC. Findings provide timely insights for the EU's Blue Deal proposed water consumption labeling, suggesting that labels highlighting AF and product value can effectively promote sustainable food choices, reduce virtual water outflows, and enhance regional water security.

Keywords: low water footprint, affordability, TPB, sustainable consumption

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O28

FOOD SUSTAINABILITY LABEL IN HUNGARY: UNDERSTANDING AWARENESS, TRUST, AND CONSUMER INTENTIONS

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Given the rise in concern about greenwashing, understanding the impact of sustainability labels on environmentally conscious consumers' purchase decisions has become increasingly important. In Hungary, the multiple international and local sustainability labels pose both challenges and opportunities for consumer purchases. This study aims to understand consumer profiles more susceptible to greenwashing and which types of greenwashing assertions are more credible, informing future anti-greenwashing measures targeting these consumers. This study examined the knowledge, trust, and purchase intentions of Hungarian consumers regarding sustainability labels. The data comprised 1,013 respondents and was representative of the country's socio-demographic, including gender, age, and location. The study used a detailed analysis of consumer perceptions and behavioral intentions, utilizing crosstabulations and clustering. The results indicate three segments: The "Greenwashing targets" is the largest group at 45.91%, it has an average level of buying intention and trust, and average knowledge, making it easily misled. The "Selective greens" comprise 43.19% of the total; they have greater knowledge and buying intention, and comparatively weak trust in the labels, which is probably due to credibility concerns and information asymmetry. "Green label skeptics" is the smallest group at 10.90%. This group is characterized by strong distrust and, therefore, the credibility of the sustainability claims. The findings indicate that greater regulatory oversight and consumer education campaigns are necessary to address greenwashing and to enhance the use of sustainability labels. Strengthening support for government-sponsored certifications and greater transparency in labeling may be a useful strategy to promote more responsible consumer behavior and combat greenwashing.

Keywords: greenwashing, sustainability, local and international labels, food industry

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MICROBIOLOGICAL SAFETY AND QUALITY OF PLANT-BASED ALTERNATIVE FOODS AT THE RETAIL LEVEL IN ESTONIA

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This study evaluated the microbiological safety and quality of plant-based alternative products available at the retail level in Estonia. As of December 2025, a total of 243 products were analysed. Microbiological examinations were conducted in accordance with ISO standards in the laboratories of the Food Hygiene and Safety Unit at the Estonian University of Life Sciences. Analyses included enumeration of aerobic mesophilic microorganisms, yeasts and molds, *Bacillus* spp. (including *Bacillus cereus*), *Clostridium* spp., *Escherichia coli*, and the detection and enumeration of *Listeria monocytogenes*. Overall, the microbiological quality of the analysed products was satisfactory, as counts of aerobic mesophilic microorganisms, yeasts, and moulds were generally low. *Bacillus* spp. were detected in 20% of samples (15% at 100–1000 CFU g^{-1} and 5% >1000 CFU g^{-1}), while *Clostridium* spp. were detected at low concentrations in approximately 15% of samples. *E. coli* was detected in only a few samples, while all samples were negative for *L. monocytogenes*. Several opportunistic and potentially pathogenic microorganisms were also identified and confirmed by MALDI-TOF MS. This includes both Gram-positive (*Enterococcus faecium*, *Staphylococcus aureus*, *S. hominis*, *S. warneri*, *S. haemolyticus*, *Micrococcus luteus*, *Leuconostoc mesenteroides*, *Bacillus circulans*) and Gram-negative bacteria (*Klebsiella oxytoca*, *Citrobacter freundii*, *Proteus* spp.). Many of these species are associated with healthcare-related infections and antimicrobial resistance. In conclusion, although the overall microbiological quality of plant-based alternative products was acceptable, the presence of opportunistic and potentially antimicrobial-resistant microorganisms highlights the need to establish specific process hygiene and food safety criteria under European food legislation to increase consumer safety and confidence.

Keywords: plant-based alternative products, microbiological safety, microbiological quality, opportunistic pathogens, public health

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NUTRITIONAL AND TECHNOLOGICAL CHALLENGES IN EMERGENCY AND CRISIS FOOD PRODUCTION

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In the current geopolitical and climatic context, the demand for highly nutritious food with an extended shelf life that is easy to prepare and consume is steadily increasing. Existing research indicates that emergency food products are primarily designed to provide sufficient energy intake; however, they present significant limitations in terms of long-term nutritional quality. It is well established that biologically active compounds decrease during storage time. These compounds, including vitamins, antioxidants, and dietary fiber, are essential for maintaining human health, supporting immune function, and enhancing disease resistance, particularly under conditions of physical and psychological stress.

This research aims to perform a meta-analysis of scientific studies to characterize distinctions between emergency and crisis food systems, evaluate environmental and socioeconomic sustainability indicators of their production, and appraise production technologies and process optimization strategies.

Despite the growing importance of emergency and crisis food systems, limited attention has been devoted to optimizing processing technologies that preserve functional nutritional properties while ensuring long shelf life. Therefore, there is a need to systematically examine technological solutions that balance durability with nutritional and functional value.

Based on a comprehensive analysis of existing scientific literature, this study seeks to identify knowledge gaps and propose directions for the development of nutritionally enhanced and sustainable emergency food products suitable for long-term storage and crisis situations.

Keywords: emergency food systems, nutritional quality, shelf life, food processing technologies, sustainability

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VALORISATION OF MEALWORM LARVAE THROUGH JEOTGAL FERMENTATION AND PROBIOTIC PROPERTIES OF INSECT-DERIVED LACTIC ACID BACTERIA

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Edible insects are gaining increasing attention as sustainable food resources in both research and industry. This study applied a Korean traditional fermentation method based on *jeotgal* (salt-fermented seafood), which provides a high-salt, protein-rich environment favorable for the selection of stress-tolerant lactic acid bacteria, to mealworm (*Tenebrio molitor* larvae). The aim was to evaluate the probiotic potential of lactic acid bacteria isolated from fermented mealworm fermented at 10 °C for 14 days.

The isolated strains were identified by 16S rRNA sequencing as *Lactobacillus curvatus* (three strains) and *Lactobacillus sakei*. Probiotic safety and functionality were assessed through gelatinase and urease activity tests, resistance to artificial gastric acid and bile juice, and antioxidant activity using the DPPH scavenging assay. All strains showed negative results for gelatinase and urease activities. The isolates exhibited more than 83% survival after 3 h at pH 3 and tolerated bile concentrations above 0.3% (w/v) for 24 h, consistent with typical probiotic selection criteria. The DPPH scavenging activity reached 43.04%, indicating additional functional benefits beyond gastrointestinal survival.

These results indicate that lactic acid bacteria isolated from mealworm fermented using the jeotgal method possess probiotic characteristics with antioxidant potential, contributing to the sustainable utilization of edible insects as functional food resources.

Keywords: edible insects, mealworm, jeotgal, fermentation, probiotics

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GENERATION Z AND WALNUT CONSUMPTION: INSIGHTS INTO PREFERENCES, FACTORS SHAPING CONSUMPTION PATTERNS, AND PRODUCT PERSPECTIVES

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The walnut market has growth potential due to increasing consumer interest in healthy eating. The study aimed to identify walnut consumption patterns among Generation Z consumers and examine key determinants of their behaviour. The study was based on a questionnaire survey which was conducted in Slovakia with 202 respondents born after 1997, all of whom were walnut consumers. Data were evaluated in the statistical programs IBM SPSS and XLSTAT 2022.4.1 with using factor analysis, Friedman's test, and Chi-square test. Results showed that 37.13% of respondents annually consume less than 300 g of walnuts, 35.64% consume 301–1000 g, and 27.23% consume over 1 kg. Of the socio-demographic variables examined, only education has a statistically significant impact on walnut consumption ($p = 0.009$). Furthermore, key reasons for consumption were taste (41.58%) and nutritional benefits (19.80%). Factors influencing walnut consumption were examined using principal component analysis with Varimax rotation and Kaiser normalization. The Kaiser–Meyer–Olkin (KMO = 0.903) measure confirmed sampling adequacy, and Bartlett's test of sphericity was statistically significant ($p < 0.001$). Four latent factors were identified: product attributes, nutritional aspect, marketing factor, and production factor. For future market development, incorporating walnuts into food products has potential, and these products are attractive for almost 70.00% of young consumers. The most preferred walnut-based products are bars, cookies, snacks, porridges, butters, and fillings. The results provide insights into walnut consumption patterns that can be used in the walnut-based products development, targeted campaigns to promote walnut consumption, and for nutrition policy.

Keywords: walnut, consumer, factors, Generation Z, Slovakia

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NUTRITIONAL VALUE OF DAIRY AND MEAT SUBSTITUTES ON THE LATVIAN MARKET

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Food consumption studies show that plant-based dairy and meat substitutes are gaining popularity among consumers. Consumers choose these products because they are perceived as healthier, often without fully understanding their ingredients or nutritional composition. The diversity of available products on the market continues to grow. Nutritional content is a priority to ensure these products provide essential nutrients and do not raise any dietary concerns.
A total of 97 dairy and meat substitute product samples were collected from retail outlets in Latvia. Sampling covered different product groups, prioritizing products of Latvian origin. For all samples, nutritional information, ingredients, and label claims were recorded.
The aim of the study was to monitor the overall market to support further risk assessment and identify emerging dietary concerns, with particular attention to food additives and salt content.
Samples were divided into five substitute categories: milk (n=22), meat (n = 32), fish (n=5), cheese (n=29), and dairy creams (n=9). Overall, 82.4% of all samples contained at least one added food additive, with up to 13 food additives identified in a single sample. The most common food additives were stabilisers, flavourings, and colours. The average salt content in meat, fish, and cheese substitutes was 1.9 g 100 g^{-1}, ranging from 1.3 to 4.3 g 100 g^{-1}.
The results indicate that vegan substitutes available on the Latvian market often have a higher total amount of ingredients and food additives than comparable animal-based products. Consumers should be encouraged to make informed choices based on product ingredients.

Keywords: plant-based substitutes, food additives, nutritional content

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SENSORY ACCEPTANCE EVALUATION OF PEA PROTEIN ISOLATE BEVERAGE IN PATIENTS WITH MENTAL DISORDERS

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Plant-based protein beverages may be a suitable dietary supplement for patients with psychiatric disorders, who are often characterized by irregular eating habits, insufficient protein intake, and an increased risk of metabolic disorders due to long-term pharmacotherapy. However, this group of patients often has altered sensory perception, which can significantly affect product liking and regular use; sensory properties are of crucial importance in the development of such beverages.

The aim of this study was to evaluate the sensory acceptability of pea protein isolate beverages in patients with psychiatric disorders. The sensory evaluation involved 78 patients who were hospitalized at the National Centre for Mental Health, Riga, Latvia. Five beverages with different flavor compositions, acidity (pH 3.7–5.7), and dry matter content (16–25%) were evaluated using a 5-point hedonic scale, analyzing appearance, aroma, taste, texture, aftertaste, and overall liking.

The results showed statistically significant differences between the beverages in ratings of appearance, aroma, taste, and aftertaste ($p < 0.001$), while no significant differences were found in ratings of texture. Beverages with a milder and sweeter flavor profile (blueberry-vanilla and blackcurrant-apple) received the highest sensory acceptability (4.00 ± 1.07 and 3.69 ± 1.13), while the lemon-flavored beverage (2.87 ± 1.04) was rated the lowest. It was concluded that flavor composition is the main factor determining the sensory acceptability of pea protein isolate beverages for patients with psychiatric disorders, and that less acidic, balanced flavor profiles are more suitable for regular use in dietary supplementation.

Keywords: pea protein isolate, sensory analysis, hedonic scale, patients with psychiatric disorders

Acknowledgments. This research was funded by the "Strengthening the Research Capacity of the Latvia University Life Sciences and Technologies " program project "DG7-Development of a plant-based beverage from pea protein isolate for nutritional supplementation in patients with mental disorders", No. 3.2-10/201 of 13.11.2023.

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INFLUENCE OF FIBER ENRICHMENT ON THE TEXTURAL CHARACTERISTICS OF A MEAT ANALOGUE

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The use of pea starch and extruded pea hulls as fibers in the development of high-moisture extruded meat analogues is one of the options for obtaining a product with appropriate textural properties and increased dietry fiber content. Adding starch promotes the formation of fibers during extrusion and stabilizes the fibrousness and textural properties. Addition of fiber disrupts the homogeneous protein-starch complex, making the product structure less fibrous and shorter fibers. The aim of this study was to investigate the effect of extruded pea hulls on the texture of a meat analogue. The raw materials used in this study included pea protein isolate (PI), pea starch (S), extruded pea hulls (F), and potato starch (PS). A sample prepared using pure PI served as the control. A formulation containing 80% PI and 20% S was used as a base, with F added at levels of 5%, 10%, and 15% by replacing part of starch. High-moisture extrusion was carried out using a twin-screw extruder. The results of texture profile analysis demonstrated that, compared with control sample, the hardness and gumminess of samples containing S and F decreased by an average of 20%. Similar trends were observed in the sensory evaluation, where panelists indicated that the addition of extruded pea hulls reduced fibrousness, resulting in softer samples that were easier to chew and more closely resembled the texture of meat. Moderate replacement of starch with F (10–15%) in high-moisture extruded products improved textural properties and provides an opportunity to further research into the development of new meat analogue products.

Keywords: meat analogue, protein isolate, pea starch, extruded pea fiber

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CHANGES IN THE CHEMICAL COMPOSITION OF *CUCURBITA* SPP. FRUITS UNDER CONDITIONS OF INTERSPECIES HYBRIDIZATION

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Interspecific hybridisation of the *Cucurbita* genus is a promising direction for obtaining fruits with improved chemical composition and high content of bioactive compounds. The combination of zucchini and pumpkin traits expands the possibilities for fruit use. The aim of the study was to evaluate the chemical composition of fruits in the technological and biological stages of ripening of interspecific hybrids *C. pepo × C. maxima* obtained by crossing 'Patriot F_1' and 'Defender F_1' squash (Great Britain) with 'Narodny' pumpkin (Ukraine). A significant influence of hybridisation and ripeness stage on the formation of the chemical composition of the fruit was established ($p \leq 0.05$). At the stage of technical ripeness, the hybrids exceeded the maternal forms of squash by 20–55% in dry matter (4.15–6.48 g 100 g^{-1}), up to 60% in sugars (2.10–3.55 °Brix) and by 10–60% in vitamin C content (4.26–7.02 mg 100 g^{-1}). Potassium content was 5–10% higher with less variability. β-carotene reached 1.30 mg 100 g^{-1}, exceeding the maternal forms by 2–6 times. Phenolic compounds remained consistently high (14.60–22.40 mg GAE 100 g^{-1}), while flavonoids were 5–25% higher or comparable to the original forms, indicating that antioxidant potential was preserved. At the stage of biological ripeness, dry matter, sugars, vitamin C, and carotenoids increased. Fruits related to pumpkin had the highest values: dry matter up to 9.24%, sugars up to 6.63 °Brix, vitamin C up to 15.51 mg 100 g^{-1}, β-carotene up to 0.51 mg 100 g^{-1}, flavonoids up to 3.86 mg CE 100 g^{-1} FW. Hybrids occupied an intermediate position, combining the characteristics of both parental lines The results show that interspecific *Cucurbita* hybrids retain high biological value of fruits at different stages of ripeness and are a promising food raw material with good adaptability to abiotic factors.

Keywords: pumpkin, squash, technological ripeness, biological ripeness

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LIPID COMPOSITION AND ANTIOXIDANT STATUS OF THE SEMITENDINOSUS MUSCLE OF ORGANIC HEREFORD BULLS REARED ON CULTURAL COASTAL GRASSLANDS

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This study characterised the vitamin E content and fatty acid profile of the semitendinosus (ST) muscle in organically raised Hereford bulls finished on cultural coastal grasslands. Four offspring of two sires (sire 1: A and B; sire 2: C and D) born in 2023 were analysed to assess animal-specific variability under identical forage-only feeding conditions. All values are presented as mean ± expanded uncertainty (U, k = 2). Intramuscular fat content ranged widely from 1.25 ± 0.05 g 100 g^{-1} in animal A to 3.19 ± 0.13 g 100 g^{-1}in animal B, with intermediate values in animals C (1.80 ± 0.07 g 100 g^{-1}) and D (1.74 ± 0.07 g 100 g^{-1}). Saturated fatty acids (SFA) ranged from 0.60 ± 0.09 g 100 g^{-1}in animal A to 1.58 ± 0.24 g 100 g^{-1}in animal B. Monounsaturated fatty acids varied between 0.42 ± 0.06 g 100 g^{-1} (A) and 1.06 ± 0.16 g 100 g^{-1} (B), with oleic acid values of 0.36–0.90 g 100 g^{-1}across animals. Polyunsaturated fatty acids reached 0.17 ± 0.03 g 100 g^{-1}in animals B and C, with n-3 fatty acids between 0.03–0.08 g 100 $g^{-1}$and n-6 values between 0.04–0.10 g 100 g^{-1}. The n-6:n-3 ratio ranged from 1.125:1 (B) to 1.429:1 (C). Trans fatty acids remained low (0.06–0.13 g 100 g^{-1}). Vitamin E concentrations showed similar variability, from 0.19 ± 0.05 mg 100 g^{-1} in animal D to 0.41 ± 0.10 mg 100 g^{-1} in animal B.

The results demonstrate substantial individual variation in lipid composition and vitamin E levels despite homogeneous nutrition. Animal B consistently exhibited higher fat concentration and a more lipid-rich profile with a lower n-6:n-3 ratio, whereas animal A represented the leanest profile. These findings highlight the influence of animal-specific factors on the nutritional attributes of organic beef.

Keywords: vitamin E, fatty acids, organic beef, Hereford, muscle composition

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SESSION VIII
FOOD SAFETY AND FUNCTIONALITY: EFFECTS OF ORIGIN, RAW MATERIALS, AND PROCESSING

KL3

MEDICINAL AND AROMATIC PLANT DIVERSITY IN THE CONTEXT OF TRACEABILITY, CHEMICAL VARIABILITY, AND CULTIVATION POTENTIAL

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Medicinal and aromatic plants (MAPs) are increasingly important as raw materials for herbal medicines, teas, food products, and other high-value applications. Their growing demand highlights the need for reliable traceability, consistent quality, and sustainable production systems. In the Baltic region, however, scientific and practical knowledge on MAP domestication and cultivation, particularly under organic conditions, remains limited. Over the past decade, the Institute for Environmental Solutions, in collaboration with SIA Field and Forest, has conducted a series of interdisciplinary studies integrating agronomy, biology, and chemistry to address these challenges. These studies are among the first in Latvia to investigate MAP cultivation on a larger scale, with particular emphasis on species diversity, cultivation potential, and chemical variability. Research activities have included the evaluation of wild genetic resources, accession-specific adaptation to local agroclimatic conditions, and the effects of cultivation on phytochemical composition. Special attention has been given to traceability from natural populations to cultivated material, providing insight into how origin, genotype, and environment influence product quality and commercial value. Field and laboratory results for selected high-potential species from Latvian natural habitats demonstrate substantial interspecific and intraspecific variation in agronomic performance, suitability for organic production systems, and chemical profiles. The findings emphasise the importance of regional domestication, genotype selection, and cultivation system optimisation for developing stable, high-quality MAP raw materials. Collectively, these studies provide a scientific basis for breeding, cultivation technology development, and evidence-based value chain expansion, supporting the sustainable introduction of new MAP crops in Latvia and the wider Baltic region.

Keywords: medicinal and aromatic plants; traceability; chemical variability; domestication; cultivation potential

O32

THE IMPACT OF GREEN LENTILS ON WHEAT BREAD QUALITY PARAMETERS AND ACRYLAMIDE FORMATION

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The incorporation of green lentils into wheat bread (WB) formulations is a promising strategy to improve physicochemical properties and effectively reduce acrylamide concentration. This study evaluated the changes in volatile compound (VCs) composition, acrylamide (A) formation and overall acceptability (OA) in WB supplemented with non-treated (NT), milled (M) and *Lactiplantibacillus plantarum* fermented (LpF) green lentils. Results showed that WB supplemented with 5–20% lentils maintained OA compared to the control. However, OA scores were significantly influenced by both the lentil content ($p \leq 0.001$) and the form of lentils used (milled vs. non-milled; $p=0.049$). After 48 h of storage, crumb hardness generally increased in the lentil-enriched samples, except for those containing 15% NT and 5% FM lentils. Milled lentils (both NT and LpF) resulted in significantly higher A content compared to NT additives, with the highest increase observed in samples containing LpF and M lentils. A direct relationship was found between A concentrations and specific VCs. The predominant VCs in all WB samples were ethanol, 3-methyl-1-butanol, phenethyl alcohol and 3-furanmethanol. No significant correlation was found between the VCs profile and OA, except for (Z)-3-nonen-1-ol, which showed a weak positive correlation ($r=0.271$, $p=0.031$). In conclusion, technological optimization is essential to ensure product safety. To achieve the safest WB formula with minimal A content, it is recommended to include 5%, 10% or 15% LpF, non-milled lentils.

Keywords: lentils, lactic acid bacteria, physicochemicals, sensory properties

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COMPARATIVE QUALITY ASSESSMENT OF THE SPRING AND AUTUMN-HARVEST SPRUCE SPROUTS

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Spruce sprouts of Norway spruce (*Picea abies* (L.) H. Karst) develop in early spring and late autumn. However, information on quality in these stages remains limited. This study aimed to evaluate the physical and biochemical properties of spruce sprouts harvested in spring (FS-S) and autumn (FS-A). To assess their quality, the following parameters were evaluated: moisture, pH, titratable acidity, colour, vitamin C, chlorophyll (α and β), total carotenoids, total phenols, flavonoids, tannins, antiradical activity, antioxidant capacity, as well as microbiological and volatile compound profiles.

The FS-A sample exhibited a significantly higher pH (4.25 ± 0.01) compared with the FS-S sample (3.10 ± 0.05). In contrast, most bioactive compounds were present at higher levels in the FS-S than in the FS-S. Vitamin C content was almost two times higher in FS-S (915.56 ± 0.05 mg 100 g^{-1} DW) compared to FS-A (505.55 ± 0.05 mg 100 g^{-1} DW). Total chlorophyll content was 15 times higher in FS-S (95.14 ± 12.12 mg 100 g^{-1} DW) compared to FS-A (6.19 ± 0.78 mg 100 g^{-1} DW); however, chlorophyll stability was greater in FS-A, likely due to the higher pH value. FS-S showed slightly higher total microbial, yeast, and mould counts, while *Escherichia coli* and *Salmonella* spp. were not detected in any samples.

Volatile compound analysis revealed a higher proportion of D-limonene in FS-S (35.56%), contributing to its citrusy aroma, whereas FS-A was characterised by fenchene (14.81%), contributing to a slightly woody and mint aroma and D-limonene (14.57%). Overall, spring-harvest spruce sprouts demonstrated superior bioactive compound content, supporting their potential application as a functional and sustainable food ingredient.

Keywords: development stages, seasonal variation, bioactive compounds, physical parameters

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O34

ANTIOXIDANTS IN FRUITS OF THE *CUCURBITACEAE* FAMILY: EVALUATION OF TOCOCHROMANOLS AND CAROTENOIDS

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While studies have examined antioxidants in various Cucurbitaceae family species, systematic comparisons across fruit parts remain limited. This research quantifies tocochromanols and carotenoids in different tissues (peel, flesh, seeds) to promote the valorization of processing by-products (18–20% of mass). Among analysed species, *C. maxima* cultivars exhibited the most diverse tocochromanol profiles, featuring multiple homologues (α-, γ-, and δ-tocopherols) and high plastochromanol-8 (PC-8) levels. Peels were richest in PC-8 for 'Melonowa Żółta' and 'Rouge vif d'Etampes', while γ-T and α-T dominated in 'Danka Polka'. Regarding carotenoids, the peel consistently contained the highest concentrations across all cultivars, with lutein identified as the dominant compound. *C. maxima* 'Amazonka' emerged as the most nutrient-dense variety, reaching a peak total carotenoid content of 121 mg 100 g^{-1} in the peel. While concentrations were lowest in seeds, a distinct gradient was observed in the flesh, with levels increasing toward the seed cavity. Crucially, these results identify pumpkin peel as a novel and significant natural source of the relatively unexplored plastochromanol-8. The high concentration found in these tissues suggests that pumpkin by-products are an efficient, low-cost matrix for the large-scale isolation of lipophilic antioxidants. However, further study is needed to determine the best ways to collect and process these materials to ensure the quality remains high on an industrial scale.

Keywords: plastochromanol-8, xanthophylls, lipophilic antioxidants, phytochemical recovery

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O35

IMPACT OF OAT DRINK PROCESSING INTERVAL TIME WITH NEUTRAL AND ACIDIC PROTEASE ON ITS NUTRITIONAL COMPOSITION

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The market demand for oat drink is increasing, but its nutritional profile remains poor. Therefore, this study investigates different time intervals of neutral (NP) and acidic protease (AP) treatments during oat drink (OD) processing to enhance its protein content and solubility. In brief, oat drink prepared from 16% oat slurry was treated with pure α-amylase for 70 min. The control sample (ODc) was withdrawn, filtered, and inactivated. The remaining slurry was then directly inactivated, cooled to 52−53 °C, and divided into two portions. One portion was treated with NP, and the other with AP, eash at a dosage of 0.5 U/g of oat flour. Samples were collected at 30, 60, 120, and 180 min from each OD, filtered and inactivated. Total and water-soluble proteins (TP and WSP, respectively) were analysed by Lowry's method, and β-glucan (BG) was measured using a Megazyme enzymatic kit. The AP treatment showed a significant effect ($p < 0.05$) for maximising the TP and WSP contents after 60 min of hydrolysis, where their increments were 0.45 and 0.61 g/100 mL OD, respectively, compared to the ODc sample. However, the NP treatment resulted in a non-significant increase ($p > 0.05$) in TP and WSP contents compared to the ODc. The correlation analysis demonstrated a strong positive correlation ($r = 0.998$) between the changes in TP and BG contents in OD during hydrolysis by both proteases. The above results indicate that protease treatment has the potential to enhance the nutritional properties of OD, particularly by its enrichment in protein and β-glucan.

Keywords: acidic protease, neutral protease, oat drink, enzymatic interval, nutritional composition

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P41

ANTIOXIDANT AND ANTIMICROBIAL ACTIVITY OF FERMENTED KOMBUCHA BLACK AND GREEN TEA

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Kombucha is a traditional fermented beverage obtained by fermenting sweetened *Camellia sinensis* L. tea with a symbiotic culture of bacteria and yeast (SCOBY). The aim of the present study was to evaluate the antioxidant and antimicrobial activities of kombucha beverages prepared from black and green tea. Fermentation was carried out at 22 °C for up to 7 days. The antioxidant activity, determined using the DPPH method, was significantly higher ($p < 0.05$) in the green tea kombucha (103.85 ± 0.76 mg TEAC L^{-1}) compared to the black tea kombucha (22.46 ± 0.11 mg TEAC L^{-1}; TEAC – Trolox Equivalent Antioxidant Capacity). A similar trend was observed for the total polyphenol content (using Folin-Ciocalteau reagent), which was also significantly higher ($p < 0.05$) in the green tea kombucha (105.13 ± 1.11 mg GAE L^{-1}) than in the black tea kombucha (86.09 ± 0.25 mg GAE/L; GAE – Gallic Acid Equivalent). The antimicrobial activity, assessed using the disc diffusion method, revealed stronger inhibitory effects of green tea kombucha against *Candida albicans* CCM 8186 (7.22 ± 0.31 mm), *Candida tropicalis* CCM 8223 (7.69 ± 0.22 mm), *Enterococcus faecalis* CCM 1875 (7.67 ± 0.35 mm), and *Salmonella enterica* subsp. *enterica* CCM 4420 (5.67 ± 0.53 mm) compared to black tea kombucha: *C. albicans* (2.65 ± 0.01 mm), *C. tropicalis* (5.11 ± 0.07 mm), *E. faecalis* (4.66 ± 0.09 mm), and *S. enterica* subsp. *enterica* (4.33 ± 0.11 mm). Kombucha beverages, particularly those produced from green tea, demonstrated strong antioxidant and antimicrobial properties. Their regular consumption may contribute to promoting health and preventing disease as part of a balanced diet.

Keywords: beverages, polyphenols, DPPH method, disc diffusion method, *Camellia sinensis* L.

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EFFECT OF ROSEMARY EXTRACT ON STORAGE STABILITY OF BUTTER

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The aim of this study was to determine the effect of rosemary extract on the storage stability of butter. Dried rosemary leaves were used to prepare a deodorized ethanol extract, which was added to cow's milk cream immediately before churning. The butter production process was carried out in a laboratory churn using ethanol extracts with a concentration of 0.05% and 0.1% rosemary to fat ratio. The peroxide value was determined every few days according to the ISO 3960 method, and the acid value was determined using the ISO 660 method. The butter and the fat obtained from it were stored at room temperature and at 60 °C for 50 days.

Analysis of the peroxide value showed that the induction period of the control sample was 19 days, while the addition of 0.05% rosemary extract extended it to 36 days, and adding 0.1% rosemary extract extended this period to 43 days. When fat samples obtained from butter were stored at 60 °C, there was a very rapid and abrupt increase in the peroxide value, which on the 47th day of storage was at the level of 224 meq O_2/kg fat in the control sample, 118 meq O_2/kg fat in the butter with 0.05% rosemary extract, and 44 meq O_2/kg fat in butter with 0.1% addition of extract (for comparison, these values obtained for fat stored at room temperature were 1.1, 0.7, and 0.4 meq O_2/kg fat, respectively). The extract obtained from rosemary also delayed the hydrolytic processes occurring in the butter, as evidenced by the acid value determined in them, which was more than three times lower than in the control sample.

The conducted research has shown the high effectiveness of ethanolic rosemary extracts in limiting oxidative and hydrolytic changes in stored butter. Combined with an extraction method that does not adversely affect sensory properties, these results indicate the potential for their practical application.

Keywords: butter, rosemary, herbs, oxidative stability, hydrolytic changes

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QUALITY PARAMETERS OF LACTO-FERMENTATED ONION

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The research aimed to determine the effect of size-reduction method and applied fermentation technique on the changes of quality indicators in lacto-fermentated onions.

Fresh onions were subjected to seven different size-reduction methods: slicing perpendicular to the longitudinal axis (3.00±0.15 and 1.15±0.15 mm), slicing parallel to the longitudinal axis (3.00±0.15 and 1.15±0.15 mm), dicing (3×2×2±0.15 and 5×5×6±0.15 mm) and grating.

Fermentation was performed under anaerobic conditions in 235 ml jars at room temperature (22±2 °C) with onion to liquid ratio 1:2. Three fermentation solutions were used – base (2% NaCl solution), base with 1 tsp kefir (2% fat) and base with lactic acid bacteria (LAB) complex (~ 10^7 CFU ml^{-1}, incl. *Lactobacillus acidophilus, Lacticaseibacillus casei, Lactiplantibacillus plantarum, Lacticaseibacillus rhamnosus, Lactococcus lactis*, *Streptococcus thermophilus*). A total of 21 samples in three replicates were tested during a 10-day fermentation by evaluation pH, soluble solids, microbiological indicators, and sensory properties.

The initial pH of samples ranged from 5.81 to 6.51. The pH gradually decreased in all samples (ΔpH 0.6–3.0). LAB growth was significantly higher in kefir- and LAB complex-inoculated samples, reaching average counts of 2.7×10^7 CFU g^{-1} and 2.1×10^7 CFU g^{-1}, respectively, after 10 days. In contrast, spontaneous fermentation resulted in only 6.5×10^5 CFU g^{-1}, which is insufficient to classify fermented onions as possible probiotics. Samples fermented with LAB complex were most sensory satisfactory in terms of flavour, aroma, texture and overall appearance.

The results indicate that the fermentation dynamics and the quality of lacto-fermented onion is dependent on the size-reduction method and the applied fermentation technique.

Keywords: lactic acid fermentation, spontaneous fermentation, starter culture, mechanical size reduction

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IMPACT OF CATTLE-RAISING METHODS ON THE QUALITY OF DRY-AGED MEAT

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Nowadays, both improving meat quality and using innovative production technologies are relevant priorities in the food industry. At the same time, the demand for sustainably produced, organically grown food products – including beef – is increasing, driven by concerns about environmental sustainability and high standards of animal welfare. Therefore, an important question arises: how does organic cattle farming influence meat quality compared with conventional farming, particularly when modern processing methods such as dry aging are used.

The aim of this study was to investigate the impact of cattle-raising method on the physicial and microbiological quality parameters of dry-aged beef. The beef used in this study was obtained from Ltd. "Cēsu gaļas kombināts". The origin of the conventionally farmed beef (CFB) sample was Latvia, but further details are unknown. In turn, the organically farmed beef (OFB) sample was obtained from farm "Saliņas", Laubere parish, Ogre municipality, Latvia. *Bone-in sirloin* cuts were used in the dry-aging process.

Physical parameters (pH and mass losses) and microbiological indicators (total plate count (TPC), *Escherichia coli*, yeasts, and molds) were analyzed during a 49-day dry-aging period. Samples were aged in a DryAged Master 63 chamber (CASO GmbH, Germany) at a temperature of 3 ± 1 °C and a relative humidity of 80 ± 5%. During maturation, pH values increased slightly in both groups (CFB: 5.59→5.76; OFB: 5.65→5.82), with no significant influence of the raising method. Moisture decreased (CFB: −27.28%; OFB: −25.16%), and total mass losses reached 45.53% for CFB and 52.48% for OFB, showing a strong negative correlation with moisture content (r=−0.93).

At the end of the aging period, TPC was 4.98 log CUF·g^{-1} in CFB samples and 6.47 log CUF·g^{-1} in OFB samples. Yeast counts increased over time, while molds and *E. coli* were not detected in either group.

Keywords: cattle-raising method, meat quality, dry-aged meat

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SUSTAINABLE STARCH-BASED ACTIVE POLYMERIC FILMS ENRICHED WITH PEQUI PEEL POLYPHENOLS FOR ANTIOXIDANT ACTIVE FOOD PACKAGING APPLICATIONS

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Lipid oxidation is a major cause of food deterioration, leading to undesirable flavors, rancidity, and reduced shelf life. Also, conventional packaging materials and synthetic antioxidants raise environmental and health concerns. In this context, this study proposes a sustainable active packaging alternative based on biopolymer films enriched with natural antioxidants. Starch extracted from sweet potato peel was used as the polymer matrix and polyphenols derived from pequi (*Caryocar brasiliense* Camb.) peel were incorporated to confer antioxidant activity. The films were produced by casting. The chemical profile of the pequi extract was characterized by UPLC-ESI-MS/MS, revealing a complex metabolite composition mainly consisting of hydrolyzable tannins, flavonol glycosides, saponins, and triterpenes. Ellagitannins were the predominant class, with punicalin and methyl-punicalin derivatives as major constituents, along with ellagic acid derivatives. Flavonoids such as myricetin 3-O-glycoside, hyperoside, and isoquercitrin, compounds well known for their antioxidant properties, were also identified. The antioxidant activity of the extract was evaluated using FRAP and ABTS assays. Film functionality was assessed by DPPH radical scavenging and migration of phenolics using food simulants. The enriched films exhibited over 90% antioxidant activity, along with enhanced release of phenolic compounds into fatty and acidic simulants after 4 h of contact under dark conditions at 20 ^{o}C. This controlled release behavior is particularly advantageous for active food packaging, enabling targeted antioxidant delivery in food systems prone to lipid oxidation. Overall, these starch-based films show strong potential as sustainable active packaging materials, promoting agro-industrial waste valorization, food preservation, and reduced environmental impact.

Keywords: starch-based biodegradable films, active food packaging, natural phenolic antioxidants, controlled release of bioactive compounds

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