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I AGRICULTURAL ECONOMICS

Economic reproduction of the quality of natural resources in the agricultural sector

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Abstract. The research aims to devise scientific and methodological strategies and practical suggestions for enhancing the quality of natural resources within the agricultural domain by employing economic measures. It encompasses raising awareness, constructing a simulation model for economically regulating the enhancement of natural resource quality in agricultural production, and enhancing the quality of land resources through the integrated utilization of poultry farm manure. The authors used a systematic approach and logical analysis to form an economic mechanism for improving natural resource quality and economic and mathematical modeling methods. The paper deals with the peculiarities of improving natural resource quality in the agricultural sector and the related cost estimates. We propose an economic model of the intersectoral balance, considering the pollution processes of agricultural areas. Furthermore, we substantiate the financial mechanism for improving the quality of natural resources in the agricultural sphere. We show that the improvement of the land resources quality due to the reproduction of humus can be achieved through the comprehensive utilization of manure from poultry farms, which facilitates the profitability of poultry farming. Finally, we investigate the economic effect of using manure from poultry farms in agriculture. The study results are used to improve the economic support for regional programs for improving the quality of natural resources in agriculture, developing an economic model of the sectoral structure and territorial organization of the local economy, and improving the quality of natural resources.

Key words: environmental economics, natural resources, agriculture, quality of natural resources, poultry farming.

Acknowledgements. The authors express their gratitude to the scientific and technical organization Teadmus OÜ (teadmus.org) for the idea regarding the topic of the research and the organization of the international research project "Optimizing Agro-Industrial Production for Sustainable Resource Regeneration and Economic Growth", the results of which are included in this article. The authors are also grateful to Sumy National Agrarian University (Ukraine), the National Scientific Center "Institute of Agrarian Economy" (Ukraine), Estonian Entrepreneurship University of Applied Sciences (Estonia), and the Academy of Applied Sciences Mazovia (Poland) for creating a favorable environment for conducting scientific research.

Digital marketing and communication strategies of agri-food enterprises on social media platforms

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Abstract. This article explores the dynamic evolution of digital marketing and communication strategies within agricultural enterprises across diverse social media platforms amidst the industry's ongoing transformation. Employing a comprehensive approach, including detailed case studies and a mix of quantitative and qualitative analyses, the study investigates how these strategies enhance online presence, stakeholder engagement, and overarching marketing goals. Utilizing an advanced econometric model, the research uncovers statistical relationships, revealing the quantitative impact of digital marketing and social media on revenue generation for agricultural enterprises. The results highlight the effectiveness of a nuanced blend of content marketing, community building, and targeted advertising in boosting visibility and engagement. Beyond statistics, the study identifies key propositions for optimizing digital strategies in agriculture, emphasizing tailored content, data analytics, and the integration of emerging technologies. By scrutinizing the dynamic interplay between digital marketing and communication dynamics within the agricultural landscape, the research contributes theoretical insights and practical recommendations. Serving as a guiding compass for stakeholders, policymakers, and researchers, the study offers a roadmap for leveraging the transformative potential of digital strategies in the evolving agricultural industry. This research provides valuable guidance for stakeholders aiming to harness the synergies between digital marketing and communication strategies, ensuring a holistic approach to navigating the complexities of the digital landscape within the agricultural sector.

Key words: digital marketing, agricultural sector, digital transformation, technological adaptation, agricultural innovation.

II AGRICULTURAL ENGINEERING

Impact of solid grain waste digestate on biometrics and photosynthetic parameters of tomato (*L. Lycopersicon Esculentum*) seedlings

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Abstract. Anaerobic digestate has been commonly used to cultivate vegetable seedlings and as one of the measures for improving the peat substrate. Studies have shown the influence on aromatic plants, and leafy vegetables, but no further research about the effect on greenhouse vegetables. The main objective was to investigate the effect of the additional insertion of different rates of solid grain waste digestate in the peat substrate on tomato seedling quality. The research was carried out in a greenhouse covered with double polymeric film at the Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry. Two factors were investigated: seedlings establishment method (transplanted and directly sowed in the pod seedlings) and different substrates: control (peat), peat +10% digestate, peat +20% digestate with 3 repetitions by using a completely randomized design. The biometrics and photosynthetic parameters of the seedling were evaluated. The results showed that +10% of digestate application with transplanted seedlings had a significant effect on plant height, leaf number, leaf area, and all plant fresh mass of tomato seedlings compared with the control variant. Photosynthetic parameters such as photosynthetic rate and transpiration rate of transplanted seedlings with +10% peat application were also higher. Transplanted seedlings with a +20% rate of peat showed an increase in leaf chlorophyll index and nitrogen balance, but not in the biometrics of the seedlings, and their photosynthetic parameters showed no significant difference between other variants. Different solid grain digestate rates can increase tomato seedling biometrics and photosynthetic parameters. The research showed that all transplanted variants of tomato seedlings have better biometrics and photosynthetic parameters compared with direct sowed in the pod seedlings.

Key words: biometrics, photosynthetic parameters, seedlings, solid grain waste digestate, tomato.

Potential possibilities carbon sink in different Lithuanian regions

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Abstract. Nowadays, we are witnessing the unprecedent climate change consequences, and the agriculture is considered as one of the main emitters of greenhouse gasses (GHG) in the economies. Though, including all agricultural activities huge amounts of carbon are sequestrated in the food and feed production, into agricultural by products and essentially into the soils. Soils are one of the most considered carbon sink mediums for reducing GHG concentrations in the atmosphere. Enhancing agricultural soils to store carbon is a win – win situation, where GHG mitigation actions are implemented, in fact, soils fertility rates increased for growing food consumption. Despite this fact, soils are able to sequestrate adequate levels of carbon and it is important to know the projections of the soil capabilities as the carbon storage instrument. Using the monitoring methodology developed the collecting, updating and validating of soil monitoring database at local, regional and national levels implemented. A key challenge in all result-based schemes is designing MRV systems that sufficiently accurately measure the impact of farmer climate actions at acceptable cost to the owner and the administrator. Objectives are to collect existing soil monitoring open data, matter and coordinate the acquisition of soil samples across different Lithuania regions, sample scanning using different spectral sensors and analysis using conventional laboratory research methods to determine base parameters (metadata). Experimental research was carried out by collecting material, coordinating and implementing soil sampling in various regions of Lithuania using and cooperating with farmers applying different practices for different types of soil, carrying out research in situ by scanning the soil using different spectrums, sensors and analysis using conventional laboratory research basic parameter determination methods. Digital collection of data per every job on the field opens new visual and informative ways of farm activities impact on CO2 absorption with clear answers as to what activities encourage highest absorptions.

Key words: LIFE; GHG; Carbon, agriculture, soil properties.

Evaluation of strip and conventional sowing technological operations

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Abstract. Today's goal in agriculture is to increase crop yields and productivity by reducing the direct impact of tillage machines for ecological and economic reasons. Therefore, the aim of this work is to carry out an evaluation of the technological processes of strip and conventional sowing in bean production. Experimental studies are carried out to determine the quality of the seedbed, the yield of beans, and an energy assessment. It is found that the seedbed is not fully compliant with the conventional sowing technology, in contrast to the strip sowing technology. In addition, it can be stated that the average yield of beans is 1.2 t ha^{-1} higher with the strip sowing technology than with conventional sowing. The energy consumption of the strip sowing technology is also lower, as shown by the higher energy efficiency coefficient obtained.

Key words: strip sawing, conventional sawing, seedbed, beans yield, energy efficiency.

Statistical modelling of influence of input and output parameters on energy efficiency of agricultural biogas plants in Latvia

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Abstract. Factor of utilisation of existing electric power or capacity factor (CF) is low in agricultural biogas plants in Latvia. In order to investigate the reasons for this evidence, different parameters of the feedstock and digestate output for 22 biogas plants in Latvia were analysed using statistical methods. Feedstock biomass in biogas plants were cow's, pig's, chicken's manures, silage, wastewater sludge, and different food industry wastes in those biogas plants. To assess the quality of feedstock and digestate in 22 agricultural biogas plants the number of samples of raw materials and fermentation residues (digestate) were analysed for total solids (TS), volatile solids (VS), plant nutrients (N, P, K) content, ash content of the input silage, proportion of silage in the feedstock and pH value of digestate. The comparison of two subgroups of biogas plants differing TS content in silage with the first subgroup including biogas plants with silage TS content greater than 29.9 % and the second subgroup with silage TS content below than 29.9 % show significant difference in mean CF values 0.812 or 0.645 for first or second subgroup respectively. To find the other governing factors influencing CF value multivariate statistical modelling of factor was provided using standard statistical analysing tools. Results of modelling showed that most important factor influencing CF value was ash content in silage. The linear regression equation developed showed that the higher the ash content of the silage the lower the CF of the biogas plant. indicating the intensity of biodegradation during the storage of the silage. Recommendations are to maintain the TS content of silage above 29.9% and to reduce biodegradation of silage during storage, for example by covering silage stacks with oxygen-proof plastic film and reducing the opening time of during removing of silage.

Key words: anaerobic fermentation, digestate, energy efficiency, silage.

Acknowledgements. Latvia University of Life Sciences and Technologies provided funding of this publication. Part of data on silage and digestate parameters in this study obtained in the framework of the recently completed Interreg Central Baltic Programme project No CB842 "Sustainable nutrient management in biogas production", funded by the European Regional Development Fund (ERDF).

III ERGONOMICS AND ERGODESIGN

Exploration of the association between technostress and burnout among healthcare professionals

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Abstract. These days, technological advances are the backbone of any organization, and the healthcare industry is no different. Due to newly developed technologies, medical facilities have become more developed than before and can provide clients with simpler and more efficient health care. This review to explore the association between technologically related stress in association with burnout syndrome in among healthcare professionals (HCPs) and give more attention to how digitization may affect the psychological well-being of medical professionals. The findings and the practical consequences they suggest can be used as a foundation for a discussion about long-term hospital digitalization initiatives that take technostress and its effects on burnout into account. Research indicates that the utilization of technological digitalization is linked to distinct psychological needs and the corresponding psychobiological stress responses. However, because epidemiological research on this type of technostress is lacking, it is still unknown if it contributes to mental problems such as burnout. However, a growing body of research indicates that technology may improve overall performance if it maximizes workplace structure, permits more flexibility, and boosts employee authority and autonomy. Employee mental health appears to be in danger from both the benefits and problems associated with the technology of work. Since there are not enough studies available right now, more investigation is required to provide a more accurate description of the benefits and drawbacks.

Key words: Technostress, Burnout, occupational stress, information and communication technologies, digitalization.

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Overview of farm safety and health risk management tools

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Abstract. The aim in this study is to give an overview of selected farm safety and health risk management tools and programs used on farms. In principle, management task in a small company like farm is to plan and set goals and finding best strategy get to the goal. In principal, risk management is to ensure that there are not unbearable risks, which could break down the company goals and strategies. Based on many studies, one of the biggest risk for the farm continuity and business sustainability is safety and health risk, because farms are typically micro size companies (1-2 persons work a farm). This means that injury accident of the farm key person could be crucial for the farm. Furthermore, in national policy level in Europe countries have several safety and health risk management program strategies in different countries, how to help farmers with safety and health management. This study utilizes risk management standard framework to define safety and health risk management tools for farms, which are identified and categorized by type, farm safety and health risk factors and risk management measures. The study is part of Strengthening farm safety and health knowledge and innovation systems (Safehabitus) project.

Key words: agriculture, farm engineering, safety, health, risk management.

Acknowledgements. This study belongs to a Strengthening farm safety and health knowledge and innovation systems (Safehabitus, 2023) project, which have a task to analyse the set of applicable and practical safety and health risk management tools for assisting farm managers in farm safety risk management. The Safehabitus project is tackling part of this problem with communities of practice multi-actor networks in eleven EU countries.

A participatory approach for development of safety and well-being in horticultural enterprises

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Abstract. Effective means of improving well-being at work and decreasing work-related health effects are needed in the horticultural and agricultural sectors. This study's objective was to create and implement a development process that can identify occupational safety, health, and well-being challenges in horticultural enterprises and co-create solutions. The study applied a participatory method in 24 small-scale enterprises (a total of 82 persons) from five different horticultural subsectors in Finland. Each participating enterprise underwent the development process from the identification of development needs, with individual interviews and process analysis, to the co-creation and implementation of solutions. The results showed that a participatory method combined with process analysis could be very productive, particularly in recognising development needs, but also in inspiring the co-creation of solutions and attaching them to the work phases and context. While long-term effects remain unresolved, the participation in the development process moderately improved subjective well-being and entrepreneurs' competence in managing well-being at work. The results suggest that the participatory approach has potential for the effective prevention of occupational injuries and diseases. The findings also painted a multifaceted and intertwined picture of the challenges highlighting the need for a multidisciplinary team, cooperation, and the possibility of peer discussions to solve challenges.

Key words: agriculture, ergonomics, health and safety intervention, social sustainability.

Acknowledgements. We wish to thank the enterprises and the steering group involved for their active and committed participation in the project, as well as senior scientist Anna-Maija Heikkilä for her valuable comments during the writing process. This study was supported by the European Social Fund and the Finnish Farmers' Social Insurance Institution Mela. The Fanny and William Ruth Foundation supported the reporting of the results as a scientific article. Professor Risto Rautiainen's efforts in this study were partly supported by the CDC/NIOSH award U54OH010162 to the Central States Center for Agricultural Safety and Health at the University of Nebraska Medical Center.

Advancing patient safety competencies in nursing education: an examination of student attitudes

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Abstract. In nursing, patient safety is of paramount concern, requiring the development of well-defined competencies among nursing students and the early integration of safety principles into curricula. This study aimed to explore nursing students' perceptions regarding patient safety, offering valuable insights for curriculum developers. The main research questions were: What are the perceptions of nursing students regarding patient safety, and how can this information be useful for curriculum developers in improving students' safety knowledge and developing the curriculum in this direction? The Attitudes to Patient Safety Questionnaire (APSQ III) was employed to gather data due to its established reputation as a comprehensive and reliable instrument for assessing student attitudes in patient safety. The questionnaire was thoughtfully distributed to first-year nursing students with work experience in the healthcare field. The study revealed that students consider patient safety important and perceive its implementation as dependent on multidisciplinary teamwork and error reporting. Based on students' perceptions, nursing educators should increase the presence of patient safety courses in the nursing curriculum, emphasizing a multidisciplinary approach and enhancing competencies related to critical thinking. This includes improving skills in error reporting, organizing practical training, and mastering the use of standardized terminology. In conclusion, the study underscores the necessity of redefining nursing competencies, early integration of patient safety principles, the significance of research, and the role of assessment tools in shaping attitudes toward patient safety in nursing education.

Key words: curricula, patient safety, nursing students, perceptions.

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Compile the initial data to artificial intelligence (AI) model for implementation in garment industry

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Abstract. The objective of the current article was to compile the initial data to the artificial intelligence (AI) model for implementation in the garment industry's human resource management. The initial data were gathered by the authors of the current paper from the scientific literature over the world. Nowadays textile (garment) industry in substantial amounts is developed in the Asian countries, like China, India, Bangladesh. Therefore, they need the scientific approach and digitalized solutions for improvement the working environment and ergonomics. The present article includes the assembly of the initial data needed for AI model: overview of the literature, models for assessing the climate conditions in the garment workplaces, model for the work-related musculoskeletal disorders (WRMSDs) development, the opinion of the workers on the working conditions and their health disorders connected with work. WRMSDs exist as the most general factory physical conditions hazards for needle work, pressing and covering workers, initiated by repetitive job, static posture, monotonous work. At the end of the paper the recommendations for managing of workplace ergonomics are given that have to similar as created by the AI model.

Key words: artificial intelligence, musculoskeletal disorders, garment industry.

IV BIOENERGY AND BIOFUELS

Anaerobic degradation of petroleum contaminated soil under methanogenic and sulphate reducing conditions

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Abstract. Petroleum, a predominant raw energy source, contributes to soil and groundwater pollution throughout exploration, refining, transport, and storage processes. Biological treatment methods have gained prominence in environmental studies due to the drawbacks associated with physical and chemical treatments, such as high costs and secondary waste production. In addition to aerobic degradation, anaerobic biodegradation offers an alternative approach characterized by reduced biomass production and biogas generation under various electron-accepting conditions. This study investigates the biodegradability of petroleum-contaminated soil in microcosms inoculated with an aquifer from Leuna, Germany, under methanogenic and sulphate-reducing conditions at different temperatures. Over a 200-day period, the study monitors biodegradation efficiency, microbial community profiles, and biogas production rates. Quantitative real-time polymerase chain reaction (qRT-PCR) and Next Generation Sequencing (NGS) are employed for microbial community profiling. Biodegradation performance is assessed through Total Organic Carbon (TOC) analysis, a precursor to total petroleum hydrocarbon (TPH) analysis. Results indicate more efficient organic matter degradation under sulphate-reducing conditions, achieving a remarkable 70% TOC removal, while methanogenic conditions show negligible TOC removal. The microbial community profile, particularly under 16S rRNA gene expression, correlates significantly with chemical analysis components, including TOC removal, gas production, and electron acceptor utilization. Molecular microbial analyses reveal aliphatic and aromatic hydrocarbon degradation in the microcosms, linking higher TOC removal efficiencies to changes in microbial community profiles under sulphate-reducing conditions. This study provides valuable insights into the efficacy of anaerobic biodegradation for mitigating petroleum-contaminated soil in environmental remediation strategies.

Key words: Bioreactor, soil pollution and control, removal of petroleum hydrocarbons, electron acceptor, bioremediation.

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Advancing circular bioeconomy: trends, clusters, and roadmaps in biofuel production and waste valorisation

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Abstract. Today, one of the important tasks of bioeconomy development is waste management based on the principles of environmental management and bioenergy production. In the context of this issue, this review focusses on the analysis of current trends in biofuel production that involve sustainable feedstocks and the valorisation of waste into useful bioproducts in agriculture. The scientometric method included the use of Scopus and Web of Science databases to compare the coverage of the research topic with keyword chain optimization. In addition, bioinformational databases was used to support the involvement of secondary raw materials in the bioprocessing cycle. The implementation of the research objectives resulted in the identification of bioeconomy clusters that emphasize the importance of developing specific regional circular bioeconomy strategies while avoiding "one-size-fits-all" solutions for individual sectoral technologies. An example of bioeconomy development in the world is bioenergy. The structure of bioenergy has been analysed. A roadmap for biotechnology modernisation was proposed using the example of anaerobic waste conversion process as part of the implementation of a circular bioeconomy. The stages of the roadmap for the modernisation of bioenergy technologies were analysed within the framework of the sectoral implementation of the circular bioeconomy. The efficiency indicators for the implementation of bioeconomy in agricultural production have been determined. In addition, an important direction unifying anaerobic technologies with the agricultural sector is the enrichment of digestates with macro and microelements, which is possible due to mineral additives, for example, phosphogypsum. This direction was also considered from the point of view of environmental safety.

Key words: bioeconomy, renewable energy, agricultural production, waste recycling.

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Reduction of PM emissions from solid biofuel fired combustion facilities using a bipolar charged aerosol agglomeration

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Abstract. Results of the experimental study of bipolar charged Particulate Matter (PM) agglomeration are presented in this paper. PM resulting after wood chips combustion was collected from the electrostatic precipitator (ESP), while PM resulting after wheat straw combustion was collected from the cyclone. Experiments were performed using a bipolar charger affecting particles by a high voltage electric field. The distribution of PM number concentration (Cn) was measured using a light scattering aerosol spectrometer. Expectedly it was obtained that particle deposition efficiency increases with increasing charging voltage. However, it was observed that a tenfold increase in deposition efficiency was achieved when applying a negative instead of a positive charging voltage. The deposition of PM2.5, in terms of Cn, due to the effect of electric charge and agglomeration was ~50% and ~9%, respectively. A maximum reduction of Cn was 60% and 81% for PM of 0.2–1 µm and 2–10 µm, respectively, and it was achieved at an air velocity of 1.0 m/s, a particle number concentration of 4.8·104 cm-3 and a charging voltage of 17.5 kV. Obtained results suggest that PM of 0.2–0.45 µm was affected by agglomeration, while PM of 2–10 µm was affected by electric deposition.

Key words: PM, charging voltage, number concentration, mass concentration, flow rate.

Production of simple sugars from olive grove pruning using acid pretreatment and enzymatic hydrolysis

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Abstract. The purpose of this paper was to optimize the production of simple sugars from olive grove pruning (OGP) using acid pretreatment and enzymatic hydrolysis. This study was based on a model composition corresponding to a 34 orthogonal factorial design and employed the response surface methodology (RSM) to optimize the pretreatment and hydrolysis conditions, aiming to attain maximum glucose, xylose and arabinose extraction from cellulose and hemicellulose of biomass. The pretreatment operating conditions considered for optimization, were temperature (60 – 180 °C), residence time (30 - 120 min) and sulphuric acid concentration (0.5 - 5% w/w). Enzymatic hydrolysis experiments on solid fraction pretreated with diluted acid were performed at a solid concentration of 5% (w/v, based on dry weight), using 50 mM citrate buffer pH 4.8 with BSA at a concentration of 60 mg/g dry biomass. The reaction mixture was incubated at 50 °C for 174 h on an orbital shaker at 150 rpm. Three commercial enzyme preparations (cellulase complex, b-glucosidase and xylanase) were used in enzymatic saccharification. Total carbohydrate content of the initial biomass was 51.25 % (in dry mass), of which glucose was the major constituent with 33.59%. Contents of lignin and extractable found in biomass were 24.96 % and 15.84 %, respectively. In this work, it was possible to extract 93.1 % of the sugars present in the olive grove pruning, with pretreatments carried out for 102 min at 156 ºC with a sulfuric acid load of 4.09 % (w/w), followed by enzymatic hydrolysis performed for 174 h, with an enzyme loading of 18 PFU, 36 p-NPGU and 36 IU per gram of substrate.

Key words: Acid hydrolysis, enzymatic hydrolysis, olive pruning, pretreatment, RSM, sugars.

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Herbicide-based selection of mutants for improved single cell protein synthesis: amino-acid inhibitor application, mutagenesis procedures and applicable microbial strains

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Abstract. This review expands the study of single-cell protein (SCP) production and provides protocols for the use of amino-acid inhibitors in the selection of microorganism mutants with enhanced protein production potential. In this approach, we use herbicides as amino-acid inhibitors to select random mutants with a higher potential for protein production. In contrast to wild-type strains, which are inhibited at a predetermined concentration, the mutant strains growing on such plates should exhibit increased protein synthesis to compensate for the inhibition. Subsequent cultivation without inhibitors is expected to result in a higher protein composition compared to the wild-type strain. The protocols, such as the use of the mutagens (EMS, MNNG and UV), as well as mutant selection strategies, combine theoretical considerations with practical applications and provide researchers with tangible methods to improve SCP-rich microorganism strains. The inclusion of herbicides as tools for the selection of SCP-rich mutants opens a novel avenue and contributes to the ongoing advances in sustainable protein production. This work focuses on the practical application of inhibitors and mutagenesis methods.

Key words: Amino Acid Inhibitors, Herbicide Inhibition, Microorganisms, Mutagenesis, Mutant Selection, Protein Production, Single Cell Protein.

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V LIVESTOCK ENGINEERING

The effect of the calibration of the spiral feeder and the type of feed pellets on the precision of its dosing

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Abstract. When feeding dairy cows, there is a need for precise dosing of concentrate feed. The quality of the feed dosing process is influenced by the physical properties of the feed material and the accuracy of the feeder calibration. The aim of the study was to investigate the influence of the accuracy of calibration of the spiral feeder and the type of granulated feed on the precision of dosing feed material at the feeding station. The study used a feeding station intended for feeding cattle, equipped with a spiral feeder with a feed rates of up to 1 kg min^{-1}. Three types of feed material with different granule diameters were used for the tests. The characteristics of the feed pellets included their bulk density, diameter and length of the pellets. In the study, the accuracy of the feeder calibration was related to the number of feed mass measurements obtained in the calibration procedure. Options for three and six mass measurements were included. The tests were performed for two feed rates, i.e. 0.3 and 0.4 kg min^{-1}. In order to determine the accuracy of feed dosing by the spiral feeder, the dosing accuracy index was calculated. The research results were subjected to statistical analysis. A statistically significant impact of calibration on the accuracy of feed dosing was found. In the study, increasing the diameter of the granules was accompanied by an increase in the accuracy of its dosing.

Key words: dosing accuracy, feeder calibration, feeding station, granulated feed properties, mechanical engineering.

Spatial variability of methane and carbon dioxide gases in a compost-bedded pack barn system

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Abstract. The dairy sector significantly contributes to global food production, however, it is closely associated with environmental concerns, specifically the emission of greenhouse gases such as methane (CH_4) and carbon dioxide (CO_2). The research problem focuses on the environmental impact of livestock farming, particularly in relation to the emission of greenhouse gases (GHG) such as methane (CH_4) and carbon dioxide (CO_2). Therefore, the objective of this paper was to assess the spatial variability of CH_4 and CO_2, as well as the thermal environment through the Temperature and Humidity Index (THI) and of air velocity (V, $m.s^{-1}$) in a Compost Bedded Pack (CBP). The experiment was carried out in October 2023, in a commercial dairy cattle facility measuring 54 x 22 x 4.5 m (length x width x height) that housed 80 lactating cows. Measurements were collected at 75 points, 0.25m above the bedding, for one minute in each point. To characterize the distribution of gases and the thermal environment, the data were underwent geostatistical techniques and kriging maps. THI values ranged from 72.4 to 78.4, categorizing the animals into two environments within the facility, comfort and alert to thermal conditions. The maximum recorded for CO_2 was 713.60 ppm in the region with a low ventilation incidence. CH_4 reached a ranging from 103.38 to 196.73 ppm in areas with low ventilation and higher temperatures. The use of geostatistics enabled the characterization of spatial variability of greenhouse gases CH_4 and CO_2, as well as THI and V. Analyzing these variables is crucial for implementing mitigation actions and developing an increasingly sustainable production system.

Key words: animal welfare, dairy cattle, gas monitoring, geostatistics, greenhouse gases.

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Use of compost from a compost barn installation as organic fertilizer

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Abstract. Organic fertilization is a profitable option and an environmentally correct alternative. The compost barn confinement system generates an organic material that can be applied to fertilize crops used to produce food for dairy cattle. This work objective is to evaluate the use of this material as an organic fertilizer. For the tests, sunflowers were planted in 15 L pots made up of ¾ soil and ¼ sand, kept in a greenhouse and four doses of fertilizer were tested (0, 5, 25 and 125 g/pot), using organic compost generated by a compost barn with Holstein dairy cows. The tests showed positive results for plant growth and development and for grain production for all doses, with a significant difference only for the 125g dose, which presented an average number of leaves of 15.96, stem diameter of 12.5 mm and thousand seed weight of 28.63g. It was found that there was greater plant growth and greater grain filling with an increase in the fertilizer dose, proving the positive effects on the plant of using organic compost from a compost barn.

Key words: composting, dairy herd, fertilizer dosage, grain, sunflower.

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The effect of artificial fog system on microclimate, heat stress, and THI in the smart dairy cowshed

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Abstract. In recent years, the warming climate in Lithuania has caused summers to become longer and hotter. Unfortunately, this has led to extended periods of unsuitable microclimate conditions in barns. As outside temperatures rise, so does the temperature inside the barns, negatively impacting animal health. This, in turn, reduces feed consumption, milk production, and reproductive characteristics, resulting in the dairy industry losing millions of dollars each year due to reduced milk yield. To determine whether animals are experiencing heat stress, the Temperature and Humidity Index (THI) plays a crucial role. When THI ≤70, cows are not heat-stressed. However, when THI reaches 70-72, cows may begin to experience heat stress, which can affect productivity. If THI reaches as high as 72-78, it can seriously affect milk production, and if it hits 78-82, it becomes severely dangerous to cows' health and can cause acute depletion of milk yield. To cool down barns, a variety of methods can be employed, such as fans, fans with water jets, and shower systems. Specifically, fan and fog systems can effectively reduce the temperature by about 4-6°C. The process is based on the evaporation of water, which is ensured by a fog system using water jets, in combination with fans. The number and power of fans and nozzles will depend on the size of the building.
The research was conducted in a state-of-the-art cowshed equipped with an advanced artificial fog system. The findings revealed that the artificial fog system has a significant impact on air temperature, reducing it by three degrees Celsius. Additionally, the temperature and humidity index (THI) in the barn was 1,98±3,33 lower than in the surrounding field. The study also revealed that the artificial fog system increases relative air humidity, thereby lowering the THI. This reduction in THI leads to decreased heat stress for cows in the barn equipped with the artificial fog system.

Key words: cowshed, artificial fog, dairy, microclimate, THI.

IGF1 and IGF2 gene polymorphisms are associated with the feed efficiency of fattened lambs in Latvian sheep breads

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Abstract. Feed efficiency is an economically important indicator in sheep farming. The most effective technology for selecting the best feed-efficient lambs for breeding is marker association selection of genetic variations in the sheep genome as potential biomarkers. In tissue growth and differentiation, insulin-like growth factors (IGFs) play a major role: IGF1 mediates the effects of growth hormone, and IGF2 is a growth regulator, regulating skeletal muscle growth. The study aims to find possible molecular markers for feed efficiency indicators in IGF1 and IGF2 genes for Latvian sheep breeds. The exonic regions of the IGF1 and IGF2 genes were sequenced for the first time in the genomic DNA of 76 controlled, intensively fattened lambs, to search for possible genetic biomarkers. Seven polymorphic loci in the IGF1 gene and sixteen in the IGF2 gene were detected. Statistically significant associations of the *IGF1* SNP rs600896367 were found with residual indicators: Residual feed intake, Residual weight gain (RWG), and Residual intake and body weight gain (RIG), and with feed efficiency and feed conversion ratio in the overall group of samples. Additionally, *IGF2* SNPs New_7 and rs429576107 exhibited associations with RWG and RIG specifically in the Latvian dark-head sheep group. On average, effect of the I*GF1* SNP on associated feed efficiency residuals is 3.9%, with the most pronounced impact observed in RFI. In contrast, the influence of IGF2 SNPs is comparatively lower. Our results indicate that rs600896367 and New7/rs429576107 are potential molecular markers for marker-assisted selection in sheep breeding for residual feed efficiency indicators.

Key words: Breeding, fattening, feed efficiency, Insulin-like growth factor, Latvian sheep, polymorphisms.

Acknowledgements. The study was funded by the LZP-2021/1-0489 project: ‘’Development of an innovative approach to identify biological determinants involved in the between-animal variation in feed efficiency in sheep farming."

MSTN gene polymorphisms are associated with the feed efficiency of fattened lambs in Latvian sheep breeds

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Abstract. The economic benefit of farmers depends on the level of feed efficiency of the lambs being raised. Promoting breed selection according to feed efficiency indicators can provide sheep breeders with higher quality and more economically profitable lambs. One type of selection in animal husbandry is marker association selection, which uses genetic or gene biomarkers associated with a trait. Myostatin (MSTN), a highly conserved member of the transforming growth factor-beta superfamily, is a major regulator of myogenesis and is a negative regulator of mammal muscle growth and development. The study aims to find molecular markers for feed efficiency indicators in the MSTN gene for Latvian sheep breeds. DNA extraction was made from blood collected from 76 controlled fatten lambs, with 63.16% belonging to the Latvian dark-head breed. Full gene sequencing analyses were performed to analyse differences in loci between different breeds and look for statistically reliable associations between polymorphisms and feed efficiency indicators. MSTN gene 23 loci were polymorphic in the Latvian lambs, including one new SNP. Statistically significant associations were found for SNP rs404916326 T>A with indicators of Residual feed intake, Residual intake, and body weight gain in the LT breed. However, SNP rs408469734 G>A was associated with the relative growth rate and Kleiber's ratio in the overall group of lambs. Our results indicate that SNPs rs404916326 and rs408469734 of the *MSTN* gene are potential molecular markers for marker-assisted selection in sheep breeding for feed efficiency indicators.

Key words: Breeding, fattening, feed efficiency, myostatin, Latvian sheep, polymorphisms.

Acknowledgements. The study was funded by the LZP-2021/1-0489 project: ‘’Development of an innovative approach to identify biological determinants involved in the between-animal variation in feed efficiency in sheep farming."

VI PRECISION AGRICULTURE

Use of geostatistical analyses for wheat production areas throung the variables NDVI, surface temperature and yield

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Abstract. Geostatistics is a crucial tool for data analysis in the field of precision agriculture, allowing the characterization of spatial variability magnitude, optimizing profitability and yield in agricultural areas. In this context, the present study aimed to evaluate the spatial dependence of the variables yield, Normalized Difference Vegetation Index (NDVI), and surface temperature in winter wheat plants. This was achieved through fitting semivariograms with different statistical models and interpolating the study variables using Ordinary kriging. The experiment was conducted at Fazenda Santa Helena, located in the municipality of Lavras in the state of Minas Gerais, Brazil, with a 12-hectare winter wheat crop of the TBIO Calibre variety. Data were collected using a grid sampling method at different stages of wheat plant growth (tillering and elongation). The analyzed variables included yield, NDVI, and surface temperature. Statistical analyses were performed using the R software. Initially, the spatial dependence of the study variables was analyzed by fitting semivariograms using the Restricted Maximum Likelihood (REML) method and considering spherical, exponential, and gaussian models. The evaluation of errors was carried out through cross-validation, and subsequently, the data interpolation was performed using ordinary kriging with the best-fitted semivariogram model. The results demonstrated a proper fit of semivariograms for the study models, with the spherical model standing out for surface temperature variables (elongation and tillering), NDVI (tillering), and the exponential model for NDVI (elongation) and yield. Therefore, the use of geostatistics is emphasized as an important tool to assist in precision agriculture management in winter wheat crops.

Key words: spatial analyses, winter wheat, cross-validation, active sensor, vegetation index.

Analysis of the relationship between the weather index of fire danger and occurrences of rural fires. Case study: centro region of Portugal

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Abstract. The aim of this study was to design an approach for establishing a plausible relationship between FWI and the monthly average burned area (ABA) and the average number of ignitions (ANI) supported by geographic information systems (GIS). The application of these results will allow the projection of burned areas in forest fires in the future, making mitigation actions possible. This approach was applied to the region of Central Portugal, and to achieve the aims of the study, the following steps were completed: (1) geoprocessing the spatial data of the daily FWI indices, burned area and number of fire ignitions and (2) developing statistical regression models capable of reproducing the variability in burned area and ignition occurrence series from FWI data during the 2001-2017 period. The predicted equations for the burned area as a function of the FWI presented high coefficients of determination for most of the considered periods, thus allowing the projection, with a high degree of confidence, of the monthly burned area values according to the various future climate scenarios. The prediction of the average number of ignitions from the FWI values class proved to be effective for establishing highly adjusted forecast models for July and August. In the spatial analysis at the district level, the ABA and ANI estimation equations were obtained from the FWI values with determination coefficients above 0.90 for most of the districts. Significant differences were observed between the districts in the number of ignitions analysed.

Key words: Burned area, Climate, Fire occurrence, FWI system, Wildfires.

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Phylogenetic diversity and relationships among sorghum genotypes of breeding collection

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Abstract. Sorghum is gaining prominence as a biofuel crop, currently taking the position as the second-largest source of grain-based ethanol after maize. Estimation of genetic diversity to identify groups with similar genotypes is important for conserving, evaluating and utilizing genetic resources. This study aimed to evaluate the genetic diversity and population structure in different genotypes of sorghum collection for breeding purposes to improve cultivars. There were investigated thirty-one sorghum genotypes of different origin. The genetic diversity of sorghum genotypes was assessed by five SSR markers. To evaluate morpho-agronomical traits, days to flowering, plant high, 1000 seeds weight and yield were studied. As the result of analysis, four cluster groups were formed based on Roger's & Tanimoto dissimilarity. These cluster groups included from three to sixteen sorghum genotypes, one genotype K2105 formed the separate cluster. The Shannon index calculated based on SSR markers was 1.99. Two principal components explained approximately 63% of the total variance. The greatest effect of year weather conditions was observed on the trait "days to flowering". The plant height was affected by the genotype of grain sorghum. The yield and 1000 seed weight were affected by weather conditions, but the impact rate was significantly lower than the effect of days to flowering. The correlation between SSR markers and trait "days to flowering" based on distances matrices was weak, but significant ($r = 0.1$). Thus, obtained results can be utilized for revealing genetic variation and identifying slightly different genotypes in a sorghum breeding program.

Key words: *Sorghum bicolor* L., SSR markers, genetical distances, morpho-agronomical traits, principal components.

Evaluation of photosynthetic variables of Brachiaria brizantha under Eucalyptus canopies in a livestock-forestry integration system

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Abstract. Livestock sector generates significant environmental impacts despite its global economic importance. The current challenge is to find sustainable ways of boosting this sector, while mitigating the negative impacts of this activity. In Brazil, degraded pastures are common because of inadequate management, damaging the soil. Integrated livestock-forestry (ILF) systems combine forest species and pastures in the area, incorporating elements of sustainability. In this system, the tree species is related to the productivity of the pasture, as the shade generated by the canopy creates different light conditions, influencing the photosynthetic activity of the forage. The aim of this study was to evaluate the influence of the luminosity of the understory of an ILF system on the photosynthetic activity of the forage species *Brachiaria brizantha* in the Atlantic Forest region of Brazil. Transient chlorophyll a fluorescence and chlorophyll concentration were analysed in forage plants grown in consortium with *Eucalyptus urograndis* (Clone 1407), with spacing of 4m between trees and 24m between tree rows. Two treatments were established based on light conditions: the control treatment, corresponding to the condition with the highest light corresponded to the pasture row, and the treatment with the lowest light, corresponding to the area under the canopy. The results show that the low light supplied to the forage plant, during the experiment period, under eucalyptus canopies, promotes changes in the intensity of chlorophyll a fluorescence and chlorophyll concentration, indicating low efficiency of the electron transport chain and changes in leaf nitrogen content, due to a possible stress situation.

Key words: cattle, forage, light stress, photosynthesis, silvopastoral system.

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Environmental assessment of precision technological operations management in winter wheat production

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Abstract. Agriculture is one of the most polluting sectors. Agricultural technologies, precise agricultural engineering processes and smart measures that allow reducing emissions of GHG emissions into the environment are strongly desirable. The aim of this study was to assess the influence of site-specific seeding and fertilization technological process management in winter wheat production on GHG emissions to the environment and to perform a production life cycle assessment (LCA), including individual impact categories. Experimental field studies were conducted in 2020–2023 using conventional uniform seeding and fertilization rates (URS) and different precision seeding technologies such as variable rate seeding (VRS), variable rate seeding and variable depth (VRSD), and variable rate seeding, variable depth and variable rate fertilization technologies (VRSD+VRF). When assessing the environmental impact of agricultural technological operations management processes in agriculture, it is necessary to have crop yield results. The best yield of winter wheat grains in the first research year was achieved in the VRS technology (7.78 Mg/ha), in the second – in the VRSD technology (8.74 Mg/ha), and in the third – in the VRSD+VRF technology (4.64 Mg/ha). The analysis of the results of the environmental impact of agricultural technological process management systems showed that the insignificantly lowest GHG emissions (about 488 kg CO2eq/ha) were obtained in the conventional URS technology, which did not require soil electrical conductivity measurements, did not use soil sampling equipment to create variable rate seeding and variable seeding depth and variable rate fertilization maps. However, due to the higher grain yield of winter wheat, the best GHG emission efficiency ratio (10.31) was obtained with the application of the precision VRSD technology. It is also necessary to mention that the application of this precision agricultural management technology resulted in the lowest GHG emissions per ton of winter wheat grains. The change in global warming potential (GWP) depends on the amount of materials used in winter wheat production (seeds, fertilizers, pesticides, diesel fuel, etc.) and changes in grain yield. In our study, GWP was most dependent on grain yield, as precision agriculture management technologies did not have a significant impact on input costs. The GWP analysis showed that a significant reduction in GWP was obtained only in VRSD technology compared to VRSD+VRF. This difference was due to VRSD having the highest winter wheat grain yield, while VRSD+VRF technology increased the chemical fertilizer input. In the development of innovative and environmentally sustainable winter wheat production, it is very important to find the right balance between the benefits to the farmer and the damage to the environment. To ensure the sustainability of agricultural production, it is not enough to apply a separate precision agriculture solution, for this a complex of various measures is necessary, which allows not only cleaner farming, but also better adaptation to climate change.

Key words: Global warming potential, GHG emission, Precision agriculture, Site-specific seeding, Variable rate fertilization.

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VII PRODUCTION ENGINEERING

Development and Case Study of an Industry 5.0 Ready Human-Centric Related Brewing Plant

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Abstract. This article explores the transformative potential of learning factories in mecha- tronic systems development. Learning factories offer a dynamic, collaborative environment that bridges the gap between academia and industry, creating a mutu- ally beneficial ecosystem. The LEONARDO project aims to develop innovative teaching methods, materials and tools for human-centric industrial engineering and management education leveraging on an industry 5.0 replica of a brewing system. Brewing as a process can be considered as highly complex, while brewing as a procedure serves as a "sexy vehicle" for appealing student's interest in industry5.0 applications and human-centric production. The brewing process is and will increasingly be more automated and highly supervised. For the latter, modern implementations of sensors such as electronic nose, electronic tongue, and infrared spectroscopy are required to be installed on the brewing equipment. To efficiently use the sensor outputs, the produced signals need to be merged locally and pro- cessed adequately, researched and investigated deeply by the authors up-front with the results to be summarized. Furthermore, to enable the physical bridging of various involved institutions across Europe, connecting the relevant sites virtually presents another technological challenge. Adequate IoT equipment needs to be selected and included in the whole setup as well. Furthermore, an emphasis needs to be made on the human-centric approach, as well as data visualization. Each of the aforementioned pieces of technology need a thorough investigation along with a decent focus in integrating the puzzle pieces into the big picture which is the brewing plant. In this paper we describe the interaction along with the system integration strategies of the listed fields to enable a future proof industry 5.0 ready brewing plant, focusing on the human-centric approach demanded in the industry 5.0 feature description.

Keywords: digital factory; smart manufacturing; gamification; industry 5.0; human centricity.

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An active learning approach in the Numerical Methods course with students of Chemical and Biological Engineering

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Abstract. In engineering education, a transition from passive to active learning methodologies is ongoing to enhance long-term memory retention and foster deeper comprehension. This has been observed in various scientific areas, where traditional approaches are yielding to the adoption of collaborative problem-solving strategies. This paper presents a case study of the implementation of active learning methodologies in the Numerical Methods course for Chemical and Biological Engineering students at the University of Minho. Through small working groups and hands-on problem-solving activities, students engage in iterative processes, data approximation, and the discretization of differential equations, preparing them for real-world engineering challenges. Feedback from students underscores the effectiveness of this approach in promoting critical thinking skills and enhancing overall learning outcomes. This study contributes to the ongoing discourse on innovative pedagogical practices in engineering education, highlighting the transformative potential of active student engagement in shaping future engineers' professional preparation and success.

Keywords: Engineering education, Learning by doing, Numerical methods, PBL.

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The Importance of Systems Thinking Competencies in Addressing Sustainability on the Example of Minifactory Laboratory

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Abstract. The aim of this article is to describe the importance of acquiring attitudes and skills related to systems thinking and the role of design thinking in addressing sustainability issues.
Understanding the concepts of systems thinking and planning sustainable processes through different activities and tools is the basis for designing for sustainability. Embracing sustainability values and addressing the complexity of sustainability is also part of the GreenComp reference framework for European sustainability competences as a driver for learning for environmental sustainability (Bianchi et al., 2022).
The Minifactory laboratory concept allows learners to visualise, evaluate, analyse, and experiment with systems thinking techniques in the design of a more sustainable and holistic production process.
Systems thinking is one of the key skills in product life cycle assessment (LCA). LCA is a systems-based tool and deals with systems from a much broader and deeper perspective (Laca et al., 2019). Such aspects require the adoption of systems thinking, which in turn is defined as the ability to see the parts of larger mechanisms, to recognise patterns and to reorganise these interactions in a more efficient and effective way.
Digitisation and 3D technology have great potential in the fashion industry. It is not only about speeding up the production process, but also about digitising product development and the production process, ensuring that personalised production (mass customisation) is possible in the industry. Acquiring new knowledge and applying new skills is a necessary step towards reducing the environmental impact of the clothing and textile industry and making it more sustainable.

Key words: design thinking, Life Cycle Assessment (LCA), sustainability, systems thinking.

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VIII VEHICLES AND FUELS

FTIR analysis for determining stability of MeOH–HVO blends for non-road engine application

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Abstract. The Green Deal targets for climate neutrality along with tightening emissions legislation fosters the research on alternative propulsion systems. In non-road mobile machinery (NRMM), particularly in agricultural domain, these efforts largely rally around new fuels substituting fossil diesel, while keeping the benefits of energy security (multi-fueling) high, and robustness provided by the Internal Combustion (IC) engine platform. In this context, the blends of Hydrogenated Vegetable Oil (HVO) and Methanol (MEOH) are amongst the most promising yet under-researched alternatives. While current fuel standards are developed primarily for diesel-like fuels, new multi-component mixtures (like MEOH-HVO) need dedicated methods for determining their suitability in engine applications. In this paper, we evaluate the feasibility of Fourier transform infrared (FTIR) analytics for determining the stability of MEOH–HVO mixtures. The research considers temperature effects during storage by conditioning the test samples at -20 °C and +20 °C respectively. The stability of the blends and different co–solvents is analyzed after six weeks and FTIR spectra is used to identify the chemical bonds. From FTIR spectra analysis, blending MEOH20 with 1-dodecanol results into stable homogenous alkyl-ether fuels, while the MEOH20 blend with methyl-butyrate results into ester fuels. The blend samples stored at room temperature maintained their visible physical properties over the period of six week while those store at cold temperature had obvious changes in their physical appearances. In conclusion, both fuel blends samples formed different fuel types which are stable and homogenous at room temperature, posing great potential for their applicability in different NRMM types.

Keywords: *Agricultural vehicles, Bioenergy, Biofuels, Co–solvents, FTIR, Fuel blend, GHG emissions, Internal Combustion Engines, Methanol, Hydrogenated vegatable oil, Spectroscopy Analysis.*

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Properties of chemically stabilized methanol-HVO blends

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Abstract. Approximately 25% of global carbon emissions come from food production. Renewable fuels are crucial for curbing greenhouse gas (GHG) emissions from vehicles, non-road machines, and agricultural machinery. Tractors, key to modern farming, are central to these efforts. As agriculture strives for sustainable practices, alternative fuels like methanol and hydrotreated vegetable oil (HVO) are gaining prominence due to their renewable nature and potential for blending. To optimize the utilization of methanol and HVO blends and due to their limited solubility in direct mixing, the addition of a co-solvent is essential. However, there is a current research gap regarding the blending properties of HVO and methanol with co-solvents. In this study, three co-solvents including 1-dodecanol, 1-octanol and methyl butyrate were employed to investigate their impact on the miscibility of HVO and methanol. The scope of experimental measurements cross-varied the co-solvent type with different blending ratios (MeOH5 and MeOH10) at room temperature. The investigated parameters include the density, kinematic viscosity, distillation properties and surface tension. The measurement methods were according to standard ASTM D7042, standard ASTM D7345, and the manufacturer's instructions. Based on the experimental results, the effects of co-solvents on methanol-HVO blends were compared. These three co-solvents effectively made the formation of a singular, clear, and homogeneous phase in methanol-HVO blends. Among them, 1-dodecanol demonstrated the highest solubilizing capacity for MeOH5 and MeOH10 blends, followed by 1-octanol. The addition of co-solvents led to increased fuel density, decreased kinematic viscosity, and to surface tension either increasing or decreasing by around 1 mN m^{-1} for MeOH5 and MeOH10. The outcomes of this investigation contribute to the optimization of methanol-HVO fuel blends for efficient and environmentally friendly use in vehicles, non-road machinery and agricultural machinery.

Key words: renewable fuels, methanol, hydrotreated vegetable oil (HVO), co-solvents, blending properties.

IX WASTE RECOVERY

Disinfection of activated sludge by a combination of the Fenton-like reagent and physical treatment

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Abstract. Activated sludge (AS) effluents must meet legislative criteria on hygienisation before their disposal or land application. Nevertheless, disinfection efficiency upon numerous technological approaches to AS stabilisation is still unsatisfactory. Furthermore, potential adverse impacts of AS treatment technologies should be evaluated, e.g., antimicrobial resistance and pathogen regrowth. The main objective of this study was to optimize the AS disinfection process by combining the Fenton-like reagent, heating and ultraviolet (UV) irradiation. The AS was sampled at the SIA "Jūrmalas ūdens" municipal wastewater treatment plant. The AS was treated by adding H2O2 and Fe(II) in the range from 0.05 M to 0.25 M and from 0.02 M to 0.08 M, respectively. Additionally, the samples have been exposed to UV irradiation and heating at 70 □C separately and by combining the two methods. Standardized effects on sludge disinfection of two variable compounds in the Fenton-like reagent were analysed using the Central Composite Design setup in MiniTab, showing the effects as Pareto charts. The disinfection efficiency was evaluated as log reduction. Particularly, the total heterotrophs and Gram-negative bacteria in the sludge were enumerated on the Standard Count Agar and Eosin Methylene Blue Agar, respectively. Enzyme activity, i.e., dehydrogenase and peroxidase, served as additional criteria for evaluating microbial response towards treatments. The results showed that treating AS by H2O2 alone was inefficient, while in combination with Fe(II), heating and UV irradiation achieved up to 4 log-inactivation. This effect was detected after one hour and 72h after the treatment.

Key words: activated sludge, antibiotic resistance, dehydrogenase, Fenton-like reagent, peroxidase.

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The effect of biostimulants on organic meat and bone meal fertilizers granules decomposition and environment

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Abstract. Organic fertilizers improve the properties of the soil, increase humus and organic carbon reserves, and the soil becomes more fertile. Meat and bone meal is a by-product of the meat processing industry, which is increasingly used as an organic fertilizer. This fertilizer contains important substances of nitrogen, phosphorus, potassium and calcium, which are vital for agricultural plants. Organic fertilizers play a particularly important role in organic farming, when chemical fertilizers cannot be used. The aim of this study was to investigate the influence of biostimulants on the intensity of decomposition of organic meat and bone meal fertilizer (OMBMF) granules and to determine the effect of biostimulants on ammonia emissions of OMBMF granules. The research was carried out in Lithuania – Vytautas Magnus University, Agriculture Academy. The experiments were performed with 3 treatments. OMBMF granules were affected by biostimulants: Bio1 (humus soil, 15 ml) and Bio2 (intensive composting, 15 ml). One treatment was a control, when the granules were not affected by biostimulants. The obtained research results showed that the fastest granule decomposition intensity was found in the treatment where the granules were affected by the Bio2 and reached 66.61%, and the lowest in the control treatment in which no biostimulant was used (58.96%). It was estimated, that after keeping the granules affected by biostimulants for several weeks, the concentration of ammonia gas changes slightly and varies in the range from ~ 0.65 to ~ 1.10 ppm on average. The lowest values of ammonia gas concentration were determined on average in the periods ~ 1600 min, 1900 min, 1300 min. The highest values of ammonia gas concentration were determined on average in periods of ~ 600 min, 1700 min. The lowest average ammonia emission from OMBMF granules was recorded after 6 days, and after 4 and 5 days significant efficiency in reducing ammonia emissions was recorded. Greater intensification of ammonia emission from granular organic fertilizers was observed on the second and third day of experimental research.

Key words: granulated meat bone meal, biostimulants, emissions, decomposition intensity, ammonia.

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The use of landfill leachates for anaerobic degradation of natural and synthetic fabrics

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Abstract. Anaerobic degradation of organic wastes in landfills represents a broad spectrum of processes, including decomposition of different types of cellulose-based fibres. The cellulose acetate (CA) polymer is used to make different products in pharmacy and agriculture, as well as textiles, plastic films, cigarette filters, and others. The aim of the present study was to evaluate a biochemical methane potential of CA in landfill leachate, comparing with other cellulose-derived materials, i.e., cellulose, nanocellulose (NC), acetate and viscose textile, as well as pectin. The process was performed during 120 days at 37 □C under laboratory conditions. The total biogas production at the end of the experiment in the tested sets ranged as follows: cellulose>viscose textile>CA>acetate textile>nanocellulose>pectin. In the control sample, i.e., non-amended leachate, biogas was not produced. Cellulase activity in the tested sets after 120 days anaerobic digestion was higher than in control (except the set with NC) and differed in dependence on the specimen added. The dry weight in the sets with cellulose and viscose was lower up to 15%, pectin -12 %, comparing with control, while in the sets with acetate textile and NC – higher by 36 % and 380 %, respectively. In the set with CA the dry weight was like that in control. The electric conductivity varied in the range from 1.17 mS/cm (cellulose) to 8.9 mS/cm (viscose and acetate textile), with 1.74 mS/cm being in the control set. Effect of different cellulose-based specimens on leachate metagenome after anaerobic digestion was analysed.

Key words: anaerobic digestion, biogas, cellulase, cellulose acetate, leachate, metagenome.

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Static analysis of cylindrical nanoshells

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Abstract. The mechanical behaviour of single – layered nanotubes is studied with the help of the Eringen's nonlocal theory of elasticity. A continuum shell model is developed by incorporating the Eringen's principles into the non-linear theory of axisymmetric cylindrical shells. The obtained system of differential equations with partial derivatives are solved by different methods. The cases of nanotubes with different edge conditions are studied in a greater detail. The results are obtained for nanotubes simply supported at both ends and for clamped nanoshells.

Key words: cylindrical sell, nanotube, deflections.

Isolation and screening of low-density polyethylene degrading bacteria from landfill

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Abstract. Municipal Solid Waste (MSW) landfills are the ultimate destination for 42% of plastic waste. Aged plastics serve as unique ecological niches for microbial communities inhabiting landfills. An increasing number of plastic-degrading microorganisms and enzymes have been identified, but knowledge regarding their biodegradation mechanisms and efficiency is still very limited. The aim of the present study was to characterize indigenous bacteria capable of degrading low-density polyethylene (LDPE), which are derived from landfill leachates and weathered plastics at MSW landfill Getlini (Latvia). A high throughput metagenomic analysis of leachate content has revealed a dominant abundance of Proteobacteria (54.7 %), which was also prevalent in the biofilms found on weathered LDPE. Bacterial isolates were tested for the biofilm-forming ability and capacity for attached growth, as single cultures, and functional consortia. Among the strategies for enhancing plastic degradation, statistically optimized incubation conditions were tested, using the Central Composite Design setup in MiniTab. Nutrient amendments, e.g., plant extracts, were shown to stimulate the metabolic functions of dominant bacteria and expand their biodegradation activity. The changes in microbial enzyme activity, i.e., fluorescent diacetate hydrolysis, correlated with the growth of biofilm on LDPE surface. The mechanisms and dynamics of LDPE biodegradation by bacterial consortia were studied in soil and liquid media, including leachates. Analytical tools (GC-MS and HPLC-MS), metagenomic analysis, microscopy (scanning electron microscopy and confocal laser scanning fluorescent microscopy), microbial respiration intensity, ecotoxicological assays, and other methods were applied to reveal the main routes for optimization of plastic biodegradation via bioaugmentation by newly obtained isolates.

Key words: Biodegradation of plastics, Biofilm, Fluorescein diacetate hydrolysis, Low density polyethylene, Metagenome.

Valorization of Aluminium Dross for the Development of Al-rich Product

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Abstract. In this study, aluminium dross undergoes a hydrometallurgical recycling process. Various chemical reagents are employed to treat the aluminium dross, facilitating the maximum extraction of aluminium content from the dross into leach liquor. The hydrometallurgical route ensures efficient aluminium leaching, forming a solution rich in Al, used as a precursor/raw material for valuable material generation. High-grade alumina is obtained by leaching dross with alkalis at 323 K for 3 h and precipitating with acids followed by a calcination process at 1473 K for 3 h. The parameters are optimized and multiple trials are done to ensure the reproducibility of the results. Morphological and topographical studies of the synthesized products are done by XRD and SEM-EDS characterizations. TGA analysis of the samples were also conducted. This work enables to recycling of aluminium dross and converts it into a valuable product which has high demand in refractory and high-temperature applications. By converting aluminium dross into a resource with intrinsic value, this process significantly mitigates environmental impact, aligning seamlessly with the principles of a sustainable and circular economy. In doing so, it exemplifies a proactive approach towards resource conservation, waste reduction, and the responsible utilization of materials within industrial processes.

Key words: Aluminium dross, Hydrometallurgy, Recycling, Recovery, Valuable product.

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Organic solvent selection for delamination of end-of-life silicon photovoltaic modules based on recyclability

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Abstract. Photovoltaic modules (PVMs) are already accepted as renewable energy sources to fulfill future energy demand. E-waste from end-of-life (EoL) PVMs will pose significant challenges for both the recovery of valuable materials and the environmental hazards in the near future. Delamination of photovoltaic modules for recycling typically involves separating the solar cell from various layers of PVM that are; glass, encapsulant ethylene-vinyl acetate, and backsheet. The solar cell is encapsulated by ethylene-vinyl acetate (EVA) layers; the photovoltaic module can be delaminated by a swelling encapsulant layer using organic solvents. The recyclability of organic solvents is investigated in this work, with an emphasis on possible contamination by encapsulated EVA during EoL PVM delamination. To investigate the interactions of encapsulant EVA with solvents, it was extracted from EoL PVMs. This work investigates contamination of organic solvents in the temperature range of 25–55°C and suggests solvent recyclability for reuse and waste reduction. Organic solvents Fourier transform infrared (FTIR) spectra after a 24-hour encapsulant EVA interaction were compared to study organic solvent contamination. This study focused on two different types of solvents: aromatic hydrocarbons (like xylene) and chlorinated hydrocarbons (like CH_2Cl_2). Xylene demonstrated resistance to EVA contamination, making it a preferred organic solvent for recycling EoL PVMs.

Keywords: Ethylene-vinyl acetate (EVA), E-waste, Organic solvent, Photovoltaic Modules, Recycling, Solar cell.

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FOODBALT 2024 - 17TH BALTIC CONFERENCE ON FOOD SCIENCE AND TECHNOLOGY

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I FERMENTATION AND MICROBIOME SCIENCE

Co-encapsulation of food-origin lactic acid bacteria exhibiting probiotic properties with prebiotics in cross-linked alginate microcapsules for long-term storage

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Abstract. The emergence of antibiotic-resistant pathogens and the gradual increase in immune-related health problems have led humanity to turn to natural health care remedies and search for alternative treatments. Probiotic therapy is one of the alternative therapies gaining momentum in healthcare. The biggest challenge is to maintain the necessary amount of viable probiotic bacteria in order to achieve a therapeutic effect. The study aims to determine the impact of prebiotics on the viability of encapsulated probiotic bacteria during long-term storage. Two lactic acid bacteria (LAB) cultures Lactobacillus plantarum and Lactobacillus helveticus were selected for the study. Bacterial cultures that were isolated from natural bread sourdough, to which no commercial leaven was added, were kindly donated by the laboratory of the Food Institute of Kaunas University of Technology. One part of the study was to determine some of the probiotic properties of local food-origin LAB cultures, while the other part was bacteria encapsulation in calcium ion crosslinked alginate microcapsules together with prebiotics inulin, trehalose, or mannitol. Microcapsules were obtained by the emulsification method, when a mixture of aqueous sodium alginate (2 %) solution, LAB bacteria suspension (109 CFU/ml) and prebiotics was dispersed in sunflower oil and then the resulting droplets were gelled with a solution containing divalent calcium ions. The LAB encapsulation efficiency, survival rate during freeze-drying and bacteria viability in freeze-dried calcium alginate capsules during long-term storage were determined. Results revealed that both of the tested cultures had antagonistic effect to B. cereus, L. monocytogenes, P. aeruginosa and were able to co-aggregate with these microorganisms. After analysing the results of experiment, it became clear that LAB cultures did not form biofilms but were able to prevent cell attachment and controlled biofilm formation by S. aureus, L. monocytogenes, E.coli and P. aeruginosa. In the second part of the study, the highest encapsulation efficiency was achieved in control calcium alginate (A) microcapsules without prebiotics and in capsules with trehalose (A-T). Capsules with inulin and trehalose (A-T-P) had the lowest encapsulation efficiency, which possibly depended on the molecular size of the prebiotics, as inulin could occupy part of the internal space of the capsules. However, A capsules showed significantly lower LAB viability after freeze-drying than capsules with inulin or mannitol. After co-encapsulation of prebiotics together with LAB, a cryoprotective effect was observed, as the survival of the bacteria during freeze-drying was significantly increased. Moreover, prebiotics increased the viability of LAB during long-term storage. For example, viable L. plantarum 9.86±0.03 CFU/g cells and 5.79±0.07 CFU/g viable L. helveticus cells were found in calcium alginate microcapsules with inulin and trehalose after 6 months of storage. In conclusion, two food-origin and not belonging to commercial collections LAB cultures exhibited probiotic properties while co-encapsulation with prebiotics helped increase their viability during freeze-drying and long-term storage.

Key words: Probiotic, prebiotic, alginate, encapsulation, viability.

Probiotic inoculated sourdough fermentation effects on complex carbohydrate composition and nutritional value of wheat and rye breads

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Abstract. During sourdough fermentation, flour undergoes transformation, enhancing its nutritional value. Fermentation processes, in both wheat and rye flour, contribute to the breakdown and conversion of dietary fiber carbohydrates, such as arabinoxylans, fructans, and β-glucans. These changes potentially lead to increased dietary fiber content and improved solubility, emphasizing the nutritional significance of sourdough bread in a balanced diet. The aim of the study was to investigate the impact of sourdough fermentation, combined with the inoculation of potential probiotic microorganisms, on the complex carbohydrate composition of sourdough and resulting bread. Four potential probiotic microorganisms (Saccharomyces boulardii, Lactiplantibacillus plantarum, Lacticaseibacillus rhamnosus, and Bacillus coagulans) were used to inoculate sourdoughs, with spontaneous fermentation acting as a control. After 24 and 48 hours of fermentation, samples were taken for analysis. The content of dietary fiber components of arabinoxylans, fructans, and β-glucans were measured in resulting sourdoughs and breads. The fermentation of wheat flour led to significant reductions in starch content and enhanced the solubility of arabinoxylans by 21%. The incorporation of probiotics, particularly Saccharomyces boulardii, notably decreased fructan content to 0.15 g/100g and boosted the soluble dietary fiber content by 38%. Similarly, in rye flour sourdough bread, fermentation increased total arabinoxylan content by 22% and improved its water solubility by 16% when combined with probiotics, with Saccharomyces boulardii demonstrating the most significant reduction in fructan levels achieving a 57% decrease. Combining sourdough fermentation with the inoculation of potential probiotic microorganisms enhanced the nutritional value of wheat and rye sourdough breads. The resulting breads exhibit increased dietary fiber content and solubility, with S. boulardii showing promising potential in enhancing both these aspects in wheat and rye sourdoughs and bread. This study highlights the potential of sourdough bread as a functional food source and the benefits of utilizing probiotic microorganisms in bread fermentation.

Key words: dietary fiber, sourdough, bread, inoculated fermentation, probiotic microorganisms.

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The impact of lactic acid bacteria and yeasts ratio on fermentation and taste of kvass

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Abstract. Kvass, a non-alcoholic beverage derived from rye malt or special rye bread through natural fermentation, traditionally involves yeast in the production process. However, the introduction of various lactic acid bacteria (LAB) accelerates fermentation and imparts a distinctive taste and aroma to the kvass. This research aimed to optimize the ratios of LAB to baker's yeast in kvass to enhance its fermentation, sensory qualities, and physicochemical properties, thereby improving its acidic flavour and overall acceptability. Baker's yeast and three commercial LAB strains were used for fermenting the kvass wort dried rye bread. The experimental design focused on four distinct inoculation ratios: 100% LAB, 50% LAB:50% yeast, 80% LAB:20% yeast, and 100% yeast. Key parameters such as pH, dry matter content, and titratable acidity were monitored over 12, 14, and 16 hours of fermentation, with a detailed sensory analysis conducted on the 80:20 LAB to yeast ratio kvass samples that were fermented for 14 hours and then cooled. It was found that varying the ratios of LAB and yeast significantly affected the fermentation process. Extended fermentation times, particularly with higher LAB ratios, led to more pronounced acidity and sensory characteristics. Optimal microbial balances, notably the 80% LAB to 20% yeast ratio, enhanced kvass's flavour profile and physicochemical properties, suggesting a tailored approach to fermentation can improve kvass's quality and consumer acceptance. These variations, alongside significant strain- and species-related differences, highlight the importance of microbial balance in enhancing kvass's acidic flavour and overall acceptability.

Key words: sour kvass, lactic acid bacteria, non-alcoholic beverage, *Saccharomyces cerevisiae*.

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Viability of L. Reuteri encapsulated in the structured W/O/W emulsions during the shelf life and gastro-intestinal digestion

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Abstract. Probiotics contribute to balanced gut microbiota, enhancing nutrient absorption, modulating the immune system, and producing bioactive compounds. However, they are sensitive to high temperatures, oxygen, and harsh gastro-intestinal conditions. To achieve a positive effect of probiotics is essential to have a substantial concentration of viable microorganisms, typically exceeding 10^6–10^7 colony forming units per millilitre or gram in the product. For this reason, the use of double-emulsion formulations is a promising strategy to encapsulate viable microorganisms and enhance their viability during the shelf life. In this study, we investigated the characteristics of W/O/W emulsions loaded with L. Reuteri cells and structured in two different ways: 1) external water phase containing whey proteins gelled with calcium chloride (W/O/Wgel), 2) oil phase gelled with carnauba wax (W/Ogel/W). The rheological features showed that all emulsions were gel-type structures with thixotropic behaviour. The W/Ogel/W samples were more stable (at 7th day it was 99.02±1.19%) than the emulsions W/O/Wgel (at 7th day it was 96.63±0.67%). Besides that, during the storage time (56 days) the stability and pH decreased in all double emulsion samples with encapsulated L. Reuteri. The bacteria viability study indicated quite promising results. It was found that bacteria encapsulation in differently structured W/O/W emulsions significantly improved bacteria viability compared to the free cells. In the initial time point, the viable cell numbers of all tested samples varied between 6.71±0.21 and 7.53±0.08 lg CFU/g. Throughout the storage period up to 56 days, L. reuteri viable cell numbers were found to be 5.45±0.14 and 6.54±0.07 lg CFU/g, when they were loaded into W/O/Wgel and W/Ogel/W respectively. To prove that W/O/W loaded with probiotics is capable of protecting them under upper gastrointestinal tract conditions, the survival of L. reuteri cells throughout in vitro digestion was evaluated. As a control, the suspension of L. reuteri cells was used and exhibited around 1 log cycle reduction at the end of the gastric stage and 2 log cycle reduction at the end of the intestinal stage. A significant difference in L. reuteri cells viability during the gastric stage of digestion was recorded when they were uploaded into the differently structured W/OW. The low survival of probiotic bacteria during the gastric phase was observed in the uploaded W/Ogel/W (1.7 log cycle reduction at the end of the gastric stage). However, no reduction of viable bacteria was recorded at this point in the case of L. reuteri cells encapsulated in the W/O/Wgel. Yet, by encapsulating probiotics in the structured W/O/W, it was possible to protect them from the effects of the bile acids present in the intestine; no decrease in the cell count was recorded during intestinal digestion in both structured W/O/W. To sum up, W/O/W emulsion with structured external water phase is favorable for the delivery of a sufficient amount of viable L. Reuteri cells without changing the structural stability of emulsion during storage.

Key words: double emulsions, double emulsion gels, probiotic bacteria, gastro-intestinal digestion.

Acknowledgments. This project has received funding from the Research Council of Lithuania (LMTLT), agreement No S-A-UEI-23-1 (22-12-2023).

Effect of dietary fiber rich berry pomace on changes in the composition of the gut microbiota in the Simulator of the Human Intestinal Microbial Ecosystem (SHIME®)

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Abstract. As a by-product of the juice industry, berry pomace is usually converted into animal feed, used as agricultural fertilizer, or placed into landfills even though they still possess phytochemicals with potential benefits for human health. Although research has been carried out in this area, the use of berry pomace as a functional ingredient is still under-investigated. This research aimed to evaluate the impact of dietary fiber-rich berry pomace fermented by Lactbacillus reuteri on microbiota composition in a simulated gastrointestinal tract during a short digestion period (48 hours). The impact of the fermented cranberry and lingonberry pomace on the gut microbiota was evaluated in vitro through the TWIN-M-SHIME® system manufactured by ProDigest (Ghent, Belgium).There was performed tripleSHIME, where SHIME I was control sample with L. reuteri, SHIME II – sample with fermented cranberry pomace and SHIME III with fermented lingonberry pomace. The quantitative changes of the target microorganisms group of gut microbiota were evaluated using absolute quantification of DNA by digital PCR (dPCR). The results revealed that dietary fiber-rich cranberry and lingonberry pomace possess prebiotic and probiotic activities as a significantly higher abundance of Lactobacillus was found in the colon reactors of SHIME II and III (cranberry 26.79 copies/µl and lingonberry 11.36 copies/µl, respectively), compared to the corresponding colon vessels of SHIME I (Control with L. reuteri 1,7 copies/µl) after 24 hours. It is known that gut microbiota is largely modulated by diet in humans: high fiber intake is associated with increased levels of Prevotella. Our results have shown that after fermented berry pomace supplementation during the first 24 h, the abundance of total Prevotella dramatically decreased in all colon vessels of SHIME systems, compared to target group of bacteria in the slurry. However, in the colon vessels, the number of Prevotella increased in the colon reactors of SHIME II and III (cranberry 116.65 copies/µl and lingonberry 37.98 copies/µl, respectively) after 48 hours of digestion. It should be indicated, that the number of Prevotella in the colon vessels of SHIME I decreased during the whole period of the study and reached 0.68 copies/µl after 48 hours. The drastic decrease in Prevotella in the colon vessels of SHIME I may be due to the influence of L. reuteri on these bacteria. The results indicated that the lowest amount of L. reuteri was in the colon vessels of SHIME I (882.31 copies/µl) as compared with SHIME II vessel (1292.6 copies/µl). Overall, these results suggest that tested fermented by L. reuteri berry pomace can be used as functional food products with probiotic and prebiotic properties.

Key words: SHIME, microbiota, berry pomace, prebiotic, probiotic.

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Characterizing the effect of fermentation on different plant-based matrices for development of cheese alternatives

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Abstract. Majority of the work has been focusing on the proteins obtained from one plant source, and less is known how different blends of plant proteins affect the aroma or sensory profile of the fermented mixtures. The need for mixing different raw materials is derived mainly from nutritional aspects, but studies focusing on the combined effects of raw materials and bacterial blends could help to achieve desired flavor profile for development of dairy alternatives as well. The aim of this study was to evaluate the effect of thermophilic and mesophilic fermentation in 6 different plant-based matrices from the point of view of the formation of dairy-like aroma compounds and reduction of off-flavors. The matrices with 7% plant protein were chosen as a base where the protein source was either yellow pea, fava bean, or a combination of thereof either with oat solution or water. The evaluation of the mixtures was based on chemical composition (organic acids, sugars, and free amino acids), sensory properties and volatile profile by GC-MS analysis. The fermentation process was characterized by following bacterial growth with isothermal microcalorimetry and acidification time with iCINAC system. The results depend on the used medium, protein source, and the bacterial composition of the starter culture. The fastest acidification time and bacterial growth was observed in all matrices with oat base as well as samples fermented with thermophilic culture. Mesophilic culture, on the other hand, produced highest level of glutamic acid in all the used mixtures, which was also confirmed by the umami taste in sensory evaluation. The main identified ketones in legume mixtures were acetoin, 2,3-butanedione and 2-heptanone. Both bacterial blends produced dairy-like compound acetoin, whereas mesophilic culture demonstrated also utilization of citrate pathway for acetoin production by consuming all the citric acid in the water-based samples. Volatile compounds, such as 3-methylbutanoic acid (sour, stinky feet, cheese) and 2-methylbutanoic acid (sweet, cheesy), depend on protein source as higher levels of these compounds were determined in pea proteins mixtures regardless of the used bacterial blend or base.

Key words: plant protein, fermentation, volatile compounds, GC-MS, glutamic acid.

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Influence of fermentation process on sensory properties of legumes spreads

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Abstract. To make legumes' concentrates a more attractive food source, efforts need to be focused on improving their sensory properties. Although fermentation is known to improve the functional, nutritional, and sensory properties of legumes, the results of different studies vary and are inconsistent depending on a protein source, microorganisms and regimes applied during fermentation. The aim of the study was to compare the profile of aroma compounds in spreads produced from different protein concentrates. The protein concentrates (PC) (LTD Aloja-Starkelsen, Latvia): brown pea, yellow pea, faba and Alomix (mix of pea concentrates), starter culture CHN22 (Chr. Hansen Holding, Denmark) were used in the research. The legumes spread were produced according to the following scheme: PC was thermal treated (72 ± 1 °C, 30 ± 5 min), cooled (22–32 °C), inoculated, mixed and fermented (till pH 4.9–4.6). PC, thermally treated concentrate, and fermented spread using different fermentation temperatures were analysed. Aromatic compounds were detected using Perkin Elmer Clarus 500 GC/MS and an Elite-Wax ETR columns (60 m × 0.25 mm i.d.; DF – 0.25 μm). Content of tannins was detected using spectrophotometer Libra S70 PC (Biochrom Ltd., USA). The studied PC, thermally treated PC and spreads differed in the concentration of tannins, but significantly lower ($P < 0.05$) concentration was detected in fermented spreads. Comparing aroma compounds significantly lower ($P < 0.05$) hexanal, and significantly higher ($P < 0.05$) 1-hexanol proportion was established in fermented spreads; however, results depend on the PC and applied fermentation temperature. The choice of PC and appropriate fermentation temperature can positively affect the taste, aroma and tannin content of the product.

Key words: aroma compounds, lactic acid bacteria, spread, tannins.

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II VALORIZATION OF FOOD BY-PRODUCTS AND UNDERUTILIZED CROPS

Evaluation of phenolic compound composition of Sambucus nigra berries grown in Latvia

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Abstract. Phenolic compounds in agricultural raw materials can vary within a species and can be affected by a combination of such factors as growing region, weather conditions and fruit ripeness. Climatic differences between the southern, central and northern parts of Europe can cause differences in the phenolic compounds present in the plant. The research was aimed to investigate the phenolic compounds of berries of *Sambucus nigra* varieties grown for commercial production in Latvia. During the study four elderberry varieties were analysed – 'Haidegg 17', 'Korsör', 'Haschberg' and 'Emma'. All samples were analysed for total phenolic compound content (TPC), DPPH free radical scavenging activity and individual phenolic compounds. In addition, sample pH and total soluble solids (TSS) were measured. Results showed that 'Emma' berry samples had the highest value of TSS content – 10.5% (°Bx) and the lowest pH value – 3.65. The variety 'Korsör' showed the lowest TSS content – 8.1% (°Bx) as well as the lowest TPC and DPPH free radical scavenging activity, the variety 'Haschberg' showed the highest pH value. The variety 'Haidegg 17' stood out with a high TPC. In total six phenolic compounds were identified and quantified in the analysed samples – gallic acid, catechin, chlorogenic acid, p–coumaric acid, sinapic acid and 3,5–dihydroxybenzoic acid. According to the obtained results, it was evident that the indicators for some parameters differ from the information available in the literature about the composition of berries of crops grown in other regions. This suggests that it is worth further researching elder tree varieties grown in northern climate.

Keywords: DPPH, elderberry, HPLC-PDA, polyphenols, soluble solids.

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Comparison of the effect of microwave treatment on the bioactive properties of zucchini and parsley

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Abstract. Numerous scientific studies confirm that frequent consumption of vegetables provides many health benefits resulting from the presence of bioactive ingredients that reduce the risk of many lifestyle diseases, such as: stroke, cancer, heart disease, type 2 diabetes, or obesity. In recent years, there has been a tendency among consumers to look for short-term methods of processing food raw materials, the use of which allows to significantly shorten the time required to prepare meals. The aim of the study was to compare the effect of microwave treatment on the antioxidant properties and total polyphenol content in two different types of vegetables - zucchini, which in terms of morphological and physiological characteristics is a fruit resulting from the outgrowth of a zucchini flower, and parsley, which is a root vegetable. Two species of vegetables were analyzed: zucchini called squash (Cucurbita pepo convar. giromontiina Greb.) and parsley (Petroselinum crispum). Freshly harvested raw materials - zucchini fruit and parsley root - were fragmented and then microwaved in a microwave oven with a power of 800 W for 2 minutes. 30 sec. The processed plant raw material was then homogenized and then extracted in 80% aqueous ethanol solution for 24 hours in the dark. The obtained extracts were analyzed after centrifugation. Total antioxidant activity was measured using the DPPH and ABTS method and the ability to reduce Fe3+ ions using the FRAP method. Total polyphenol content was also measured using the Folin-Ciocalteu reagent method. Application of microwave processing caused significant changes in the bioactive properties of the tested vegetables. A decrease in the total reducing activity (Fe3+ ions) in parsley was observed. However, in zucchini no significant reduction in total reducing activity was observed as a result of microwave treatment. A significant increase in the content of polyphenolic compounds was observed as a result of microwave treatment in both tested vegetables. However, the microwave treatment resulted in a higher increase in the content of polyphenolic compounds in zucchini than in parsley. The conducted research indicates that microwave processing may be beneficial in terms of the content of polyphenol compounds for vegetables such as zucchini and parsley. Perhaps in the tested vegetables, as a result of microwave processing, a large amount of polyphenolic compounds are released from the polysaccharide matrix that is an element of the vegetable cell walls. Moreover, microwave heating resulted in a relatively small loss of reducing activity in the tested vegetables (especially zucchini), which indicates that this type of rapid thermal treatment may be beneficial in terms of bioactive activities for the tested raw materials.

Key words: thermal processing, zucchini, parsley, polyphenols; antioxidants.

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Growth dynamics of microorganisms in rainbow trout marinated with fruit and berry pomaces

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Abstract. In recent years, there has been an increasing trend in food technology to increase the use of various plant-origin materials including fruit, and berry pomaces, a by-products of juice production, in the composition of food of animal origin. This is mainly because of potential health benefits of plant derived bioactive components to human health. Also, this is in good agreement with the principles of the circular bioeconomy. The use of berry pomaces reduce the food waste and provides added value to the final products. The aim of the study was to evaluate the effect of apple, black currant, rhubarb or tomato pomace aqueous extracts containing marinades on the growth dynamics of microorganisms in raw rainbow trout within the determined study period.
Fresh rainbow trout (Oncorhynchus mykiss) fillets were purchased from a local fish farm. The pomaces were obtained after juicing of the apples (Malus domestica Borkh.), black currants (Ribes nigrum L.), rhubarbs (Rheum rhaponticum L.) and tomatoes (Lycopersicon esculentum Mill.). Aqueous pomace extracts were prepared in a ratio of 1:10 (w/v), calculated for a solids content of 10%. The pomace extracts were pasteurized at 80 ºC for 20 minutes, sealed airtight in glass bottles and cooled. Finally for each pomace extract the 3% sugar, 3% salt, 1% acetic acid and 0.25% citric acid were added to obtain the marinade. Enumeration of aerobic mesophilic microorganisms, yeasts and moulds, presumptive Pseudomonas spp., and L. monocytogenes was performed according to the ISO standards. The challenge test in accordance with the technical guidance document (version 4 of 1 July 2021) of the European Union Reference Laboratory for L. monocytogenes was carried out to determine the growth potential (δ) of L. monocytogenes in marinated fish samples.
It was found that in most of the samples the number of aerobic mesophilic microorganisms increased during the 22-day study period. However, interestingly in all samples, there was a decrease in the number of Pseudomonas spp. from 3.42 log10 cfu/g to 1.00 log10 cfu/g. Also, the numbers of moulds and yeasts were low in all tested samples throughout the study period remaining between 1.00 and 2.95 log10 cfu/g. The growth potential of L. monocytogenes was lower than 0.5 log10 cfu/g in all tested samples during the 15-day challenge period, which means that the marinated product did not support the growth of L. monocytogenes. Comparing the results of initial and final numbers of L. monocytogenes, a tenfold decrease in the average counts of the pathogen was counted in the black currant pomace, followed by the apple pomace and rhubarb pomace fish samples. Within the entire study period, the lowest average numbers of L. monocytogenes were observed in the black currant pomace containing fish samples compared to the control. On the final day of the durability study, day 15, the lowest growth potential of L. monocytogenes was found for black currant pomace and apple pomace containing marinated fish samples.
The use of apple, black currant, rhubarb and tomato pomaces in marinades can ensure a sufficiently long and microbiologically safe shelf-life for the marinated raw rainbow trout products.

Key words: marinated rainbow trout, pomaces, microbiological quality and safety, valorization of food by-products, Listeria monocytogenes.

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Minimal inhibitory concentrations, polyphenolic prophile and antioxidative properties of the extracts of selected berries and their pomaces

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Abstract. The aim of the study was to establish minimal inhibitory concentrations (MIC) of the aqueous vs 30% aqueous ethanolic extracts of Aronia melanocarpa (Michx.) Elliott i.e. chokeberry (CB), Ribes nigrum L. i.e. blackcurrant (BC), and Sorbus aucuparia L. i.e. rowan berries (RB) and the corresponding pomaces (+P) against bacterial species L. monocytogenes, S. aureus, E. coli, and C. jejuni. Polyphenolic prophile and antioxidative properties of the extracts were also determined. Aqueous extracts and 30% aqueous ethanolic extracts were prepared of the powders of dried berries and corresponding pomaces in the ratio 1:20 (w/v). The extracts were chromatographically analyzed using a 1290 Infinity system (Agilent Technologies, Germany), coupled to an Agilent 6450 Q-TOF mass spectrometer equipped with a Jetstream ESI source and to an Agilent 1290 Infinity Diode Array Detector. The minimal inhibitory concentration (MIC) values of the extracts were determined against tested bacteria by the broth microdilution method in 96-well microplates, according to the EVS-EN ISO 20776-1:2020 guidelines. Analyses of antioxidative properties (AO) of plant extracts were performed using the DPPH free-radical-scavenging method on an Infinite 200 Pro M Plex plate reader instrument (Tecan Austria Gmbh, Austria). The total content of polyphenols (TCP) was significantly ($P < 0.05$) higher in the ethanolic extracts than in the aqueous extracts. The TCP of plant extracts was in descending order as follows: CB > CBP > BC > BCP > RB > RBP in etahnolic, whereas in aqueous extracts the order was different: CB > BC > CBP > RB > BCP > RBP. The berry pomaces contained 60 – 70% of the polyphenols of the corresponding berries. The sensitivity of tested bacteria to the extracts of berries and berry pomaces starting from the most sensitive bacteria was as follows: S. aureus > L. monocytogenes > E. coli ≈ C. jejuni. No correlation was established between TCP and antibacterial (AB) properties of the plant extracts. The antioxidative properties in extracts with both solvents from highest to lowest were as follows: CB > CBP > BC > BCP ≈ RB > RBP. The AO properties were significantly ($P < 0.05$) higher in the ethanolic extracts than in the aqueous extracts. TCP correlated strongly positively with AO, both in aqueous ($r = 0.92$) and in 30% ethanolic extracts ($r = 0.93$). The extracts of CB and BC berries and berry pomaces had higher TCP, they also had better AB and AO properties compared to RB and its pomace. Among studied plant extracts TCP did not correlate with MIC values, indicating that other compounds besides polyphenols e.g. organic acids can cause the AB effect in the studied plant extracts. As berry pomaces, left over from juice pressing contain 60 – 70% of the TCP of corresponding berries, they should be further used as a source of beneficial compounds and not discarded as waste.

Keywords: MIC values, chokeberry, blackcurrant, rowan berries, berry pomaces.

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Baking properties of einkorn wheat grown in Estonia

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Abstract. In addition to bread and durum wheat, other types of wheat are grown on smaller scale in the world. Einkorn and emmer wheats (Triticum monococcum L. subsp. monococcum and Triticum turgidum subsp. dicoccum) are some of the aforementioned. Einkorn wheat was one of the first plants that was domesticated and cultivated. Einkorn wheat has lower yields but can survive on poor, marginal soils comparing with modern common wheat varieties. There has been an increasing interest in healthy ancient wheat products in Europe. In Estonia, einkorn is not yet known to producers, but is used to some extent by the food industry. Also, health-conscious nutritionists are familiar with this type of wheat. Since Estonian producers and food industry are interested in cultivating and using innovative and healthy cereals, the agricultural company Rannu Seeme OÜ applied for a project "Growing single grain wheat in Estonia and diversifying the use of wheat and rye" with Estonian Crop Research Institute and the Agricultural Research Centre (METK) and Tallinn University of Technology as cooperation partners. In addition to cultivation, the project also explores the possibilities of einkorn for sprouting and baking, as well as questions related to health (content of protein and gluten, fibers, microelements and B group vitamins). According to Brandolini and Hidalgo (2011), einkorn has a much higher protein content (15.5-22.8%) and antioxidant content than common wheat. Its composition of essential amino acids is higher than that of hexaploid bread wheat. At the same time, its gluten is different from that of common wheat (gluten is softer). Therefore, it is expected that a different baking methodology will be required. Since Estonia is north of the historical and evolutionary origin of einkorn wheat (Turkey, Georgia, Armenia, Iran, etc.), it is necessary to test different genotypes of einkorn and to develop technologies for the food industry so that locally produced rare grain can be used. Baking trials with einkorn wheat were carried out in METK and Tallinn University of Technology. Aim of these experiments was to study applicability of einkorn flour for sourdough and yeast fermented bread baking in comparison with white-bread wheat. The einkorn variety used was 'Terzino', grown in Estonia by Rannu Seeme in 2022. Sourdough breads were prepared from four wholegrain flours: rye, wheat, spelt and einkorn with the same technology using long (24 h) fermentation time. The doughs and breads were analysed for pH, organic acid content, microbiome, bread volume, texture and sensory properties. For yeast fermented bread the mixing time and flour water absorption of dough were tested. Our results showed that einkorn wheat can be used for bread baking but it has specific taste and smell. Refined einkorn flour was not suitable for bread as a single cereal. Use of einkorn wheat in combination with rye and other flours will be tested next.

Key words: Einkorn wheat, bread, sourdough, yeast fermented, wholegrain.

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Valorization of spent osmotic solutions by spray drying

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Abstract. The research aimed to valorize spent osmotic solutions (applied in other study for apple osmotic dehydration), including classic sucrose solution, honey solutions, fruit juice concentrates solutions and mannitol solution by production of powders through spray drying operation. Additionally, inulin was tested as the value-added replacement for maltodextrin, to check its usefulness as a drying carrier. Spray drying was done at inlet air temperature of 160°C, while outlet air temperature was 60°C. Powders were analysed for moisture content, water activity, particle morphology and size, solubility, hygroscopicity, bulk density and flowability. Sucrose solution, characterized by higher glass transition temperature than fruit juices and honey could be dried without stickiness problem, which was observed for fruit juices or honey. The yield of spray drying was dependent on the type of raw material, and it varied from 6% (apple solution) to 92% (sucrose solution). Only two experimental variants could be classified as efficient: sucrose and buckwheat honey (61%). Low yield for mannitol (26%) could result from low particle size, low moisture content and bulk density – small and light particles were probably not possible to be separated in the cyclone and were lost with outlet air. Low yield indicated much worse properties of inulin as a carrier than maltodextrin applied for similar materials in previous studies. Drying yield was significantly negatively correlated with particle size. The particle size of apple juice solution, acacia honey solution, cherry juice concentrate, chokeberry juice concentrate powders was significantly higher (above 700 □m) than observed usually for spray dried materials. It resulted from high stickiness and low usefulness of inulin as a carrier for these raw materials. Other physical properties were at the typical levels for this type of materials: moisture content below 5%, water activity below 0.3, high hygroscopicity (higher than 15%), high solubility (higher than 95%). Exceptional properties were observed for mannitol powder (very low moisture content and hygroscopicity, lower bulk density that other powders), what probably resulted from its crystalline form. Powders were characterized by good or medium flowability according to Hausner ratio values

Key words: spray drying, powder, drying yield, particle size, physical properties.

Onion skin waste extract's double encapsulation as method to manage food waste

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Abstract. Nowadays, we can observe the increasing interest in natural food colorants and bioactive compounds of health beneficial properties. Moreover, food industry seeks methods for reutilization or more economical applications of food by-products that reduce processing waste. Encapsulation is a method that enables to protect unstable compounds by lowering the risk of degradation caused by environmental conditions. This research aimed to evaluate the double encapsulation as a method of producing health beneficial powders of food waste material. Ultrasound assisted extraction (60%, 20 min, 50°C) of red onion waste solids was performed. The extract was encapsulated first using 18.5 mg/mL, 37 mg/mL, 74 mg/mL HP-β-CD ((2-Hydroxypropyl)-β-cyclodextrin) and then the anthocyanin and phenolic content were assessed in order to determine the highest content of bioactive compounds in order to choose the best variant for the second stage of encapsulation. The variant of 74 mg/mL of HP-β-CD was lyophilized using maltodextrin (MD) and gum Arabic (GA) as carriers (5:1 and 9:1 carrier:extract solids, MD:GA 1:1). Moisture content, water activity, particles morphology, phenolic and anthocyanin content and antioxidant activity of obtained powders were assessed. Both variants characterized with water content lower than 5% and water activity lower than 0.2, which ensured powders stability. Higher phenolic and anthocyanin content was observed in the variant with lower carriers content, which was an effect of higher content of extract in encapsulated powders.

Key words: food waste, double encapsulation, lyophilization, bioactive compounds, food powder.

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Microencapsulation of sea buckthorn (*Hippophae rhamnoides* L.) pomace bioactive compounds

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Abstract. Sea-buckthorn (*Hippophae rhamnoides* L.) is cultivated in Estonia on more than 1000 ha and most of the plantations are under organic fruit production. The processing side streams of sea-buckthorn comprise up to 15% of pomace derived from the juice production which is rich in many bioactive compounds such as polyphenols and tocopherols. Spray drying is a method for preserving the valuable bioactive ingredients and enhancing their storage and stability. For this purpose, proteins of animal origin are mainly used alone or in combination with other compounds as wall materials for protection and encapsulation of the core material. The current study focused on applying the proteins from hemp, canola, and flax seed combined with maltodextrin as wall material for producing fully plant-based spray-dried powders, but using whey protein as control. The sea buckthorn pomace extracts were used as core material for obtaining polyphenol rich powders. The sea-buckthorn pomace was obtained from juice production at Polli Horticultural Research Centre of Estonian University of Life Sciences, Estonia. The yield and efficiency of the encapsulation were calculated, as well as the colour, morphology, particle size distribution, hygroscopicity and storage stability of the spray-dried powders were determined. The protein content of hemp, canola and flax concentrates was 70, 50 and 47 g 100 g^{-1}, respectively, with good emulsifying and foaming capacity. The encapsulation yields of sea buckthorn extracts ranged from 60.9–74.3% and the efficiency of the encapsulation was 69.2–80.3%. The difference in encapsulation yield and efficiency between different wall materials was not statistically significant. The use of hemp protein resulted in particles about twice as large as those obtained with canola, flax, and whey. All obtained powders were considered as only slightly hygroscopic, as the hygroscopicity was ≤ 20% for all samples. The study aimed to characterise the functional properties of oil-seed proteins, namely hemp, canola, and flax, and test their application as wall materials for microencapsulation in combination with maltodextrin. The results were promising for considering the high potential of encapsulation of sea buckthorn pomace bioactive compounds for further use in food industry.

Key words: sea buckthorn, bioactive compounds, pomace, encapsulation, full valorisation.

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Valorisation of different genotypes of rowan (*Sorbus* spp.) for development of functional food ingredients

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Abstract. The by-product of juice production, the rowanberry pomace possesses significant antioxidant capacity values. In order to choose the best candidates for development of functional food ingredients out of the rowanberry pomace, the polyphenolic composition and antioxidant capacity were evaluated for pomace samples of locally grown 16 sweet rowanberry cultivars and wild rowanberry (*S. aucuparia* L.). The lyophilized pomace of the most promising cultivars 'Likernaja', 'Solnechnaja' and wild rowanberry were selected for further biorefining due to their highest antioxidant capacity and total polyphenolic contents. Their preparations were applied as food ingredients for inhibiting the lipid oxidation in meatballs and prolonging their storage time. The untargeted metabolomics, which aims to analyze small molecules (metabolites) in a food system, was used for evaluating the changes of metabolites in meatballs with and without the addition of rowanberry pomace-based antioxidants during their shelf-life period to identify the biomarkers of food spoilage. The natural ingredients possessing antioxidant capacity obtained by rowanberry pomace valorisation were defatted pomace (AC), extraction residue (R) and lyophilized ethanolic extract (E) with sensory acceptable doses of 2% AC and R and 1% E. The most effective rowanberry ingredient was 1% of E. During 14 days of storage test, the ingredients inhibited the development of unpleasant flavours caused by carbonyl compounds, while the concentration of linoleic acid derivatives decreased only in the control sample, indicating the peroxidation of unsaturated lipophilic components. These findings prove the hypothesis that the rowanberry pomace-based ingredients can be beneficial functional ingredients for food.

Key words: antioxidant capacity, lipid oxidation, pomace, rowanberry, untargeted metabolomics.

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Processing of non-marketable P. Eryngii mushrooms to form a nutritional supplement with improved content

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Abstract. Mushroom processing residues occur in the production of various preparations and gastronomy products, but also during mushroom growth process, which is a product that is not suitable for market, which can make up to 25% of the raw material. This by-product is a rich source of biologically active compounds and is useful for further use in nutrition. As a result of our applied processing, a non-marketable P. Eryngii mushroom extract based on xanthan gum (E415) is obtained, which is enriched with vitamin D2, α/β-glucan and contains an increased amount of amino acids and water-soluble vitamin B. Successful results were obtained by exposing fresh fruiting bodies of P. Eryngii mushrooms under a light source in the UV-A/B range. As a result of processing, mushroom sterol (ergosterol) is transformed into vitamin D2 (ergocalciferol), indirectly enriching the biomass with a biochemically important component. With a 45-min exposure to a UV-A/B light source (293/47 kJ m-2), it is possible to obtain up to 3.00 mg/100 g dry weight. It is noteworthy that not only the significant benefit in the production of vitamin D2, but also the preserved ergosterol content in the final product of 625 mg/100 g. Taking into account the fact that the creation of a functional composition is limited by the size and volume of the capsule shells, it is necessary to obtain the mushroom extract mass first hand. Among the studied extraction variants (CO2/EtOH, nephrase, H2O, H2O/EtOH), alcohol/water extraction (EtOH, 45%) was recognized as the most appropriate, showing the highest ABTS value (11.00 ± 0.10 g TE/100g extract). Extraction of dry mushroom mass with 45% EtOH gave an extract with 1.80 mg/100 g vitamin D2 content. In addition, the exposure of mushrooms under UV light source has a beneficial effect on the extraction of group B vitamins, which is higher (15.0 mg/100 g DW) than that contained in mushroom extracts that were not irradiated (1.20 mg/100g DW). Of particular interest is the content of amino acids in the obtained extracts, which form the taste of mushrooms. The content of sweet amino acids in 45% EtOH extracts is lower (270 mg/100g DW) than the content of bitter amino acids (2630 mg/100g), which in turn mainly consists of essential amino acids. An important indicator is the low amount of remaining fiber (30–40 %), in contrast to the extraction using a non-polar solvent (nephrase) (99.0–99.4 %), supercritical CO2 (97–99 %) and polar (water) (35–45 %) extractant. From the apparently low value mushroom fiber, α/β-glucans, whose content reaches 22.0 mg/100 g, were additionally isolated by the hot-water extraction method. The last step involves drying the obtained extracts in a spray dryer. The combination of amphiphilic polysaccharide E415 emulsion with the obtained glucan extract mass and alcohol/water extract (1:0.02:10) shows excellent properties of the final product. The resulting powdery mass can be supplemented with extracts of other plants and biologically active substances, such as zinc citrate, succinic acid and the like.

Key words: pleurotus eryngii, dietary supplement, UVA/B light, vitamin B, vitamin D2.

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Relationships between the effects of plant additives on linoleic acid oxidation and microbial growth in minced pork

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Abstract. Peroxidation of polyunsaturated fatty acids (PUFA), especially unconjugated linoleic (9,12-octadecadienoic) acid and microbial degradation of various constituents are the main integrated processes of spoilage of muscle foods. Peroxidation of linoleic acid in meat occurs through the combination of enzymatic and free radical mechanisms, the most important oxidation enzymes being lipoxygenase (LOX) and cytochrome oxidase P450 (CYP450). The aim of this study was to describe the relationship between these two processes in minced pork in the presence of nine plant-derived additives. Powders of freeze-dried apple (*Malus domestica*), also without seeds, blackcurrant (*Ribes nigrum*), rhubarb (*Rheum rhaponticum*), tomato (*Lycopersicon esculentum*), chokeberry (*Aronia melanocarpa*), garlic (*Allium sativum*), and rowan berries (*Sorbus aucuparia*) were mixed with fresh minced pork (2% w/w) and stored at 6 °C during 8 or 14 days. Samples were taken at days 1, 4, 6, 8 and additionally at days 11 and 14 for rhubarb. Enumeration of aerobic mesophilic microorganisms, yeasts and moulds, and presumptive *Pseudomonas* spp. was performed according to the ISO standards. The main primary oxidation products of linoleic acid (oxylipins) were quantified by LC-MS performed on a 1290 Infinity system liquid chromatograph coupled to 6450 Q-ToF mass spectrometer (Agilent Technologies, Germany). Concentration of malondialdehyde (MDA) as a main secondary oxidation product of linoleic acid was estimated using 2-thiobarbituric acid reactive substances (TBARS) method on an Agilent 1100 series LC-UV/Vis chromatograph. All additives inhibited the growth of tested microorganisms compared to meat, but to different extents. Blackcurrant (BC) powder had both high antioxidant and antimicrobial activity. The antioxidant activity of BC is mainly due to the free radical scavenging and LOX inhibiting effect of polyphenols of the anthocyanin group, there are various hypotheses about the mechanisms of the BC`s strong antimicrobial effect. Chokeberry (CB), with higher anthocyanins content, showed lowest MDA value, but had lower antimicrobial activity than BC. Rowan berries, which contained less anthocyanins than CB or BC, also had lower antioxidant capacity, but moderate antimicrobial activity. Garlic and rhubarb had by far the lowest antioxidant activity, showing the highest values of both MDA and total oxylipins already at days 4 and 6, respectively. However, these additives were most effective in inhibiting microbial growth that could be caused by MDA and oxylipins. According to the literature, MDA is also synthesized by the corresponding bacterial enzymes. As an efficient cross-linker of macromolecules such as DNA, MDA is particularly toxic to microorganisms. Removal of seeds significantly reduced the antibacterial and antifungal activity of apples, while maintaining high antioxidant capacity. Apparently, seed-specific substances such as furocoumarins or phloretin, which have no antioxidant effect, are responsible for the antimicrobial effect of apples. Seedless tomato significantly inhibited linoleic acid oxidation, while like seedless apple, was relatively powerless against microorganisms. Considering both antioxidant and antimicrobial effects, it is difficult to achieve reasonable extension of the shelf life of minced pork when combined with a single plant.

Key words: antimicrobials, antioxidants, oxylipins, plant-derived, pork.

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Effect of different defatting methods on Japanese quince seed protein extract technological properties

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Abstract. While fleshy parts and seed oil of Japanese quince ae well-studied as sources of bioactive ingredients, little research has been done into proteins, which constitute a significant portion of the seed. The aim of the study is to determine the effect of different defatting methods on protein extractability and technological properties. Seed flour protein content was analysed using the Kjeldahl method. Whole seeds contained 19.86% protein and 11.75% fat. For defatting, screw-pressing, supercritical CO2 extraction and a combination of the two were used. Protein extract purity was calculated as amino acid sum, recovery was taken as percentage of extracted protein from total protein in flour used for extraction. Protein was extracted using alkaline extraction-isoelectric precipitation. Water and oil absorption were determined gravimetrically, viscosity (1% dispersion) was analysed using a viscometer, foaming activity was calculated on displaced liquid basis, emulsification activity (both 0.5% dispersion) was determined spectrophotometrically. Supercritical CO2 extraction had a slight negative effect on protein yield (by about 1%), but reduced fat content had a positive effect on protein extract purity (R2=0.85) and recovery (R2=927). Extract purity was 64.65% from non-defatted flour, 80.12% from press cake flour, 94.11% from CO2 defatted flour, and 96.09% from combination defatted flour. In most of the flours, the globulin fraction solution had the strongest Biuret reaction, except press cake protein, in which the glutelin fraction reaction was strongest and fraction yield was highest. The albumin solution Biuret reaction was significantly stronger than the prolamin solution, but the yield was similar and very small. The technological properties of the proteins followed similar pH-dependant curves, but differed between differently defatted samples. Water and oil absorption capacity were inversely associated with fat content in the flour (linear regression R2water=0.977 and logarithmic regression R2oil=0.903), while only water absorption capacity was strongly associated with protein extract purity (linear regression R2=0.916). Both were lowest in the non-defatted flour protein (48% oil absorption, 198% water absorption) and highest in the combination-defatted flour protein (117% oil absorption, 332% water absorption). Viscosity was highest at pH 7, except for combination-defatted flour protein, which was more viscous at pH 5, but similar at pH 7 and 9. Foaming activity index was lowest at pH 7 and differed significantly between samples ($p < 0.01$). Foam stability did not differ ($p > 0.08$) between pH or CO2¬ and combination defatted flour protein extract dispersions, which were the only ones with a significant displaced liquid volume. Emulsification activity index was also lowest at pH 7 and was highly variable within samples and similar between defatting methods ($p > 0.05$). Emulsion stability did not differ between pH or defatting methods ($p > 0.1$). Higher purity protein extracts from more efficiently defatted flour exhibited better technological properties. Other conditions in play during defatting need to be accounted for, such as increased pressure and heat, which can negatively affect protein extract purity and recovery. Due to differential technological properties, differently defatted flour cannot be considered interchangeable in subsequent protein extraction.

Key words: Chaenomeles, emulsifier, functional protein, fruit, valorization.

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Second life for food industry by-products – Valorization of blackcurrant pomace as a functional component in restructured freeze-dried snacks

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Abstract. Consumers seek healthy and convenient products derived from high-quality and nutritious materials. At the same time, concerning the concepts of sustainable production and circular economy, the food industry faces the challenge of processing by-products management. One of the common by-products exposing the potential for further use is fruit and vegetable pomace. They contain a significant amount of bioactive compounds, pectin and fibers, which consequently contribute to the technological and functional properties of pomace. Therefore, the application of fruit pomace as a food additive could be a solution addressing the needs of both consumers and producers. The purpose of this research was to evaluate the possibility of dried blackcurrant pomace powder valorization and its effect given on selected physicochemical properties and microstructure of multicomponent freeze-dried snacks. The matrix consisted of frozen carrot, concentrated orange juice, ginger and water. Additionally, dried blackcurrant pomace powder (BP) was added at 1, 3, and 5% combined with calcium lactate (0, 0.01, 0.05%). The material with no additives and with low-methoxyl pectin (LMP) at 0.5% with 0.01% calcium lactate was the control material. The BP was subjected to hydrothermal treatment in calcium lactate solution at 85°C for 1 min. All components were blended in a laboratory knife mill GM 200 (Retch, Germany) at 4500 rpm for 1 min, frozen at –40°C, and freeze-dried in Alpha 1–2 LD plus freeze-dryer (Martin Christ GmbH, Germany) at 30°C (63 Pa) for 48 h. To evaluate the effect of the pomace powder addition, the developed samples were tested in terms of water content and activity, hygroscopic properties, microstructure—including porosity and pore size distribution, texture, color, polyphenols content (TPC) and antioxidant activity. The application of BP lowered the water activity and porosity of the material. Computed tomography exposed the presence of a large number of small and unevenly distributed pores in the structure. As a consequence of the microstructure modification, the reduction of hygroscopic properties with the growing amount of BP was observed. Applied additives strengthened the structure, hence causing changes in compression curves and elevated hardness. Considering texture, the effect given by 5% of BP was comparable to that obtained with 0.5% of LMP. Moreover, blackcurrant pomace infusion affected also the nutritional value of the snacks by increasing TPC and enhancing antioxidant activity. The material structured with BP was characterized by significantly different colors compared to both control samples. Overall, obtained results showed that dried blackcurrant pomace powder (BP) can be successfully applied and valorized as a food additive supporting stability, texture, and bioactive compounds content, thus fortifying the physicochemical properties of freeze-dried fruit and vegetable snacks.

Key words: blackcurrant pomace, pectin, freeze-dried snacks, microstructure, physicochemical properties.

Nordic-Baltic Committee on Food Analysis: Current Activities, Validation of Methods, and Application of Mass Spectrometry

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Abstract. The Nordic-Baltic Committee on Food Analysis (NMKL, https://www.nmkl.org) is an important network for food analysis experts to address current analytical challenges in food analysis. NMKL was established in 1947 consisting of chemists, microbiologists, sensory analysts and statisticians from the Nordic countries. NordVal International, reviewing and certifying proprietary methods, was established in 1999 and incorporated in NMKL in 2007. Food experts from the Baltic countries Estonia, Latvia, and Lithuania joined NMKL in 2022. NMKL is linked to Nordic Council of Ministers by EK-FJLS Food. NMKL aims at developing standardized methods and procedures fit-for-purpose to ensure safe and healthy food products in our region. We prepare guidelines and procedures relevant for laboratories and stakeholders, and hold courses, seminars, and workshops to help and support food laboratories and users of their services. An overview of ongoing activities in the NMKL groups of Microbiology, Chemistry, Sensory and NordVal International will be presented. Currently, NMKL has announced two upcomming events that are open for registration (https://www.nmkl.org/events). First, a workshop on validation and certification of alternative methods for food analysis to be held 28 May in Vilnius. Second, a general microbiology course in food analysis for laboratory personnel to be held in Helsinki 27-28 November. The latter course is intended to be held in different Nordic and Baltic countries in respective national languages in the near future, and the recently published new procedure (Proc. No. 33) on quality assorance on PCR in food and feed microbiology laboratories will be presented in this course. This talk will introduce important aspects of method development, validation, verification, and application. As an example, I will present the new and further developed method for simultaneous determination of the vitamins B1, B2, B3, B5 and B6 in feed and food using LC-ESI-MS/MS. The fact that only one sample preparation is needed makes this method very attractive due to both time and cost efficiency. The trueness of the method normally lies within 80-120% with an RSD below 10% for for all these vitamins in standard reference materials and other matrices tested. A brief orientation will be given about execution of an InterLaboratory Study validation of the method and attempts to harmonize such a standardization process with other international standarization ordanizations.

Keywords: LC-MS/MS, method validation, NMKL, vitamins.

III FOOD PRODUCTION AND PROCESSING

The effect of dark cutting and wet ageing on the technological properties of the beef

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Abstract. The study aimed to determine the effect of dark cutting on the technological properties of beef. Twenty-seven grass-fed beef cattle bulls from two farms were slaughtered at the age of 13–18 months. The sires of the offspring belonged to the Hereford and Simmental breeds, while the dams' breeds were Aberdeen-Angus, Hereford, and Simmental. Semitendinosus muscles were harvested from the carcasses for analysis, which was carried out on the 7th, 14th, 21st, and 28th days of ageing. Eight muscles exhibited a pH of 6 or higher within the wet ageing period, which was defined as the threshold for dark cutting. A linear mixed-effects model in the R 4.3.2 package 'lme4' was utilized to identify statistical differences between the groups. Dark cutting significantly affected the CIE L*a*b* colour space results. Meat samples with high pH tended to be darker and less intensively red and yellow compared to muscles with normal pH during the ageing period. However, no significant colour change was observed in either group over time of ageing. Dark cutting of the beef had a significant effect on water holding capacity (WHC), as meat samples with high pH retained moisture better even under external pressure. The loss of moisture from dark cutting meat samples during the ageing period varied from 5.97 to 7.24%, compared to 9.41–11.82% in muscles with normal pH. Drip loss of water in vacuum packages was also significantly lower in the dark cutting group (1.10–2.17%) during the last three ageing days compared to meat samples with normal pH (3.21–5.21%). WHC exhibited a significant decrease between day 7th and later ageing days in meat samples with normal pH, whereas an increase in drip loss in vacuum bags was observed over the ageing period. Although WHC remained stable during the ageing period in dark cutting beef, drip loss in vacuum bags increased, being significantly lower between day 7 and the last three days. While Warner-Bratzler shear force (WBSF) indicated that dark cutting beef was tenderer than meat samples with normal pH, no significant difference was found. The ageing period did not affect the tenderness of the beef in both pH level groups. The semitendinosus muscle, being a weight-bearing muscle, tends to have a denser structure with more connective tissue. This inherent toughness can make it resistant to tenderization during ageing compared to muscles with a finer texture and less connective tissue. The results revealed that the presence of dark cutting was not related to the chemical composition and the physical measurements of the semitendinosus muscle and the growth performance of the beef cattle. However, the fatness score on the SEUROP scale was significantly lower (1.61) in carcasses with higher muscle pH values compared to normal ones (2.24). Dark cutting beef is often associated with leaner muscle tissue due to increased glycogen utilization and altered metabolic processes. Overall, the findings suggest that dark cutting significantly influences the colour and WHC of semitendinosus muscle in beef but does not have a substantial impact on tenderness.

Keywords: beef, semitendinosus muscle, dark cutting, wet ageing, technological properties.

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Striving for carbon-flow balance through the reduction of dietary land footprint

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Abstract. This study addresses the urgent need to counteract the rise in anthropogenic greenhouse gas (GHG) emissions, underscoring the significance of balancing carbon flows. Through an exploration of socially acceptable dietary changes, the research aims to reduce the land footprint of food consumption in Estonia, thereby decreasing land-based carbon emissions. Evaluating three diets, including a reference diet and a nationally recommended diet (NRD), the optimized diet demonstrates a 15% reduction in land footprint through reduced animal product consumption and increased intake of plant-based foods. Featuring a versatile modeling framework, this study contributes valuable insights to global initiatives striving for a harmonious balance in the carbon cycle.

Key words: consumption land footprint, diet change, multi-objective nonlinear programming, Estonia.

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Influence of Light Intensity and Spectra on Swiss Chard Microgreens Growth, Pigment Composition and Total Phenolic Contents

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Abstract. Microgreens have recently paid attention, because of their high nutritional quality, short growth cycle and minimal space requirements. Microgreens contain abundant amounts of antioxidant compounds, e.g. phenolics, carotenoids, and chlorophylls, which are important in the maintenance of human health and disease prevention. As these phytochemicals are closely related to photosynthesis, the most important factors impacting their content changes are light quantity and quality. In previous studies, influence of light intensity and spectrum to growth and chemical composition of most cultivated and consumed leafy microgreens and common herbs are widely studied. The mixture of red and blue light has been reported to be beneficial for many crops, but the results are species-specific. This is the first study investigating impact of light intensity and quality to growth, and production of total phenolic compounds, chlorophylls, and carotenoids of Swiss chard (Beta vulgaris ssp. vulgaris var. cicla) microgreens. Swiss chard microgreens were grown 17 days under two different light intensities. Cool white fluorescence tubes were adjusted to light intensities 170 µmol $m^{-2}s^{-1}$ (F170) and 300 µmol $m^{-2}s^{-1}$ (F300). LED lighting was set to intensity of 300 µmol $m^{-2}s^{-1}$ and the spectrum containing red (660 nm) and blue (450 nm) wavelengths (LED300). Experiments were carried out in growth chambers with 16-hour daily photoperiod. Day/night temperatures were 22/19 °C and humidity 60/70%. The experiments were carried out with six replicates. Polyphenols and pigments were extracted using accelerated solvent extraction (ASE) and determined spectrophotometrically. As assumed, in both high light intensity treatments (F300 and LED300), fresh and dry weights of the microgreens were higher than under low light intensity (F170). The higher total phenolic content (9.96 mg GAE g^{-1} DW) was obtained under blue/red light spectrum with high light intensity (LED300) than in low light intensity treatment (F170) (9.07 mg GAE g^{-1} DW), whereas there were not differences between the other treatments. The highest total chlorophyll and carotenoid contents in microgreens were obtained under low light intensity (8.69 and 1.19 mg g^{-1} DW). Exposure to blue/red spectrum in LED300 treatment resulted to the lower amounts of both pigments (7.10 and 1.00 mg g^{-1} DW) than in F300 treatment (7.78 and 1.09 mg g^{-1} DW). Our results Indicated that light intensity and quality cause variation in Swiss chard microgreens growth and phytochemical composition. Overall, our results demonstrate that exposure of Swiss chard microgreens to high light intensity enhances the growth and production of phenolic compounds, whereas cultivation under low intensity light increases carotenoid and chlorophyll contents. The elevated levels of phenolics, carotenoids and chlorophylls in the leaf tissue increase nutritional quality of the Swiss chard microgreens, but as shown in this study, optimal light conditions for production of specific compounds vary.

Key words: light intensity, light spectrum, microgreens, Swiss chard, phytochemical content.

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Furan content in commercial baby foods produced in Estonia

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Abstract. The aim of this study was to analyse the Estonian surveillance data on furan content in baby food. Organic baby food pouches were collected under surveillance program of the Agriculture and Food Board in 2021 and 2022. Baby foods were collected from Estonian retail markets. Materials included eighteen commercial organic baby food pouches samples from 2021 and twenty samples from year 2022. Products were categorized to the following groups: vegetable-based baby foods, vegetable-meat based baby foods and fruits-based baby foods. Analyses were performed in Eurofins WEJ Contaminants GmbH laboratory, in Germany. The determination of furan in foodstuffs was done by gas chromatographic headspace analysis (headspace GC/MS) according to JCFU4, CON-PV 00572 (2021-03) HS-GC-MS method. Quantification limit was 5 µg kg^{-1}.
Furan contents of baby foods of various compositions were different. In 2021 and 2022, a total of 38 infant food samples were analysed for furan content. The majority of samples analysed were fruit-based infant foods (n = 27), with fewer vegetable-based samples (n = 3) and vegetable meat based food samples (n = 8). The highest average furan levels were found in vegetable meat-based infant foods (120 µg kg^{-1}). In contrast, fruit-based infant foods had an average furan level of 7.40 µg kg^{-1}. From the category of fruit-based foods, the highest furan content was detected in Lingonberry-blueberry-rye porridge. In these products the furan content was 17 and 25 µg kg^{-1}, respectively. The main components added to cereal-based infant foods were fruits, but since cereal-based ingredients were also added, their furan content was slightly higher than that of purely fruit-based infant foods. Difference was found between fruit- and vegetable-based baby food groups. Vegetable-based infant foods had an average furan level of 43 µg kg^{-1}. All fruit-based samples contained similar amount of furan (SD ± 4.6). Both vegetable-based and vegetable-meat-based groups had high dispersion between the data indicating that they contain furan in very different amounts (SD ± 36.81 and ± 67.78). Based on the results of statistical comparison between studied food groups, it can be concluded that there was significant difference (P < 0.05) between the furan content of each baby food group. The highest median was in the vegetable-meat-based group and the least was in the fruit-based group. Vegetable-based foods usually require higher temperatures and/or longer cooking times, which potentially increases the furan formation.
Vegetable- and vegetable-meat-based food groups contained higher amounts of furan compared to fruit-based food groups. The furan content of these three food groups were compared and a significant difference was found. In this study, the highest furan content was in the vegetable-meat-based food group. Furan formation in baby foods is a significant safety concern and strategies to reduce the formation of furan should be addressed.

Key words: baby foods, furan, content, food safety, surveillance.

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Experimental system for investigating processes of shock freezing of meat

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Abstract. Shock freezing affords reduction of freezing time, production of much smaller ice crystals that preserves the tissue structure and nutritional value of the product. The advantage of using ultrasonic bulk waves for monitoring the freezing process is the ability to trace the dynamics of changes in the properties of the meat tissue directly using ultrasound velocity, attenuation and the waveform shape. The purpose of the study was to create an experimental freezing system with follow up ultrasound propagation parameters in meat specimens during shock freezing. The samples were frozen by the electric pipe-freezing unit Frigo 2F-Zero of REMS with the temperature control by a calibrated thermocouple. Ultrasonic signals were recorded continuously by a custom-made ultrasonic setup in the through transmission mode using a pair of 2.5 MHz transducers mounted on a calliper-based probe. The following trends were observed during the freezing stages. Ultrasound velocity decreased in lean meat and increased in fatty meat with cooling at temperatures above zero. Rapid drop of ultrasonic signals at temperatures below zero associated with the beginning of the crystallization process and the presence of both liquid and crystal components. Ultrasonic signals increased as the samples were completely frozen and ultrasound velocity increased to values close to those in icy bodies. Differences in ultrasonic parameters on a time scale during freezing were revealed for lean and fatty meat samples demonstrating a possibility to investigate specific freezing regimes for different types of meat.

Key words: meat products, shock freezing, ultrasonic testing.

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A review of the food authentication research using class-modelling approaches

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Abstract. Food authentication, the process of verifying the alignment between product characteristics and claims, is a critical aspect of the food sector, particularly in the face of globalization and complex supply chains. Besides the analytical technique used to determine food authenticity, a proper and meaningful data processing with multivariate statistics and chemometrics is fundamental. For instance, discriminant and class-modelling approaches are often used in the context of food authentication and both assign objects to predefined classes. Discriminant techniques compute a mathematical function that delineates boundaries in the multivariate space, effectively partitioning it into regions corresponding to dataset classes. However, in scenarios where the main focus is on the 'authentic' class, class-modelling approaches like SIMCA (Soft Independent Modelling of Class Analogy) are preferred. These approaches construct a function for the target class, outlining a region where its samples are more likely to be situated. SIMCA, emphasizing individualized class characterization, yields robust results even when modifications are introduced to the dataset after the model is built, providing a distinct advantage over discriminant methods. Therefore, the aim of this article is to review the advancements of food authentication and underline the role of SIMCA in guaranteeing meaningful results. This review is based on a literature search conducted using the Scopus database, considering works published over a 10-year span from 2015 to the present (1st January 2024).and containing the terms 'SIMCA,' 'Food,' and 'Authentication' within their titles, abstracts, and keywords. A total of 71 research papers have been selected. The review is structured around three key elements: i) the aims of the research, ii) the technologies employed for food authentication, and iii) the specific food products under investigation. Adulterant detection emerged as the most extensively studied issue, with 29 out of 71 articles, highlighting the significance of combating adulteration practices in the food industry. Other key topics include the verification of geographical origin (19 articles), authentication of a food category (17 articles), and confirmation of the species used in products (9 articles). Analytical methods used in these studies revealed the prevalence of spectroscopic analyses, primarily based on NIR and IR spectroscopy (29 articles), Raman, NMR, and UV-Vis spectroscopy (18 articles). The advantages of these methods include the possibility to perform the analysis using portable instruments. Additionally, 19 articles described the application of analytical methods, including chromatography and mass spectrometry. Among food, the categories ‘spices and herbs’ and ‘oil and fats’ were the most investigated. In fact, these classes are identified as particularly susceptible to adulteration and food frauds. SIMCA provides robust results in food authentication even in the presence of dataset modifications. While recent advancements in portable spectroscopic devices offer interesting potentialities, limited studies indicate a need for further exploration in this area. As future perspectives, the review suggests a need to shift attention towards emerging food products, such as insects, meat analogues, and food based on alternative proteins. The dynamic nature of the food supply chain requires continuous adaptation, and future research should address the authentication needs of these innovative products.

Key words: Food Authentication, Class Modelling, Food Frauds, Adulterations, Geographical origin.

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Evaluating disinfection strategies against resistant microbial communities

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Abstract. In the food industry, biofilms pose significant challenges in maintaining cleanliness and ensuring product safety. Biofilms are complex microbial communities that adhere to surfaces, forming a protective matrix of extracellular polymeric substances. These structures can develop on various surfaces within food processing facilities, including equipment, pipelines, and storage containers. The purpose of this study was to evaluate the effectiveness of possible biofilm elimination strategies using bacterial isolates from the production environment of 8 representatives of the dairy, meat, bakery, and vegetable industries. Bacterial strains were selected based on their frequency and ability to cause product quality problems. The research focused on finding effective methods to combat these resistant microbial communities. Bacterial strains (n=167) from 18 taxonomical families were analysed. The biofilm formation of bacterial monocultures and the resistance of the formed biofilm to disinfectants commonly used in Estonian food processing facilities were evaluated after 24 and 48 hours of cultivation at 37 °C on microtiter plates. After biofilm formation, the efficacy of four most used disinfectants was tested: Epides Strong 73.5% (active ingredient: ethanol), P3-oxysan ZS 0.3% (active ingredients: acetic acid, peracetic acid, hydrogen peroxide), alkaline solution 1.5% (active ingredient: NaOH), and acidic solution 1.5% (active ingredient: HNO3).The effectiveness of the disinfectants was evaluated by treating biofilm-covered surfaces with the corresponding solution for 15 minutes and subsequent staining with crystal violet (CV) and 2,3,5-triphenyltetrazolium chloride (TTC). This method allows simultaneous assessment of disinfectant impact on biofilm quantity and microorganism viability. Strongest biofilm formers were isolated form vegetable and dairy industries. Across various food industries most effective biofilm formers after 24 and 48 hours of incubation included representatives from both gram-positive and gram-negative species among *Bacillus* spp., *Kocuria* spp., *Acinetobacter* spp., *Micrococcus* spp., *Cronobacter* spp., *Staphylococcus* spp., and *Macrococcus* spp. The most effective disinfectant against biofilms of varying biofilm growth ages turned out to be the acid-base disinfection method. Research findings demonstrated that viable cells persisted even after chemical treatment, suggesting that the biofilm matrix shields bacteria cells from disinfectants, and mechanical intervention is necessary to completely eradicate the biofilm. Interestingly, there were differences in the effectiveness of disinfectants for the same bacterial species isolated from different food processing plants. This finding suggests that microorganisms in the food industry adapt to the disinfectants and decontamination programs used in the facility.

Key words: biofilm formation, microbial adaptation, food production hygiene

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Effect of ozone on sugar content in seeds and sprouts

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Abstract. The sprouts of seeds and grains have been used in the world diet for centuries. Sprouts are used not only because of their high nutritional value, but also because of their soft, juicy and refined taste. Sprouts not only diversify the menu, but also contain many biologically active substances, sugars, proteins, fibers, various vitamins and minerals. The aim of this study was to determine the effect of ozone on the sugar content of broccoli (Brassica oleracea), radish (Raphanus sativus), alfalfa (Medicago sativa) seeds, wheat (Triticum aestivum) grain and sprouts after treating them with ozone gas. Ozone is a strong oxidizer and an unstable chemical compound that breaks down into molecular oxygen and a free oxygen atom in a relatively short time. For seed and grain treatment the following ozone gas concentration were chosen: 50 ppm at a flow rate of 1.0 l/min for seed exposure for 1, 2, 3, 4 and 5 hours. Not treated with ozone edible seeds/grains were as control. Samples were prepared from dry seeds, sprouts after 3 days of germination and sprouts after 7 days of storage in a cold chamber at 3 ± 2º C in the dark. Fructose, glucose, sucrose and maltose were determined in the samples. The results of the study showed an insignificant effect on the sugar content after treatment with ozone.

Key words: sprouts, seeds, germination, ozone, sugar.

Chemical characteristics of PEF-pretreated strawberries dried by various methods

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Abstract. Agricultural raw materials, such as vegetables and fruits, are important food products in everyone's diet because they provide many bioactive nutrients. The high water content in these materials and their seasonal availability oblige manufacturers to use operations aimed at modifying and/or preserving these products. At the same time, the cellular structure, which is sensitive to mechanical processes, and the presence of thermolabile bioactive ingredients limit technological possibilities. The mechanism of pulsed electric field (PEF) is based on a phenomenon called electroporation - the formation of pores in the cell membrane. As a result, the treated tissue is characterized by increased permeability. The aim of this work was to investigate the impact of PEF (electric field strength: 1 kV/cm; specific energy inputs: 1, 2.5, and 4 kJ/kg) on selected chemical properties (total phenolic content – TPC; antioxidant activity – ABTS and DPPH assays) of strawberries dried using the following drying methods: convective (CD – air temperature: 55°C; air velocity: 1.5 m/s), infrared-convective (IR-CD – distance between material and infrared lamps: 20 cm; air velocity: 0.5 m/s), microwave-convective (MW-CD – microwave power: 200 W; air velocity: 2 m/s), and vacuum (VD – pressure: 4 kPa; air temperature: 55°C). Moreover, reference process, carried out without PEF pretreatment, was performed for comparison purpose. The application of PEF as a treatment before CD caused lower retention of phenolic compounds and a reduction in the antioxidant activity of the treated materials (in relation to the untreated sample). PEF may have increased the activity of polyphenol oxidase – an enzyme responsible for the oxidation of phenolic compounds that have an antioxidant character. Opposite trends were observed in the case of IR-CD and MW-CD – all PEF-treated strawberries exhibited higher TPC and antioxidant activity than untreated samples. PEF, by shortening the drying time of processes mentioned above, reduced the time for which these samples were exposed to unfavorable conditions. The VD case shows how important it is to properly select the process parameters. The mild-processed sample (1 kJ/kg) had higher TPC and antioxidant activity than the untreated sample, but the samples which were treated with PEF at higher specific energy inputs (2.5 and 4 kJ/kg) were characterized by lower content of these compounds than the untreated sample. The higher amount of energy supplied during the PEF treatment might have resulted in an overprocessing of the materials. PEF applied as a pretreatment, by creating pores in the treated tissue, and thus, by improving the drying rate, led to an increase in total phenolic content and antioxidant activity of majority of the dried strawberries (in relation to untreated samples).

Key words: pulsed electric field, electroporation, hybrid drying, bioactive compounds, quality.

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Comparative analysis of organic and conventional milk from brown and holstein breeds in Latvia: possible role of bioactive compounds in lactic acid bacteria growth

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Abstract. Developing organic fermented dairy products is of great interest as they combine the benefits of or functional products with sustainable practices. However, there is still limited information regarding the factors that presumably can affect the growth of lactic acid bacteria used as a starter culture during the production of fermented dairy products from organic milk. Therefore, the present study aims to differentiate the bioactive composition of organic and conventional milk and emphasize its possible role in developing lactic acid bacteria. Organic (n = 15) and conventional (n = 15) milk samples approached by HPLC revealed similarities ($P > 0.05$) in the content of immunoglobulin A and polyunsaturated fatty acids as only 2.9% and 7.1% differences were observed; the values corresponded to 154.33 and 149.84 µg mL^{-1} and 5.04 and 4.68 g 100 g^{-1}, respectively. However, the results of whey proteins, detected with ELISA Kit, indicated 20.4% ($P < 0.05$) higher lactoferrin values in organic milk samples than in conventional milk, amounting to 45.27 µg mL^{-1} and 36.04 µg mL^{-1}, respectively. In turn, the amount of lysozyme in conventionally produced milk was 1.4-fold higher ($P < 0.05$) than that observed in organic milk, corresponding to 22.04 µg L^{-1} and 15.68 µg L^{-1}, respectively. The concentration of monounsaturated fatty acids was also statistically higher ($P < 0.05$) in conventional milk than in organic, corresponding to 28.65 and 26.02 g 100 g^{-1}, respectively. Overall, the profile of bioactive compounds in organic and conventional milk indicated substantial differences between the groups. Both organic and conventional milk samples represented constituents responsible for antimicrobial activity. It can be assumed, that the higher concentrations of lysozyme and MUFA in conventional milk may serve as factors enhancing a higher inhibitory activity against lactic acid bacteria when compared to organic milk. In the future, this must be confirmed by comparing both individual components and their combinations in correlation to the growth dynamics of lactic acid bacteria in organic and conventional milk.

Key words: monounsaturated fatty acids, lysozyme, lactoferrin, Lactobacillus delbrueckii ssp. bulgaricus, Streptococcus thermophilus.

Biochemical profile and antioxidant activity of dried fruit produced from apricot cultivars grown in Latvia

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Abstract. The study aim is to evaluate the profile of bioactives and the antioxidant activity of Latvian cold-hardy apricot (Prunus armeniaca L.) cultivars and demonstrate a possible way of processing them to obtain a new food product, such as dried candied fruit. It is hypothesized that North Europe's apricot fruit grown under certain abiotic stress conditions are nutrient-denser than its counterparts grown in Southern regions. Four cultivars (cv.), i.e., 'Dimaija', 'Velta', 'Gundega', and 'Boriss' grown in the orchard of the Institute of Horticulture were used as raw material for the preparation of dried candied fruit products. As a control, apricot fruits of Greek origin were purchased from the local market to compare the results. The physical-chemical characteristics of apricot fruit and its candied products: moisture, total soluble solids, titratable acidity, carbohydrate, vitamin C, phenolics, flavonoids, carotenoids and antiradical activity (DPPH, FRAP) were studied. Sensory evaluation utilizing a 12-point line scale and a 5-point hedonic scale was performed to assess the color, appearance, taste, sweetness, sourness, texture, and overall acceptability of dried candied fruit developed by osmotic dehydration and convective drying. The outstanding composition of group compounds, i.e., phenolics, flavonoids, and vitamin C, was observed in the cv. 'Dimaija', followed by cv. 'Gundega' and cv. 'Velta'. The lowest values were found in the cv. 'Boriss' and fruit from a market of Greek origin. However, the latter two contained the highest carotenoid levels due to a more pronounced maturity. Amongst the 13 individual phenolics detected, rutin, chlorogenic and neochlorogenic acids, catechin, and epicatechin prevailed. Osmotic dehydration and convective drying of apricot fruit variedly influenced the content of bioactives in dried candied fruit products. The most substantial decrease due to thermal lability was observed in the vitamin C content in candied fruit products, accounting for a 95.3% loss for all cultivars. The content of total phenolics, flavonoids, and carotenoids in products, on average, was 62.7%, 49.6%, and 87.6% lower than that observed in the raw fruit, respectively. On average, the content of individual phenolics in candied fruit products, such as rutin and chlorogenic acid, decreased by 63.8% and 20.8%, respectively. However, the increase in the content of cell wall-bound phytochemicals, such as catechin and epicatechin, was observed in products, corresponding to a 59.5% and 255.64% increase compared with the raw fruit, respectively. Panellists generally responded positively to the developed candied fruit products; however, greater preference was given to products with a lower phenolic content, such as cv. 'Boriss' and those produced from the market fruit. Overall, apricot fruits represent the abundance of bioactives retained in candied fruit products after osmotic dehydration and convective drying. The findings observed in the current study allow us to consider candied fruit products as a functional food; however, given the high sugar content, their consumption should be in moderation.

Key words: convective drying, fruit processing, fruit quality, osmosis, phenolic compounds.

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IV NOVEL FOODS AND FUNCTIONAL FOODS

Evaluation of plant-based ice cream quality during storage

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Abstract. Ice cream is a type of frozen dessert that is consumed by almost all segments of the population. Recently, the market for plant-based alternatives has rapidly expanded, including the consumption of plant-based ice creams, as consumers become more aware of the health and environmental benefits of plant-based products. Ice cream is a highly temperature-sensitive product. Temperature fluctuations during the storage and distribution stages can cause physical, chemical, and sensory changes, leading to a reduction in quality. Dairy ice cream has been extensively studied in terms of storage conditions and changes in ice crystal size due to the recrystallisation phenomenon. It is known that when the recrystallisation occurs, then a critical average ice crystal size (around 50 µm) can be reached, resulting in a coarse and grainy mouthfeel. However, the scientific information regarding the plant-based ice cream changes during the storage is limited. The present study has two objectives: firstly, to evaluate the sensory properties and acceptability of plant-based ice cream after storage for 9 months; secondly, to evaluate the effect of storage temperature using microscopic techniques. For that stable storage conditions (-20°C) are compared with samples subjected to heat shock for 4 weeks. The results demonstrated a slight increase in the ice crystal size of the heat-shocked ice creams which was not detectable by sensory evaluation. Based on the results of the studied storage time points, we can conclude that the plant-based ice cream was stable over time and has maintained its original quality.

Key words: plant-based, ice cream, storage, quality, ice crystal.

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Crickets (Acheta domesticus) - Novel Food Ingredient: Influence on Bread and Biscuits Quality and Safety Characteristics

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Abstract. The European Food Safety Authority recognized insects (IN) as novel foods (2015/2283), as well as, the Food Agriculture Organization recommended including them in Western diets [1,2]. The global IN market is expected to increase by 28.5 % for the period 2020 to 2027 [3]. However, the use of IN as food is still limited in the Western countries [4]. One of the solutions to include IN in the main diet in Western countries may pass by be their incorporation into the main formulas of the traditional food. The application of cricket flour (CF) in the food formulas is very broad, however, it should be pointed out, that the addition of proteinaceous ingredients to the food that is thermally treated can lead to an increase in the formation of acrylamide (AA), which is a neurotoxic and carcinogenic compound [5]. The aim of this study was to assess respondents' opinions about the perception of IN as a food or food ingredient and to evaluate the influence of CF on the quality and safety parameters of wheat bread (WB) and biscuits (BI). Taking into consideration that CF contains high concentration of protein, the content of AA in WB and BI was analysed. Also, to prevent AA formation in WB and BI, fermentation with Lactiplantibacillus plantarum (Lp. plantarum No. 122) strain was applied as a CF pre-treatment for WB preparation, as well as, fermentation with Lp. plantarum No. 122 and Lacticaseibacillus casei No. 210 strains was applied as a CF pre-treatment for BI preparation. Various parameters on non-treated and fermented CF were evaluated (pH, lactic acid bacteria (LAB) count, color coordinates, fatty acids (FA), volatile compounds (VC), and biogenic amines (BA) concentration). The tested product groups were prepared by adding to the main recipe different quantities of non-fermented and fermented CF. It was established that 70.7% of the respondents had never eaten IN. After fermentation, LAB count in fermented CF was, on average, 8.24 log10CFU/g and pH - 4.26. In most of the cases, fermentation reduced the BA concentration in CF and influenced the VC profile in both CF and end-products (WB and BI). Most of the WB with non-treated and fermented CF showed higher AA content (except WB with 10% of fermented CF), in comparison with the control. However, the lowest AA concentration (84.1 µg/kg) was found in biscuits with 40 g of Cr fermented with No. 210 strain, and, BI colour, VC profile, and AA concentration were all influenced by non-fermented and fermented CF addition. Due to the demonstrated decrease of AA concentration in BI, fermented CF can be recommended for the manufacture of such type of products. However, for WB preparation, 10 % of fermented CF can be recommended, because, most of the WB with non-treated and fermented CF showed higher AA concentration, in comparison with control samples.

Key words: insects, Acheta domesticus, wheat bread, biscuits, fermentation, acrylamide, lactic acid bacteria.

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Development and Characterization of Nutrient-Rich Biphasic Structure Suitable for 3D Printing

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Abstract. 3D printing is beneficial for creating functional foods tailored to specific dietary requirements. In this research, we aimed to design a complex biphasic structure with high amounts of proteins (>20 %). Bigels are unique semisolid formulations made by combining two immiscible gels (oleogel-in-hydrogel or hydrogel-in-oleogel) at a high shear rate, which afterward exist as a uniform dispersion throughout. In recent years, bigels has received several approvals as a suitable matrix for 3D printing. In our study, three biphasic gel systems were developed by homogenizing hydrogel and oleogel at the ratio of 80:20. In all systems the hydrogel was composed of 12.5 % pea protein, 12.5 % collagen, 0.6 % κ-carrageenan, and 0.1% KCl. The oleogel was formed by mixing sunflower oil with 1% of soy lecithin or 2 % of mono- and diglycerides of fatty acids (E 471) as oleogelators. Non-gelled oil was also mixed with the hydrogel and this system was considered as a control. The following physicochemical characteristics of the biphasic gel systems suitable for the 3D-printing were examined: solvent holding capacity, freezing and heating stability, rheological properties, textural properties and 3D printability. It was found that all three formulated gels were self-standing immediately after preparation. After five heating and freezing-thawing cycles gels showed no visual signs of oil/water syneresis. However, under centrifugal force, the oil holding capacity decreased with each freezing-thawing cycle and was lowest in the matrix containing oleogel structured with soy lecithin (44 % after the 5th cycle), while water holding capacity remained stable during the cycles (> 96 % for all samples). The thermo-reversibility of formulations was traced rheologically by measuring the storage modulus (G') and loss modulus (G") during the heating-cooling cycles. All three formulations were thermoreversible and at the end of the cycle, the highest (20732 Pa) and lowest (8327 Pa) G' values were observed in formulations containing oleogels structured by E471 and soy lecithin, respectively. Analysis of shear recoverability at 30, 35, 40 and 45 ºC demonstrated lower recovery of biphasic systems at lower temperatures. 3D printability results revealed that all tested formulations were printable at the temperature of 30-40 ºC, however, the highest accuracy and shape-supporting characteristics were observed in the samples printed at 40 ºC. Textural analysis of 3D-printed structures showed that biphasic systems containing oleogel with soy lecithin had the lowest hardness, springiness, adhesiveness and cohesiveness values, while there were no significant differences between the other two formulations. Taken together, our findings provided valuable insights for the design of biphasic structures with high amounts of proteins, suitable for 3D printing and adapted to provide balanced nutrition for the consumers.

Key words: 3D printing, biphasic gel, bigel, rheology, stability.

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Rational food design of food products, oriented to malnutrition and sarcopenia prevention in aged people

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Abstract. A frequent problem faced by aged people is under-assessed and under-managed malnutrition mostly related to negative physiological and anatomical changes caused by aging. Good nutrition status is important in maintaining health and function in seniors; however, this is not without challenges. Aged people oriented food must provide textural, sensorial, and nutritional characteristics, meeting essential requirements that in most cases could be achieved only by multiscale food structuring/assembling approach. Thus, the aim of the presented study was to develop three different nutrient-dense high-protein food product groups, oriented to malnutrition and sarcopenia prevention that are easy to swallow, masticate and digest, while providing positive sensorial sensations, by using different food structuring techniques such as emulsification, gelation and 3D printing. First group by emulsification technique: a nutrient-dense yoghurt type product with bioactives-loaded (health-promoting berry polyphenols; vitamins C, B9, B12 A, D) double emulsion W/O/W was produced. Analysis of the nutritional composition of the developed yoghurt-based product showed that it can contribute to the protein and vitamin demands of older people. The stability of vitamins in the product after 20 days of storage was 80.0%, 70.37%, 54.14%, 94.04%, and 90.0% for vitamins B9, B12, C, D, and A, respectively. Results from the in vitro digestion analysis show that fortification of product by bioactives-loaded double emulsion did not hinder the release of vitamins during digestion. Geriatric patients described the developed product as 'comfortable' because of good swallowing and textural attributes. Second group by gelation technique: a high-protein bigel-based food products with required rheological properties that responds the needs of the dysphagia patients were developed with carnauba wax in the oleogel phase by changing collagen concentrations in the hydrogel phase (40, 60%) and oleogel to hydrogel ratio (40:60-60:40). All bigels were stable without phase separation and had a pleasant taste with good mouth-feel, except bigels with the higher oleogel fraction. Based on the viscosity results bigels were divided into two groups: honey-like and spoon thick (showing suitability for easier swallowing). A novel bigel-based product had high protein concentration (16–36%) that is cruicial in the diet of the elderly as it helps to prevent malnutrion developing. Third group by 3D printing technique: tofu-based nutritionally customized, comfortable-consumed, appetizing finger foods were developed by using 3D printing technology. The dietary composition of the developed food was: 19-21 g/100g protein, 6-8g/100g fiber, 8-9g/100g fat, 11mg/100g iron, 14 mg/100g zinc, 70 µg/100g selenium, corresponding to recommended dietary allowance of aged people. Foods were also enriched with branched-chain amino acids, for proper muscle protein metabolism. Formulated foods were classified as having 6 level by International Dysphagia Diet Standardisation Initiative classification. Older people evaluated finger foods as very easy handled by hand, soft, easy to swallow, having a moderate flavour intensity and a weak after-feel. However 7% of the participants indicated that 3D printed foods were sticky to dentures. The study demonstrates that different food structuring techniques can be successfully used for formulations of novel, comfortably consumed, attractive, nutritionally customized foods considering nutritional, physiological and psychological aspects of aged people.

Key words: nutrient-dense, elderly, dysphagia, sarcopenia; food design.

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Evaluation of the supply of food products developed for diabetics in the Latvian market

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Abstract. There is an increasing trend in the number of diabetic patients, which creates a demand for certain foods that do not rapidly and significantly increase blood glucose levels. The aim of the study is to identify the developed food products available on the Latvian market for diabetic patients and to analyze the sweeteners used in these products, as well as their energy and nutritional value. The study analyzed 92 products developed for diabetic patients, manufactured in 19 countries and available in stores and online stores that offer their products on the Latvian market. The evaluation was carried out from September to November 2023. Information on the products' country of origin, added sweeteners, nutritional value and energy value was taken from the product labels. Most of the food comes from Spain (30.4%), Belgium (14.1%) and Germany (9.8%). Sweets and drinks in which natural sugar has been replaced with sweeteners such as maltitol, isomalt and sucralose are the most widely offered on the Latvian market. Of the offered products, natural sweeteners - such as steviol glycosides - are used the most in the production of sweets. The synthetic calorie-free sweetener acesulfame K is most often used in the production of beverages. The average energy value for all product groups ranged from 40.8 kJ 100 ml-1 in beverages to 1764 kJ 100 g-1 in flour products. Carbohydrate content in the products ranges from 3.8 g in 100 ml-1 drinks to 62.3 g in 100 g-1 flour products, including sugars from 0.2 g in 100 ml-1 drinks to 3.7 g 100 g-1 flour in products. The Latvian market would need a wider range of products suitable for people with diabetes, which would be suitable for providing a healthy meal instead of sweets and drinks, as well as reducing the use of synthetic sweeteners in the development of new products.

Key words: Diabetes, sweeteners, glycemic index, nutritional and energetic value.

Development of innovative energy drink based on cold brew-spruce sprout and its comparison to commercial energy drinks

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Abstract. Commercial energy drinks have high content of caffeine and sugar that can lead to various health problems. Spruce sprouts could have beneficial effects on human health. This research aims to prepare alternative energy drinks with less caffeine and sugar that are based on spruce sprout, cold brew, and fruit juice. In the study, three commercial energy drinks were used - RedBull original (RBo), RedBull zero sugar (RBzs), and RedBull Tropical fruits (RBt) - and three spruce sprout - cold brew energy drinks were prepared. The spruce sprout - cold brew energy drinks were - cold brew coffee 96.8% with spruce sprout juice 3.2% (SCB), cold brew coffee 25% with orange juice 71.8% and spruce sprout juice 3.2% (SCBo), and cold brew coffee 25% with apple-aronia juice 71.8% and spruce sprout juice 3.2% (SCBaa). All energy drinks were evaluated for their Vitamin C content, titratable acidity, pH, soluble solids, colour evaluation, total phenolic content, and anti-radical activity by DPPH. The results showed that Vitamin C increased significantly ($p < 0.05$) by 30 times in the spruce sprout - cold brew energy drinks (104–244 mg $100g^{-1}$), compared to its content in commercial drinks (4.23–6.24 mg $100g^{-1}$). Comparing the total phenolic content in commercial energy drinks (6.67–10.69 mg GAE $100g^{-1}$), its content increased significantly ($p < 0.05$) by 20 times in the spruce sprout - cold brew energy drinks (128.46–253.93 mg GAE $100g^{-1}$). In conclusion, spruce sprout - cold brew energy drinks could be considered as an alternative to commercial energy drinks.

Key words: biochemical composition, caffeine, cold brew, energy drink, spruce sprout.

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New reports on the health-promoting properties and possibilities of using apple cider vinegar in health prevention

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Abstract. Apple cider vinegar is a special type of product that is produced by fermenting an aqueous extract obtained from crushed apples. Due to the content of acetic acid, this product is often used for preparing dishes and preserving food. Scientific research shows that apple cider vinegar is rich in numerous bioactive substances such as polyphenols, amino acids and vitamins. The aim of the work is to present the latest scientific reports on the properties and benefits of using apple cider vinegar in the treatment of somatic and lifestyle diseases. The research method used in this work was a systematic literature review. On its basis, it was concluded that consuming apple cider vinegar can provide the body with direct health benefits and support the treatment of certain diseases. The research results confirmed that apple cider vinegar can be effective in lowering the level of triglycerides and total cholesterol in the blood. It is also suggested that consuming apple cider vinegar helps control body weight, normalize blood glucose levels and reduce inflammation in the body. Apple cider vinegar has been shown to increase tissue sensitivity to insulin, which ultimately leads to reduced insulin resistance, which is considered one of the main causes of the development of type 2 diabetes. Dermatological studies have shown that apple cider vinegar applied directly to the skin is effective in removing bacterial and yeast infections. The literature research conducted indicates that apple cider vinegar is a product with high nutraceutical potential, which in many situations and disease states may be beneficial to maintaining or regaining the health of consumers. However, based on the information collected, it should also be stated that the scope of health benefits and the mechanism of action of bioactive substances contained in apple cider vinegar are not yet fully researched. In order to fully and clearly assess the impact of apple cider vinegar on the human or animal body, it is necessary to analyze the results of ongoing intensive research on animal models and isolated cell cultures.

Key words: apple cider vinegar, bioactive compounds, polyphenols, lifestyle diseases.

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Short-term pectin-enriched smoothie consumption has beneficial effects on the gut microbiota of low-fiber consumers

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Abstract. Adequate consumption of fiber has a positive effect on health. The crossover study examined the effect of a pectin-enriched smoothie on gut microbiota and health parameters. During 3 weeks, 31 adults consumed two smoothies (11.6 or 4.8 g of fiber/day) alternating with washout periods in different order. At the end of each period, weekly food diaries, blood samples and stool microbiota were collected. Changes in microbiota during smoothie consumption were associated with baseline fiber intake. A greater proportion of up- (Lachnospira, Colidextribacter, Bacteroides) or down-shifts (Streptococcus, Holdemanella) was observed in low-fiber (n = 22) compared to high-fiber consumers (n = 9). In both groups, the pectin-enriched smoothie reduced the number of the Ruminococcus torques group bacteria. Our results showed that the short-term approach is effective to estimate relationships between food components and gut bacteria.

Key words: dietary fibre, pectin, gut microbiota, intervention trial, 16S rRNA sequencing.

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Determination of fructan content and low-fodmap portion sizes in diverse grains products

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Abstract. Gastrointestinal disorders, such as irritable bowel syndrome (IBS) and inflammatory bowel diseases (IBDs), are common health concerns that can be aggravated by the consumption of certain carbohydrates known as FODMAPs (fermentable oligo-, di-, mono-saccharides and polyols). The aim of the study was to establish safe portion sizes for grains and bread within low-FODMAP diets and to comprehensively analyze fructan levels in diverse commercial cereal products, contributing to an understanding of the potential digestive impact of FODMAPs in grains. A sample of twenty different types of cereal products, including breads, rice, and cereal grains, were analyzed for fructan content, moisture, and color parameters. Consumer evaluations were also considered. The analysis was correlated with the principles of a low-FODMAP diet. The study found significant variation in fructan levels across the cereal products analyzed. Inulin-containing varieties showed over seven times higher fructan content than non-inulin containing counterparts. Among the products tested, gluten-free pita bread exhibited the highest fructan content per serving at 2.10 g, while gluten-free rolls bread had the lowest fructan content per serving at 0.08 g. Analysis fructan content per serving of various rice (0.00-0.13 g), barley (0.29-0.72 g), wheat groats (0.25-1.02 g), and buckwheat (0.09-0.19 g) showcases challenges managing fructans in low-FODMAP diets. Identification of potential safe grains like white long-grain rice (0.03 g) and arborio rice (0.00 g) contrasts with caution required for barley groats (0.72 g) and couscous (1.02 g), underlining the need for personalized dietary choices. Additionally, the analysis revealed a positive correlation between fructan content and cooked grains moisture content, implying that water content may play a role in fructan stability.The study underscores the importance of understanding FODMAPs' presence in grains and cereals. It provides insights into the fructan levels of different cereal products and support improved dietary guidance for individuals with FODMAP-related disorders.

Key words: fructans, grains, bread, lowFODMAP diet; cereals.

Effect of extrusion on breakfast cereal with whole grain oat physico-chemical, functional and nutritional charesteristics

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Abstract. Oats are a common cereal used in the production of various cereal-based products such as oatmeal, muesli, and granola etc. It is a good source of protein, fiber and minerals. Due to its high fat content, it is less used in the production of extruded breakfast cereals as it affects the physico-chemical parameters of the final product. Compared to traditional breakfast cereal production, extrusion is one of the most cost-effective and versatile production methods to produce functional and nutritious breakfast cereals in different shapes and flavors. In this study, the effects of extrusion on the texture, digestibility (OMD), nutritional value and sugar content of breakfast cereals containg whole grain oat were investigated. Samples were prepared using twin-screw extruder with screw speed 400 to 575 rotations per minute, temperature profile 80-110-110 °C. The results showed that the product texture is mainly influenced by the oat content in the product and the screw speed. The higher the oat content and the lower the screw speed, the lower the product hardness. Hardness of samples varied from 301 to 2463 N. Bulk density varied between 124 and 321 g L^{-1}. The starch content increased, while the fat content decreased the expansion ratio of the samples. The extrusion process increased the digestibility of the product between 1.91 and 3.59%. There were no changes in fructose, glucose, galactose, and maltose content in the product upon extrusion.

Key words: breakfast cereals, whole grains, oats, extrusion, texture.

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The Effect of Extrusion Parameters on the Physicochemical and Textural Properties of Meat Analogs Produced from Dry- fractionated Durum Wheat Cake and Pea Proteins

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Abstract. Defatted durum wheat cake is the solid by-product derived from the durum wheat oil extraction, and the dry-fractionation process to produce a protein-rich ingredient has been proposed as a technological strategy to valorise it.
Considering the strong interest in alternative protein ingredients and plant-based meat, dry- fractionated durum wheat cake (DWC) could be extruded to produce low-moisture meat analogs. In order to produce a structure that could imitate meat, the setup of the different extrusion parameters must be optimized. Thus, the aim of this research was to produce low-moisture meat analogs from DWC in combination with pea protein isolate (25:75 w:w), studying the effect of extrusion parameters (screw speed, moisture content, and pH of the melt), on the physicochemical textural properties of the products. To reach this objective, a response surface methodology approach was used. The results revealed that the pH of the melt and the screw speed had a major influence on the water holding capacity (WHC) and water solubility index (WSI) of the extrudate. In particular the WHC increases and the WSI decreases by increase the screw speed and the pH of the melt. According to the texture profile and sensory analysis, hardness decreased significantly ($P < 0.05$) with increasing screw speed indicating the presence of a more puffed structure. These findings demonstrate that dry-fractionated durum wheat cake protein can be recovered to produce meat analogs and adjustment of extrusion conditions could significantly modify the physicochemical and textural properties of the final product.

Key words: dry-fractionation, durum wheat by-products, extrusion-cooking, meat analogs, protein ingredients, sustainability.

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Assessing the stability of phenolic compounds in various purees based on accelerated shelf-life testing methodology

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Abstract. Fruits, berries, and vegetables are considered as good sources of health-beneficial bioactive compounds such as polyphenols. However, the amount of these compounds can decrease with applying heat during processing, for example, when producing pasteurized purees. In addition, storage time and choice of packaging may also have a significant effect on the quantity of polyphenols. Therefore, it is important to evaluate the stability of phenolic compounds in pasteurized purees to assess the quality of these long-shelf-life products during storage.This study aimed to (1) monitor the stability of total phenolic content (TPC) in four-grain puree with banana and blueberry (FGBB), mango-carrot-sea buckthorn puree (MCB), and fruit and yogurt puree with biscuit (FYB); (2) study the effect of aluminum-layered vs. aluminum-free packaging on the changes in TPC; and (3) assess the suitability of accelerated shelf-life testing (ASLT) methodology to evaluate the stability of polyphenols. The samples were stored at 23°C for 182, 274, 365, and 427 days. The corresponding time points during ASLT at 40°C were 28, 42, 56, and 66 days, calculated using Q10 = 3. The TPC was determined with Folin–Ciocalteu method. The results revealed that the biggest decrease in TPC took place with high-pH FGBB, which contained fewer ingredients with bioactive compounds. Minor changes were seen in FYB and MCB, which had lower pH values, and contained a larger amount of ingredients that include polyphenols. In addition, the choice of packaging material did not affect the TPC decrease in each puree. Finally, it was concluded that the ASLT methodology is suitable for studying the TPC changes in such purees, but the corresponding Q10 factors may vary and should be determined based on the chemical profile and ingredient list of the product. In conclusion, the results of this study can be used to conduct more accurate ASLTs with long shelf-life products containing health-beneficial phenolic compounds.

Key words: total phenolic content, folin–ciocalteu assay, pasteurized purees, packaging, accelerated shelf-life test.

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Aroma and texture characterization of cooked chicken and beef fillet

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Abstract. The rising demand for plant-based meat alternatives stems from concerns over environmental sustainability, animal welfare, and public health, highlighting the need to explore innovative approaches. It is shown that plant-based meat alternatives differ from conventional meat in terms of texture, taste, and mouthfeel. A comprehensive understanding of conventional meat products is pivotal for developing appealing and marketable plant-based alternatives. The aim of this research was to characterize the aroma and texture attributes of cooked chicken and beef fillet to provide future insights for the development of plant-based meat products. Understanding meat properties facilitates the creation of more accurate and acceptable alternatives for consumers. Texture Profile Analysis (TPA) and gas chromatography coupled with mass spectrometry (GC-MS) and -olfactometry (GC-O) were employed to evaluate the textural and aroma profiles, respectively. Both meats exhibited similarities in overall aroma profile, with aldehydes predominating (57.2% for beef and 62.8% for chicken), though beef displayed a higher overall concentration of volatile aroma compounds. Sensory analysis corroborated instrumental findings, highlighting differences in texture attributes and aroma intensity between chicken and beef. Chicken showed higher hardness in both sensory and instrumental analysis, while beef exhibited higher adhesiveness in both cases. The taste and odor profile were overall more intense for beef, especially in attributes like roasty, umami and metallic. These findings provide useful insights for the development of plant-based meat alternatives, as they elucidate the distinct aroma and texture characteristics of conventional meat products. Understanding these properties enables the formulation of more accurate and appealing plant-based alternatives, catering to consumer preferences and advancing food options.

Key words: texture profile analysis, sensory analysis, GC-MS/O, chicken, beef.

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Sensory properties of rainbow trout in marinade with apple, black currant, rhubarb and tomato pomaces

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Abstract. New product development and experiments with new flavours, at the same time combining different plant-based materials, are preferred, but also sensory characteristics have a particular significance for consumer preference. The colour and appearance of a product are noticed first and are very important to determine the purchase decision of the customer. The aim of the study was to evaluate the effect of the used fruit and berry pomaces on the sensory quality of marinated rainbow trout.
The fresh rainbow trout (Oncorhynchus mykiss) fillets originating from Estonian fish farm were cut into 2 x 4 cm pieces with equal thickness. Marinating process was performed at temperature 6 ±1°C in plastic boxes covered with lids, with fish and marinade solution ratio 1:1. The marinade contained pasteurized aqueous extracts of the apple, black currant, rhubarb or tomato pomace, sugar (3%), salt (3%), acetic and citric acid (1% and 0.25%, respectively). The control marinade solution consisted of water instead of pomace aqueous extract. Twelve assessors assessed the sensory properties rating the samples for the appearance of the marinade, appearance of the flesh, odour, flavour, aftertaste, texture and overall acceptance on a 9-point hedonic scale (1—dislike extremely and 9—like extremely). Intensity levels of saltiness, acidity and consistency were evaluated on a 5-point Just-about-Right (JAR) scale.
The appearance, colour, odour and flavour of the flesh depended on the pomaces used in the marinade. The appearance of the marinade without pomace (control), the appearance of the flesh, the odour, flavour and overall acceptance of the sample was scored with the highest points; a good taste and the soft texture were highlighted. The assessors least liked the appearance of the marinade with rhubarb and the unusual purple colour of the flesh in the marinade with black currant pomace. The lowest scores for overall acceptance were given to the samples with apple pomace due to an unusual apple taste. The apple pomace gave a strong apple odour and flavour, which some assessors considered unusual, peculiar and too sweet, while others liked it. The highest points for juiciness and aftertaste were given to the fish in the rhubarb pomace marinade. The black currant turned the fish an unusual dark purple colour, adding acidity and a peculiar sour berry flavour that the assessors found surprisingly good. The rhubarb pomace gave the marinade a pinkish colour, added acidity, made the flesh consistency quite soft and gave the product a delicate sour odour. The appearance of the marinade with tomato pomace was a bit more orange than the others. The flesh had a soft consistency, was slightly sour and had a good tomato odour and flavour that most assessors liked. The JAR results showed positive acceptance of all products. However, the JAR scores showed that the assessors were not satisfied with the consistency of the flesh in the rhubarb marinade sample. The assessors would have liked a bit more saltiness and less acidity in the samples with rhubarb and black currant pomaces. In the case of consistence, the results differed among the marinades being most of the cases close to "just about right".
The sensory properties of the marinated fish depended on the used pomaces. The sensory properties of all tested samples were acceptable. Addition of the rhubarb, tomato and black currant pomaces affected positively the "saltiness" level being almost "just about right". It can be concluded that adding sour pomaces to marinades could help reduce the usage of salt in the marinades.

Key words: sensory properties, rainbow trout, pomace marinades.

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