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Marco Dalla Rosa, Pedro Fito Maupoey

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Contents

Prologue

After Spain, China and Argentina the Foodinnova Conference docks at Cesena, in Italy, hosted by the Alma Mater Studiorum Università di Bologna, which is considered one of the oldest universities in the world. Indeed, the courses of Food Science and Technology and the research groups in food science and engineering, among the best in Italy and Europe, belong to the University Campus of Cesena.

The region where Cesena is situated, Emilia Romagna, is the first in Europe for the number of EU certified typical and traditional foods PDO and PGI. Nevertheless many food industries are working and continuously developing new foods based on fruit, vegetable and meat products with excellence in quality and management (many of them run co-operatively), establishing themselves as leaders in different food chains. Furthermore, Emilia Romagna is also proud of its food machinery industries that combine the best of technological innovation and industrial practice by the use of high precision mechanics and refined ICT.

Consequently, the location chosen for the conference could not have been better. Cesena is a small town in a rural area where the agriculture coexists with highly organized touristic industries, advanced mechanics, high level gastronomic offerings and hospitality, in keeping with the concept of the "wellness valley".

More than 200 participants from all over the world and 20 highly qualified speakers bring the scientific value of the conference to the highest possible level.

Thus, Foodinnova once again brings the paradigm of innovation to improve quality, sustainability and the social and economical role of food production, from traditional foods to the consumer demand for more sustainable, healthier and tastier food products in everyday life.

This edition of Foodinnova introduces topics such as foodomics, packaging, bioeconomy, hygienic design and rules harmonization and these scientific arguments will go to make up the core of the conference, as food engineering, food safety and quality. This opening approach shall be the keyword for the integration of different disciplines in a multidisciplinary view where the concept of food engineering will be called upon to break borders.

Marco Dalla Rosa and Pedro Fito Maupoey

1 | Invited Lectures

FOODINNOVA CONFERENCE AND THE PARADIGM OF THE INNOVATION IN TRADITIONAL FOOD PRODUCTION

Marco Dalla Rosa

Alma Mater Studiorum, Università di Bologna

Foodinnova 2017 is the fourth edition of the conference on food innovation, in particular focusing on advances in food engineering, technologies, packaging and analyses.

The innovation in food processing is facing the paradigm of the necessity to innovate the food production to open new opportunities to the food industry and to give more sustainability to the food system a planetary need. In the frame of this view, it could seem to be a paradox, indeed, to talk about innovation in traditional foods. In fact, the first issue of the Foodinnova conference, in Valencia on 2010, was mainly finalized to this mega-topic. But it is not a paradox, since the local and traditional food production is doing a gradual - even some times not evident for the consumer view - evolution in the frame of the valorization of the traditional foods and the rationalization of their production. For sure, traditional foods are the basis of many of both European and extra-European countries diets, even if the development of the food processing in the last decades brought to the design, industrialization and commercialization of new foods.

As a result of a EU policy on local food valorization, a large number of traditional products were certified throughout the Certifications of Origin (Protected Origin Denomination, Protected Geographical Origin, etc.) in order to certify the labeling of certain type of traditional food well recognized for tradition, history and quality.

Food engineers and food scientists have thus also a “mission” to ensure the safety of industrial products of mass consumption, but also that to support the industries –even in the traditional production - in their process of knowledge development and food processing and products’ innovation, in a perspective of improving the sustainability of the food system at a whole.

Aim of the present talk shall be to individuate the contexts in which food engineering and food science could play an essential roles in developing strategies to implement innovation steps in traditional food productions, considering some example mainly related to the EU and Italian domain.

TAKING ADVANTAGE OF PHASE CHANGES FOR INNOVATIVE FOOD PROCESSING: SELECTED EXAMPLES FROM LOW TO HIGH TEMPERATURES AND PRESSURES

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The currently established methods used for processing and producing food primarily concentrate on combining different processes to achieve desired qualities and shelf-life. With the exception of fermentation and the addition of permitted preservatives, the processes used often have a purely physical effect on the food matrix. However, with the use of conventional thermal processes the properties of the complex system "food" and/or single food components could be influenced, with respect to the process target. On one hand different aggregate states are used for drying, steaming, crystallizing, melting and extracting, on the other hand the reactive state of high and low molecular organic substances, enzymes and microorganisms are selectively influenced (e.g. blanching, pasteurization, sterilization). The phase or state changes are not only influenced by temperature but also directly effected by the acting pressure.

Cold atmospheric pressure plasma (CAPP) has been applied in diverse fields of research to achieve several purposes, e. g. to produce specific functional groups at the surface, increase surface energy and hydrophobicity, introduce surface cross-linking and remove weak boundary layers or contaminants. Plasma is often referred to as the fourth state of matter, according to a scheme expressing an increase in the energy level from solid to liquid to gas, and ultimately to an ionized state of the gas plasma, which exhibits unique properties. Plasma is comprised of several excited atomic, molecular, ionic, and radical species, coexisting with numerous reactive species, including electrons, positive and negative ions, free radicals, gas atoms, molecules in the ground or excited state, and quanta of electromagnetic radiation (UV photons and visible light). Most active chemical species of plasma are often characterized by very efficient antimicrobial action [1].

Consequently, the application of CAPP is an alternative process for the inactivation of microorganisms on dry and also heat sensitive surfaces. The inactivation of microorganisms on the surface of dry products, like herbs, spices, and/or flours is challenging, because of the higher resistance of microorganisms when compared to a medium with a higher water activity. Furthermore, CAPP applications allow specific product-process interactions at the gas-solid interface along the pre- and post-harvest chain of selected food materials. CAPP influences flavonol glycoside profiles and metabolic activities of pea seedlings in different growth stages. Further up the process chain CAPP can be applied to modify techno-functional and protein properties of different flour fractions. The results indicate that CAPP can be exploited as a means to modulate functionality of dry protein-rich materials in the food and feed sector.

On the other hand, with the application of high hydrostatic pressure there arises a new opportunity to specifically control phase changes during treatment of foods especially in the low temperature domain. Increased hydrostatic pressure influences the phase transition of water by way of depressing the freezing/melting point as well as reducing the latent heat of fusion. Furthermore different solid states of pure water with a higher density than the fluid exist under hydrostatic pressure above 209 MPa.

Significant shortening of freezing/thawing times was observed for pressure supported phase transition processes when compared to conventional processes. Different metastable states of water (liquid and solid) were experimentally observed and defined according to their process dependent stability.

THE INTERFACE BETWEEN FOOD ENGINEERING AND GASTRONOMY

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Modern consumers increasingly derive their foods from away-from-home sources and demand for novel culinary experiences. At the same time, food engineering is in urgent need to expand its scope and engage in new collaborations and partnerships. Gastronomic Engineering (GE) means using the vast body of knowledge accumulated in food engineering and food materials science to propel the creativity of chefs to what is technologically feasible. GE opens new opportunities for food engineering, a discipline that has been mostly oriented to the food processing industry. This presentation describes the emergence of GE or a new branch of food engineering, as a space of co-creation between chefs and food engineers in a university set-up. Our GE unit consists of an experimental kitchen headed by a chef, a food engineering area and a materials science laboratory. The impact of GE on teaching, research (e.g., starch-protein matrices with low-glycemic index) and outreach experiences will be discussed.

BIOECONOMY AND CIRCULAR ECONOMY: CHALLENGES AND OPPORTUNITIES

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The Bioeconomy includes primary production of biomass, such as agriculture, forestry, fisheries and aquaculture, as well as industries using / processing biological resources, such as the food and pulp and paper industries and parts of the chemical, biotechnological and energy industries, the ones producing fiber, bio-based products and bio-energy. It contributes protecting the environment by reducing dependence on fossil fuels and finite materials without overexploiting renewable resources, preventing biodiversity loss and land use change, regenerating the environment and creating new economic growth and jobs, leveraging on local diversities and traditions, in particular in the rural, coastal and industrial areas (including the abandoned ones). It represents a market of over EUR 2 trillion, providing 20 million jobs and accounting for 9 % of total employment in the EU (*http://ec.europa.eu/research/bioeconomy/*).
The circular economy focuses mainly on the efficient use of finite resources and ensures that those are reused or recycled as long as possible (*http://europa.eu/rapid/press-release_IP-15-6203_en.htm*) . The bioeconomy is circular by nature because carbon is sequestered from the atmosphere by plants. After uses and reuses of products made from those plants, the carbon is cycled back as soil carbon or as atmospheric carbon once again. The bioeconomy is thus a perfect illustration of circularity in that it regenerates CO2 and uses renewable raw materials to make greener everyday products.
So far, Bioeconomy and Circular economy have been developed in parallel but their integration could offer real opportunities for Europe. A transition towards a circular bio-economy could see the traditional approaches to circular economy and bio-economy integrated together, leading to more sustainable resource use at a lower cost while developing new income streams, favouring the emergence of new sectors, adding value to products and boosting jobs. Achieving this will not be easy: key activities in the transition include improving knowledge through research and sharing of best practice, improved stakeholder engagement and policy interaction, and enhancement of markets in the bio-economy and circular economy while fostering collaboration within and between sectors.
Horizon 2020 provides incentives to R&I in the Bioeconomy via the Societal Challenges 2 (SC2) by sustaining actions addressed to: a) improve food production and processing and the global food security; b) test and upscale new approaches to boost economic development, environmental services and entrepreneurial innovations – in particular in SMEs- in rural and coastal areas, and c) exploit sustainably the diversity of marine life. SC2 together with the Joint Technology Initiative on Bio- based Industries (JTI BBI) (*http://bbi-europe.eu/*) also sustain R&I and coordination actions addressed to boost the delivery of public goods by agriculture and forestry, the supply side of the biomass to bio- products value chain through the development of innovative feedstock, research on next generation bio-refineries, and supporting markets for bio-based products. The EU commission investments on Circular Economy cover the full lifecycle: from production and consumption to waste management and the market for secondary raw materials. This transition will be supported financially by ESIF funding, €650 million from Horizon 2020 (the EU funding programme R&I), €5.5 billion from structural funds for waste management, and investments in the circular economy at national level. In the presentation, the main R&I needs and opportunities in the area of circular Bioeconomy will be discussed.

LAST ADVANCES IN THE TRILOGY: FOOD, HEALTH AND FOODOMICS

Andrea P. Sánchez-Camargo, Lidia Montero, Alberto Valdés, Miguel Herrero, Elena Ibáñez, Alejandro Cifuentes

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During the last year [1-16], one of the main topics in our lab has been the search of new food compounds with anti-cancer activity following a Foodomics approach. To carry out this work, advanced omics platforms such as transcriptomics, proteomics and/or metabolomics have been employed. This work has included: a) the development of new green extraction processes to obtain bioactive compounds from different natural sources (algae, microalgae, food by-products, plants, etc) [1-4]; b) the determination of the antiproliferative effect of the new extracts against different *in vitro* and *in vivo* models of colon cancer [5-8]; c) the development of advanced analytical approaches including metabolomics profiling based on comprehensive LCxLC-MS/MS for the chemical characterization of the bioactive extracts [9,10]; d) the identification of genes, proteins and metabolites differentially expressed in cancer cells using whole- transcriptome microarrays followed by RT-PCR confirmation, nano-LC-MS for proteomics and/or non- targeted whole-metabolome approaches based on LC-MS and CE-MS [11-14] and; e) the development of different algorithms for the comprehensive analysis of these MS-based datasets [15,16].
These strategies represent a good example of the important challenges that still have to be addressed by Foodomics in order to solve the binomial Food & Health and will allow us to discuss in this work some of the current and future challenges in this area of research.

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FOOD WASTE RECOVERY & INNOVATION

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The prospect of recovering high added-value compounds from the non-consumed materials of food processing is a story started few decades ago. The first successful efforts dealt with the recovery of oil from olive kernel, the production of essential oils, flavonoids, sugars and pectin from citrus peel, as well as the recapture of protein concentrates and lactose from cheese whey. These commercially available applications inspired the scientific community to intensify its efforts for the valorization of all kind of food by-products for recovery purposes. Nowadays, many relevant projects progress around the world and across different disciplines, whereas the existence of numerous scientific articles, patents, congresses and commercialization efforts have emerged a wealth of literature in the field. However, despite this plethora of information and the developed technologies that promise the recovery, recycling and sustainability of valuable compounds inside food chain, the respective shelf products remain rather limited. This is happening because the industrial implementation of recovery processes meets several implementation problems that require careful consideration of different aspects. For instance, a commercially feasible product can be manufactured only if a certain degree of flexibility and alternative choices can be adapted in the developing methodology. The current presentation highlights the most important assets that cause stifling of innovation in the field. Finally, solutions are provided in order to help progress and reveal relevant innovations with an ultimate goal to fulfil market and consumers' needs.

Books

Food Waste Recovery: Processing Technologies and Industrial Techniques (Academic Press, 2015, www.store.elsevier.com/9780128003510) acts as a guide to recover valuable components of food by- products and recycle them inside the food chain, in an economic and sustainable way. The book investigates all the relevant recovery issues and compares different techniques to help you advance your research and develop new applications.

Innovation Strategies in the Food Industry: Tools for Implementation (Academic Press, 2016, www.store.elsevier.com/9780128037515) is an indispensable resource for the food industry to introduce innovations in the market, stand out from the competition and satisfy consumer demands. This book reports the most trend advances of the food science, while providing insights and ideas to overcome limitations for their actual implementation in the industry.

COMPREHENSIVE UTILIZATION OF MANDARIN ORANGE CANNING WASTE WATER: PROCESS AND APPLICATIONS.

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Keywords. Mandarin orange canning; wastewater treatment; by-products; polysaccharides; flavonoid

Canned mandarin orange segment, a delicious and convenient fruit production, is popular around the world with an annual trade value of near $900 million. The segment membrane removal by acidic and basic hydrolysis, one major operation during producing, discharges of large amounts of waste water with high COD (chemical oxygen demand) value (~10000mg/L). The COD is mainly contributed by several valued organic components from segment membrane, such as pectic polysaccharides, small molecule pectin and flavonoids. We established a pilot-plant scale production line to comprehensively utilizing the resource in the effluent with water quality improvement meanwhile. Many operations including filtration, concentration, precipitation, ethanol recovery, electrodialysis and microporous barrier filtration were applied synthetically. The pectic polysaccharides with the yield of ~0.4% (w/v) could be popularly used in ice cream and cookies as fat replacer, or in jam and milk beverages as thickener and emulsifier. The small molecule pectin produced by chemical hydrolysis incidentally, could be developed as a functional food. The flavonoids as well-known phytochemicals could be produced for healthy drink. The so-called waste water almost totally changes into valued by-products and becomes the important “processing water”, having large benefits to environment and economy.

ELECTROTECHNOLOGIES – TAILORED APPLICATION CONCEPTS FOR FOOD PROCESSING

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Keywords. Pulsed electric fields, Ohmic heating, thermal and non-thermal effects, process design and optimization, microbial inactivation, product quality

Thermal and mechanical energy is applied for a large number of unit operations used in food processing. The direct application of electrical energy is not new but application concepts are emerging. Pulsed electric fields technology (PEF) as well as Ohmic heating (OH) are gaining interest due to their scalability and flexibility. Microbial inactivation and food preservation as well as food structure modification are the two key application areas. Whereas PEF is applied as a non-thermal technology or in combination with a moderate heating only, Ohmic heating aims at a fast dissipation of electrical energy in the product leading to a rapid temperature increase up to sterilization conditions.

PEF involves the application of short pulses (microsecond range) of high voltage (above 1 kV) in order to permeabilize membranes of biological cells, a phenomena that is called electroporation. Applied to plant materials, current industrial processing concepts mainly focus on the pre-treatment of potato for French fries production but other applications for the enhancement of mass transfer processes during drying or extraction or the structure modification to facilitate peeling of plant materials are emerging. The application as a preservation technology is used for fruit juice treatment in an industrial scale and processing concepts for other heat sensitive products are in development.

For Ohmic heating, lower electric field intensities are applied and the energy input is achieved by longer pulses and a higher pulse repetition rate. It is the aim to dissipate the electrical energy in order to heat the product. Process benefits from the fast heating mainly apply for high viscous products containing large pieces since a volumetric heating can be achieved. In addition, the absence of hot surfaces has also advantages for low viscous products in terms of reducing the fouling in case of heat sensitive ingredients.

For both technologies, the treatment chamber design is crucial for the different types of application in order to optimize electric field, flow behavior and temperature distribution. In addition, thermal and non-thermal effects may occur for both technologies and their differentiation is of high relevance for the establishment of treatment protocols and the optimization depending on the treated type of product.

The presentation will focus on recent application concepts for both technologies as well as on the basic research needs for a further science-based development and implementation of these electrotechnologies. This includes the evaluation of suitable product properties, the consideration of underlying mechanisms regarding the effects on plant and microbial cells, the differentiation of thermal and non-thermal effects, the development of suitable treatment indicators as well as the process optimization using modeling and simulation tools.

Achieving optimum performance of Coloring Foods in Food & Beverage Applications

Marcus Volkert

GNT Europa GmbH

Today's consumers demand food and beverages with vibrant color shades as well as clean label products that are free from additives. Coloring Foods perfectly meet these expectations as they are concentrates from fruits, vegetables and edible plants. Hence, the most natural way to color foods.

The production of GNT's EXBERRY® Coloring Foods, which involves only physical processing and no selective extraction, is actually very simple but not at all easy. The high demands on the functionality and performance of coloring ingredients makes product- and process development in the category of Coloring Foods a great food engineering challenge. The high variety of natural raw materials, together with the high diversity across market products, create a complex cause and effect matrix. It needs deep understanding of ingredient interactions and manufacturing processes to take coloring foods to optimum performance. However, overcoming the technical challenges results in product solutions that offer not only technical performance but also are well accepted by the consumer, as they meet the needs of today's global markets and trends.

The talk will give a supplier perspective on how to master these challenges in foods and beverages across categories. It will give insight into different approaches on the various hurdlers that need to be overcome in the successful implementation of natural colors in foods and beverages. In the last years significant progress was made in the development of coloring food products with new and increased functionality. Recent examples are oil dispersible colors that offer a coloring solution for fat based products, such as chocolate compounds. Another example is the development of functional powders, limiting separation effects and increasing color intensity.

3D PRINTING: A HYPE OR A NEW ERA FOR FOOD PRODUCTION?

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Keywords. 3D Food Printing, Sodium caseinate, Fused deposition modelling

Over the last decade, additive manufacturing also known as 3D printing has boomed as a production technology in the manufacturing industry. More recently, researchers have started experimenting with 3D printing of foods, which connects to the trend that our future food production will be much more tailored to individualistic needs and preferences. Printing of foods could enable rapid production of customised products that are suited to the need of each person, such as foods with personalized nutrition. Despite the promises of 3D food printing, the development of the technology still faces many challenges such as difficult scale-up and lack of knowledge on ingredient behaviour to arrive at attractive 3D printed food concepts other than funny chocolate objects.

Fused deposition modelling (FDM) technique is the most applied technique for 3D food printing. It employs a pneumatic or screw-driven dispenser that extrudes a material to create a solid object. Different approaches exist towards FDM of liquid foods (Godoi, Prakash, & Bhandari, 2016). Self- supporting soft materials can be extruded, such as dough, paste and cheese by soft-material extrusion. Chocolate objects are typically built with melt extrusion. Finally, gel-type products are created with hydrogel-forming extrusion. Such formulations comprise a viscoelastic polymer solution, which yields a self-supporting gel after reaction (e.g. cross-linking, coacervation or cooling).

In this presentation we present an overview of recent research activities at Wageningen University in the area of 3D Food Printing. These activities are aimed on the one hand at exploration of novel added value concepts for 3D printing of foods and on the other hand at generating underlying scientific insight required to stimulate the development of this technology. Specifically, we investigated the creation of 3D printed objects from sodium caseinate dispersions, exhibiting reversible gelation behaviour. These formulations may be considered as a model system for cheese products. Gelation and dispensing behaviour of sodium caseinate formulations were investigated by rheological analysis. Subsequently, FDM of sodium caseinate dispersions was evaluated via creating objects with multiple layers at varying protein concentrations. An enzymatic cross-linking procedure was established to enable printing of caseinate dispersions at lower protein content. Besides our research on 3D printing of caseinate dispersions, we will also present recent work concerned with printing of fruit juice products and novel structured pea products from dry-enriched pea ingredients aiming at creating pea cookies with novel textures. Finally, we strongly believe that it is of paramount importance to identify and investigate added-value 3d printed food concepts with multidisciplinary teams of mechanical engineering, food process engineering, and sensory experts.

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INNOVATIONS IN HYGIENIC DESIGN

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Keywords. food safety, guidelines, cleaning validation, test method

Introduction. Hygenic Design of food factories and equipment is a prerequisite for food safety and food quality. In the past decades experts in different fields, coming from food companies and academia, worked together in associations like EHEDG (http://www.ehedg.org) to collect practical know-how and best practices in hygienic engineering and design for improving product safety, process efficacy, and production efficiencies and to provide this to the food sector in form of guidelines and training workshops.

Materials and Methods. Every second year there is the EHEDG World Congress on Hygienic Engineering and Design, where new developments and best practices are presented. In 2016 the congress was arranged together with FOODTECH (http://uk.foodtech.dk), a fair for processing and packing where more than 290 exhibitors presented their newest products.

Results. The topics of the EHEDG world congress 2016 covered the importance of hygienic engineering & design in food safety and auditing programs, trends to develop hygienic design as a set of principles, like HACCP, 6 sigma and TPM into a standard like ISO or GFSI recognized scheme. The needs of hygienic manufacturing in fish, meat and fresh produce industries and the latest findings in surface aspects of materials in product contact and easy-to-clean equipment design as well as typical hygienic hazards in critical equipment areas such as elastomeric seals were highlighted. Further new trends in cleaning validation, test method development and dry cleaning aspects and economic and environmental benefits of hygienic design as a tool for cost reduction and improvement of factory design were presented. Recent publications of EHEDG are Doc. 47 on Air Handling Systems in the Food Industry and Doc 43 on Hygienic Design of Belt Conveyors for the Food Industry.

Conclusions. The available guidelines are intended to assist food and equipment producers, especially SMEs, to comply with regulations and standards. Sometimes very simple and cheap solutions are available, but there is still a lot to do in order to transfer this knowledge to the food industry, to architects and equipment suppliers.

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2. EHEDG Doc. 47 on Air Handling Systems in the Food Industry

"MULTICORE" MICROENCAPSULATION OF BIOACTIVE-RICH EXTRACT FROM BERRY POMACE FOR HIGH HEALTH BENEFITS OF FUNCTIONAL FOOD INGREDIENTS

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The food industry faces challenges to use bioactive-rich extracts for functional food ingredients. Polyphenol-rich extracts are labile compounds and susceptible to degradation by pH, oxygen, heat, light and metallic ions, etc., lead to loss their bioactivity. It is a critical technical requirement to protect bioactivity, to enhance the stability of polyphenol-rich extracts and to facilitate controlled release at the desired site for absorption with high bioavailability of polyphenol-rich extracts. "Multicore" microencapsulation of more than one kind of bioactive components in an encapsulation system can enhance the bioactivity and functionality. A new "multicore" microencapsulation process focusing on berry pomace extract as carriers, instead of free single pure compound, can effectively enhance absorption rate, show great promising in enhancing bioactivity, providing protection against oxidation, and masking their odour and bitter taste, promoting high bioavailability. Research was conducted to take critical approach to develop unique "multicore" microencapsulation with berry pomace extract and other natural antioxidants to promote synergistic effects and enhance bioactivity. Research developed "multicore" formulation with polyphenols-rich berry pomace extract and other natural bioactives to reach high bioactivity. The research also evaluated the potential use of food-grade whey protein isolate-based gels and pectin for the encapsulation of berry pomace extract for high gel strength, target release characteristics, etc. The research also characterized encapsulated polyphenol-rich extract particle microstructure, particle sizes, and for *in vitro* studies and storage stabilities. The optimum proteins-polysaccharides shell model was designed to select food- grade proteins and polysaccharides to protect efficiently bioactives in core against oxidation and degradation by complex coacervation technology and finally by freeze-drying. The optimum shell model of "multicore" complex coacervation has high potential to increase their bioavailability of the polyphenol-rich berry pomace extract, and control the rate of bioactive release to reach their intended targeted delivery destination in the gastrointestinal (GI) tract. The shelf-life of encapsulated polyphenol-rich berry pomace extract can be considerably extended in different applications. The innovative "multicore" formulation of bioactive mixture from berry pomace extract can promote synergistic antioxidant effects, greatly increase bioactivity and stability, promote high absorption rate and bioavailability with controlled release. The new food ingredients made by "multicore" microencapsulation technology can be considered as new generation of functional food ingredients.

EMERGING AND COMMON SAFETY ISSUES ASSOCIATED TO FRESH PRODUCE

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Keywords. Fresh fruits and vegetables; foodborne pathogens; bacteria; viruses; chemical hazards

Introduction: Fresh produce accessing EU markets have to comply with a strict regulatory framework of measures with a particular emphasis on pesticides, which must not exceed the maximum levels permitted under EU law. This has led growers and producers to invest much of their resources monitoring the pesticide residue limits in fruits and vegetables. Due to disease outbreaks and rapid alerts attributed to fresh produce starting from the large outbreak of the hemolytic–uremic syndrome caused by *Escherichia coli* O104:H4 occurred in Germany in May 2011, concerns have risen with regard to foodborne pathogens. Since 2011, growers not only have to deal with chemical risks but also microbial risks.

Summary of major findings. In 2013, EFSA published a prioritized list containing the food/pathogen combinations of highest concern (EFSA, 2013). The top ranking food/pathogen combination was *Salmonella* spp. and leafy greens eaten raw followed by *Salmonella* spp. and bulb and stem vegetables, *Salmonella* spp. and tomatoes, *Salmonella* spp. and melons, and pathogenic *Escherichia coli* and fresh pods, legumes or grain. A sequence of five different opinions addressing each of these combinations were published by EFSA in 2013-2014 focused on 1) the identification of the main risk factors, including agricultural production systems, origin and further processing, and 2) to recommend possible specific mitigating options and to assess their effectiveness and efficiency to reduce the risk for humans. Quantitative microbial risk assessment (QMRA) using scenario analysis and predictive microbiology constitutes a useful approach in the ongoing efforts to manage food safety risks (Bassett et al., 2012). A QMRM represents a good approach to evaluate the impact of different on farm intervention strategies on the distribution of the pathogen contamination in fresh produce but the low prevalence of foodborne pathogens in fresh proudce makes validation of QMRA very difficult. However, quantitative microbial exposure model (QMEA) of generic *E. coli* could represent a good approach to evaluate the impact of different on farm intervention strategies on the distribution of the *E. coli* contamination in fresh produce.

Conclusions. The use of QMEM might represent a good tool for growers and producers to decide the impact of specific preventive and intervention strategies aiming to reduce microbial contamination.

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WATER – CHALLENGES IN FOODS

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Water in food materials has an enormous impact on food materials science characteristics with impact on processing, performance, properties and structure. Water has presented numerous challenges as it as a substance is required by all life, including microorganisms, it requires large quantities of energy in food processing steps, some food products may contain up to 99% water, and physicochemical and sensory characteristics of foods are dependent on water. Furthermore, water dominates food performance in the gastrointestinal tract and presents challenges to modern food engineers in understanding food beyond traditional food engineering steps. Studies of water relations in foods recognized the importance of its thermodynamic properties and use of water activity in stability control rather than the use of water content. On the other hand food solids interactions with small quantities of water had to deal with the water plasticization of food solids and its consequences to food solids properties. Food structuring and the design of complex food formulations for sensory pleasure and nutrient delivery require the uses of food materials science principles in food characterization and engineering of food components to innovative and desired structures. Our studies have shown that water in food materials is distributed across food components according to water sorption characteristics of the individual components. Conversely, heterogeneous component distribution may result in microstructural differences of water plasticization and stability. Water may also show temperature-dependent redistribution which seems to take place in polymeric components of food materials, such as carbohydrate polymers and proteins. Novel processing technologies and understanding food materials science have present numerous new opportunities for the food industry.

DESIGN OF INNOVATIVE POLYMERIC MATERIALS FOR SUSTAINABLE FOOD PACKAGING

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Keywords. biobased polyesters, structure-property relationship, barrier properties, compostability.

Introduction. The use of renewable biobased carbon feedstock is seriously taken into consideration these days because it offers the intrinsic value of a reduced carbon footprint and an improved life cycle analysis, within the framework of a sustainable and environmental development. Many efforts both from the academic as well as from the industrial world have been therefore devoted to the development of bio-based alternatives to fossil-based plastics, in view of a greener and more sustainable economy. Indeed, the bioplastic production is expected to increase from the actual 1.7 million tons to over 7.8 million tons in 2019, highlighting a very fast growing rate[1].
Lactic acid (obtained by fermentation of renewable agricultural raw materials[2]), 2,5-furandicarboxylic acid (obtained from the oxidation of hydroxymethylfurfural (HMF), in turn derived from the dehydration of (poly)saccharides)[3] and succinic acid (obtained by sugar fermentation)[2] have emerged as some of the most competitive among the different renewable starting materials.
For food industry, the prediction and control of the ageing of the packed food are a major goal to reach the expectation of the consumers. Packaging contributes to this final quality of the product by appropriate berrier properties.
In this framework, the design of a material plays an important role to ensure optimized final properties for an intended use. The aim of this contribution is therefore to correlate the "*ad hoc*" desighed polymer chemical structure with final properties in order to extrapolate useful correlations.

Materials and Methods. Different synthetic approaches have been used, depending on the properties to be modified: i) copolymerization with other diacids or diols to obtain random linear copolymers; ii) melt reactive blending to obtain multiblock copolymers characterized by different block length; iii) multiblock copolyester-urethanes by chain extention of hydroxyl terminated sequences designed "*ad hoc*"; PLA-based chain-extended triblock structure obtained by ROP. Molecular, solid-state, mechanical, structural and barrier properties have been investigated and compostability studies performed.

Results. Solid-state properties and biodegradation rate can be tailored acting on chemical composition or molecular architecture: the type and amount of comonomeric units and the sequence distribution deeply affect the material final properties owing, among all, to the different ability of the polymer to crystallize.

Conclusions. The results obtained in the present work confirm that all the synthetic approaches adopted represent a winning strategy to modulate the polymer performances according to the desired application: morevoer, such approaches are simple, versatile, eco-friendly and cost-effective synthetic strategy to obtain a wide range of materials.

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WHY HARMONIZE FOOD REGULATIONS AND IF HARMONIZED, HOW TO MAKE IT WORK IN PRACTICE?

Huub Lelieveld

Global Harmonization Initiative

Regrettably after decades of negotiations between countries and supranational organizations, there are still too many differences that hamper movement of safe food across borders and hamper innovations and it does not look like the differences will disappear soon. Therefore, where possible, serious scientists should continue to work together to provide scientifically correct evidence that may be used as tools by stakeholders to try influence negotiations and to try convince local authorities that harmonization is in the interest of everybody. To make it work in practice requires that the scientific evidence is understood by those who need to know and that means most people, at all levels. Not only large companies are affected by unjustified differences in regulations, but also small companies and street vendors and ultimately all consumers, who in many countries have a democratic vote and thus are influential. In turn this makes it necessary that the science is translated in a language that the those who need to know understand. The Global Harmonization Initiative therefore not only tries to find consensus on scientific issues, but also seeks means to make the findings understood by everybody, requiring simplification, but without losing the true scientific facts, and translation into local languages. Then having the results published in, scientific journals, popular scientific magazines, newspapers and magazines aimed at the general public. Another crucial aspect is that those who do the negotiations understand what they are talking about, because expressions used in regulations and during negotiations tend to have – often vastly - different meanings in different countries or regions.

COMBINED RHEOLOGICAL METHODS FOR FOOD CHARACTERIZATION: FROM HUMIDITY AND TRIBOLOGY TO RHEO-OPTICS AND BEYOND

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Rheology plays a crucial role in materials characterisation for the measurement of viscous and viscoelastic properties under different conditions.

Anton Paar MCR rheometers platform allows to combine rheological measurements with other relevant techniques for deeper insight on the properties of food samples: humidity, tribology, rheo-optical techniques (Microscopy, SALS) for structure analysis allow to get complete information on samples behaviour for R&D and QC.

Besides temperature, the water content of a sample and the relative humidity of the ambient air is a key factor for the rheological properties of a broad variety of food. Rheological parameters can be used as a measure of sensory attributes like mouth feel, crispness or firmness, which are strongly affected by the water content. The control of humidity is also of great interest regarding production and storage stability.

Tribology combines the studies of friction, wear and lubrication. In food research, tribology is employed to understand naturally occurring motions between tissues (e.g. tongue) and foodstuffs. It allows to investigate the influence on friction of the fluid composition (e.g. fat content of dairy products) and is used to optimize materials formulation.

Rheological measurements reveal information on macroscopic material properties. The combination of rheometry with optical techniques such as microscopy and Small Angle Light Scattering (SALS) provides additional structural information. Since the mechanical material properties strongly depend on the microstructure, establishing a connection between microstructure changes of a fluid in a flow field and their consequences on its macroscopic properties leads to a better understanding of the behavior of complex fluids and allows an optimization of their parameters.

The innovative MCR rheometer series from Anton Paar is designed to combine advanced material characterization to traditional rheolometry within a single instrument platform.

BIOPOLYMER BASED ANTIMICROBIAL MATERIALS FOR FOOD PACKAGING

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Keywords. Active packaging, biodegradable polymers, antimicrobial compounds, controlled release,

Introduction. Biodegradable antimicrobial materials for food packaging applications are in great demand by the food industry and society alike for the purposes of extending food shelf life, while reducing the environmental impact associated with synthetic plastics. Biopolymers from different origins can be used for food packaging applications or food coating purposes, but the functional properties of biopolymer-based materials in terms of their mechanical and barrier properties need to be adapted to food requirements.

Materials and Methods. Of the different strategies used to adapt these materials to food packaging requirements, polymer blending with or without compatibilizers, lipid addition, crosslinking processes by chemical or physical modifications [1], or multilayer films combining materials with complementary barrier properties, have been analysed. Antimicrobial and antioxidant compounds have been incorporated to biopolymer matrices to obtain active films, directly or previously encapsulated, to prevent their deterioration or to control their release in food systems. In this sense, antimicrobial enzymes, phenolic compounds, essential oils [2], and bacteriocins, among others, have been added to the film formulations, using both thermoprocessing methods and casting techniques. In vitro and in vivo tests have been used to analyse antimicrobial properties of the active films and the release kinetics of actives into food systems

Results. The antimicrobial properties of several active compounds, as well as their action when included in different biopolymer-based matrices were analysed, focusing on their incorporation methods. The effect of active compounds on the film's functional properties and their effective release into food systems were analysed, as affected by polymer-active interactions and the nature of the food. Likewise, the antimicrobial action of some of these active compounds, embedded in different biopolymer matrices, were also discussed both in *in vitro* studies and in antimicrobial tests performed using foods of different composition.

Conclusions. Biopolymer films and coatings are promising systems for the improvement of food quality, shelf-life, safety, and functionality. They can be used as individual packaging films, food coating materials, and carriers of active ingredients. Their efficiency and functional properties are highly dependent on the inherent characteristics of their constituents as well as on the film formation method and treatment. Therefore, for industrial application, particular studies are necessary to apply the adequate process to optimize the functional properties of biopolymer-based materials. Different studies have been carried out to analyse the commercial feasibility of biopolymer films, including new process evaluations, safety and toxicity analyses, regulatory assessments, and consumer studies. However, the forecasts for industrial production still face important issues related to cost and performance. So, further studies are required in order to adapt the properties of biopolymer films to large-scale industrial processing and applications.

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COATING TECHNOLOGY ADVANCEMENTS FOR SHELF LIFE EXTENSION AND SUSTAINABILITY ENHANCEMENT OF FLEXIBLE PACKAGING MATERIALS

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It's a long time that coatings are recognized as powerful tools for improving properties of food and beverage packaging materials. Nowadays, a great interest is also related to the opportunity of using coating technology for a cost-effective shelf life extension; therefore, for contributing positively to the containment of food losses and wastes, while increasing sustainability of packaged food products. After a preliminary review of state of the art from the earliest applications of coating technology, to the current industrial uses for food and beverage packaging materials, this lecture will highlight the novel strategies for higher performances available by the coating processes. As far as novel substances to be used as coatings are concerned, the use of hybrids of organic and inorganic constituents, nanocomposites, bio-based polymer and nanocellulose will be presented, with special reference to the researches carried out by our labs. The extension of possible coating substances, mainly as water based preparations, lead to focus on the issue of surface activation energies of substrates, as well as the different approaches available for structuring novel coatings. Also in this case a general overview of the topic and some examples from current researches will be provided. Coatings can be a valuable place where is possible to include barrier, anti UV or anti fog substances in a customized way; coatings can represent easy to design matrices for active substances such as antioxidants, antimicrobials, leading to controlled release packaging systems. In this special case, the so-called "in situ coating generation" seems very promising and some preliminary results about a layer-by-layer releasing coating, to control oxidation and microbial proliferation of fresh foods, will be presented.

The scenery of novel coating applications is wide indeed but the most intriguing perspectives are related to the possible thickness reduction of oil-based conventional plastic films, through coating on them a thin layer of functional bio-based materials. This may represent a significant challenge for reducing dependence on fossil resources and increasing the packaging sustainability; furthermore, because the most advanced researches in this field are addressed to shelf extension, it is easy to show how these technologies can be part of efforts aimed to reduce the food waste and loss problems.

SUPERCRITICAL IMPREGNATION PROCESS: AN ALTERNATIVE FOR THE DEVELOPMENT OF ACTIVE AND FUNCTIONAL PACKAGING MATERIALS

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Keywords. Antimicrobial packaging, nanocomposites, format, supercritical impregnation, migration.

Introduction. The main objective for food industry is to increase food shelf life, maintaining food quality, and to enhance food safety. The aim of food packaging is to protect food. A new food packaging concept has arisen "*Active food packaging system",* it involves a positive interaction between the packaging and the food. Between them, antimicrobial packaging is one of the most studied as it focus on reducing growth rate (Galotto et al, 2016; De Azeredo et al, 2013). A wide range of antimicrobial substances have been tested for their potential applications in the antimicrobial food packaging. Spices and herbs essential oils (EOs) are an important sources of antimicrobial agents, against several Gram-positive and Gram-negative bacteria, yeast and fungi. The main problems associated to the incorporation of EOs on polymer matrix are related with their very low thermal resistance. Supercritical impregnation of polymer is a new technique in which supercritical CO_2 allows the incorporation of active components in the polymer at low temperature. The aim of the present work was to study the mass transfer characterization in the migration process of thymol from LDPE nanocomposites, impregnated with supercritical CO_2 (sCO_2).

Materials and Methods. Low density polyethylene nanocomposites, with cloisite 20A (0, 2.5 and 5%) was impregnated with thymol as active compound. Impregnation process was carried out at 12Mpa, 40°C and with two depressurization rate 10 and 1 mPa/min. Physico-chemical properties (mechanical and thermal), X-ray diffraction patterns, infrared spectroscopy, Diffusion coefficient and partition constant of the migration process of thymol was determined for all nanocomposites (Torres y col, 2014).

Results and Conclusions. Thymol incorporation was favored by the presence of nanoclays and the use of the lowest depressurization rate after the impregnation process.XRD results show that supercritical impregnation is an effective method to improve intercalation of LDPE into C20A through the promotion of the plasticizing effect of thymol and the improvement of the interaction between thymol and nanoclays, observed through the SEM and FTIR assays.In the nanocomposites the coefficient diffusion of thymol was slower than the obtained in LDPE and also independent of the depressurization rate, indicating that the intercalated structure that present the impregnated nanocomposites could make difficult the diffusion of thymol in the polymeric matrix

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FOOD ENGINEERING: A PROPOSAL FOR RECONCEPTUALISING THE DISCIPLINE

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For years, Food Engineering has struggled to establish a strong identity of its own as an academic discipline and has been conducted as a subset of other branches of Engineering: principally, Agricultural or Biosystems Engineering and Chemical Engineering, which initially served to incubate the discipline. Although a variety of factors have contributed to the discipline finding itself in this rather unfortunate situation, the time has come for Food Engineering to assert itself, and be visible, as an independent branch of engineering with its own set of core competencies, in order to serve the health and well-being of every society through an industrial sector, which is well over a fifth of the manufacturing GDP of most countries. This presentation identifies: a) health, b) environment and c) security as the three key drivers of the discipline, and proposes a new definition of food engineering. This definition requires the discipline to have a broader science base, to include biophysical, biochemical and health sciences, in addition to engineering sciences. This definition, in turn, leads to the discipline acquiring a new set of subject-knowledge competencies that is fit-for-purpose for this day and age, and hopefully for the foreseeable future. The possibility of this approach leading to the development of a higher education program in food engineering is demonstrated by adopting a theme based curriculum development with five core themes, supplemented by appropriate enabling and knowledge integrating courses. At the heart of this theme based approach is an attempt to combine engineering of process and product in a purposeful way, termed here as *Food Product Realisation Engineering*. It is hoped that this reconceptualization of the discipline will not only make it more purposeful for the food industry, but it will also make the subject more intellectually challenging and attract bright young minds to the discipline.

FOOD ENGINEERING IN SOUTH AMERICA

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Latin America and the Caribbean region are important global food producers. FAO (Año 2014) reports a world share of 7% cereal production, 17% oil seed production, 13% meat production and 12% fish production among other indicators. Although a significant exportable surplus is generated, 34.3 million people still suffer from chronic undernourishment. Despite the fact that it is the governments´ responsibility to fight hunger, society as a whole should commit to generating the required changes to balance economic development with social equality and sustainable food production. Providing undergraduates and graduates with the necessary competencies to become change agents in the Food Science and Technology field becomes a responsibility of utmost importance in our particular case as a university. A comparative analysis of the Food Engineering degrees curricula, as well as the graduate professional competencies, offered by universities in Argentina, Brazil, Chile and Uruguay was performed. Innovations and different alternatives to offer during the Food Engineering professional training are suggested in order to enhance their competencies in the regional context.

2 Oral Contributions

2.1 Innovative Emerging Food Processing

RECENT ADVANCES ON MICROBIAL TRANSGLUTAMINASE AND DAIRY PRODUCTS

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Keywords. transglutaminase, cross-linking, milk proteins, dairy products, functional properties.

Introduction. Microbial transglutaminase (MTGase) is an enzyme widely known to modify food proteins by forming both inter- and intra-molecular isopeptide bonds in and between proteins by cross-linking of the amino acid residues of protein bound glutamine (acyle donor) and lysine (acyle receptor). MTGase has been used increasingly in the dairy industry to promote desire changes in the functional properties of various dairy-based systems.

Scope and Approach. The specificity of MTGase towards milk proteins and the bioavailability of cross-linked proteins are of key factors for industry and consumer preferences. Various attempts have been carried out utilizing MTGase to improve the yield and/or the functional properties of cheese types, fermented milks, milk powders, caseinate and other dairy products, which are discussed hereby.

Results and Conclusions. MTGase implication in dairy protein-based products alters the technological/functional properties of milk proteins, such as gelation, heat stability, viscosity, water holding capacity, emulsification and foaming stability. Variations in reaction conditions (pH, temperature, substrate availability and specificity, enzyme concentration) enable different levels of protein modification to be achieved. MTGase is recognized as a safe substance for human ingestion, and has been considered a generally recognized as safe (GRAS) substance since 1998. The frontiers of knowledge and technology in this review contribute substantially to make a foundation for the dairy industry to develop innovative and/or functional product with satisfactory flavour and good texture properties.

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ULTRAVIOLET LIGHT ASSISTED BY MILD HEAT TREATMENT FOR MICROBIAL INACTIVATION IN CARROT-ORANGE JUICE BLEND

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Keywords. ultraviolet light, microbial inactivation, carrot-orange juice, flow cytometry

Introduction. Short-wavelength ultraviolet light (UV-C, 254 nm) has shown to be an alternative to reduce microbial contamination in a wide range of liquid foods and beverages. Although, due to the presence of suspended aggregated particles, many fresh juices transmit relatively little UV light, and consequently, this treatment has been mainly limited to clear beverages. The aim of this research was to study the inactivation of *Escherichia coli* ATCC 35218, *Saccharomyces cerevisiae* KE 162 and *Pseudomonas fluorescens* ATCC 49838 in fresh carrot-orange juice blend processed by a combination of UV-C light and mild heat treatment. Additionally, flow cytometry (FC) was used to analyze the induced damage on a single-cell basis. The indigenous flora of uninoculated treated juice blend was analyzed along storage.

Materials and Methods. Inoculated carrot-orange juice blend (1:1 ratio (v/v), pH_{adj}: 5.0, 10.6°Brix, $\varepsilon_{absorptivity}$: 0.32 cm^{-1}, turbidity: 7667 NTU, particle size = D[3,2]: 5.1µm, D[4,3]: 60.81µm) was recirculated through an annular reactor (750 mL) consisting of two serially connected 100w-UV germicidal lamps, each one inside a 0.87 m-long glass tube leaving an annular flow channel (1.6 L/min, 15 min, 0-11.4 kJ/m^2, T: 20, 40, 45 and 50°C). Single and combined treatments (UV, T, UV-T) were evaluated. Samples were taken at preset intervals and analyzed for survivors by the CFU method. Response Surface Methodology (RSM) was used to study the relationship between treatment temperature (T) and time (t) with microbial log reductions (MLR). For FC study, treated juice samples were labeled with fluorescein diacetate (FDA) for detecting esterase activity, and with propidium iodide (PI) for monitoring membrane integrity at different UV doses and 50 ºC. Additionally, surviving indigenous flora (aerobic mesophilic, moulds and yeasts, and coliforms) was monitored in single and combined treated juice samples along 13-day refrigerated storage (4°C).

Results. After single UV exposure, 2.0-2.9 MLR were obtained in the juice, being *E. coli* and *P. fluorescens* more sensitive than *S. cerevisiae.* Combined UV-T treatments were significantly more efficient achieving between 2.7-6.0 MLR, with additive and synergistic effects compared to single treatments. RSM revealed that, t was the most influential parameter, followed by t^2, T y T^2 in the estimation of MLR (R^2_{adj}: 89.6-98.9), evidenced by the curvature of the surface plots, with an exponential increase of MLR with t. This rate of change increased with T and was higher for *P.fluorescens* and *E. coli*. FC study revealed the same damage pattern (although at different UV doses): a gradual shift from FDA^+-PI^- gate (esterase active cells without membrane damage), to FDA^--PI^+ gate (cells with non-detectable esterase activity and permeabilized membrane), indicating that all treatments, with different degree of intensity, provoked rupture of cytoplasmic membrane allowing PI to penetrate cells and progressive loss of esterase activity. The shift was markedly more pronounced for the UV-T treatment. Double stained cells F^+PI^+ (5.3-8.5 %) were found at high doses only for single treatments, indicating that cytoplasmic membrane integrity was affected, but cells retained esterase activity; whilst UV-T treatment ensured the absence of sub-lethally damaged cells. UV-T treatment produced 0.5-2.5 MLR of indigenous flora, respectively, and prevented from its recovery along 7 days of refrigerated storage, while in control system, native flora began to grow since the first day of storage.

Conclusions. The proposed UV-T treatment significantly improved microbial inactivation achieved in carrot-orange juice by single treatments. FC evidenced the presence of sub-lethally damaged microbial subpopulations which could seriously affect the juice shelf-life. Membrane permeabilization would not be the sole inactivation mechanism, as much more MLR were obtained by the CFU method in comparison with the log increase in permeabilized cells determined by FC at a given UV dose. UV-T treatment inhibited native flora growth during 7-day storage (4 ºC), in contrast to single treatments.

INFLUENCE OF MODERN BIOTECHNOLOGY ON RURAL AFRICAN ARTISANAL FOOD PROCESSING

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Keywords. biotechnology, food, processing, Africa

Introduction. Africa have undergone various improvement in food processing technology since the colonization. During last decade the new trend of globalization have a significant impact on the ability of local population to innovate (5). These innovations in food science domain are influence by the inclusion of modern biotechnology ingredients in artisanal food processing by local population. This paper aims at presenting some evidences of the use of so called modern biotechnology ingredients in rural areas of Africa.

Material and Methods. In addition to the compilation of bibliographic literature review, data collection was completed by a cross-sectional and descriptive study including a qualitative survey (1) in connection with the opinions, attitudes and practices of people in terms of technologies applied to artisanal food processing by stakeholders. Information on processing techniques were collected through the organization of focus Group discussions and Depth interviews with producers (4).

Results. From the various process identify, artisanal fermentations performed in African rural areas involve the use of modern biotechnology tools. This has revolutionize the ability of local farmers in rural areas to process food. Local farmers have changed their methods of processing grain to bread and fermented beverages (2). The raw material used are mainly imported and are mainly genetically modified organisms. They now prepare their traditional fermented milks (Kindirmou, leibol ...) with industrial starter cultures *Lactobacillus sp*. and Streptococcus sp. They produce local beer using commercial yeast *(Saccharomyces cerevisiae)*. We recorded emerging of small local food factories dealing with transformation of cereals grains and tubers, meat and fermented fish, fruit, vegetables and fermented beverages, fermented dairy products, fermented condiment gathering products, etc (3). We also notice that a local know-how in food fermentations under the influence of globalization is evolving through constant amelioration.

Conclusions. It is likely that technology from advances countries in modern biotechnology are already being use in rural area of Africa. The rapid expansions of modern biotechnology in rural area of Africa may raise concerns about biodiversity, health and society. We believe that modern biotechnology is too recent to really know how these ingredients will behave and evolve in African rural ecosystems, and what interactions they may have with other species of natural microflora on local foods systems.

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RESEARCH ON APPLICATIONS OF POWER ULTRASOUND IN ORIENTED MODIFICATION AND DEGRADATION

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Keywords. ultrasound, degradation, modification, structure, synergistic effect

Introduction. Ultrasound is an efficient, energy-saving, environment-friendly technology and has been widely applied in the modern food industries. Power ultrasound (with frequency of 20 kHz−100 kHz) generates cavitation effects in liquid medium and has the potential to modify and degrade polymers.

Materials and Methods. Pectin was purchased from sigma corporation; fucoidan was extracted from *I. badionotus* after papain digestion. The ultrasonic processor had a maximum power of 900 W and was operated at a frequency of 22 kHz. Structural characterization of the polysaccharides was conducted with the aid of the HPLC, FT-IR, NMR, AFM, etc.

Results. The weight-average molecular weight and polydispersity index of pectin decreased with the increase in the ultrasound intensity and duration, but they increased with the increase in temperature. The monosaccharide content of pectin slightly changed with ultrasound treatment. The reduced (Gal + Ara)/Rha ratio after ultrasonication suggested the degradation in the neutral sugar side chains of pectin. Results of AFM images confirmed the degradation of pectin chains at nanolevel (1). Furthermore, the ultrasound-induced degradation of sea cucumber fucoidan was also investigated. Higher ultrasound intensity, lower temperature and lower fucoidan concentrations led to a more effective sonochemical effect on degradation. Antioxidant activity of fucoidan was improved after ultrasound treatment and mechanisms of ultrasonic degradation were put forward according to the structural analysis (2). On the other hand, the combination of ultrasound and enzymes was used to pectin degradation in order to obtain larger degradation extent. The synergistic effects of ultrasound and pectinase were observed at the temperature range of 20–50°C, which was possibly contributed by the favorable modifications in the pectinase structures (3). The degree of methoxylation (DM) of sonoenzymolysis pectin significantly decreased whereas the degree of acetylation (DAc) remained unchanged compared to the original and enzymolysis pectin. Simultaneous functions of ultrasound and pectinase caused severe decomposition in pectin homogalacturonan (HG) regions without altering the monosaccharides types, configurations and glycoside linkages of the pectin samples. The complex polymeric structures of pectin transformed into smaller units with simpler branches and shorter chains after sonoenzymolysis reactions (4).

Conclusions Ultrasound was an effective method in polymer modification and degradation.

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INNOVATIVE FOOD APPLICATIONS OF ALGAE

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Keywords. algae, food, algae extracts

Introduction. Today, there is a growing interest in natural plant products that fulfill the different function in food. Society deliberately chooses food products of natural origin, which are perceived as healthier and safer. Extracts from seaweed, macro and microalgaes are rich in compounds that have a well-documented antioxidant properties.

Materials and Methods. The work is dedicated to latest achievements in seaweed, macro and microalgae application in food products. Obvious achievements as particular compounds of those planst were mentioned briefly and the main attention is paid to extract or full plant application. The potential economic aspects as well as sustainable approach within such products manufacturing was also presented.

Results. The potential of adding seaweed to foods as a source of antioxidants compounds having antimicrobial properties is important direction of research in order to commercialize algal extracts. Seaweeds are also rich in minerals, especially sodium, potassium, iodine, and polysaccharides. Another potential area where with gaining importance is the ability of this additives to improve structure texture of food products. The algal extracts are also vitamins such as A, B1, B12, C, D and E, riboflavin, niacin, pantothenic acid and folic acid. Bioactive compounds, macro and microalgae have shown antibacterial activity against many Gram-positive and negative. The addition of fucoxanthin (*U. pinnatifida*) reduced the value of the parameter L * and caused an increase in the parameters a * and b * of poultry, improved appearance and durability of meat and meat products. A high content of polysaccharides and mineral seaweed causes that they are used as a thickener. This additive makes it possible to reduce the salt content of many foods. In addition, activities are carried out in order to use the nutritional properties of seaweed, by adding them to other food products in order to improve their qualities. Seaweeds have also served as a source of soluble fiber in the bread. The addition of *H. elongata, U. pinnatifida* and *P. umbilicalis* to meat improved water absorption and binding properties of fat, increased the hardness of the cooked meat products and reduced elasticity and cohesiveness.

Conclusions. Seaweeds, macro and microalgaes in native form or extracts are a rich source of natural antioxidants and antibacterial agents. Algal extracts are the source of all the nutrients that form the basis of a healthy diet. The addition of these natural extracts, not only improve the quality of food products, but also improves their nutritional properties and making them more secure.

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THE UTILIZATION OF ACOUSTIC AND MECHANICAL PROPERTIES TO EVALUATE EFFECTIVNESS OF PULSED ELECTRIC FIELD TREATMENT

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Keywords. acoustic emission, pulsed electric field, mechanical properties, texture, electroporation

Introduction. In general, the pulsed electric field (PEF) treatment efficiency is evaluated by the means of electrical parameters measurement, e.g. electrical conductivity or impedance. On the basis of determined electrical parameters the cell disintegration indexes can be calculated which are easy to interpret [1]. Due to the electroporation, also mechanical or acoustic properties can be altered. Therefore, the aim of this study was to evaluate the possibility of utilization of acoustic and mechanical properties measurement of apple tissue in order to evaluate the effectiveness of electroporation

Materials and Methods. PEF treatment of apple samples was performed in a laboratory reactor at electric field intensity equal to E = 1.85-5 kV/cm and number of pulses n = 10-100. After the PEF application the electrical conductivity (EC) of material was determined and based on this measurements the cell disintegration index Z was calculated. Furthermore, untreated and PEF treated samples were subjected to compression test (up to 90% of deformation) in order to evaluate both mechanical (compressive force and work, peak force and Young's modulus) and acoustic properties registered by the means of either contact or microphone method (number of acoustic events and average event energy). Based on obtained results the mechanical (Z_M) and acoutis (Z_A) cell disnintegration indexes were proposed. Statistical evaluation was performed by the means of ANOVA, PCA, cluster analysis and Pearson's correlation procedures.

Results. Electrical conductivity of PEF treated apple tissue was higher in comparison to untreated sample and thus the cell disintegration index Z was equal up to 0.90 in the case of apple treated by 50 pulses at 5 kV/cm. Electroporation resulted in alteration of acoustic and mechanical properties of investigated samples. Both, number of acoustic events and average event every were, in general, lower in the case of PEF treated samples than in the case of intact material. What is worth emphasizing, only contact method of acoustic emission registration gave results suitable for further analysis. In turn, compressive force registered at 15% strain was reduced by PEF treatment up to 73% in comparison to untreated material. Moreover, Young modulus of samples treated by 5 kV/cm (regardless of the number of pulses) was significantly lower than the value of this parameter for intact apples. Determined acoustic (Z_A) and mechanical (Z_M) cell disintegration indexes stayed in a close and relevant correlation with traditional cell disintegration index Z calculated on the basis of electrical conductivity measurements.

Conclusions. Pulsed electric field application results in alteration of mechanical and acoustic properties of plant material as exemplified by apple tissue. Therefeore, these properties can be used to evaluate the effectiveness of electroporation.

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DEVELOPMENT OF A NON-DESTRUCTIVE DETECTION SYSTEM OF DEEP PECTORAL MYOPATHY (DPM) IN POULTRY BY DIELECTRIC SPECTROSCOPY

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Keywords. Deep Pectoral Myopathy, chicken meat, DPM categorization, dielectric spectroscopy, radiofrequency.

Introduction. In recent decades, the strong genetic selection has caused positive effects in terms of reproductive parameters and the yields achieved in poultry industries. However, this production intensification has led to an increase in the incidence of internal malformations in chicken and turkey broilers, especially the pectoral muscles, as Deep Pectoral Myopathy (DPM) (1). DPM disease is characterized by muscle atrophy and necrosis of the deep pectoral that cause hemorrhagic or green colour and rigid texture that make it unsuitable for consumption (2). Currently, there is no method to detect the DPM, being the visual appearance, the only parameter used. In this context, the use of dielectric spectroscopy in radiofrequency range, complemented by a chemical, biochemical and microstructural study may become feasible for DPM detection, even in whole carcasses with skin. The aim of this research was to develop a scientific methodology to categorise the damage level in chicken breast meat and to determine the feasibility of dielectric spectroscopy technique for identifying the affected breasts with DPM.

Materials and Methods. The experiments were performed using non-damaged and affected (DPM) chicken breasts with 5 hours of post-mortem. Water content, pH, CIE L*a*b* coordinates, differential scanning calorimetry (DSC) and ion content were measured. The microstructure was study by CryoSEM and dielectric properties were measured in radiofrequency range (40 Hz to 1 MHz) by using a flat plate sensor (IuIAD & I3M-UPV) connected to an *Agilent* 4294A impedance analyser.

Results. The DSC and structural analysis shows that after a muscle infarct episode, a high level of collagen degradation (endomysium) is produced, inducing the accumulation of electrolytes in the affected area and generating repulsions between the adjacent collagen covers and a high denaturation level of structural proteins. Based on significant ($p<0.05$) variables such as pH, L* and a* coordinates, DPM damages can be classified into three different categories; 0. Non-damage tissue, 1. Hemorrhagic with haematomas and blood clots and 2. Necrosed tissue.
Regarding to the dielectric properties, the relaxation frequency and the relaxation dielectric constant at α dispersion shows statistically significant differences between the non-damaged tissue and the rest of the samples ($p<0.05$).

Conclusions. A microscopic analysis of the non-damaged tissue and the tissues affected by the DPM were done and it was possible to relate it with the protein degradation. An objective and scientific methodology to categorize the level of the DPM in poultry it has been developed. It have been demonstrated the feasibility of dielectric spectroscopy as a tool able to detect the breasts affected by DPM in the whole chicken carcasses by the relaxation parameters in α-dispersion range.

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EFFECT OF EXTRACTION PROCEDURE ON COMPOSITION AND FUNCTIONAL PROPERTIES OF MIGRATORY LOCUST (*LOCUSTA MIGRATORIA*) PROTEINS

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Keywords. edible insects, novel protein, protein extraction, solubility, techno-functional properties

Introduction. Recently, edible insects have received wide attention as a novel and sustainable source of animal-derived protein and are highly discussed as an alternative to conventional protein sources used in livestock husbandry and human nutrition such as soy, crops, fishmeal, and meat. According to compositional data, edible insects, especially species of the order Orthoptera (locusts, grasshoppers, crickets), provide considerable amounts of proteins (up to 77 % db) and well-balanced amino acid spectra comparable with that of staple foods (1). The use of edible insect proteins as a viable alternative to common food/feed proteins inevitably requires the fundamental knowledge of extraction processes as well as their composition and functional properties, considering relevant application conditions such as pH or ionic strength.

Materials and Methods. Two differentially produced protein extracts from whole migratory locusts (*Locusta migratoria*) were investigated: one of them was commercially purchased (NGN BV, Helvoirt/NL) and the other one self-processed (LP1). Commercial extract (LP2) was generated by removal of legs/wings, wet grinding, aqueous extraction at pH 3.8, and removal of chitin and fat via filtration and centrifugation, respectively. LP1 was produced by freeze-drying, removal of legs/wings, hexane defatting, alkaline protein extraction at pH 9, and separation of chitin by filtration. The two freeze-dried extracts were subjected to compositional analysis according to AOAC (2). For the assessment of applicability, techno-functional properties of the extracted proteins in terms of solubility (Biuret assay), foaming properties, and emulsifying activity at different pH and ionic strengths were determined and compared to egg white protein concentrate.

Results. The two extraction procedures resulted in significant differences in extract composition due to the applied extraction pH and separation techniques used. LP1 and LP2 were composed of 82 % and 61 % protein, respectively. Fat and fibre content were successfully reduced by 87 % and 62 % in LP1. Extraction procedure of LP2 resulted in a 50 % decrease of fat content but an increment in fibre. Ionic strength as well as pH significantly influenced the solubility of the extracts. Both solubility profiles indicated best solubility at alkaline conditions around pH 9-10 while isoelectric points were found in the acidic range (pH 2-4). Increment of ionic strength led to a decrease in solubility at acidic pH. The emulsifying activity of LP1 and LP2 at pH 5 and pH 3, respectively, were comparable with the performance of egg white protein concentrate. Foam stability in general was found to be inferior in comparison to egg white reference. Nevertheless, maximum foamability of LP1 at pH 3 was able to compete with the best results determined for egg white protein.

Conclusions. Extraction procedure decisively affects the compositional and functional properties of locust protein. Procedure using hexane defatting and alkaline extraction was suitable to produce a locust protein concentrate. Under certain tested conditions, extracts showed promising techno-functionality similar to egg white protein, which could help to promote industrial applicability.

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INNOVATION: ICE CREAM TECHNOLOGY

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Keywords. food, innovation, ice cream, technology, ingredients

Introduction. The presentation explains and evaluates a variety of innovative ice cream and frozen dessert industry technologies, which have transformed the industry over the past fifty year.

Background. Ice cream is traditionally defined and regarded by its composition of dairy products, sugar, and air. However, while ice cream's fundamental ingredients remain essential to the product's integrity, producers are now looking beyond conventional ingredients and means of ice cream production to create innovative, high quality frozen desserts. The evolution of technology, the availability of specific raw materials and, in particular, the evolution of the consumers' needs—both in nutritional terms and under the thrust of what's "in fashion"—have promoted these changes to the ingredients and methods used in the production of ice cream.

Overview. As a leading food technologist in the ice cream industry, Bray will present and explain a sample of the food technology and ingredient advancements that have been a source of great innovation in the ice cream and frozen dessert industries. Novel ingredient-use discussed will include the use of vegetable oils as fats, reduction in or substitution of sugars with sweeteners, increased use of whey protein, reduction of additives (stabilizers & emulsifiers), and nondairy formulations. The technologies presented will include cryogenics, ice particle inclusion, ice structuring and antifreezing, ultra-high pressure homogenization, slow churning, microfluidification, and ultrasound technology. The presentation is engaging and relevant, as Bray will trace the use of each ingredient and technology process within the context of ice cream product that we see on supermarket shelves.

INNOVATION FOR THE ELDERLY: APPLE WITH WATERMELON TEXTURE

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Keywords. elderly, fruit, shelf-life, high pressure processing, sensory attributes

Introduction. Ageing is one of the greatest social and economic challenges of the 21st century for European societies. By 2025 more than 20% of Europeans will be 65 or over, with a particularly rapid increase in numbers of over-80s[1]. The development of innovative foods adapted to the sensory, nutritional, physical and logistic needs of the aged is a challenge for the food industry. The aim of the present study, in the framework of the European project OPTIFEL[2], was to sensory evaluate and validate the production process and shelf-life of an innovative apple product enriched in vitamin C and submitted to high pressure processing (HPP).

Materials and Methods. Apple with watermelon texture was prepared by immersing apple wedges in a covering liquid (apple juice containing either 0.2% ascorbic acid (A) or 0.2% ascorbic acid + 0.3% $CaCl_2$ (AC)) at a 4/6 ratio. Portions of 250 g were packaged in stand up pouches and submitted to HHP (450 MPa, 3 min). A sensory analysis comparing A and AC batches was performed by trained panelists. Shelf-life was evaluated through enumeration of mesophilic and psychrotrophic bacteria and yeasts and moulds at selected times during storage at 8°C up to 30 days in pressurized and non-pressurized samples. HPP-treatment lethality was validated through a challenge test in AC product inoculated 1% with a cocktail of 3 *Listeria monocytogenes* and 3 *Salmonella* strains at 6-8 log cfu/g each species. Enumeration of pathogens was performed before and immediately after treatment.

Results. Apple with $CaCl_2$ showed significantly higher scores for hardness and crunchyness and lower scores for crumbiness in comparison with samples without $CaCl_2$. Similarly, acceptability was significantly higher (5.8) for samples with $CaCl_2$ when compard with those containing only ascorbic acid (5.1). Physicochemical analyses recorded soluble solids content and pH values of 12.4 ºBrix and 3.7, respectively. Initial levels of mesophilic bacteria were *ca*. 4 log cfu/g while psychrotrophic bacteria and yeasts and moulds were at 3 log cfu/g. In non-HPP treated batches levels of mesophilic, psychrotrophic and yeasts and moulds increased up to 6.5-7 log cfu/g after 30 days of storage at 8ºC. In HPP-treated samples levels remained below the limit of detection (10 cfu/g) during the whole storage. No significant differences were found between A and AC batches. Challenge test results showed that HPP reduced the counts of *L. monocytogenes* and *Salmonella* at least 6 and 8 log units, respectively, proving the validity of the lethality treatment required to achieve pasteurization standards.

Conclusions. Apple wedges with watermelon texture, an apple product enriched with ascorbic acid and $CaCl_2$, is a technologically and sensory innovative soft-solid product. The designed manufacturing process, including HPP, ensures microbiological quality and safety of the product throughout its shelf-life even if temperature abuse (8ºC) occurs.

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CLEANROOMS IN FOOD PROCESSING – A PROMISING CONCEPT FOR THE FOOD FACTORY OF THE FUTURE?

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Keywords. cleanroom technology, food safety, hygienic processing, food process engineering

Introduction. Cleanroom technology bears a great potential for avoiding the intrusion of particles and microorganisms into sensitive products. As such, it is already established in several industries. In the food industry, however, the utilization of this technology is still very limited. The use of cleanrooms can significantly contribute to prevent future outbreaks of foodborne pathogens and to meet increasingly tightening regulatory requirements.

Materials and Methods. Selected current applications from the food industry will be presented. These include aseptic filling and packaging, cutting, and the preparation of *fresh cut* products. Data are obtained from manufacturers as well as from a past and a currently ongoing research project. Furthermore, future applications and processing concepts will be outlined.

Results. It was shown that cleanrooms are able to significantly increase the hygienic status of food production plants by systematically excluding pathogens and spoilage organisms throughout the production process. Especially perishable foods, e.g. meat and meat products, as well as dairy products, benefit fom the implementation of cleanrooms. Fields of application comprise handling of raw materials, slicing, and packaging.
However, in case the raw materials are already contaminated, the use of cleanroom technology might not be sufficient for the production of safe foods. Consequently, a relatively new and innovative approach is the implementation of cleanrooms for the generation of raw materials. This may involve susceptible plant materials, e.g. bean sprouts, as well as innovative animal-derived resources, e.g. edible insects. Thus, the potential applications of cleanrooms in the value chain are evaluated, with a special focus on the production of raw materials and their implications on subsequent food processing concepts. Concepts for the production of raw materials under controlled conditions are established and evaluated. This includes the cultivation in cleanrooms as well as challenges that need to be overcome with regard to the specific pre-treatment and input of necessary resources such as air, light, decontaminated feed and water, seeds or fertilizer.

Conclusions. Cleanrooms can contribute to increase the shelf life of products and reduce food waste. Thus, this technology has advantages from an economical as well as an ecological point of view. Future considerations and open points include cleaning procedures and automatization, the optimization of operating procedures, especially material and personnel flows, and the implementation of state-of-the-art decontamination technologies, smart technologies, e.g. contactless switches, as well as smart and antimicrobial surfaces.

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SET UP OF BIOTECHNOLOGICAL STARTEGIES FOR THE PRODUCTION OF FRESH CHEESES HAVING DIFFERENT FUNCTIONALITIES

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Keywords. Functional microorganisms, innovative fresh cheeses, tailor made products.

Introduction. In the last decades consumer demands in the field of food production has changed considerably. Consumers more and more believe that foods contribute directly to their health. Today foods are not intended to only satisfy hunger and to provide necessary nutrients for humans, but also to prevent nutrition-related diseases and improve physical and mental well-being of the consumers. In this regard, dairy products produced with functional lactic acid bacteria strains used as co-starter has been recognized as functional food able to provide potential benefits in preventing some diseases. The aim of this study was to produce different soft cheese types characterized by different functionalities. In particular, depending on the co-starter, was possible to obtain products characterized by specific functionality and able to cover specific niche of consumers, including woman gender food.

Materials and Methods. Two kinds of functional fresh cheese were produced, in collaboration with a dairy industy, and were compared with the traditional one. In detail, 2 different lactic acid bacteria, recognized for their functional characteristics, were used as co-starter and were inoculated in milk 40 minutes after the inoculum of the starter (*Streptococcus thermophilus*). The selected co-starter were: *Lb. paracasei* A13, probiotic strain isolated form Argentinean yogurt and *Lb. crispatus* BC4, isolated form women healt vagina environment, characterized by antagonistic activities against the principal etiological agents of urinary tract infections. The three cheeses obtained were tested for the viability both of the starter and the functional strains over a period of 18 days. The viability of the functional strains was also assessed after a simulated stomach-duodenum passage. In order to evaluate the impact of the presence of the co-starters in the final product, also the textural, and sensory features as well as the volatile molecule, the lypolitic and protelytic profiles were evaluated.

Results. The results showed that fresh cheese is an optimal carrier for the tested functional strains. In fact, the fresh cheese intrinsecal chemico-physical characteristics are able to protect the microorganisms and to maintain their viability and their metabolic activity during the refrigerated storage and also during the simulated stomach-duodenum passage. The presence of the co-starters implied positive modifications of the aromatic profile and also of the apreciability expressed during the sensorial analysis. An interesting additional result regarded the high concentration of the starter and the co-starer in the whey directly after the coagulation process, identifying this industrial waste as a potential natural whey culture able to be directly re-used in the production process.

Conclusions. The adjunct of functional cultures as co-starter in the fresh cheese production has been identified as realistic technology to obtain functional fresh cheese able to respond to different consumers demands. In particular, in this context two functional cheeses were obtained: probiotic fresh cheese and cheese specific for woman health. These products provide consumers a modern way to follow a simple healthy lifestyle.

EFFECT OF (ULTRA)-HIGH PRESSURE HOMOGENIZATION AND NATURAL ANTIMICROBIAL BASED NANOEMULSIONS ON KIWI JUICE SAFETY AND SHELF-LIFE

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Keywords. (ultra)-high pressure, antimicrobials, nano emulsions, juice, shelf-life, safety

Introduction. Essential oils (EOs) and their components received great attention because gifted of high antimicrobial, antioxidant and anticancer activities (1). Their efficacy in food and vitro systems has been proved by several Authors. However, their practical exploitation is limited due to their great impact in food products and their fast degradation. EO nanoencapsulation could represent a viable and efficient approach to increase their physical stability and bioactivity. Also (ultra)-high pressure homogenization (UHPH) has been described as a cold treatment with great potential to provide "fresh-like" and safe fruit juices with prolonged shelf-life (2). The aim of this work was to evaluate the potential of UHPH, in combination with natural antimicrobial nano based emulsions, on safety and shelf-life of Kiwi juice.

Materials and Methods. The kiwi juice was obtained by kiwifruits (*Actinidia deliciosa* cultivar Hayward). The juice was divided in four batches and two of these were added of nano based emulsions of hexanal and (E)-2 hexenal (70, 35 ppm, respectively). One of these and one kiwi juice batch were inoculated with pathogenic and spoilage microorganisms at level of 3 log cfu/ml. The four batches were then treated at 200 MPa for 2 and 3 cycles by using a Panda Homogeneizer (GEA, Parma, Italy). The samples treated at 0.1 MPa were used as controls. The samples were stored at 5, 15, 25°C and analyzed over time for the level of natural occurring and inoculated microorganism cell loads, pH, colour and viscosity in relation to the treatment applied.

Results. The results showed that, although the pathogenic species were affected by the pH of the juice, their death kinetics were increased by the the most severe HPH treatment applied and, more, by the addition of nano emulsions. The yeasts represented the main spoilage group and the application of a treatment at 200 MPa for 3 cycles and the addition of nanoemulsions increased the shelf-life of kiwi juice stored at 25°C for, at least, 14 days compared to the only use of HPH treatment. Differently, the addition of nanoemulsions did not affect the colour and viscosity of the kiwi juices. In fact, for these the HPH played a more significant role contributing to increase/mantain sample brightness and viscosity also over time.

Conclusions. The approach proposed based on the use of UHPH and natural antimicrobial based nanoemulsions contributed to the stabilization of kiwi juice without detrimental effects on quality, trying to satisfy the aim of the industry about the storage at room temperature.

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PHOTO-INDUCED MODIFICATION OF FOOD PROTEIN STRUCTURE AND FUNCTIONALITY

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Keywords. ultraviolet, pulsed light, photoreaction, protein

Introduction. Proteins are major target polymers for photoreactions due to abundance of endogenous chromophores, ability to bind exogenous ones, and rapid reactivity with other excited state species. As food structure and functions are the result of the status of food constituents, photoinduced structural modification of food proteins can lead to new product characteristics or improved functionalities.
The aim of this presentation is to discuss possible applications of light radiation to modify food protein structure, inducing changes in their technological and biological functions.

Materials and Methods. Structural changes of food proteins, including egg white, gluten and enzymes, were induced by exposure to selected UV and pulsed light treatments under different a_w conditions and in the prersence of other food ingredients (sugars, polysaccharides). Structural properties of proteins were analysed by absorption spectroscopy, dynamic light scattering, free sulfhydryl groups determination, SE-HPLC and SDS-PAGE. The possibility to exploit photo-induced modifications to steer protein solubility, thermal stability, activity at water/air/oil interface, catalytic activity and immunoreactivity was also studied.

Results. Light processing was shown to improve the technological performance of proteins by modulation of rheological, film, emulsifying and foaming properties of proteins. Similarly, significant effects of light on activity of enzymes and reactivity of allergens were demonstrated. The photo-response of proteins dramatically changed when they were embedded in crowded and complex matrices such as foods. The occurrence of a food supra molecular structure selectively favoured or hindered specific photo-reactions. Under these conditions, there was plenty of possibility to photo-induce protein reactions with other food components, further leading to unexplored possibilities to steer protein functionality.

Conclusions. Advances in light processing have made these technologies available, sustainable and of easy integration into food industries. Light processing is generally exploited as a non-thermal alternative to conventional disinfection methods but offers advantages well beyond it. The intense photo-reactivity of proteins as well as the large variability of the deriving structures indicates a wide potential of light radiation in modifying functionality of food proteins and protein-rich foods. These aspects certainly represent a challenging research area which would require exploration.

STRUCTURING OILS FOR THE DESIGN OF LOW SATURATED FAT FOODS

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Keywords. structured oil, saturated fats, replacement

Introduction. Due to increased concern about the negative effects of saturated fatty acids in the diet, the development of novel formulation strategies to design healthier fatty foods is an interesting and timely topic. It is a matter of fact that the simple replacement or reduction of saturated fat does not allow foods with satisfactory quality characteristics to be obtained. The final structure of the product as well as its sensory properties are highly related to the three dimensional architecture established by the saturated fat crystal network (1). One promising strategy to fill this gap is the substitution of plastic fats with unsaturated oils structured through the addition of molecules forming self-assembly hierarchical structures (2). The aim of this presentation is to highlight possible strategies to obtain structured oils, evidencing advanges and pittfalls from a technological perspective.

Materials and Methods. Olegels and structured emulsions containing different structurants, such as monoglycerides, waxes, phytosterols and carbohydrates were obtained by developing the most appropriate technological process and characterized at nano, micro and macro level by using different techniques. The exploitability of these systems to replace saturated fats, such as shortenings and palm oil derivatives, in different foods was then studied.

Results. Results highlighted that the use of oleogels and structured emulsions could be a suitable approach for the replacement of saturated fats. In fact, foods with comparable quality characteristics can be obtained. However, depending on the technological needs of the involved process as well as the complex interplay among ingredients, different constrains should be overcome leading to the need of processing modifications or food reformulation.

Conclusions. Nowadays the search for oil structurant agents resulted in a variety of possible candidates having peculiar physico-chemical properties. Their in-depth characterization allowed the understanding from molecular interactions up to macroscale performances. Howerver, to effectively exploit these systems as saturated fat replacers, this knowledge should be integrated with technological needs.

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PRODUCTION AND CHARACTERIZATION OF BIODEGRADABLE STARCH-BASED AEROGELS FOR FOOD APPLICATION

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Keywords. aerogels, starch, carrier system, supercritical drying, surface area and porosity

Introduction. Aerogels have attracted a growing interest in food industry due to their outstanding functional properties related to surface area, porous and lightweight structure, leading to potential applications such as carrier system for sensitive food components[1]. Starch is increasingly considered as edible, bio-based and biodegradable material for the production of aerogels. However, the concept of polysaccharides (PS) as aerogel-forming materials is novel and compared to other PS such as alginate and cellulose, research in starch aerogels is still in its infancy. The morphology and physical characteristics of these aerogels will be discussed, emphasizing properties that are vital for application as food material. The influence of different starches, the addition of n-propoanol/ethylenglycol on aerogel formation and characteristics were investigated.

Materials and Methods. For the production of aerogels, potato, corn, and wheat starch were used as raw material. These steps include heat-induced gelatinization, subsequent retrogradation, and conversion of hydrogels into alcogels by solvent exchange, which were subsequently converted into aerogels by supercritical carbone dioxide (sc-CO2) drying. Starch dispersions (10% w/v) were prepared and different n-propanol/ethylenglycol concentrations (0, 0.5 and 1% v/v) were added. The dispersions were stirred at 300 rpm upon heating up to 90°C. The gelatinization process was stopped after the viscosity of the solution increased. Alcogels were formed by replacing water by ethanol using a series of ethanol-water baths with increasing ethanol concentrations of 30, 50, 70, and 100% (v/v) ethanol for 24 h each. Drying of the alcogels was performed at 150 bar (45°C) for 4 h. The analytical investigations include the linear- and volume shrinkage through processing, residual moisture content, microscopic analysis (SEM), water absorption, oil adsorption, the porosity and BET surface area.

Results. Along the processing, the aerogels decreased linerarily and volumetrically up to 42 and 78 %, respectively. Among the starches tested, potato starch was most capable of producing aerogels with a high BET surface area between 65-73 m^2/g and low densities ranging between 0.5-1.5 g/cm^3. Further, these aerogels showed a nanostructure with a high porosity between 60-73 %. The residual moisture of all starch aerogels ranged between 2-4 % db, which is necessary for microbial safety during storage. The addition of n-propanol/ethylenglycol affected the residual moisture content and the resulting structure was significantly affected by the addition of ethylenglycol, whereas the use of n-propanol did not show any effects. Potato starch aerogels showed water and oil ad-/aborption capacities up to 10.8 and 1.5 %, respectively, indicating loading possibilities for hydrohobic/hydrophilic components.

Conclusions. Due to the high surface area and nanoporous structure, potato starch aerogels are promising carrier systems for i.e. bioactives and drugs in food and pharmaceutical applications. Additional benefits arise from their biodegradable nature opening further application areas.

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BREADforALL (MSCA IF) – PRINCIPLES OF APPROACH

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Keywords. microwaves, high-moisture treatment, buckwheat, teff, oat

Introduction. Mimicking the complex (texture, nutrition, sensory) function of gluten underlies investigation of changes in physicochemical properties of gluten-free raw materials. The main goal of this proposal is to elaborate the prototype procedure using microwaves for changing the functional properties of gluten-free flours to adapt them successfully to traditional baking.

Materials and Methods. The 24-month long research program aims to elaborate the unique procedure of microwave assited heat moisture tratment (μHMT) and investigate its impact on physicochemical characteristic of gluten-free flours which further affects complex cascade of phenomena resulting in final quality of gluten-free products. Work Package 1 is dedicated to choosing suitable from nutritional point of view raw materials, among which buckwheat, teff and oat are more promising; Work Package 2 - focuses on microwave assisted heat moisture treatment (μHMT) aiming in elaborating of innovative working prototype environment for further treatment of flours; Work Package 3 containes post μHMT raw materials evaluation measuring the changes; Work Package 4 contains comparative analysis of doughs and batters originating from native and μHMT flours and evaluates changes on dough and batter manufacturing from treated flours vs. native ones; in Work Package 5 the comparative analysis of breads originating from native and μHMT flours on physicochemical, nutritional and sensory assessment will be made and the project ends with summarising results for future perspectives in Work Package 6.

Results. We expect that proposed novel approach will result in controlled remodeling of physicochemical characteristic of flours from gluten-free raw materials by microwave assisted heat-moisture treatment (μHMT). The overall assessment of modifications by measurement of manufactured gluten-free dough's and batters parameters and physicochemical, nutritional and sensory characteristic will reveal the quality in resulting bakery products. Successful approach outcomes in restriction and simplification of bakery recipes from various sensory quality additives (eg. hydrocolloids) and enrichment in nutritious natural components of gluten-free flours.

Conclusions. The BREADforALL project ties together various science disciplines as food sciences, engineering, physics, chemistry, nutrition, environmental and social sciences, medicine and public health resulting in multi- and interdisciplinary, inspiring research program with many benefits and perspectives of industrial application.

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ANALYSIS OF THE CONSTRAINTS OF THE DETERMINANTS OF THE AGRICULTURAL VALUE CHAIN: ISSUES; CHALLENGES AND PERSPECTIVES FOR LOCAL AND INCLUSIVE DEVELOPMENT

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Keywords. constraints, determinants, agricultural value chain, local and inclusive development.

Introduction. Our research was assigned as general objective stress analysis of the agricultural value chain: Issues, Challenges and outlook for local and inclusive development in the Groupement of Buzi / Minova in Kalehe territory. The formulated research hypothesis was secondary to the issue which stated that constraints related to the operationalization of the agricultural value chain are multiple orders and preambles explain the general lack of an agricultural policy. That said, he would observe of land access difficulties with consequent area, no input and first-generation seeds. Added to this is the lack of use of agricultural techniques, the lack of basic agricultural infrastructure, lack of financial support of the agricultural sector and a lack of market organization.
To achieve our goal, a cross sectional study was effective with data collected from the sample of 200 households selected by random method multiple degrees. These data were processed and analyzed using Excel software. The results across samples casual kind were extrapolated over the whole agricultural population farmer, researcher, trader of agricultural products, suppliers of agricultural inputs....

Materials and Methods. The systemic method facilitated by tools like systemic triangulation in its aspects: Functional, structural, historical, supported by documentary techniques, sampling, interview with interview guide, participant observation were used for us provide an understanding of internal and external relationships, structure, laws or emergent properties characterize the system of the agricultural value chain finally meet our hypothesis.

Result. The result of our study shows that the agricultural value chain in the groupement of Buzi is mounded several constraints organizational, structural, financial, technical, political and administrative.... This confirmed our hypothesis because results proved that the too low level of education of our investigations is the basis of non-application of new agricultural techniques, the non-government involvement in agriculture hinders the development of this sector which sets stop the development machines of the agricultural value chain. The dispersion of borers producers in agricultural activities does not give them the strength to achieve satisfaction in agriculture.

Conclusion. The lack of basic agricultural infrastructure, non-use of agricultural products processing machinery inaccessibility to arable land, lack of funding of the agricultural sector disadvantage the development of the agricultural value chain in the rural environment although men participate to countryside activities and competition does not exist in the area.

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APPLICATION OF THE METHOD TASTING FOR DESCRIBING AND EVALUATING THE ACCEPTANCE OF DIFFERENT DRINKS OF PASSION FRUIT POWDER

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Keywords. CATA, powdered drinks, passion fruit, sensory and ideal product.

Introduction. The passion fruit (*Passiflora edulis L.*) contains vitamins and minerals, providing great nutritional support to people. The spray drying method allows to obtain powdered products that maintain the parameters of color, smell, taste and nutritional properties to be reconstituted in water very similar to those of fresh produce. On the other hand, it has been proved that the new techniques of sensory evaluation are useful to describe and understand their acceptability to consumers about a particular product. The objective of this research was to apply the CATA method (Check all that apply) question to describe the sensory attributes that presented the powdered drinks of passion fruit.

Materials and Methods. Worked with five powdered juice brands that were based on the indications of the packaging with fifteen attributes. These were evaluated by students between 18 to 25 years old, which described the attributes and the acceptability of the product. Test was applied with Cochran method for each attribute.

Results. Of the Cochran test it was found that the attributes (very sweet, less sweet, concentrated and less concentrated) presented a significant difference in relation to the value of p. Also, when considering the attributes (sweet, natural flavor, artificial flavor, diluted, astringent, fluid and amber), it can be observed that for all samples of powdered juice drink it does not present significant differences. However, attributes (very sweet, less sweet, cloudy, acidity, concentrated, bitter, less color and intense color), shows a significant difference from one to sample to another.

In regards to the description of the ideal product, it was found that this should be amber in color, less sweet and filled with natural flavor. It was also noted that the attributes less sweet, sweet and artificial flavor are directly related to the acceptability of the product. Accordingly, it was observed that the attributes less sweet, very sweet and/or diluted are essential in the development of a powdered drink.

Conclusions. It is concluded that the acceptability of the powdered drinks are directly related with the attributes sweet and artificial flavor. In addition, the ideal product should be less sweet, amber in color and more natural flavor to achieve maximum acceptability by consumers.

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CRUNCHY BLUEBERRIES FROM OSMOTIC DEHYDRATION AND VACUUM AIR DRYING

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Keywords. blueberry, crunchy, osmotic dehydration, vacuum air drying.

Introduction. Dry-crunchy fruits are made to target a specific group of consumers and processors. Dehydration processes of fruits extend their shelf life, however not all methods maintain fruit quality properties (1). Osmotic dehydration involves partial removal of water from fruit's tissues and incorporation of solutes (2). It increases the sugar/acid ratio and enhances the texture and stability of pigments during further processes and storage. Drying fruits under vacuum conditions reduces the boiling point of water and the risk of fruit property losses (3). The aim of this study was to obtain crunchy blueberries using osmotic dehydration (OD) and vacuum air drying

Materials and Methods. Fresh blueberries in wholes and halves were osmotically dehydrated by immersion in a hypertonic sucrose solution (67°Brix, a_w = 0.8535) in a 1:5 weight ratio (4) for 14 h at atmospheric pressure. Osmotically dehydrated berries were then dried in a vacuum oven at 60°C and 25 cm Hg for 27 hrs. The compression force necessary to fracture the dried blueberries was determined using a texturometer TA-XT and taken as an indicator of crunchiness. The water content of fresh and dried berries was obtained by weight difference after drying in a convective air oven at 65°C for 12 h.

Results. Fresh blueberries had a water content of 84.54 ± 0.33%. Processed wholes berries had a humidity of 11.34 ± 0.42 % compared to 0.263 ± 0.021 % humidity of dried halves. Whole dried berries were deformed with a compression force of 146.79 ± 9.65 N and a distance of 5.43 ± 0.29 mm. Blueberries cut in half needed a compression force of 68.51 ± 10.44 N and a distance of 7.02 ± 0.45 mm. This difference in texture indicates that berries in halves were crunchier than wholes at the end of the process.

Conclusions. Blueberries in half achieved higher dehydration levels than wholes after OD and vacuum drying processes. Compression tests with the texturometer showed that fruit halves also required less force to fracture than wholes, indicating a crunchier texture in cut blueberries

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ENOLOGY MEETS BREWING: IGA CRAFT BEER AS A NEW PRODUCT TO LINK INNOVATION AND CONSUMERS PREFERENCE

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Keywords. beer, IGA, grape, consumer preference

Introduction. Recently, the "Italian Grape Ale" (IGA) has been included as a new beer style in the "Beer Style Guidelines" (1) developed by the international organization Beer Judge Certification Program (BJCP). As a result of the acknowledge, Italy owns the leadership of a specific brewing sector to develop in the worldwide market. Based on the proposed placement category the IGA beer is considered a fruit beer produced in an enological perspective. In fact, the use of grape berry/juice and exhausted barrel or cask is part of the IGA production process.

Materials and Methods. In this work, five craft ale beers belonging to the IGA category were produced with all grain method and use of grape juice. The beers, designed to be heterogeneous from the stylistic point of view, included either the clear (Trebbiano grape juice) and dark typology (Sangiovese grape juice). After the production the beers were analyzed for the main chemical parameters (pH, alcoholic strength, total acidity) and assessed by technical tasters belonging to the association UNIONBIRRAI, based on the score sheet used for the competition "Beer of the Year". Moreover, beers were evaluated by a group of 60 consumers, who were asked to give a judgment of preference.

Results. The chemical analysis highlighted differences between the five beers produced, especially in terms of alcohol strength and total acidity. Consumers, regardless of the area of origin and age preferred the beer produced with Trebbiano grape juice and characterized by a strong acidity. Conversely, expert tasters gave higher score to Pilsner I.G.A, also based on Trebbiano grape juice but with lower acidity and higher aromatic complexity.

Conclusions. The use of grape juice in the production of craft beer allows to diversify the style of beers offered in the market to fit the consumer liking, thus making the "hybrid" product between beer and wine-making industries a considerable innovation in the brewing industry. This is also demonstrated by the rising interest of consumers toward this new type of product and, in general, of craft beers.

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EFFECT OF HOT AIR DRYING ON THE PROBIOTIC SURVIVAL AND IN VITRO DIGESTION OF *L. SALIVARIUS* SPP *SALIVARIUS* ENCAPSULATED WITH HIGH PRESSURES HOMOGENIZATION AND INCORPORATED INTO A FOOD MATRIX.

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Keywords. microencapsulation, hot air drying, probiotic survival, gastrointestinal simulation.

Introduction. Microencapsualtion of probiotics can maintain survival rates and viability higher over the shelf life compared to non encapsulated cells (1). Encapsulation and the inclusion of bioactive compounds into a food structure are strategies that can control the liberation of the component in the target site, increasing its functionality (2). The aim of this work is to determine the effect of hot air drying on the survival and resistance to digestion of an encapsulated and non encapsulated probiotic microorganism included into a food matrix and stored during one month.

Materials and Methods. *Lactobacillus Salivarius* spp. *Salivarius* (CECT 4063) was microencapsulated by homogenization pressures at 70 MPa with a homogenizator Panda Plus 2000, GEA. Microcapsules were added to 9 log UFC/mL in mandarin juice. Juice with non encapsulated microorganisms was prepared following inoculation and fermentation at 37ºC during 24 h. Apples slices were impregnated with both juices (10 min at 50 mbar and 10 min at atmosferic pressure) and dried by hot air drying (at 40 ºC during 24 h, POL-EKO model CLW400 TOP, Madrid). Dried apple slices were evaluated in terms of water activity, moisture, pH, counts of viable cells and availability during gastrointestinal simulation during one month of storage time.

Results. During the technological operations as vacuum impregnation and drying there was a decrease of the microbial content but the encapsulated microorganisms showed lower reduction due to the protective effect of the capsule. Dried apple slices with encapsulated probiotic had higer amount (7.19±0.07 CFU/g) than non encapsulated (6.71±0.08 CFU/g). Encapsulation had an effect on the survival; during the storage time the probiotic content diminish less in encapsulated than in non encapsulated probiotic cells. There was a significant effect on the availability after the gastrointestinal simulation; CFU/g of encapsulated microorganism were higher than in the case of apple with non encapsulated cells.

Conclusions. Encapsulation by HPH has been able to increase survival and resistance of *L. salivarius* to technological operations as drying and to gastrointestinal conditions during the storage time.

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SURFACE DECONTAMINATION OF FUJI APPLES: COMPARISON BETWEEN PLASMA TREATMENTS, WASHING WITH PLASMA ACTIVATED WATER, ELECTROLYZED WATER OR HYPOCHLORITE

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Keywords. Fuji apple**,** plasma exposure, plasma activated water, electrolyzed water, microbial inactivation, fruit quality

Introduction. The consumption of fresh fruit and vegetables has increased over the last 2 decades also as a consequence of campaigns highlighting their health benefits due to their high contents of nutrients, vitamins and fibres. Fresh fruits and vegetables are usually contaminated by spoilage microorganisms which can attain levels ranging from 3 to 8 log units after harvest, depending on the produce and the growing conditions. On the other hand, also pathogens, mainly *Salmonella* spp., *Listeria monocytogenes*, *Escherichia coli*, can contaminate raw produce Among the various chemical and physical treatments available to reduce/eliminate the microorganisms from fruit and vegetables, washing with chlorine solutions still remain the most widely used one due to its efficacy, cost-effectiveness ratio and simple use. However, the association of chlorine with the possible formation of carcinogenic chlorinated compounds in water has called into question its use in food processing. The aim of the study was to evaluate and compare the efficacy of both direct exposure to plasma treatments (PT) and washing with plasma activated water (PAW) or electrolysed water (EW) in reducing populations of natural microflora and *Listeria monocytogenes* inoculated onto Fuji apples.

Materials and Methods. Plasma treatments were conducted in the DBD device (1) by direct exposure of fruits to plasma for 45 and 90 min. PAW was prepared by treating water with plasma for 50 min, while EW was produced by means of an EVA SYSTEM® (Industrie De Nora S.p.A) generator. Washing treatments were performed by dipping fruits for 10 min.

Results. Mesophilic spoilage microflora was sensitive to all the plasma treatments although differences were observed in relation to the conditions adopted. Direct exposure to plasma resulted in significant ($p<0.05$) inactivations with reductions ranging between 0.9 and a 1.5 log units depending on the treatment time. Washing fruits with both PAW and EW also caused a 1-1.5 log inactivation of mesophiles. Similar viability losses were observed by using chlorine solutions. Overall population of natural contaminating microflora was more resistant to EW than inoculated *Listeria monocytogenes*. Nvertheless reductions ranging between 3 and 6 log were achieved for *L. monocytogenes* after washing with EW in relation to the content of active chlorine (50-200 ppm) generated during EW preparation. No significant effect of PT, nor PAW and EW on apples' quality parameters were observed being colour and antioxidant activity unaffected by the longest treatments.

Conclusions. This study showed that both direct plasma treatments and washing with PAW or EW provided effective inactivation of matural spoilage microbiota and *L. monocytogenes* on Fuji apples. Thereforore all these treatments can be considered promising alternatives to clorination having the advantage of a minor adverse impact on environment and consumers' health.

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INNOVATIVE USE OF *ZYMOMONAS MOBILIS* IN BREAD-MAKING

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Keywords. *Zymomonas mobilis*, yeast intolerance, *Lactobacillus sanfranciscensis*, dough- model system, bacterial association, yeast free-products.

Introduction. The research is focused on the possibility of creating a new area of leavened bakery products avoiding the addition of baker's yeast (*Saccharomyces cerevisiae*). *Zymomonas mobilis* is an obligate fermentative GRAS bacterium. Its sugar catabolism proceeds through the ED pathway, with the latter step to ethanol + CO_2 proceeding similarly to *S. cerevisiae*. As *Zymomonas* does not convert maltose and starch present in flour, the effect of glucose addition to doughs, as well as the possibility of an unconventional microbial association with *Lactobacillus sanfranciscensis*, lactic acid bacterium (LAB) usually present in sourdoughs, was investigated. This LAB hydrolyzes maltose releasing one mole of glucose in the medium, potentially used by *Z. mobilis* to carry on the alcoholic fermentation.

Materials and Methods. Growth of *Z. mobilis* subs. *mobilis* DSM 424 and *L. sanfranciscensis* DSM 20663 were achieved in DSM liquid medium and MRS maltose media. Biomass were differently combined (1:1, 1:10 and 1:100 *Lb:Zym*) in a model dough containing 333 g flour type 0 Manitoba and 167 mL H_2O. Leavening trials were also performed by adding glucose (1 and 5 % w/w on flour) to dough. In the sourdough back- sloping procedure, 50 g of a 16 h-old leavened dough was added to a new freshly formulated dough for a total of 500 g. CO_2 production was monitored as reported in Musatti et al. (2015). Time course of ethanol production and sugars consumption were determined by RI- and UV- HPLC (column SH1821 Shodex, 210 nm).

Results. CO_2 production in doughs leavened by *Zymomonas* alone was limited (max 20 mL/g). Glucose addition allowed to increase dough leavening up to 250 mL/g after 6 h incubation at 26°C. As regards the microbial association, the best leavening performances were found employing the combination 1:100 *Lb:Zym*, in which the pH decrease due to LAB metabolism limited only marginally *Zymomonas* alcoholic fermentation.
Trials performed by applying the sourdough back-sloping procedure highlighted that *Zymomonas* was found to suffer the acidic environment created by the LAB, which has more sugar availability (i.e. maltose) in doughs.

Conclusions. The research illustrates an innovative strategy to set-up yeast-free baked goods leavened by Z. mobilis alone or in combination with *L. sanfranciscensis*, in which LAB metabolism favors the set-up of a mutualistic association. Nevertheless, glucose released by the LAB is probably not enough to support *Z. mobilis* fermentative metabolism.

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IN VITRO SIMULATED GASTROINTESTINAL DIGESTION OF CYCLOPROPANE FATTY ACIDS: A STUDY COMBINING ^{1}H NMR AND GC-MS APPROACHES

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Keywords. cyclopropane fatty acids, simulated gastrointestinal digestion, bioaccessibility, 1H NMR, GC-MS

Introduction. Cyclopropane fatty acids (CPFA) (dihydrosterculic and lactobacillic acids) are unusual fatty acids found in microorganisms, seed oils of some sub-tropical plants, and protozoa. The production of cyclopropane ring in bacteria is related to changes in the membrane fatty acid composition, representing one of the most important adaptive microbial response mediating the stress tolerance of several bacteria, such as *Lactobacillus helveticus*, *L. bulgaricus*, *L. acidophilus* and *L. sanfranciscensis* (1). Recently, CPFA were identified in milk and dairy products from cows fed with silages (2), and they have been described as quality marker molecules for Protected Designation of Origin (PDO) cheeses, for which the use of silage in feed is forbidden.
To the best of our knowledge, no information about the occurrence and metabolic pathway of CPFA in humans have been reported in the literature. Certainly, CPFA should be considered dietary relevant, as present in milk fat in the thousand mg/kg order, as well as in bovine meat.

Materials and methods. With the aim to investigate the metabolic fate of CPFA present in foods, food matrices rich in CPFA have been firstly submitted to *in vitro* simulated gastrointestinal digestion, especially for evaluating the effect elicited by the intestinal lipase activity (3).

Results. ^{1}H NMR and GC-MS analysis of the digested samples provided comprehensive and complementary information for determining the bioaccessibility of lipophilic compounds.
Preliminary results showed that the *in vitro* gastrointestinal model was suitable for lipid-rich foods. Both dihydrosterculic and lactobacillic acids were released from triglycerides and the cyclopropane ring was not degraded, indicating their stability and bioaccessibility after GI digestion in the analysed food matrices.

Conclusions. Cyclopropane fatty acids are not degraded by GI dicestiona nd are bioaccssible as the other fatty acids. Future in vitro experiments are needed in order to better investigate the effect induced by the microbial fermentation occurring at colonic level in humans.

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2.2 Food Waste Sustainability and Losses Reductions

EFFECT OF BREWERY SIZE ON BEER CARBON FOOTPRINT

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Keywords. beer, carbon footprint, glass and PET bottles, sensitivity analysis; specific energy consumption

Introduction. Energy and water consumption, waste generation, and emissions to air are the chief environmental issues of the brewing industry. A number of strategies has been so far suggested to reduce its impact on the global climate. This study was carried out to assess the effect of the brewery size on the carbon footprint (CF) of the production and distribution of 1 hL of a beer, packed in 66-cL glass or Polyethylene terephthalate (PET) bottles, as well as to identify an appropriate strategy to mitigate the overall GHG emissions.

Materials and Methods. The life-cycle analysis was performed in compliance with the PAS 2050 standard method [1,2], the stages of which being the following: goal and scope definition, inventory analysis, impact assessment, and interpretation of results. The scope of this study was to assess the environmental impact from cradle to beer distribution centers, this complying with a business-to-business study in accordance with PAS 2050. All data used were of the secondary type, while all the emission factors were transparently reported in previous work [3].

Results. A CF value of the order of 70 kg CO_{2e} per hL of industrial beer was estimated, this including a CO_{2e} credit of ~14,5 kg CO_{2e} hL^{-1} thanks to the utilization of beer co-products (i.e., spent grains and yeast surplus) as feed. The greenhouse gas emission (GHG) contribution of packaging materials (~34 kg CO_{2e} hL^{-1}) was predominant, being followed by those associated with raw and process material production (~22 kg CO_{2e} hL^{-1}), brewing and packaging (~13 kg CO_{2e} hL^{-1}), and raw material and final product transportation (~13 kg CO_{2e} hL^{-1}). The sensitivity analysis allowed the main hot spots in the life cycle of beer (i.e., glass bottle manufacture, barley cultivation, thermal energy consumption, packed beer transportation, and electric energy consumption) to be identified and targeted for lessening the beer carbon footprint. The smaller the brewery production capacity the greater the lager CF becomes. In spite of the different operating conditions assumed, CF was found to increase almost linearly (r^2=0.99) with the brewery overall energy consumption. Finally, a series of mitigation actions, such as the use of 100%-recycled glass or PET bottles, barley grown locally using organic agriculture methods, rail instead of road transport; solar-photovoltaic electricity, thermal energy from the anaerobic digestion of wastewaters, etc., allowed the beer CF to be about halved.

Conclusions. A cost/benefit analysis is thus needed to identify the best opportunity for reducing the beer environmental impact, as well as to decide to invest on the collection of selected primary data to make the CF calculation more accurate, or further progress in the estimation of other selected impact categories.

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REDUCTION OF MICROBIAL GROWTH IN LIQUID PRODUCTS USING ELEVATED PRESSURE SONICATION

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Keywords. bacterial kill, dairy, beverage, ultrasound, protein recovery

Introduction. There are a number of treatments available to reduce the viability of bacteria in dairy and beverage streams which are typically used in combination, (except HTST and UHT), to reduce viability of spoilage and pathogenic bacteria to acceptable limits in the final product [1]. All these treatment routes are unsuitable to reduce and stabilise the bacteria content in some process streams found in the dairy industries. For example, separator desludge, a milk by-product, cannot be treated by these routes due to formation of a highly viscous solid under elevated temperature and is currently disposed at high cost to the processor. Here we present the development of a novel approach to stabilise desludge entitled elevated pressure sonication (EPS) [2]. The products recovered were assessed for protein and fat content.

Materials and Methods. The technique used a combination of elevated CO_2 pressure (up to 100 bar) and relatively low frequency sonication (20 kHz as opposed to 18 to 500 MHz commonly used in other antibacterial processes) to assess the viability of reducing aerobic and lactic acid bacteria numbers in centrifuge desludge. Process conditions (pressure, sonicator power, processing time) were optimised for batch and continuous at constant temperature of 50^{o}C. Cell counts were determined by plating samples onto either nutrient agar or MRS (De Man, Rogosa, Sharpe) agar. Fat and protein content were determined using Rose Gottlieb and MaxSignal® No-Mel Milk Test Kit, respectively. COD was measured for liquid samples before and after treatment.

Results. Pressure or sonication alone did not kill bacteria, however in combination a 4.5 log-fold decrease in aerobic bacteria and 5 log-fold decrease in lactic acid bacteria can be obtained. Low CO_2 pressure (50 bar) reduced the viable aerobic bacteria whereas high CO_2 pressure (100 bar) was required to reduce lactic acid bacteria numbers. High pressure sonication in the presence of N_2 resulted in insignificant cell death. Sonication power as low as 5J/mL was used to kill aerobic and lactic acid bacteria in a very short treatment time (< 0.5 min). In comparison to HTST of fresh milk the technology leads to at least a ten-fold reduction in energy requirement. Recovered curd contained 88% protein (dry weight).

Conclusions. EPS is an effective way to stabilise desludge. Pressure alone or sonication alone do not kill bacteria, however in combination log-fold decreases given above can be obtained. Due to its high protein content the curd fraction could potentially be used as feed product. Following modification, the process has also been used to produce cheese from milk. The whey fraction was a potential source of bioactive peptides. The technique has potential to cross-over to brewery waste and beverage processing.

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RECOVERY OF ANTIOXIDANTS FROM APPLE BY-PRODUCTS WITH SUPERCRITICAL CARBON DIOXIDE EXTRACTION

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Keywords. fruit by-product, apple pomace, supercritical carbon dioxide, unsaturated lipids fatty acids oxidation, isothermal microcalorimetry

Introduction. Reduction of food losses and by products valorization is a tighten issue in food processing as the large amount of non-edible residues produced by the industries cause pollution, difficulties in the management and economic loss. Taking into consideration the waste produced during the transformation of fruits, a huge amount of materials such as peels, seeds and bagasse is produced whose disposal represents a problem. Research over the past 20 years has revealed that many food wastes could serve as a source of potentially valuable bioactive compounds, such as antioxidants, vitamins and fibers with increasing scientific interest thanks to their beneficial effects on human health (1).

Materials and Methods. This work describes the use of a green extraction technology for the recovery of valuable components from apple by-products. Supercritical carbon dioxide was applied as an alternative to the classical solvent extraction to recover antioxidants from apple pomace. Pressure (10–30 MPa), temperature (40–60°C), ethanol concentration (5–20 wt %) and extraction time (10–60 min) were modulated to obtain the highest extraction yield of polyphenols. The antioxidant capacity of the extracts was determined by Folin–Ciocalteu, 2,2-diphenyl- 1-picryhyldrazyl (DPPH) assay and electrochemical analysis. For electrochemical analysis, a cross-flow cell equipped with a glassy carbon electrode (Dual 3 mm) and a non-aqueous reference electrode (Ag/Ag+) was used. Injections of the samples were performed with HPLC 1260 auto sampler. Chronoamperometry at two different potentials +400 and +900 mV was applied for analysis of strong antioxidants (+400 mV) and total phenols (+900 mV). Moreover, the antioxidant properties of the extracts were examined for their potential to inhibit the oxidation of unsaturated lipids fatty acids (2) by isothermal microcalorimetry.

Results. Supercritical carbon dioxide was efficiently able to extract polyphenol from apple pomace at 25 MPa, 50°C, 40 min and ethanol concentration of 15%. The antioxidant capacity measured by electrochemical detection showed good correlation with Folin–Ciocalteu index and the results of 2,2- diphenyl- 1-picryhyldrazyl (DPPH) assay. Isothermal microcalorimetry results showed the efficacy of the extracts to inhibit the oxidation process.

Conclusions. Overall, the results of the current study assessed the potential of supercritical carbon dioxide to extract polyphenols with high antioxidant capacity from by-products of apple transformation. The technology provides an innovative approach to increase the production of specific compounds for use as nutraceuticals, antioxidants or ingredients in the design of functional foods.

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EFFECT OF PEF AND STEAM BLANCHING TREATMENTS ON THE EXTRACTION YIELD OF CAROTENOIDS FROM TOMATO WASTES

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Keywords. PEF, extraction, tomato wastes, carotenoids, lycopene, antioxidant activity

Introduction. Industrial transformation of tomatoes typically include a thermophysical peeling phase of the fruits, which lead to the production of large amount of wastes, namely peels. These wastes are currently used as feed for animal or sent to landfill leading to environmental and economical problems for the industry. However, they represent a cheap and rich source of several carotenoids, particularly lycopene. Therefore, in order to pursue the concept of "zero waste" or "total use" of agri-food residues with increasing industrial profitability, the recovery of these high-added value compounds is a challenge. Traditionally, these compounds are recovered by extraction with solvent which is a time consuming process and requires large quantities of solvents. The aim of this work, which was carried out in the frame of the European project "*FieldFood*", was to assess the potential of pulsed electric field (PEF) technology alone or in combination with steam blanching, to improve the recovery of carotenoids from tomato peels.

Materials and Methods. PEF treatments of whole tomato fruit were carried out at field strengths in the range 0.25-0.75 kV/cm and energy input between 0.25 and 5 kJ/kg. The evaluation of the cell disintegration index via impedance analysis was used to select optimal PEF treatment conditions. Tomato samples treated under these optimal conditions were then peeled with or without the application of a thermal treatment by steam (50–60–70°C). The achieved peels were subjected to solvent extraction in acetone for 24h, and the extracts were analysed by both spectrophotometric and HPLC analysis in order to evaluate the total carotenoids content and antioxidant activity of the extracts as well as the chemical composition of the extracts.

Results. Results showed that, for each field strength applied, the cell disintegration index increased with increasing the energy input, reaching a saturation value for an energy input of 1 kJ/kg. The application of PEF pretreatment at different field strengths and at 1 kJ/kg at room temperature, allowed to increase the total carotenoids content and antioxidant activity of the extracts up to, respectively, 2.7 and 4.2-fold those detected in the untreated samples. The application of a combined treatment (PEF + steam blanching) significantly increased the carotenoids content and the antioxidant power of the extracts, allowing to save energy with respect to a conventional steam blanching treatment. HPLC analyses revealed that PEF pre-treatment alone or in combination with steam blanching increased lycopene concentration in the extracts with respect to the untreated samples. Moreover, no evidence of selective release or degradation of individual carotenoids due to PEF application was detected.

Conclusions. Results obtained from this study demonstrate the potential of PEF as pre-treatment method to improve the efficiency of industrial processing of tomato fruits.

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COMPARATIVE EVALUATION OF VOLATILES IN MAGLIOCCO CANINO AND DIMRIT GRAPE SEED OILS

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Keywords. grape seed oil, Magliocco Canino, Dimrit.

Introduction. Grape seed oil (GSO) extracted from the seeds of grape (*Vitis vinifera* L.) berries is drawing attention of the food, cosmetic and nutraceutic industries with its healthy, delightful and nutritional nature. The utilization of this remarkable oil also contributes to the economy of the wine and fruit juice industry by the valorization of the grape seed wastes that contain up to 20% oil yield. Organoleptic characteristics of this oil strongly influence consumer preferences. However, researches about aroma compounds of GSO is still scarce. The present study was designed to investigate oil yields and aroma profiles of a less-known red local Italian variety (Magliocco canino) and a Turkish red variety (Dimrit).

Materials and Methods. The "Magliocco canino" and "Dimrit" cultivar samples of *Vitis vinifera* were supplied from private vineyards, located in the Calabria region of Italy (Cantina Masicei) and Nevsehir province Turkey, respectively. Seeds were manually separated from berries and immediately put into oven for 24 h at 60°C. Dried seeds were grinded and the extraction of GSO was performed by a semi-continuous solvent assisted oil extractor (Soxtherm, Gerhardt, Germany) for 6 h at 80°C. Obtained oil-solvent mixture was evaporated by vacuum evaporator (Buchi, Rotavapor, Switzerland) to remove solvent residues. A purge and trap system was used to carry out the isolation of aroma compounds as described in Sonmezdag et al. (1). The gas chromatography system was performed as described in our last study (2), used to characterize aroma profiles of those two GSO samples.

Results. Oil extraction yields of Magliocco canino and Dimrit varieties were 15.8% and 7.5% respectively. A total of 40 aroma compounds were detected in Magliocco canino GSO and consisted of 20 volatile alcohols, 5 esters, 4 acids, 3 terpenes, 3 ketons, 3 aldehydes, a lactone and a phenol. Meanwhile, a total of 28 volatiles of Dimrit GSO and consisted of 12 alcohols, 5 volatile phenols, 3 terpenes, 3 acids, 2 aldehydes, 2 ketones and an ester. Although, alcohols were dominant compounds in both varieties; terpenes, such as styrene, were also found in higher concentrations in Magliocco canino GSO, while aldehydes, such as hexanal and nonanal that are responsible of green, grassy and fatty notes (2), were the second major group in Dimrit variety.

Conclusions. Difference between oil yields and some aroma compounds demonstrated the fact that oil yield and aroma profiles of GSO may vary significantly from one cultivar to another even if the extractions were carried out precisely under the same conditions. As the aroma plays a crucial role for the consumer perceptions, it is expected that the rising popularity of GSO will draw attention of aroma investigations and therefore main aroma characteristics of this special healthy oil will be clearer in the future.

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TOTAL-USE CONCEPT OF AGRI-FOOD WASTES: AN EXAMPLE OF APPLICATION TO THE RESIDUES OF TOMATO PROCESSING

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Keywords. High pressure homogenization, Tomato processing, Agri-food residues, Total use, Intracellular components

Introduction. The total-use concept of wastes can involve the redesign of resource life cycles, of manufacture processes, as well as the rethinking of wastes as resources of valuable compounds. In particular, most of the residues from agri-food industry often represent an environmental burden, despite the fact that they are still rich in several intracellular compounds, which can be efficiently valorized if adequately recovered. This work addresses the use of High Pressure Homogenization (HPH) processing as an efficient comminution process to mechanically disrupt the plant cells and release the high-added value intracellular components into green solvents, such as water or vegetable oils. The case study of the residue of a tomato processing plant will be considered.

Materials and Methods. The vegetable matrices, consisting of tomato peels and seeds, were suspended in water, pre-milled and screened at 600 µm. Subsequently, the vegetable suspensions, added with variable amounts of vegetable oils, were processed from 1 to 5 times by HPH, at pressures ranging between 100 and 200 MPa, which were controlled by changing the size of the homogenization valve. Centrifugation (5000×g for 30 min) is used to separate the different fractions (oil phase, aqueous phase, and insoluble fibers).

Results. The results show that HPH processing causes the complete disruption of the vegetable cells in suspension, and the release of the intracellular material. The resulting paste, containing the vegetable cell debris with a size distribution comprised between 10 and 50 µm, exhibits a statistically significant increase in both supernatant antioxidant activity (related to the antioxidant compounds released in the aqueous phase upon HPH processing) and surface antioxidant activity (related to the antioxidant still bonded to the surface of cell debris). Remarkably, the mechanical disruption of the vegetable cells also (a) induces a measurable increase in the viscosity of the suspension, and (b) contributes to reduce the particle size below the eye detectability limit, enabling its direct use in novel product formulation, to increase the content of fibers and bioactive compounds, such as lycopene.

Moreover, upon centrifugation, the vegetable cell debris fraction is easily separated, and a lycopene enriched oil phase and aqueous phase are obtained. The oil migh find direct use as an enriched oil, while the aqueous phase, which is rich also in polysaccharides with high interfacial activity, can be exploited as a thickening agent or stabilizer, or as an edible coating. The solid fraction, is instead exploited as a gelling agent, through the formation of a water-based capillary network, in oil structuring to replace palm oil.

Conclusions. In conclusion, HPH processing enables the fine comminution of the vegetable cells and the complete release of high-added values intracellular components, using a purely physical process and green solvents (water or vegetable oils). Therefore this approach, integrated with the development of novel processes and products, contributes to pursue the concepts of sustainable valorization and total use of the of agri-food residues.

VALORIZATION OF GINGER AND TURMERIC PEELS

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Keywords. by-products, ginger, turmeric, peels, antioxidant

Introduction. The *Zingiberaceae* family includes ginger (*Zingiber officinale*) and turmeric (*Curcuma longa*) zhizomes which are primarily used in the dried spices or essential oil production and are widely recognized for their health benefits due to their strong anti-inflammatory and antioxidant activities. This work is aimed to investigate the antioxidant potential of ginger and turmeric peels which are usually discarded during post-harvest operations.

Materials and Methods. The powder obtained from ginger and turmeric peels after freeze-drying, grinding and cryogenic milling under liquid nitrogen was subjected for 5 minutes to three different extraction methods such as extraction with 70% v/v ethanol, infusion at 90°C and sonication (1) in distilled water. The antioxidant activities of these extracts were evaluated using DPPH and FRAP assays and expressed as Trolox equivalents (mg TE) per g of powder. The total phenolic contents were also detected by Folin-Ciocalteu method and expressed as gallic acid equivalents (mg GAE) per g of powder. Moreover, the HPLC analysis was carried out in the extracts of ginger and turmeric peels to identify respectively 6-gingerol (2) and curcumin (3) which are considered the main bioactive compounds with antioxidant effectiveness. All of the data were analysed by two-way analysis of variance (ANOVA) using the SAS (Statistical Analysis System) software 9.3 version and including in the model the *Zingiberaceae* species, extraction method, and their interactions as the fixed effects.

Results. The total phenolic contents and the antioxidant activities of the extracts obtained from the powdered peels of ginger and turmeric rhizomes resulted in statistically relevant differences ($P \leq 0.0001$) depending on the *Zingiberaceae* species and extraction method. In details, the ethanol extraction compared with infusion and sonication techniques was more effective in increasing their antioxidant activities based on DPPH (4.16, 2.17, 2.17 mg TE/g, respectively) and FRAP (65.07, 18.81, 15.49 mg TE/g, respectively) assays because of higher yields of phenolic substances (78.73, 36.84, 33.08 mg GAE/g, respectively) such as 6-gingerol (12.78, 0.41, 0.58 mg/g, respectively) and curcumin (48.62, 5.42, 1.38 mg/g, respectively) detected by HPLC analysis in ginger and turmeric extracts, respectively. Moreovere the ethanolic extracts of turmeric peels showed the better performances than those of ginger peels with higher amounts of phenolic substances (104.88, 52.57 mg GAE/g, respectively) and consequently greater antioxidant activities based on DPPH (4.45, 3.87 mg TE/g, respectively) and FRAP (72.38, 57.77 mg TE/g, respectively) assays.

Conclusions. The discarded peels of ginger and turmeric rhizomes can be recovered as a source of natural antioxidants not only in food additives but also cosmetic and medicinal products.

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PRODUCTION OF VINEGAR FROM PINEAPPLE WASTE: PROCESS OPTIMIZATION AND CHARACTERIZATION OF PRODUCTS THROUGH A METABOLOMIC APPROACH

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Keywords. fermentation, HSPME/GC/MS, pineapple waste, UHPLC/QTOF/MS, vinegar, wine.

Introduction. Due to the growing interest in adding value to raw agricultural by-products (4) new types of beverages have recently been produced. This work had the aim to optimize the processing of saccharification and fermentation of pineapple (*Ananas comosus* (L.) waste and to evaluate its feasibility for producing a quality vinegar.

Materials and Methods. Searching for the optimal conditions for the enzymatic hydrolysis step of pineapple waste (1) highlighted the need to reduce biomass recalcitrance by means of 4 pre-treatments (microwave, boiling, high pressure with pressure cooker and autoclave) for different lenghts of time (3). The alcoholic fermentation of the liquid from the saccharified waste was performed with three strains of *Saccharomyces cerevisiae* at 25, 20, and 15°C (2), and the acetic fermentation of pineapple wine was carried out at 32°C for 30 days using *Acetobacter aceti*. Reducing sugars, total soluble solids, titratable acidity, and pH were determined together with the analysis of inhibitory compounds and cost evaluation. Pineapple wine and vinegar were also analyzed for ethanol, fixed and volatile compounds using HPLC, HSPME/GC/MS, and a metabolite platform UHPLC/Q-TOF/MS.

Results. Autoclave pre-treatment was shown giving the highest sugar yield, both alone and coupled with the enzymatic hydrolysis with an estimated cost of 0.16 €/g_{sugar}. At the end of the saccharification no compounds from non-enzymatic browning were showed (3). In the alcoholic fermentation the highest levels of ethanol, i.e., more than 7 and 8% v/v, were reached in 96 h both at 20 and 25°C. Differently, at 15°C higher levels of citric and malic acids were maintained. Moreover, at 20°C the highest concentration of acetate and ethyl esters was observed, whilst at 25°C and 15°C terpene compounds stressed the wine volatile profile. In vinegar higher alcohols, esters, acetoin, 2,3-butanediol, ethyl acetate, and 2-phenylethanol, L-lysine, mellein, and gallic acid were the major metabolite markers.

Conclusions. The study demonstrates that properly saccharified pineapple waste can be considered the chief raw material for further fermentation into vinegar, which has wider food applications.

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VALORIZATION OF LOCAL CHEESE WHEY BY PRODUCING A LACTIC ACID FERMENTED, PROBIOTIC, CARBONATED AND FRUIT JUICE-ADDED WHEY BEVERAGE

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Keywords. cheese whey, probiotic culture, lactic acid fermentation, carbonation, fruit juice

Introduction: Whey, a major by-product of cheese manufacturing process, is usually discarded in Sri Lankan cheese processing industries due to the lack of high-end fractionation techniques to convert it to value-added products. In a nutritional point of view, cheese whey has a high protein digestibility corrected amino acid score and contains many bioactive peptides with functional benefits. However, direct consumption of cheese whey is limited due to problems such as lactose intolerance, low digestibility of whey proteins and whey protein allergenicity (1). Therefore, the present study focused on overcoming these problems by formulating a fruit incorporated, fermented and carbonated whey beverage.

Materials and Methods. Cheese whey (initial pH=4.8, TSS=6.2^{o} Brix) obtained from a local cheese processing plant (Lili Dairies, Giriulla, Sri Lanka) was filtered, added with 0.05% (w/v) of ascorbic acid and concentrated in a water bath to increase the TSS up to 9.2^{o} Brix, with subsequent heat treatment at 80 ^{o}C. Whey protein denaturation was ensured by measuring the absorbance at 420 nm before and after heat treatment using a UV-Vis spectrophotometer, after treating the samples with saturated NaCl and HCl. Pasteurized orange juice (TSS 11^{o} Brix) was incorporated at the level of 15% (w/v) and lactic acid fermentation was allowed by the inoculation of a lyophilized Direct Vat Set probiotic starter culture (STI- 12 Chr. Hansen, Denmark) and incubation at 42 ^{o}C for six hours. Absorbance was measured at 550 nm using a UV-Vis spectrophotometer before and after fermentation to ensure proteolysis, after adding the Biuret reagent. Sugar and pectin were added to the fermented mix at the levels of 9% (w/v) and 0.5% (w/v) respectively, based on sensory evaluation results from previous studies (2). The mix was subjected to carbonation (6 psi) at 5 ^{o}C after aseptically filling into pre-sterilized bottles. The prepared whey beverage was stored under refrigerated conditions (7 ^{o}C) and proximate analysis was carried out. Microbial counts were obtained by conducting a total plate count.

Results. The whey beverage formulation contains 75% whey (v/v) and 90.5±0.14% of moisture, 0.07±0.007% of fat and 1.90±0.01% of crude protein. The final pH was 4.0 (titratable acidity 3.38± 0.005%) and the final TSS was 18^{o} Brix. The product contained 2.44x10^{6} CFU/ml. There were statistically significant differences in the reduction in absorbance confirming both the denaturation of whey protein during heat treatment ($p=0.004$) and the proteolysis of whey protein during fermentation ($p=0.000$), due to the proteolytic activity of *Stretococcus themophilus*.

Conclusions. A lactic acid fermented probiotic and carbonated whey beverage containing *Bifodobacterium animalis* subsp. *lactis* (BB-12®) with added orange juice can be prepared with significantly reduced whey protein allergenicity and improved whey protein digestibility. The formulated whey beverage can be assigned an approximate shelf-life of 14 days at 7 ^{o}C. The cost of production is highly economical (approximately LKR 80.00 for a 250 ml bottle).

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SUSTAINABILITY OF I AND IV GAMMA SALAD PRODUCTS, IMPACTS AND MITIGATION STRATEGIES BY MEANS OF LCA: FOCUS ON NURSERY STEP

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Keywords. food sustainability, polystyrene trays, mixed salad, compost, peat cubes, eco-design**.**

Introduction. Life Cycle Assessment (LCA) is a worldwide methodology applied from late 80' to assess the environmental burden of products, production chains and services. In the last two decades LCA applied to the food sector has been focused on the primary production stage and on the processing phases but only for few crucial products (e.g. pasta, wine). Regarding the primary production stage, there are a lot of papers assessing and comparing different aspects. As well horticulture is largely assessed, it remains a lack of information regarding some specific aspects (e.g. industry and nursery). In Italy salads and greens are mainly used for I and IV gamma products production belonging to two crop groups, endive and chicory together representing, in 2011, about 6% of horticultural products in terms of cultivated area and 4% in terms of yield. There are many impact categories considered in literature and the most reported are: global warming (GW), fossil depletion (FD), freshwater-marine eutrophication (FE, ME), human toxicity (HT), terrestrial, marine and freshwater ecotoxicity (TE, ME and FE), ozone depletion (OD), abiotic depletion (AD). However the knowledge regarding the nursery step, primary system providing materials used in secondary areas, remain insufficient. Due to the lack of specific studies on nursery step finalized to horticultural crops, the main aim of this work is to evaluate the environmental load of four different species of endive and chicory.

Materials and Methods. The study was conducted following ISO standards on life cycle assessment with a "cradle to nursery gate" approach. Data for inventory analysis have been detected throughout surveys, questionnaires and direct measurements. In more details materials used for structures, energy and mass flows have been considered. The functional unit selected was one small plant in polystyrene tray. The selected calculation method is the CML 2 baseline 2000 v. 2.05 with the related impact categories. Three different mitigation scenarios have been proposed: replacement of polystyrene trays with another system; substitution of peat with compost; and substitution of polystyrene trays with squared holes.

Results. Results show that the four species have a comparable environmental load. Differences among the different impact categories are lower than the 30% excluding eutrophication for escarole (-56%) with respect to sugarloaf chicory. Species that presents the lowest impact is Escarole. Thermoplastic and plastic materials and their production, substrates extraction and direct emissions are the main contributors affecting the environmental sustainability of seedlings production. The substitution of peat with compost in growth media has some potential environmental benefits. Compost has a lower impact on all the categories considered. In terms of GW the saveing is about 1.7e-4 kg CO_2 eq for eache seedling produced. The substitution of polystyrene trays with a system based on peat cubes generate a lower impact on AD, AC, EP, GW, HT, PO and an higher impact on OD, FE, ME, TE. The use of polystyrene trays with squared holes in repleacement of circular shaped trays imply a reduction of impact for almost all the categories excepted OD, FE and ME.

Conclusions. Consistently with other studies, energy consumption, such as electricity give a load of little relevance. The nursery step taken into account contributes to the total load of cultivation in open field in percentages ranging from 0.7% to 11.8%, so it could be a relevant contributor considering the whole production chain. The analysis of different scenarios shows several possible solutions useful to reduce the impact in seedlings production, and the LCA tool has been useful for this purpose and could be applied to many other food products and related production chains.

2.3 Food-omics approach on Digestion and Nutrition

IMPACT OF EARLY POSTNATAL NUTRITION ON THE NMR URINARY METABOLIC PROFILE OF INFANT

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Keywords. metabolomics, NMR, neonatology, human milk, formula milk, urine

Introduction. Formula milk (FM) provides a safe and nutritionally adequate substitute to human milk (HM) in circumstances when breastfeeding is not possible. Although the progress in improving FM to replicate HM more closely has evolved over many years, research in their formulation still continues. To this aim, knowledge of the influence of postnatal nutrition on infant metabolism may provide important contribution to the understanding of fundamental mechanisms of nutrition. Metabolomics is an interesting tool for assessing metabolic responses of humans or animals to dietary interventions (1).
Here, we used metabolomics to compare the metabolic urinary profiles of exclusively breast fed term infants with those of a double-blinded controlled trial with formula-fed term newborns randomized to receive either an infant formula enriched by functional ingredients (ENR) or a standard formula (ST).

Materials and Methods. A total of 60 infants were enrolled: 24 subjects were given ENR formula, 25 received ST formula, and 11 were breast-fed. Both formulas were supplied by Heinz Italia S.p.A. (Latina, Italy). Infants were visited at the enrolment as baseline, at around 60 days of age, and at ca 130 days of life. At each visit, antropometric data were taken and urine samples collected. ^{1}H NMR spectra of formula milk and urines were recorded on a Varian UNITY INOVA 500 spectrometer.

Results. A common age-dependent modification of the infant urine metabolome was observed for the three types of nutrition. Contrariwise, differences in the metabolic profiles were identified according to the type of diet (HM vs FM), while no significant difference was observed between the two formulas. These modifications are discussed mainly in terms of the different milk compositions.

Conclusions. This study emphasizes the potential of metabolomics strategy in the assessment of nutritional response in newborns and in providing useful information to the improvement of the nutritional properties of infant formulas

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IDENTIFICATION OF WHEAT VARIETIES WITH A LOW IMPACT ON CELIAC-DISEASE GENETICALLY PREDISPOSED SUBJECT

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Keywords. durum wheat, *in vitro* digestion, gluten peptides, celiac disease, LC-MS

Introduction. Celiac disease (CD) is an autoimmune entheropathy that develops in genetically predisposed subjects after the ingestion of wheat gluten or related proteins of barley and rye. During gluten digestion several resistant peptides are formed, some of them being able to trigger an immunological response in celiac patients. Despite genetic predisposition to CD (HLA-DQ2 allele) is fairly widespread (about 30% of the population) (1), CD affects approximately 1% of the population (2). The loss of the immunological tolerance to gluten in CD predisposed subject is still not clear, and it has been ascribed to different factors, among which the amount and quality of dietary gluten (3).

Materials and Methods. One hundred *Triticum durum* genotypes were submitted to *in vitro* digestion. Peptides containing sequences known to trigger CD were identified and quantified with liquid chromatography coupled to mass spectrometry. Six *T. durum* genotypes grown in four different Italian regions were analysed too, in order to evaluate environmental influence on the production of CD related peptides.

Results. Eleven peptides were identified as containing sequences known to elicit CD response. The amount of immunogenic peptides was found to be highly variable among the different wheat varieties, ranging from 386 ppm of the Valerio genotype to 1661 ppm of the Amedeo genotype. Among the 100 genotypes analysed, 10 were found to produce an immunogenic peptide amount lower than 500 ppm, while 4 genotypes produced more than 1550 ppm of immunogenic peptides after *in vitro* digestion. As shown by the data, the naturally high variability in immunogenic peptides production can be exploited to reduce the exposure of CD predisposed subject: the substitution of dietary wheat with a "low impact" variety will thus reduce the triggering immunogenic sequences up to 75%. Environmental effects were evaluated too: the amount of immunogenic peptides was not statistically different among three of the four Italian regions analysed, while it was slightly higher for Sicily. The impact of genetic was then prevailing over the environmental conditions.

Conclusions. Wheat varieties having a potential low impact on CD predisposed subjects were identified on the basis of immunogenic peptides produced after in vitro digestion. The most promising wheat variety will be used to replace wheat products in the diet of CD predisposed subjects and of naïve CD patient. Serological and immunological markers will be evaluated and compared with controls (normal diet), to verify an effective improvement of the "low immunogenic" wheat diet.

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2.4 Innovation in Food Safety, Microbiology and Regulation

EFFECT OF CHITOSAN COATING ON FUNGAL SPECIES IN PADDY RICE AND BYPRODUCTS

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Keywords. Paddy rice, molds, sample, chitosan, inhibition growth

Introduction. Argentina participates with 1.3% of world exports of paddy rice. In the province of Entre Rios, where 31% of domestic production is planted, campaign 2015 -2016 closed near to 455 tons, a total of 17% below the previous season, because the weather has conditioned the crop, causing losses in different areas. There has been performed an analysis on representatives samples obtained from 200 tons silobags that showed abnormal microbiological count regarding molds. These molds have been characterized and isolated. An in vitro essay using chitosan coating has been carried out to evaluate its effect on the mycelial growth.

Materials and Methods. This study was carried out using long thin rice, (*var*. Irga 424). Sampling of paddy rice, milled rice and its by products (husk, bran, half grain and fourth grain) was performed using the ISO standard sampling methods: 950-1981 for sampling of grains and cereals.The samples were collected aseptically from a local industry located in the province of Entre Ríos, Argentina during 2016. From each product stream 5 kg replicates were taken. Assessment of molds and yeasts -MY- count were carried out using ISO 21527. Isolation of fungal species: The rice and byproducts samples were sieved to remove gravels and plant debris. Twenty five grams of the each sample were diluted in 0.85% sterile saline tubes up to a dilution of 10^{-1}; 0.5 ml of the diluted sample was spread on the surface of sterile pre-solidified potato dextrose agar -PDA- plate using a sterile L-shaped glass rod. The plates were incubated at 28°C and observed for the morphology of fungal colonies. Chitosan -Q- (degree of N-deacetylation 98.6 %) was obtained from Parafarm LTD. Stock solution of chitosan -SSQ- (2.5 $mg.ml^{-1}$) was prepared in 1 % (v/v) acetic acid adjusting pH using NaOH. After stirring (25000 rpm) for 3min at room temperature. Sterile, deionized water of pH 6.0 was used as a control. The effect of the Q coating on mycelial growth -MG- was evaluated by inoculating a 10 mm-diameter mycelial disc from a 5-day-old-colony of each fungi strain isolated on the center of a plate with PDA amended with SSQ. Plates were incubated at 28°C and the diameters of the fungal colonies were measured when the control PDA medium was fully covered with the mycelium. Each treatment was replicated using five plates, and the experiment was performed three times.

Results. Microbiological results of MY showed significant differences between samples ($p<0.05$). The sample that showed the highest count was the one on paddy rice ($1.10^7 \pm 1.10^2$ $UFC.g^{-1}$). Milled, fourth grain and half grain showed a lower number (<100 $CFU.g^{-1}$). Three different molds strains were isolated: *Rhizopus oryzae*, *Aspergillus flavus* and *A. oryzae*. There was a significant difference in the inhibition of MG of *R. oryzae* compared against the control and the essay showed 65-80% inhibition of MG.

Conclusions. Effectiveness on inhibition of MG of a Q-based coating has been evaluated against the isolated species obtaining promising results as a contribution in order to implementate a safe treatment against the attack of molds on rice and its byproducts.

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LEVELS OF SUGGESTED PROCESS HYGIENE CRITERIA (*E. coli*) ON FRESH PRODUCE AFFECTED BY THE QUANTIFICATION TECHNIQUE

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Keywords. qPCR, Propdium monoazide, plate count, viable cells

Introduction. Although well-known limitations, *E. coli* has been proposed as a process hygiene criterion for fresh produce. Traditionally, the presence of *E. coli* in fresh produce is evaluated by plate count. However, the use of culture methods might lead to underestimations of the *E. coli* levels, because environmental conditions may affect bacterial growth or culturable capability (1). Molecular approaches such as qPCR and PMA-qPCR have been proposed as more effective than culture methods. However, qPCR techniques cannot differentiate between viable and dead cells, leading in this case to an overestimation of the *E. coli* levels. DNA intercalating dyes as Propidium monoazide (PMA) has been reported as an efficient methodology for alleviating this limitation (2). Our goal was to identified the most suitable quantification techniques for *E. coli* in order to improve the performance of this indicator when associated to the presence of pathogenic bacteria.

Materials and Methods. Two trials (lab-scale and greenhouse) were carried out to detect native *E. coli* in fresh produce (lettuce and zucchini) irrigated with different types of water sources commonly used by growers. Prevalence and levels of *E. coli* were determined by using quantitative PCR (qPCR), PMA-qPCR and culture-based assay. Correlations between the presence of pathogens and the levels of *E. coli* in irrigation water (IW) were also determined.

Results. In the lab scale trial, *E. coli* levels in lettuce samples by plate counts was lower than those quantified by qPCR and PMA-qPCR. However, no significant differences were observed between both molecular techniques. Additionally, lettuce samples were spray irrigated with a mixture of IW and heat-treated irrigation water (1:1), which increased the numbers of dead cells. This experiment validated the capacity of the PMA-qPCR assay to distinguish between live and dead cells, showing significant differences between PMA-qPCR and PCR. In the greenhouse trial, *E .coli* levels in zucchini samples using cultivation based technique was below the detection limit (<0.7 log cfu/g). However, the median counts of *E. coli* enumerated using PMA-qPCR was 2.6 log cfu/g (IQR 2.5-3.1). The differences observed between cultivable *E. coli* and PMA-qPCR could be due to bacteria viable but non cultivable (VBNC) occurrence in the fresh produce. In IW, positives samples for pathogens showed significantly higher *E. coli* levels than samples negative for pathogenic bacteria when both enumeration methods were used. No positive samples for pathogens were found in Zucchini.

Conclusions. The results obtained showed that PMA-qPCR assay represents a suitable technique for the selective detection and quantification of total fraction of viable *E.coli*, including VBNC cells induced under stress–provoking environmental conditions in fresh produce. Correlation between the presence of pathogens and the levels of *E. coli* in irrigation water were observed using both quantification techniques.

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EFFECT OF THYMOL, CARVACROL AND THERMAL TREATMENTS ON VIABILITY, INJURY AND STRESS RESPONSE OF *LISTERIA MONOCYTOGENES*

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Keywords. Flow cytometry, aroma compounds, *Listeria monocytogenes*, thermal treatments

Introduction. The need to reduce thermal treatment has addressed many studies towards the use of alternative treatments or the combination of mild treatments with other physico-chemical factors. The exploitation of essential oils and/or their constituents, whose antimicrobial activity is well known, has gained increasing interest. Several researches reported a synergistic effect of mild thermal treatments and aroma compounds against foodborne pathogens or spoilage microflora (1,4). The efficacy of these treatments is usually determined by classic microbiological culture-dependent methods. However, it is documented that mild treatments or other stress conditions can trigger the occurrence of populations, called viable but not culturable cells (VBNC), which lose their ability to grow on plates but still show metabolitc activity (3). Since some of these cells could recover the damage and revert to their physiologically active condition, the determination of injured cells is nowadays a great concern for food microbiologists.

Materials and Methods. The viability and the sublethal injury of *L. monocytogenes* cells exposed to mild thermal treatments (45, 50 and 55°C) in the presence or not of aroma compounds (50 mg/l of thymol and/or carvacrol) was investigated by classical microbiological approach (plate counting) and by flow cytometry (FCM), an efficient and less time-consuming method to assess the viability of microorganisms, allowing to obtain real-time data at single cell level (2). While classical microbiological counting allows to estimate only viable and culturable cells, FCM enables to distinguish viable, injured (including culturable and non-culturable but metabolically active cells) and dead cells through the utilization of specific fluorochromes (i.e propidium iodide to assess membrane integrity).

Results. The data confirmed the synergistic effect of heat treatment and aroma compounds. Moreover, the presence of aroma compounds strongly affected the potential recovery of cells possibly survived to the adopted treatment. The results obtained through the two approaches were not always congruous (i.e. low percentage of injured/dead cells but no growth on agar medium after sublethal heat treatment), evidencing the need to use culture-dependent and independent methods in a complementary way.

Conclusions. In this study FCM approach was helpful in determinating the effect of thermal treatments and aroma compounds on *L. monocytogenes*. However the need to focus on different cell targets in addition to membrane integrity (e.g. membrane potential, esterase activity) was evidenced, with the aim to better elucidate the physiological response of this microorganism.

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A STUDY ON DETECTION OF HORSE OR DONKEY MEAT ADULTERATION IN RAW BEEF MIXTURES BY FOURIER TRANSFORM INFRARED (FTIR) SPECTROSCOPY

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Keywords. horse meat, donkey meat, FTIR Spectroscopy, adulteration

Introduction. Fraudulent addition of low-quality meats in meat formulations in order to reduce production cost has been a common adulteration practice in the meat industry for financial gain when it is done without informing consumer. Authentication for the identification of different species of animals is a major concern for food authorities. Horse and donkey meats are not conventional sources of meats in most of the countries in the world because eating these meats is taboo or prohibited due to religious beliefs. There have been incidences of undeclared utilization of these meats in meat products formulations. This is not a food safety issue; however, it is considered an important breakdown in the traceability of the food supply chain. Therefore, the purpose of the current study is to detect fraudulent substitution of horse or donkey meats at different concentrations in beef mixtures by Fourier Transform Infrared (FTIR) spectroscopy.

Materials and Methods. Horse or donkey meats were added into beef as the main meat material at the levels of 0, 5, 10, 20, 40, and 100%(wt/wt) to make different meat mixtures. FTIR Spectroscopy measurements were performed by using ATR in liyophilized mixtures and spectra were recorded in the mid-infrared region. Hierarchical cluster analysis (HCA) and principal component analysis (PCA) were also conducted to classify the different meat mixtures.

Results.Six characteristic regions (2980-2800 cm^{-1}, 1770-1710 cm^{-1}, 1480-1360 cm^{-1}, 1290-1210 cm^{-1}, 1210-1140 cm^{-1} and 1140-1020 cm^{-1}) were identified from FTIR spectra. The spectra of %100 horse and donkey meat samples were similar and obviously different from the spectrum of %100 beef. Increasing amount of substitution of horse or donkey meats generally resulted in a reduction in the intensities of characteristic bands from beef. In addition to observations of clear differences with naked eyes between the spectra of % 100 beef sample and adulterated mixtures, characteristic regions were also evaluated for grouping mixtures into different cluster branches to classify their spectral similarities by hierarchical cluster analysis and principal component analysis, which provided generally better differentiation than fingerprint region and general spectrum.

Conclusions. The results of this study show that detection of relative species-specific changesfrom FTIR spectra is a sound technique capable of the identification of fraudulent substitution of different meat species such as donkey and horse in raw meat mixtures.

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IFS STRENGTHENING THE CAPACITIES OF EARLY CAREER SCIENTISTS IN DEVELOPING COUNTRIES TO CONDUCT RELEVANT AND HIGH QUALITY RESEARCH IN THE FIELD OF BIOLOGICAL AND WATER RESOURCES

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Keywords. early career scientists, developing world, small grants, capacity building, sustainable food production, food security, enabling innovation.

Introduction. The International Foundation for Science- IFS is a research council, based in Stockholm, Sweden and founded in 1972. It provides competitive grants to early-career researchers together with a capability building agenda to nurture their skills within limited scientific landscapes in the developing world. IFS focusses on the sustainable use, management and conservation of biological and water resources. It includes the social sciences perspectives that are important in the production, the renewable utilization and conservation of the biological resources base.

Materials and Methods. The IFS identifies promising young scientists through a careful and competitive selection. Eligible countries and concrete examples of IFS supported research projects can be found on our website. Young researchers from and working in the developing world may apply for small individual / collaborative research grants in the fields of biological resources in terrestrial systems, water and aquatic resources and food security, dietary diversity and healthy livelihood. Addressing the challenges of food security and healthy livelihood requires a multifaceted approach, bearing in mind the demand for a sustainable use and conservation of the biological resources base and taking in account the global challenges such as climate change and sustainable water use. In line with these challenges, IFS has been supporting research addressing issues for example in food production, post harvest technologies and food safety, food engineering and processing, biotechnology, food quality and safety, nutrition, hygienic engineering, reduction of post-harvest and other food losses and waste throughout the food supply chain. Besides these research grants, IFS awards to its grantees additional support such as travel grants for conferences, networking, training workshops and purchasing services. IFS has been striving to encourage its successful grantees to put science results into use for innovation. This may be done through communication towards stakeholders and policy makers. In some cases, results have been implemented to the benefit of different stakeholders.

Results. IFS has awarded so far about 8000 research grants for scientists in Sub-Saharan Africa, North Africa and some countries of the Middle East, South Asia, South East Asia, South and Central America. IFS grantees have a good record of scientific publications and many have subsequently taken leading positions in their countries. Applications of grantees' results in policy or enterprises can be documented. However, with the growing global challenges, and a pressing demand for responses to address food security in a sustainable way, there is an increasing need to enable more young and dynamic young scientists in the developing world to generate knowledge and innovative applications. IFS will contribute more to respond to such a global need if linked to and collaborates with other players and stakeholders who can join forces. These can range from organizations supporting science to private entities interested in innovations.

FOOD METAGENOMICS AGAINST FRAUDS: APPLICATIONS OF NEXT GENERATION SEMICONDUCTOR BASED SEQUENCING ON MEAT AND DAIRY PRODUCTS AND HONEY

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Keywords. Next Generation Sequencing, food DNA, metagenomics, authenticity.

Introduction. Many frauds in foods are derived by the intentional substitution of ingredients or by mislabelling of the origin of the products for economic reasons. Sometimes, accidental substitutions or contamination could occur during the processing steps. The precise identification of what is mentioned on the food labels is an important issue in food control, food safety and integrity of food production chains. For these reasons we applied the Ion Torrent next generation sequencing technology for the identification of the species of origin of meat and dairy products and for the identification of the botanical origin of honeys.

Materials and Methods. We first tested this next generation sequencing platform in artificial DNA pools containing equimolar or variable amounts of DNA of different meat or dairy species. Then we extracted DNA from processed meat and dairy products of different origin (e.g. milk, cured cheese, ricotta cheese). All DNA pools and extracted food DNA were amplified with universal primers to amplify three vertebrate mitochondrial DNA fragments. DNA extracted from honey was amplified with two universal primers designed on chloroplast genomes. Generated amplicons were barcoded and sequenced on two 318 Ion Torrent chips that generated about 3 billion of sequenced nucleotides. A bioinformatics pipeline was developed for filtering and aligning obtained reads on reference DNA sequences using a proprietary database designed for each food product.

Results. Sequencing results obtained direct evidence of the species of origin of meat and dairy products, including mislabelling in one analysed dairy product. In honey, generated DNA reads provided evidences on the geographical origin of the products in addition to the most frequent botanical species.

Conclusions. This study indicate that Ion Torrent metagenomics data are powerful tools for food authentication.

FUNGAL CONTAMINATION OF FERMENTED FOODS PRODUCED IN SOUTH AFRICA AND FERMENTED FOODS EXPORTED FROM NIGERIA TO SOUTH AFRICA

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Keywords. *mahewu*, fungi, fermentation, safety, South Africa

Introduction. Fermented foods represent a significant part of the diet of peoples around the world and the assessment of their safety is paramount based on their wide consumption and increasing demand in the export markets. This study assessed the safety of some fermented foods produced in South Africa and fermented foods exported to South Africa from Nigeria.

Materials and Methods. Fermented; maize meal (*mahewu*): maize gruel (*ogi*): sorghum beverage (*umqombothi*): locust beans (*iru*): African oil bean seed (*ugb*a) and melon (*ogiri*) were randomly collected from Gauteng province of South Africa. The pH, moisture content, total titrable acidity and fungal load of the samples were determined. Fungi isolated were identified by their macroscopic and microscopic characteristics and their identities were confirmed through molecular means.

Results. The pH of the samples ranged from 3.60 - 8.54 and umqombothi had the highest moisture content. The total fungal load of *ogiri* and *iru* were 1.71 x 105 and 8.30 x 105 cfu/g, respectively. Fungi isolates belonging to eighteen genera were identified namely; *Aspergillus, Fusarium, Curvularia, Candida, Rhizopus, Saccharomyces, Moniella, Geotrichum, Gibrella, Penicillium, Mucor, Monascus, Rhodotorula, Talaromyces, Phoma, Biopolaris, Zygosaccharomyces* and *Epicoccum*. *A. fumigatus* was the dominant *Aspergillus spp*. isolated from the samples while 85% of the fungi found in the *mahewu* samples were yeast principally *Saccharomyces cerevisiae* and *Candida krusei.*

Conclusions. The study led to the discovery of new fungal strains in the fermented foods some of which are: *P. polonicum* strain AD47 (KX215146), and *F. andiyazi* strain AD34 (KX215140). It is also the first report on the occurrence of some fungal species such as *P. solitum, P. viriditicatus and A. fumigatus* in *umqombothi* and *mahewu*. The fermented foods have high fungal load and were contaminated with different potentially toxigenic fungi species. This study emphasizes that proper storage, handling and processing of fermented foods and other variable management practices are important to ameliorated possible fungi contamination that could potentiate marked health complications among consumers. Furthermore, these foods should pass through stringent quality control inspection before being conveyed to vendors and consumers.

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2.5 Materials Science and Packaging Technology

RHEOLOGY AND MICROSTRUCTURE OF BLUEBERRY PUREES: INFLUENCE OF THE PROCESS DESIGN

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Keywords. Blueberry, rheology, hydration properties, absorption and scattering optical properties, fluorescence microscopy

Introduction. Fresh blueberries are one main source of phenolic phytochemicals. Few knowledge is available which combines the accessibiklity of the bioactive component to the spatial arrangement of the soft deformable insoluble particles dispersed into the serum, which result from blueberries processing. A mesoscale investigation of the rheological and structural properties of the purèe tissue can therefore help in evaluating the post-processing phenolics functionality. The resulting effect on phenolics accessibility is reported elsewhere (1).

Materials and Methods. Highbush blueberry fruits, harvested at market maturity and individually quick frozen, were used for purées production. A processing plan was developed in which a vacuum-blanching procedure was implemented either before or after the homogenization step, for various processing times.
The capability of the dispersions to retain the liquid phase under increasing external forces was evaluated. Histochemical features of thermally treated homogenised products were analysed by fluorescence microscopy modes. The rheology of the blueberry purées was studied in dynamic mode by means of strain sweep tests. The absorption and scattering optical propeties were studied by time-resolved reflectance spectroscopy (2).

Results. Fluorescent microscopy observations indicated how the processing design can alter the mesoscale structure of the pulp by changing, or less, the cell walls and membrans continuity and consequently the phase volume of the dispersed phase. The order of the two operations influenced the scattering properties of blueberry purées, as well as the tightly-bound water, whereas the blanching time the loosely bound water. Blueberry purées, in agreement with previous studies, showed a "weak gel character" and a yield stress which modified with the process design. The rheological assessment, therefore, confrmed the changes in the dispersions' phase volume that are due to hydrodynamic interactions of the dispersed particles.

Conclusions. Solids content, particle size distribution of solids and serum viscosity play important roles in the structural behaviour of plant food dispersions and are strictly related to the technological sequence of mechanical and thermal operations during processing. Ultimately, the process-structure relationship is responsible for the blueberry phenols retention/accessability after processing.

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A LIFE CYCLE ASSESSMENT APPLICATION OF POLYLACTIC ACID TRAYS PRODUCTION FOR FRESH-FOOD PACKAGING

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Keywords. Lyfe Cycle Assessment (LCA), Polylactic acid, Carbon footprint, Food packaging

Introduction. Life Cycle Assessment (LCA) has been significantly improved over the past three decades and now can be considered as a systematic and robust tool allowing for both identification and quantification of the potential environmental impacts associated with product's life cycles. LCA is mainly used for product/process selection, design and optimisation and can also be coupled with simulation techniques and design tools, in order to help companies take consciousness of the environmental repercussions of their actions, both on- and off-site. This is what makes LCA an invaluable decision-support tool for the stakeholders like researchers, manufacturers, policymakers and company owners.
In this context, this paper discusses about the evaluation of both life-cycle environmental impacts and improvement potentials for micro-level decision in the field of fresh-food packaging Polylactic Acid (PLA) trays.

Materials and Methods. LCA was applied in this study and elaborated according to the ISO standards 14040 and 14044. Inputs and outputs associated with the system investigated were identified and referred to its Functional Unit (FU), namely 1 kg expanded-PLA trays. The system boundaries included the phases of manufacturing, delivering and disposal of the trays considered. In particular, the first phase encompassed the production and supply of the raw materials demanded for 1kg tray manufacturing, whilst the end-of-life was modelled considering that the tray is treated in an industrial compost plant. For the impact assessment development, the classification/characterisation scheme provided by Impact 2002+ was used, within the SimaPro 7.3.3 software.

Results. The study highlighted that the total damage is equal to 1.854 mpt and is due mainly to: production (for almost 49.7%) and transport (for 25.43%) of the PLA granules; the electricity consumption for their processing (for 12.2%); and for 5.94% to the delivery of the produced trays. All the other processes and phases account for the remaining 6.73%.

Conclusions. It is confirmed that PLA granule production is the most impacting phase and other relevant contributions to the environmental impact associated with the investigated system are made by the:

- transportation of the granules to the tray manufacturing plant;
- electricity consumption for the processing of the granules into trays.

The results of this study will form the base for another one regarding the assessment of second-generation PLA granules, namely those produced by processing both wastes and wastewaters from starchy crop cultivation systems and processing plants.

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ENCAPSULATION OF BETALAINS AND POLYPHENOLS EXTRACTED FROM LEAVES AND STEMS OF BEETROOT: A STRUCTURAL STUDY

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Keywords. antioxidants, encapsulation, waste reduction, functional foods

Introduction Nowadays the reduction of waste and its reuse are key points in the Food Science Industry. To produce potential functional foods, one of the strategies is to extract valuable compounds and introduce them in adequate delivery structures. Red beetroot (*Beta vulgaris*) is the major source of betalain-based commodity commercially used in food industry, with high antioxidant activity (1). Being the root the principal source of these compounds, leaves and stems are leaved as waste material in most countries (1). This work emphasized in the extraction of antioxidant compounds (betalains and polyphenols) derived from stems and leaves, and their subsequently encapsulation in alginate-Ca(II) beads. Since the presence of the extracts could affect the microstructure of the alginate network, it was assessed by small angle X-ray scattering (SAXS).

Materials and Methods. Stems/leaves (*Beta vulgaris*), obtained from the local market, were scald and then mixed in blender; weighted samples were then mixed with solvent (1:2) (water, ethanol and methanol) for 45 min at 20°C and then centrifuged. Total polyphenols and antioxidant capacity were determined by Folin Ciocalteu and ABTS, respectively. Betalains (betaxhantin -BX- and betacyanin -BC-) were quantified spectrophotometrically at 480 and 535 nm, respectively. Alginate-Ca(II) beads were generated using the dropping method (2). The microstructure characterization was performed at the LNLS SAXS2 beamline in Campinas, Brazil.

Results. BC extraction from stems was maximized by water: (48.3±0.9) mg BC/100g sample (methanol: 38.6±0.7 and ethanol: 31.6±0.9). For BX, ethanol and water gave similar results (around 27 mg BX/100g sample). The concentrations of BC and BX in leaves extracted with water were much lower than in stems (~14 mg/100g samples). However, the extraction of BX was much higher with ethanol (50±2 mg/100g). Total polyphenols were between 2-3 times higher in leaves than in stems, giving ethanol a 20% increment respect to water. Both extracts were successfully encapsulated in alginate-Ca(II) beads. The presence of the extracts affected the microstructure, showing rods with smaller radius R but with higher compactness ($\alpha 2$) than control beads without extracts. Besides, stem extract provokes an increase in $\alpha 1$, showing higher rods interconnection.

Conclusions. Water was chosen as an extraction solvent considering the concentrations of the extracted BC+BX, its availability, relative cost, and considering beads preparation (and further dehydration process). Both extracts affect the microstructure of the beads, which could have implication on the release and stability of the encapsulated biocompounds.

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SILK FIBROIN EDIBLE COATINGS FOR STRAWBERRY PRESERVATION

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Keywords. Silk fibroin, secondary structure, edible coating, strawberries

Introduction. In this study, the use of silk fibrous waste was explored in the material design of an edible coating of silk fibroin (SF) for fruit preservation. Strawberries, non-coated (NC), SF coated (SFC), and SF coated and treated by water annealing (SFC-WA), were compared in terms of weight loss, morphology and visual infection. Changes in secondary structure of SF coating due to water annealing treatment were also studied.

Materials and Methods. The coating silk fibroin solution was prepared using silk fibrous waste previously degummed with 0.5% (w/v) Na_2CO_3 solution. The fiber was dissolved in 9.3 M LiBr solution at 60°C (1). Silk fibroin suspension obtained was dialyzed and then purified by centrifugation and filtration, yielding a final concentration of 3.8% (w/v). Fresh strawberries were dip coated 4 times in silk fibroin suspension. Then the coated fruits were dried in an environmental chamber for 4 h at 22°C, 38% RH. Once dried, one set of coated strawberries was placed in a vacuum oven for 12 h in saturated water vapor environment in order to induce SF coating crystallization by water annealing treatment (2).

Thickness measurements of SF coatings were obtained examining microtome sections of coated strawberries with an optical microscope. Strawberry freshness was evaluated gravimetrically and by visual inspection during 5 days. For each treatment condition, analyses were performed in triplicate. The relative content of β-sheet structures in silk fibroin materials was determined using an IR Affinity-1S spectrometer (Shimadzu). FTIR spectroscopy scans were taken using film samples obtained at the same drying and treatment conditions applied before to SF coatings (SFC y SFC-WA). The Amide III region (1200-1350 cm^{-1}) was selected to analyze relative values for the β-sheet content of the films (2).

Results. The thickness of SF coatings was in the range of 10-25 µ. After 5 days NC strawberries lost 74 wt% of their original weights. Conversely, both SF coating conditions seems to improve water retention, resulting in a weight loss of 42% and 48% for SFC and SFC-WA respectively. The aforementioned results suggest that an increasing in β-sheet content in SF-WA did not significantly affect fruit dehydration. However, visual inspection revealed that water annealing treatment, therefore high β-sheet content, prevent mold infection.

Conclusions. SF coating prevent dehydration and fungal infection in fresh strawberries. An increase in β-sheet content seems improve the antifungal activity of the coating. This result showed that silk fibrous wates have potential in the development of materials for food preservation.

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PREDICTING MINERAL CONTENT, TEXTURE AND COOKING TIME IN PROCESSED DRY BEANS (*Phaseolus vulgaris* L.) USING VISIBLE/NEAR-INFRARED SPECTROSCOPY AND HYPERSPECTRAL IMAGING TECHNIQUES

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Keywords. Dry beans, bean quality, Vis/NIR spectroscopy, hyperspectral imaging

Introduction. Fast, accurate and noninvasive sensing techniques are needed by dry bean breeders and processors to predict various quality parameters simultaneously. A prior knowledge of some key physicochemical and sensory quality traits before processing would substantially help in the rapid and objective quality characterization and inspection of dry beans. The present study evaluated the potential of visible and near-infrared spectroscopy (Vis/NIRS) over the wavelength range of 400–2,498 nm and an hyperspectral imaging system (HIS) over the range of 400–1,000 nm for predicting minerals (Ca, Cu, Fe, K, Mg, Mn, P, S and Zn), texture (firmness/softeness) and cooking time simultaneously.

Materials and Methods. Different sets of bean samples planted and processed in 2013, 2014 and 2015 were used for analysis. For analysis, several preprocessing techniques for reflectance spectra and imaging including: smoothing, first and second derivatives, continuous wavelet transform decomposition and two-band ratio methods were evaluated and compared. More than 600 parameters were extracted by these methods for each bean sample. The best parameters were then selected for predicting the quality traits based on partial least squares regression (PLSR) analysis. The prediction models using both systems were compared in terms of their correlation coefficients (*R*) and standard error of prediction (*SEP*).

Results. Prediction results were significantly improved using the two-band ratio preprocessing method for both techniques and all measured traits (reducing the SEP in more than 15% as compared with the traditional methods). Overall, Vis/NIRS technique showed better results for minerals content and texture than those using HIS with accuracies higher than 88.0% and 83.6%, respectively, which should be explained by the wider range of wavelength points used in the Vis/NIRS analysis. However, comparable prediction results were found for cooking time using either Vis/NIRS or HIS giving accuracies higher than 83.0%.

Conclusions. These results indicate that optical sensing techniques (i.e., Vis/NIR and HYP) combined with a suitable preprocessing technique have great potential for predicting mineral and processing quality properties of dried seeds with a single measurement. Therefore, Vis/NIRS and HYPERS have great potential for predicting the end-use quality of cooked beans; however, the robustness of sensing models seems to be affected by the genotypic diversity, planting year and distribution of the firmness data used for model building, and hence, chemometric models should be constantly maintained and updated with new data.

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ECOTOXICITY ASSESSMENT OF SOME BIODEGRADABLE POLYMERIC MATERIAS SUITABLE FOR FOOD PACKAGING

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Keywords. ecotoxicity, seed germination, biodegradabale, polymeric

Introduction. Plastics represent synthetic organic polymers that are produced worldwide at a rate of hundreds of million tons per year and are increasing day by day. The increased consumption has led to elevated levels of plastic in the environment via industrial discharge or household waste. The manufacture and potential application of biodegradable polymers for food packaging applications has gained increased interest as alternatives to conventional food packaging polymers due to their sustainability. Polymers from renewable resources are currently attracting attention as a method for manufacturing environmentally friendly materials.

Materials and Methods. In order to verify the environmental sustainability, biodegradation studies of PLA/chitosan composites were performed. After the biodegradation in soil process of some newly developed composites based on PLA, chitosan and two different plasticizers, the soils were analized in order to determine its ecotoxicity using the seed germination bioassay. For this purpose, samples of soil were analyzed after 50/100/150 days of composting and initial soil was used as control. An extraction in water was performed for each sample of soil, and then it was filtered; the resulted supernatant was diluted with distilled water to yield 0, 25, 50, 75 and 100% supernatant (extract). The resulted supernatant was used for seed germination bioassay on radish (*Raphanus sativus*) and cucumber (*Cucumis sativus*) seeds.

Results. The germination capacity and root length were determined after germination for both radish and cucumber seeds. It was also calculated the global germination index (GI), which was the Gi averages of 50 and 75% dilution treatments for each sample, which represents a very sensitive index wich indicates the fact that the soil has no phytotoxic effect when its values are over 80%.

Conclusions. The tested soils that resulted after the polymeric materials degradation tests proved to have a nontoxic effect over the radish and cucumber seeds after 150 days. Moreover, the values obtained for root length and seed germination capacity were higher compared to the control.

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EXTERNAL FACTORS AND NANOPARTICLES EFFECT ON WATER VAPOR PERMEABILITY OF PECTIN-BASED FILMS

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Keywords. biodegradable films, pectin, water vapor permeability, nanoparticles

Introduction. Water vapor permeability (WVP) of polysaccharide films is strongly influenced by environmental and composition factors (1). It has been observed that the incorporation of nanomaterials improves mechanical strength and hinders gas permeation (2). The aim of this study was to determine the effect of SiO_2 nanoparticles (NPs), temperature and relative humidity (RH) on the WVP of pectin films from orange and mango peel.

Materials and Methods. Pectin and other accompanying functional compounds were extracted from orange and mango peels, as described elsewhere (3). Two batches of pectin extracts with glycerol (1.1% db) were prepared, and SiO_2 NPs (5-15 nm) were added to one of the batches (1.3% db). Pectin films were prepared by casting and then used for WVP determination by covering weighing bottles, containing water or supersaturated solutions to keep RH at 100%, 75% (NaCl) or 43% (K_2CO_3). The weighing bottles were put on an analytical balance that was placed in a chamber at 30% RH. Weight variation was automatically recorded through a developed Labview program. Permeability was measured in quadruplicate at three different temperatures (5, 25 and 35°C) and RH gradients.

Results. WVP of orange and mango pectin films ranged between 1.05 - 76.56 and 1.36 - 64.7 g mm kPa^{-1} m^{-2} d^{-1}, respectively, depending on NP content, RH gradient and temperature. In general, presence of NPs decreased the WVP of orange and mango pectin films at all studied temperatures and RHs. The largest decrease observed in WVP was 61% in films from orange peel, exposed to 25°C and 100% RH. An Arrhenius type relationship between WVP of the films and temperature was not observed. In all cases, incrementing the RH gradient across the films led to an increase in their WVP.

Conclusions. WVP of orange and mango pectin films was affected by RH and temperature. Addition of SiO_2 NPs in the formulation of the film forming solutions significantly increased the water vapor barrier of the films. Increasing the RH gradient lead to higher WVP. WVP values did not follow a clear Arrhenius behavior.

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KINETIC RELEASE, THERMAL AND STRUCTURAL CHARACTERIZATION OF NANOCOMPOSITES IMPREGNATED WITH THYMOL BY SUPERCRITICAL IMPREGNATION

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Keywords. Supercritical impregnation, nanocomposite, LDPE, thymol, nanoclay, thymol mass transfer

Materials and Methods. Nanocomposites films based on low density polyethylene prepared by melt extrusion with different concentrations of Cloisite 20A (2.5 and 5.0% (w/w)) were impregnated with thymol by means of supercritical impregnation using carbon dioxide, with the aim of obtaining an antimicrobial active packaging. Impregnation assays were carried out in a high-pressure cell for 1 h at 313 K and employing two depressurization rates (10.0 and 1.0 MPa min^{-1}) after the impregnation process. This procedure allowed the preparation of materials containing thymol at concentrations varying from 0.42 to 1.19% (w/w).

Results. The highest incorporation percentages of thymol were obtained employing the lowest depressurization rate. Incorporation that was favored by the presence of nanoclays in the materials. A complete thermal characterization of the materials was obtained from DSC and thermogravimetric analysis. Meanwhile, its structural characteristics were assessed by XRD, FTIR spectroscopy and SEM analyses. XRD results indicated the improvement of intercalation in the nanocomposites impregnated with thymol. Simultaneously, with the aim of evaluating the effect of nanoclay incorporation and the depressurization rate on the release rate of thymol, a phenomenological mass transfer model has been used to describe the release of thymol from LDPE and a nanocomposite with 2.5% (w/w) of C20A to an aqueous (ethanol 10% (v/v) solution) and fatty (ethanol 95% (v/v) solution) food simulant. This model was used to correlate the experimental release kinetic data, obtaining the values for diffusion coefficients. The diffusion coefficients of thymol in the different materials were independent of the depressurization rate employed before the impregnation process. Thus, the diffusion coefficient obtained for thymol in LDPE took values between 1.0 and 1.3 x 10^{-12} ^{m2} s^{-1}. While in the nanocomposites the diffusion of thymol depends on the type of food simulants taking values between 0.7 and 0.9 x 10^{-13} m^2 s^{-1} in the aqueous simulant and 3.0 x 10^{-13} m^2 s^{-1} in the fatty simulant.

Conclusions. Present results indicate that the impregnated nanocomposites present an intercalated structure generating a tortuous path that makes the diffusion of thymol through the polymeric matrix more difficult.

2.6 Update on Water in Food

EFFECT OF MALTODEXTRIN ON THE WATER SORPTION AND GLASS TRANSITION OF FREEZE-DRIED MANGO PULP AND ITS APPLICATION TO OTHER DRY FRUITS

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Keywords. water sorption, glass transition temperature, mango pulp, freeze drying

Introduction. Mango is one of typical tropical or subtropical fruits (1). Dry mango powder is convenient, and thus can be used to prepare many food products. However, the dry fruit powder has a low glass transition temperature (T_g) because of the high ratio of low-molecular carbohydrates (sucrose, glucose, and fructose). When the T_g is lower than storage temperature, the dry powder may show some physical deteriorations including, structure collapse, stickiness, and re-crystallization of sugar (2). Maltodextrin having a high T_g can be used as a physical stabilizer for dry powders. Although effect of maltodextrin on the T_g of dry fruits has been studied extensively, there was no systematic data on the dry mango pulp. The purpose of this study was to understand effect of maltodextrin on the water sorption and T_g of freeze-dried mango pulp. In addition, the results were compared with other dry fruits, and an empirical prediction approach was proposed.

Materials and Methods. Alphonso mango puree cultivated in India (19.2ºBrix, Taiyo Kagaku Co., Ltd.) and maltodextrin (DE = 17–21, San-ei Sucrochemical, Co., Ltd.) were kindly provided. Freeze-dried mango pulp: maltodextrin mixtures at 20:80, 40:60, 60:40, and 80:20 (dry weight ratios) were prepared. The mixtures were placed in hermetic chambers containing saturated salt solutions with different relative humidities (RH) ranging between 11.3% and 84.3% at 25°C. After equilibrium, the T_g value was determined by using a differential scanning calorimetry. Equilibrium water content of the samples was determined gravimetrically by oven-drying at 105°C for 16 h.

Results. Water sorption isotherm of the samples showed a typical sigmoid curve, and the behavior was characterized by the Guggenheim–Anderson–de Boer (GAB) model. The T_g of mango pulp-maltodextrin mixtures increased with increase in maltodextrin content and decrease in water content. The anhydrous T_g showed a discontenious T_g-change between 60% and 70% maltodextrin content. The effect of water content on the T_g was analyzed by the Gordon–Taylor (GT) model. From the fitting results of GAB and GT, each critical water content or water activity (water content or water activity of which the samples show glass transition at 25°C) was evaluated. The critical water content or water activity increased by the addition of maltodextrin. From the relationship between anhydrous T_g and k (a fitting parameter in GT) not only for the mango pulp-maltodextrin mixture, but also for other many kinds of dry fruits, it was found that the result can be roughly described by a linear equation. These results will be useful for predicting the physical stability of dry fruits.

Conclusions. The T_g and critical water content or water activity of freeze-dried mango pulp-maltodextrin mixture were determined. In addition, an empirical linear relationship between anhydrous T_g and k applied for many kinds of dry fruit was proposed.

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STUDY OF RELATIONSHIP BETWEEN WATER, MICROSTRUCTURE AND SPECTRAL PROPERTIES OF SEVEN QUINOA AND TWO CAÑIHUA VARIETIES

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Keywords. Quinoa, cañihua, water sortion, hyperspectral image, micro structure

Introduction. Today Quinoa and cañihua are considered as Andean grains, which are the backbone of nutrition in the Andean countries as Peru, Bolivia and Ecuador, also are considered as superfoods, high amount of protein and micro nutrients such as zinc, iron and calcium, the absence of gluten and its great capacity to adapt to climate change, make Andean grains as foods of the future for the Andean regions and the world. The objective of this research is determine the usability of different commercial varieties of quinoas and cañihuas grown over 3800 meters above sea level in the region of Puno through water sorption capacity, related with microstructure, and spectral properties that allow select these varieties for specific culinary and industrial uses, thereby generating basic information for possible geographical origin denominations.

Materials and Methods. The quinua seeds (Cehenopodium quinoa willd, variety; Salcedo INIA, Illpa INIA, Kankolla, Rosado choclo de taraco, Altiplano, negra collana, pasankalla) and cañihua seeds (Chenopidium pallidicaule Aellen; variety cupi and Illpa) they have been acquired of the National Agricultural Research Institute Puno Peru, The quinoa and cañihua seeds were equilibrated with different saturated salt solutions to 20°C. Water activity was measured with a dew point hygrometer AqualabR series 3 TE (Decagon Devices, Inc., Washington, USA), Moisture was determined by AOAC method 945.15 (2000) a Quanta 650 Scanning Electron Microscope FEI (Thermo Fisher Scientific Inc.USA) to 30 kV, 30 mm distance work, It was used to observe the microstructure, Image analysis has been made with functions and scripts implemented in Matlab 2015a. Hyperspectral images, acquired in the range of 400 to 1000 nm using a camera spectrograph model Pica XC from Resonon Inc.USA, were correlated to water activity by the method of partial least squares regression (PLSR).

Results. It found significant differences in water retention capacity between varieties of quinoa and average moisture monomolecular layer evaluated GAB is 0.04 (kgw/kg ss), There are also differences in retention between the two varieties of cañihua that have been evaluated with inflorescence without inflorescence being the average value of the monolayer is 0.039 (kgw/kg ss), additional comparison of 3 commercial varieties of quinoa (salcedo Inia, negra colla y pasankalla) harvested 2,600 and 3,800 meters above sea level They are different in their water holding capacity in which the average value of the monolayer is 0.042 (kgw/kg ss) y 0.037 (kgw/kg ss) respectively, Image analysis of microstructures shown differences between quinoa and cañihua for each water activity . The PLSR analysis show right correlation between spectral profiles and water activity with correlation coefficient (r2) over 0.90 and 0.94 for quinoa and cañihua respectively.

Conclusions. It is possible different uses of different varieties of quinoa for gastronomy and industrial uses Through his water sorption properties related to its microstructure, as well as their differentiation between production zones, cañihua seeds with inflorescence and without inflorescence show differences in water retention capacity that related to their spectral properties can be an alternative for post-harvest operations and precision agriculture.

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2.7 Advanced Food Engineering

MODELING OF TEXTURAL PROPERTIES DURING RIPENING PROCESS OF SWISS-TYPE CHEESE USING SPECTRAL PROFILES

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Keywords. hyperspectral, PLSR, ripening, spectral, wavelength

Introduction. Evaluation of texture during cheese ripening requires invasive and destructive methods as well as specialized equipment. The objective of this study was to perform modeling of the textural properties of Swiss-type cheese during the ripening process using their spectral profiles.

Materials and Methods. Twenty-eight samples were prepared and stored under ripening conditions: [0-5] weeks, 20°C and 80% Relative humidity. Hyperspectral images were acquired during the ripening process, employing a range between 400 to 1000 nm. The profile texture analysis (PTA) was conducted using two compression cycles, and the hardness values (D) for each compression cycle (D1 and D2) was determined. Then the hyperspectral images were pre-processed and analyzed in order to obtain the average spectral profiles using in Matlab 2015a. Correlations between the spectral profiles and the hardness values were determined by using the method of partial least squares regression (PLSR), by minimizing the predictive residual sum of squares(PRESS).

Results. The correlations showed that the most relevant wavelength for D1 were 592, 496, 576, 456, 512, 560, 680 and 624 nm and for the D2 were 592, 496, 576, 456, 512, 624, 680 and 560 nm (sorted by influence on the model). Finally, the adjusted correlation coefficients (r^2) were estimated to be 0.89 and 0.90 for D1 and D2, respectively.

Conclusions. It is possible to predict textural values using a model based on spectral profiles with an r^2 value close to 90 % and the more important wavelengths are in the range of 450 to 680 nm.

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STRUCTURAL AND PHYSICAL CHARCATERIZATION OF CREAMED HONEY

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Keywords. crystallization, creamed honey, texture, viscosity

Introduction. Honey is a highly viscous sugar solution, often supersaturated, that is susceptible to time dependent crystallization (1). For most commercial honeys, crystallization is a defect that causes quality loss due to phase separation, sedimentation and increase in water activity.
On the other hand, controlled crystallization can be used to obtain a desirable product, such as creamed (or set) honey, in which there are a large number of crystals of very small size, that lead to a very smooth texture (2). The aim of this research was to evaluate the physical and structural properties of creamed honey obtained by controlled crystallization compared to honey set in a traditional static manner.

Materials and Methods. Two types of honeys, characterized by different glucose/fructose ratios (G/F) of 1.05 and 1.25, were nucleated with 5% of a crystal nucleus and continuously stirred at 14 rpm at 14°C until the end of the crystallization process. During storage at selected intervals, honey was analyzed for crystal content by DSC, rheological properties and textural parameters and compared with the same honey crystallized under static conditions.

Results. Kinetics of crystal formation were evaluated for both samples according to the different crystallization process. As expected, honey with 1.05 G/F reached the end of the crystallization process faster compared to the sample with 1.25 G/F; the former sample was also harder and more viscous. The continuous stirring significantly influenced crystallization kinetics and the final structural and textural properties of honey due to the formation of a larger number of smaller crystals.

Conclusions. The controlled crystallization of honey through constant stirring enables to obtain honey characterized by a smoother and creamy texture and lower viscosity parameters compared to static honey.

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MODELLING AND ANALYSIS OF CONFECTIONERY WAFER BAKING STRESS-TIME PROFILES

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Keywords. wafer baking, single plate oven, stress-time profiles, mathematical model

Introduction. Wafer baking process is studied through the analysis of stress-time profiles obtained from variations in batter recipe, batter holding time and processing conditions including batter mixing speed, batter deposition rate and baking oven temperature. These stress profiles contain information about the mechanisms by which pressure is developed and released during wafer baking and the effects of formulation and baking conditions on these mechanisms. This measured stress is the sum of total normal stress resulting from the porous solid and the pressure from the gas between the pores. Information is quantified from these baking stress profiles and quantitative data is related to the formulation and processing variables. Different batter recipe variations are investigated using Nestlé Single Plate Oven (SPO) for pilot scale wafer baking trials and experimental rig to study wafer baking on laboratory scale.

Materials and Methods. Wafer baking experiments are conducted using wafer batter prepared from different recipe variations and baked in an electrically heated single plate oven. The experiments generated stress versus time graphs which form the basis of this research. These baking experiments are conducted to measure the effect of change in gassing agents in batter recipe and process conditions such as batter pump speed and steam venting mechanism on the obtained stress profiles.

Results. Data analysis of these stress profiles reveal that the baking stress profiles can be broadly classified into two main types –Type 1 with a single shoulder and Type 2 with two shoulders, with Type 1 profiles more common. The peak stress obtained using batter with higher viscosity is much smaller when compared with lower viscosity batter. Also the change in type and quantity of enzymes results in much greater area under the stress curve with system maintaining higher stress over a longer period of time resulting in a better textured product. The data obtained from these trials is used to develop a mathematical model for wafer baking process using baking plates etched with reeding pattern.

Conclusions. This research focuses on understanding different stages of wafer porous structure formation by studying pressure increase due to gas generation and expansion within the batter system, and the subsequent decline in pressure due to the foam-to-sponge transition as the wafer structure sets. Pilot scale wafer baking trials and non-linear modelling of the experimental data provide stress profiles and correlations which explain the mechanisms by which pressure is developed and released during wafer baking and the effects of formulation and baking conditions on these mechanisms.

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APPLICATION OF NANOWIRE GAS SENSOR DEVICE (S3) FOR THE QUALITY CONTROL PROCESS OF PARMIGIANO REGGIANO

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Keywords. S3, nanowire sensor, Parmigiano Reggiano, SPME-GC-MS, quality control.

Introduction. The characteristic volatile fingerprint of a given food matrix, may offer information about safety and quality of the production process. Currently the applied methods to the quality control process in the food chain requires time, high amount of money and high level trained lab staff. The new device S3, based on nanowire sensors, exploits the production of the set of Volatile Organic Compound (VOC) of a given matrix, to detect qualitative and quantitative changes in the volatile profile obtaining the results in less than 1 minute. The goal of this work is the setting up of a new method based on the collaboration of metal oxide nanowire sensor device S3 with SPME-GC-MS to be applied in the quality control process of Parmigiano Reggiano.

Materials and Methods. S3 is a portable device which carries a sensor chamber where are placed 6 semiconductor metal oxide (MOX) gas sensors, where 3 of them are indeed nanowire sensors (1). A nanowire sensor whit 1 mm square, is a gas sensor based on the semiconductor capacity of the metal oxides. This oxide once heated at high temperature produce changes in the resistivity of the sensor when it is exposed to a mixture of volatiles compounds. The electrical signals are then collected and elaborated by means of PCA. A total amount of 2g of sample was placed in a 20mL chromatographic vial and was analyzed with SPME-GC-MS and nanowire gas sensor device in parallel.

Results. In figure 1 it is possible to observe how the instrument is able to individualize the 3 main different steps of seasoning of the Parmigiano Reggiano regarding the indication of the production rules providing 3 well separated clusters. The selected VOC markers for this application were 5-Methyl-1-heptene and 3-Methylbutanal wich increase their concentration as the ripening time increase.

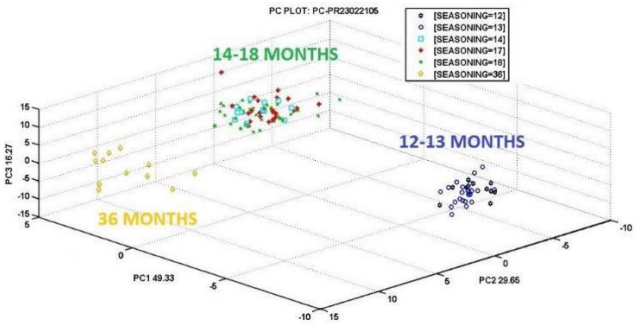

Fig. 1 PCA score plot showing the 92,25% of the total information recorded by the instrument enclsed in the 3 axes.

Conclusions. The obtained results show a remarkable correlation between the classical techniques and the nanowire gas sensor device results. In all cases was possible to individualize unequivocally the presence of off-flavour in the tested samples providing information about the quality or ripening state.

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INFLUENCE OF TWO DIFFERENT COCOA BASED COATINGS ON QUALITY CHARACTERISTICS OF FRESH-CUT FRUITS DURING STORAGE

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Keywords. Fresh-cut fruits, cocoa-based coatings, quality, shelf-life, rheological properties

Introduction. The use of edible coatings on fresh-cut fruits surface has the purpose to reduce moisture and aroma losses, minimize colour changes, improve textural quality and reduce microbial growth. As known from the literature, edible coating can be divided into three categories, taking into account the nature of their components: hydrocolloids (containing proteins, polysaccharides or alginates), lipids (constituted by fatty acids, acylglycerols or waxes) and composites (made by combining substances from the two previous categories) (1). Inside the lipid based coating group we can find chocolate coatings, solid suspensions whose continuous phase is hydrophobic and provides good barrier performances, improving at the same time the sensorial characteristics of the covered product (2). The aim of this work was to compare and evaluate the effect of two different cocoa-based coatings on some quality characteristics of fresh-cut fruits (grape and apple) during storage.

Materials and Methods. Cocoa based coatings were characterized from a rheological point of view by using a controlled stress rheometer at 40°C. Apple samples were cut in small pieces before application of chocolate coating, for grape single berries were used. Fresh-cut fruit samples were dipped in the cocoa mixture (previously melted at 50°C for 1 hour) in order to obtain a thin layer of coating, kept to solidify in a refrigerator at 4°C for 15 minutes. Coated products were packed in polyethylene terephthalate (PET) trays under atmospheric conditions and stored for 10 days at 6°C and analysed at 0 – 2 – 4 – 6 – 8 - 10 days for water activity, moisture, colour, texture, image analysis, cell viability, microbiological and sensorial quality.

Results. Cocoa coatings were able to maintain cell viability in both fruits during storage until the 10th day of storage. Water migration from fruit samples to coating was observed, however this phenomena was more evident in apples than in the grape fruits. Differences in the two cocoa coating types in terms of composition and rheological characteristics influenced the final appearance of products during shelf-life and the microbial growth. In particular, fruit samples covered with cocoa coating having more fats and less sugar, were more glossy without blooming on their surfaces. These samples showed also less resistance to breakage compare to the others, a positive attribute for consumers.

Conclusions. Cocoa-based coatings on fresh-cut fruits showed to be a good alternatives to traditional coatings, providing positive effects on the overall quality characteristics of tested products, mainly on firmness and appearance, also improving their sensorial properties. However, results obtained in this study, showed that rheological characteristics of chocolate types are extremely important because they affect some final products' properties, such as sensorial and textural ones. For this reason the choice of the cocoa coating with the most suitable rheological properties become a key factor in order to obtain products with desirable final properties.

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SET UP A GLOBAL INCIDENT ALERT NETWORK FOR UNAUTHORIZED FOOD ADDITIVES

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Keywords. Incident alert, unauthorized food additives

Introduction. Food additives are used widely for specific purposes during food processing. Basically, the food additives are well certificated for use. However, some food additives are not the original type. Some of them are recombined, premixed or modified by the wholesalers for reaching better commercial quality, stability or appearance. Food additives those may be unhealthy but are unregulated. This may be the case when a substance is added to the food that has never been added to food before, such as in the well-known case of melamine to milk. Cloudy agents containing plasticizer is the other example in Asia.

Materials and Methods. Melamine was found damage to kidney in many studies, and many cases were confirmed. Plasticizer, a very cheap industrial product and no rancidity problem, was used to replace palm oil in cloudy agents. The plasticizer contaminated cloudy agents were widely used as emulsifier in sport drink, juice, jelly, capsule, power type food products and some medicine. High potential risk of plasticizer has been reported, especially the damage to fertility and cancer. There may also be additives due to migration of constituents of packaging material into the packaged food. Because these additives are not known, authorities are not checking for their presence of absence.

Results. To avoid the food safety problem from unauthorized food additives, good and new regulation and monitor are required. Cloud computing and big data could be very useful for assisting the management of food additives. It was concluded that it would be great if somebody, anywhere in the world, finds out about a (potentially) dangerous addition to foods. It is reported who then may alert local authorities, enabling them to take appropriate actions. A system will be developed including • collect relevant information • inform other members • alert authorities • consider how to obtain information anonymously.

Conclusions. The global incident alert network for unauthorized food additives is required. GHI (global harmonization initiative) will set up this alert system in the future soon.

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3 | Poster Session

PHENOLIC AND FLAVONOIDS IN COLOMBIAN CORBICULAR BEE POLLEN: ANTIOXIDANT AND FREE RADICAL SCAVENGING ACTIVITY

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Keywords. antioxidants, phenols, flavonoids, corbicular pollen

Introduction. Corbicular bee pollen is a natural product result from the activity of bees that removed pollen grains from anthers and agglutinate it into tiny pellets, after the addition of nectar and hypo pharyngeal enzymes, (1). The final product is stored in the hives and used as a nutritional sustenance of the colony (2). Variability and properties of this product has attracted research attention due to its nutritional properties (3-4). This work has focused on the composition and chromatic variability of pollen collected in two bio geographical zones.

Materials and Methods. For the study were collected 63 samples at the premountain wet forest (*bh-PM*) and very wet premountain forest (*bmh-PM*) wildlife zones. The structure of the loadings was made after their separation and color classification using Pantone´s scale 747XR. Phenols, flavonoids, and its activity was determined on extracts using ethanol-water (70:30) as a solvent, in addition to their density, total extract and UV-Vi spectra.

Results. Pollen samples are composed by 3 to 8 types of loads, being dominant samples with 6 different color types (34.9%) and (4+5) types that represent 41.2%. Average of density change between 0,8840 ± 0,01 to 0,8851 ± 0,01 g/mL, total extract from 3,30 ± 0,70 to 7,10 ± 1,25 g/100 mL. UV-Vis spectra show typical patterns of phenolic and flavonoids compounds. These metabolites show significant differences in connection respect to its geographical origin. The phenolic fraction observed varies between 11,8 ± 2,22 and 30,6 ± 7,10 mg EAG/g, and flavonoids from 5,67 ± 2,35 to 12,1 ± 1,13 mg Eq. Quercetin/g pollen. The reducing capacity (11,8 ± 2,22 to 30,6 ± 7,10) and (9,00 ± 3,43 and 17,9 ±4,30) μM Trolox/g for FRAP and ABTS respectively. A structural function PLS-PATH and their correlations respect to the properties and components responsible for the antioxidant activity has been raised.

Conclusions. The results are indicative of a significant contribution of phenols and flavonoids, in colombian bee pollen from Andean zones, its removal and concentrations allows the incorporation as additive in food supplements or pharmaceutical products.

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SEARCH FOR RAW MATERIALS FOR CREATION FORTIFIED FOODS

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Keywords. sea cucumber, amino acids, protein, pumpkin, β-carotene, nutrients enriched product

Introduction. Oceans is rich in biologically active natural raw materials, such as a protein. Currently, in many countries there is a shortage of raw meat, including in the Russian Federation, where the livestock sector has growth rates of about 21% per year. In this regard is the use of topical byproducts such as chicken liver (1, 2).
There is therefore a need to establish the natural food dresser marine and terrestrial origin, have a high nutritional value, functional and curative properties.

Materials and Methods. The objects of study were selected: sea cucumber, pumpkin varieties Japanese woman, Muscat, Common.
In the process of studying the use of the product obtained by standard techniques. The protein content was determined by the standard, the colorimetric method by Lowry O. ()3.

Results. The protein content of pate "Energy" was 20.5 g, which is comparable with beef or pork. The studies pate of chicken liver with the addition of sea cucumber satisfies the human need for protein to 17.64 ... 31.76% for men, at 23.73 ... 35.60% for women.
The content of β-carotene in liver pate spectrophotometry spectrophotometer (Shimadzu UV1800). The content of β-carotene in the pate was 1,54 ± 0,012 mg / 100g. It is found that 100 g of liver pate satisfy the daily requirement of β-carotene 26.6%.

Conclusions. Work analysis leads to the conclusion that the resulting paste provides human body with essential nutrientnymi substances essential for normal functioning of all body systems. Since the mass fraction of protein in Pate "Energy" was 20.5 g / 100 g, which is 2 times higher than the control sample (Pate "Liver" (TU 9213-019-50831611-2005, Russia ")). Thus, from the Far East seafood sea cucumber is a rich source of animal protein.
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USE OF ANTIOXIDANTS FAR EAST FUNGUS *INONOTUS OBLIGUUS* FOR QUALITY PRESERVATION OF FOOD

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Keywords. oxidation, lipids, minced meat, *Inonotus obliguus*, birch fungus, antioxidants, extracts, antioxidant activity, antiradical activity, 1,1-diphenyl-2-picrylhydrazyl radical (DPPH)

Introduction. Maintaining a high level of food quality is an important task, which should be paid attention to all stages of product distribution. Especially important problem is protection of lipid fraction of food, which easily oxidized under the influence of external factors. Therefore, experts food industry have attached great importance to search for new types of natural antioxidants and investigation of antioxidant properties (1). One of the most perspective sources of high antioxidant activity is a fungus *Inonotus obliquus*, which grows throughout territory of Russia. In studies of researchers (2, 3) experimental data about high antioxidant activity of aqueous and alcoholic extracts of the fungus are shown. However, currently, there are no information about use of fungus compounds as food antioxidant protection.

Materials and Methods. Dry extract was obtained by evaporation and lyophilization of aqueous and alcoholic extracts, which were prepared by a maceration method. Antiradical activity was measured using DPPH. Degradation lipid peroxidation of minced meat was assessed by change peroxide number and fat acidity value.

Results. Dry *Inonotus obliquus* extract at concentrations from 0.06 mg/ml to 1 mg/ml has a high antiradical activity and inhibits from 67 to 90% of free radicals. Peroxide number has decreased by 11.4%, fat acidity value was reduced by 18.7% on the second day of experiment.

Conclusions. The powdered extract of the fungus has a high antioxidant activity. It allows to consider extract as an effective antioxidant additive in food industry for prolonging shelf life of food products.

This work was supported by Russian Science Foundation (Convention № 14-50-00034).

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HIGH INTENSITY PULSED LIGHT AS PRE-TREATMENT FOR ENZYMATIC HYDROLYSIS TO MODIFY WHEY PROTEIN.

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Keywords. High intensity pulsed light, Enzymatic hydrolysis, Food allergens, Whey proteins

Introduction. Food allergies are hypersensitivity reactions mediated by immune mechanisms triggered by the presence of antigens –generally proteins- in food, such as those found in cows' milk. International guidelines recommend the use of extensively hydrolyzed formulas as alternative for children with Cow milk allergy. Strategies to reduce allergenicity of food proteins comprise treatments such as heating and hydrolysis. Non-thermal treatments are able to induce protein modifications similarly to thermal treatments; however less damage is produced by these innovative processing methods. Thus, high intensity pulsed light (HIPL) technology can be proposed alternatively to thermal treatments to assist on the reduction of food allergenicity.

The aim of this work was to assess the effect of the use of HIPL treatment previous to enzymatic hydrolysis, applied to modify the antigenicity of target proteins, such as whey proteins.

Materials and Methods. Experiments were carried out to verify the effectiveness of HIPL technology to accelerate protein hydrolysis reaction with a selected enzyme. The combined treatments are an alternative to induce further modification of proteins structure in order to affect their allergenic power. For this purpose, samples of whey solution were submitted to different HIPL-energy doses (0, 1, 3, 5, 8 and 12 J/cm2) at a fixed distance from the light source. Untreated sample was used as control. For the combined treatment, bromelain was added to HIPL pre-treated samples at an enzyme/ substrate ratio of 1/10 (w/w). Hydrolysis was carried out for 0, 5, 10, 20, or 30 min.

Results. Concerning the efficiency of HIPL treatment to induce protein unfolding, the highest exposure of free SH groups took place upon the highest energy doses. When HIPL treatment was combined with enzymatic hydrolysis, a raise in the degree of hydrolysis was observed, particularly at the highest energy levels tested.

Conclusions. Results obtained in the present work suggest that, even if an increased antigenicity potentially occurs due to the exposure of hidden linear epitopes upon the unfolding induced by the non-thermal treatment assayed, further peptide bonds cleavage also take place after hydrolysis. This effect could change whey proteins antigens, and thus its antigenic power. Although further studies are required these preliminary result is promising.

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CONSUMERS' KNOWLEDGE OF ANTIOXIDANT COMPONENTS: RESULT OF A QUESTIONNAIRE SURVEY IN HUNGARY

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Keywords. antioxidants, questionnaire survey, vitamin C, tomato

Introduction. Functional foods are intended to provide humans with necessary nutrients and to prevent nutrition-related diseases and increase physical and mental well-being of consumers. Market of these foodstuffs is growing steadily worldwide. Antioxidant components are frequently used for the production of different funtional foodstuffs. Antioxidants are substances naturally occur in plant-based foods such as fruits, vegetables which can help prevent or stop cell damage by oxidants causing cancer (1), which is one of the leading cause of death in Hungary (2). However, do consumers know these components, their natural sources or even there health effects? The aim of the present study was try to give answers to these questions.

Materials and Methods. In order to analyse consumers' knowledge regarding antioxidant components a self-administered questionnaire survey was developed and implemented in Hungary (N= 273). For the data analysis IBM SPSS Statistics 24.0. (IBM, Armonk, New York, USA) was used.

Results. Consumers were found unknowledgeable about antioxidant components. Only 42.6% of the participants answered that they could specify substances having antioxidant effects. The most frequently mentioned components were vitamin C (25.6%) and vitamin E (13.9%). Only 51.1% of the respondents thought that they could list fruits or vegetables containing antioxidant elements. The most frequently alluded ones were tomato (15.8%), pepper (12.8%) – which are typical ingredients of the Hungarian cuisine – as well as carrot (11.1%). When several foodstuffs and components were listed to the consumers, antioxidant effect was linked mainly to carotine (93.7%), vitamin C (93.6%) and flavonoids (93.2%), as well as to tomato (95.4%) blackcurrent (94.2%) and carrot (91.5%). Analysis of the knowledge showed adequate awareness regarding the beneficial health effects of antioxidant substances. Furthermore, it was favourable that fruit and vegetable consumption was idenfied as better source of antioxidants than dietary supplements. Females, higher educated and inhabitants of the capital found to have significantly ($p \leq 0.05$) higher level of knowledge.

Conclusions. This study suggests that in spite of the fact that Hungarian consumers are aware of the beneficial health effects of antioxidants, further authentic and plain information supply is needed for their more consciousness food choice and for the promotion of their health.
The opinions expressed herein and the conclusions of this publication are those of the authors and do not necessarily represent the views of the International Life Sciences Institute Europe and the Hungarian Chamber of Agriculture.

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PULSED ELECTRIC FIELD (PEF) PROCESSING OF APPLES: MICROSTRUCTURAL AND METABOLIC RESPONSES

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Keywords. PEF, resistivity, water distribution, heat production, respiration rate

Introduction. Pulsed electric fields (PEF) induce structural changes in plant tissue by affecting the membrane permeability, i.e. electroporation. The alteration of microstructure can lead to improve mass transfer in several food processes as well as metabolic changes in plant tissue. The present work is focused on microstructural and metabolic changes upon the application of PEF in apples at three different electric field strength levels, 100, 250 and 400 V/cm, leading to the reversible and irreversible electroporation of membranes (1).

Materials and Methods. Apple samples were obtained from parenchyma and placed in a treatment chamber equipped with 2 stainless steel electrodes. The trials were performed using near-rectangular shape pulses generated by a PEF based on MOSFET. A 60-pulses train series was applied, with 100 µs pulse width (100 Hz). Time domain nuclear magnetic resonance with a contrast agent and electrical resistivity were employed to evaluate microstructural changes as a consequence of water redistribution upon PEF treatments (2). Metabolic heat, O_2 and CO_2 gas analysis were employed to jointly evaluate the PEF-induced effects on tissue metabolism during 24 h at 10°C after the treatments [3].

Results. Experimental trials showed that resistivity of samples linearly decreased when the electric field strength was increased, however, at 250 and 400 V/cm, electrical resistivity changed during the pulsation, probably due to the irreversible effect of electroporation. Water distribution results confirmed irreversible change of microstructure caused by the loss of compartmentalization (1,2). In addition, PEF treatments at 250 and 400 V/cm significantly lowered O_2 consumption and CO_2 production. A severe drop of heat production was accordingly achieved. Low residual cell activities were ascribed to the probable loss of the cell viability at those electric field strength levels. On the contrary, minimal changes in metabolic heat, O_2 and CO_2 balances were noticed at 100 V/cm (3).

Conclusions. Treatments below the threshold of non-reversibility slightly modified the water distribution among the compartments without any significant effects on metabolism. Conversely, high field strength levels led to marked changes in the microstructure which led to the alteration of the respiration processes and the probable loss of cell viability.

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FUNCTIONAL COOKIES ENRICHED WITH HEMATIN IRON

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Keywords. hematin iron, functional properties, cookies

Introduction. Bovine blood from animal slaughter in fiscalized places is an hematin iron rich residue. If one consider Brazil as a country with high numbers of children that show some level of anemia, especially iron deficiency, it may be noticed the need to develop iron enriched food and then the bovine blood constitutes abundant source of hematin iron with easy acquisition and use. There is also the interest to economically exploit this residue from the slaughter industry as it is extremely polluent. The aim of this study was to develop an hematin iron enriched cookie and verify the levels of carbohydrate, protein, lipidium, humidity, ashes and iron present in the product.

Materials and Methods. Blood was obtained from fiscalized slaughtered animals by veterinarians and collected in hyginied recipients with sodium citrate at 2,0% (p/v) as anticoagulant agent. The bovine blood collected was transported in refrigerated recipients at 0°C and the cookies were developed in the Dietetic Technical Laboratory of the Universidade de Uberaba. The iron content was determined by spectrum photometria. The ashes, fat and humidity contents were determined according to the Analytical Laws of the Adolfo Lutz Institute[1] The protein determination of the samples was achieved by using the Kjeldahl and the carbohydrate determination was achieved by the difference method, which means the percentages found for lipidium, proteins and ashes were added, and then it was subtracted from 100%. The microbiological analysis were achieved by investigating the presence of fecal coliforms, *Salmonella* sp and *Staphylococcus aureus*. The sensorial analysis was achieved by using a facial hedonic scale offered to 100 students of a city school after their parents signed a consent term.

Results. The analysed cookies samples showed the average of 71% of carbohydrates, 0.8% proteins, 13% fat, 10% moist (humidity) and 1% ashes. As it comes to iron, the cookies showed average of 7.2% mg/100g and as there is no Brazilian law to set physical and chemical parameters for products such as these ones, the results were compared to similar products from the market and the values found were higher. On microbiology the product is proper as there was no presence of the investigated microorganisms and out of the 100 children who sensorial analysed the product, 98% showed likes for the product.

Conclusion. The achieved analysis showed the produced cookies showed higher iron values to the one existing in the marked, which shows the possibility to use the hematin iron as the food industry ingredient.

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PHYSICAL FEATURES OF TOFU DUE TO SOYBEAN QUALITY

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Keywords. tofu, damaged grains, physical features, soy

Introduction. Tofu quality depends on some factors such as sowing characteristics, protein level, extratc coagulation and also the complex interaction of the chemical composition of soy, pH, type of coagulant agent and its concentration, method of mixing, time and temperature of coagulation (1). The present work aimed at evaluating the physical characteristics of tofu related to soybean quality.

Materials and Methods. Soyabeans from cultivar BRSMG 790A, crop 2014/2015 and 2015/2016, from Empresa de Pesquisa Agropecuária de Minas Gerais, Uberaba, MG were used. The experiment was assembled in DIC with six treatments and four repetitions. Tofu was obtained by the coagulations of the extract of dihydrated calcium sulfate. It was evaluated the influence of both crops and the presence or absence of bugs in the grains. For the analysis of the texture profile (TPA), it was used the Texturemometer Stable Micro System model TAXT2i with a cylindrical probe of 36mm of diameter, plain edge to evaluate hardness, cohesivity, gummy chewing qualities. The color of the product was determined by the colorimeter Minolta, model Chroma Meter CR-3000, system L*a*b CIELAB. The experiment was analysed by ANOVA.

Results. The hardness values showed significant difference among crops, as crop 2014/15 showed average 4,91 among treatments and crop 2015/16 showed average 3,30. Cohesivity showed significant difference among treatments and crop, as it showed one average number to non damaged bug treatment (GND) and another average number to bug damaged treatment (GD) of 0,45 and for the treatment with adding of 50% of GD the average was 0,42 for crop 2014/15, for crop 2015/16 treatments GND and with adding of 50% of GD the average was 0,39 and GD of 0,42, showing less resistance. As far as it comes to gummy quality, there was significative difference among crops 2014/15 of 2,19 (p 0,001) and to crop 2015/16 of 1,33 (p 0,001). Chewing quality showed significant difference only among crops with averages for 2014/15 of 2,09 (p 0,001) and for crop 2015/16 of 1,27 (p 0,001). As it comes to luminosity (L), there was significant difference among treatment of crop 2014/15, for GND the average of 88,79 (p 0,001), by adding 50% of GD average of 88,20 (p 0,001) and for GD the average of 87,78 (p 0,001). Although there was no significant difference among treatments of crop 2015 of average of 88,75 (p 0,001). For yellow luminosity there was significant difference among treatments of crop 2014/15, for GND the average was 17,55 (p 0,001), by adding GD with average of 16,88 (p 0,001) and with GD the average was 16,51 (p 0,001), but there was no significant difference among treatments of crop 2015/16 with average 20,33 (p 0,001).

Conclusion. It is recommended to produce tofu with grains from recent crops, as they show soft texture and light color, which contributes to the physical quality of the product.

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EMERGING MUSCLE ABNORMALITIES IN BROILERS: IMPACT ON QUALITY TRAITS OF RAW MEAT FOR FURTHER PROCESSING

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Keywords. poultry, abnormalities, breast meat quality, further processing.

Introduction. In the past few decades, the breeding companies focused on the genetic selection of high growth-rate and breast yield chicken hybrids. Within this context, although an overall improvement in the live performances was achieved, an increased incidence of several emerging muscle abnormalities termed as White-striping (WS) and "Spaghetti-Meat" (SM) was observed (1).

Materials and Methods. Ninety-six boneless and skinless *Pectoralis major* muscles were selected from the same flock of high-breast yield hybrids (males) in the deboning area of a commercial processing plant and classified by two experienced people according to the presence of WS and SM defects: 24 Normal (NORM), 24 WS, 24 SM and 24 WS/SM samples. Implications of WS and/or SM abnormalities on quality characteristics (morphometric measurements, pH, colour, physicochemical state of water molecules by LR-NMR) and muscle proteins traits (as assessed by SDS-PAGE analysis, Myofibrillar Fragmentation Index, protein solubility and oxidation) were assessed. In addition, since both WS and SM defects seemed to mainly affect the superficial part of the *Pectoralis major* muscle, each parameter was separately determined in the superficial and in the deep part of each fillet in order to assess whether any difference might be attributed to the sampling position.

Results. The findings of the present study evidenced that WS and SM abnormality occurring alone or combined within the same *Pectoralis major* muscle significantly affected all the parameters assessed within this study. In detail, although only negligible effects might be observed within the deep part of the fillet, the occurrence of WS and SM defects severely affected the superficial layer of the P. major muscle. Furthermore, even if no relevant differences were found concerning colour, all samples affected by muscle abnormalities exhibited significantly higher pH and a remarkable increased proportion and mobility of extra-myofibrillar water fraction. In addition, although no significant differences were found concerning both myofibrillar and sarcoplasmic proteins solubility, protein functionality was found to be significantly impaired within the samples affected by WS and/or SM muscle abnormalities. This might be partly explained by the higher fragmentation index, the increased carbonylation level as well as by the overall altered myofibrillar and sarcoplasmic protein profiles observed within the abnormal samples.

Conclusions. This study evidenced that especially SM abnormality can impair breast meat quality properties as previously evidenced for wooden-breast condition (2). Within this context, considering that abnormal fillets are normally downgraded by the poultry industry and included as raw materials for processed products manufacture, further studies are needed in order to identify the proper technologies and formulations to apply. Additional information would also help to identify the proper proportion of abnormal meat to be included within the formulation of processed products without impairing quality traits and functionality.

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ADDITION OF BROWN ALGAE - ASCOPHYLLUM NODOSUM TO MUFFINS

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Keywords. Ascophyllum nodosum, algae extracts, muffins, functional foods

Introduction. Brown algae have been traditionally used as food products mostly in Asia. To date, China and Japan are paying particular importance to the daily intake of sea algae. Polyphenol-enriched extracts from *Ascophyllum* containing phlorotannins and have been found to inhibit α-glucosidase and α-amylase and therefore have the potential to influence glycemic control in vivo. As eating habit change seems to be the hardest challenge the wise engineerened sweet bakery could be the mild solution. The aim of this study was to evaluate the impact of addition of *Ascophyllum nodosum* in powder on sensory characteristic of muffins.

Materials and Methods. Muffins were baked from wheat flour with addition of 1 – 10% of *Ascophyllum nodosum* powder. The staling characteristic was measured within period of 14 days, the colour in CIE lab environment, the total volume by seed displacement method. Sensory analysis of five sensory attributes (appearance, aroma, taste, texture, aftertaste) as well as overall acceptability were evaluated vs control muffin which have addition of malt extract.

Results. The addition of seaweed powder to sweet bakery has changed the taste experience due to salty characteristic od seaweed. Also the staling characteristic was positively changed due to high water retention by *Ascophyllum nodosum.* Color changes were more subtile vs the malt extract controls. Higher levels of seaweed powder impacts significantly on specific volume of muffins. The most interesting information comes from sensory analysis which have revealed high level of acceptance of Ascophyllum nodosum powder addition.

Conclusions. Seaweeds as a rich source of natural antioxidants and antibacterial agents. The addition of these natural extracts, not only improve the quality of food products, but also improves their nutritional properties and making them more secure. Positive sensory response to seaweed addition in sweet bakery products opens new area of successful exploration of their pro-healthy potential.

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ESTABLISHMENT OF A SONOTRODE EXTRACTION OF PHENOLIC COMPOUNDS FROM *PSIDIUM GUAJAVA L.* LEAVES BY RSM APPROACH

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Keywords. Guava, Box Behnken design, Response Surface Methodology, HPLC-QqQ-MS, phenolic compounds

Introduction. *Psidium guajava* L., one of the most gregarious fruit trees from the Myrtaceae family, is common throughout tropical and subtropical areas. Different parts of the tree, e.g. the fruit, flowers, shoots, bark and leaves have been widely used for the treatment of several diseases. Several authors reported that these effects are due to the presence of phenolic compounds in the plant. For instance, Liu et al. (1) evaluated the effects of aqueous guava leaf extract on insulin resistance in high glucose-induced insulin-resistant mouse FL83B cells, and suggested that single and/or synergistic effects of the multiple bioactive components present in the extract promote the anti-hyperglycemic activity. Because of that, the aim of this work was to set up a sonotrode extraction method of phenolic compounds from guava leaves.

Materials and Methods. Box-Behnken design has been applied for the extraction of target compounds from guava leaves via sonotrode extraction. Different extraction times (5, 30 and 55 min), ratios of ethanol/water (50, 75, and 100 % (v/v)) and US power (80, 240 and 400W) were tested to find their effect on the sum of phenolic compounds (SPC), flavonols and flavan-3-ols via HPLC-ESI-QqQ-MS and antioxidant activity (DPPH and TEAC assays). Established method has been used to extract phenolic compounds from two guava leaves varieties (*pyrifera* and *pomifera*).

Results. The best process conditions to extract phenolic compounds from guava leaves were: 40 min, 60/40 ethanol/water (v/v) and 200 W. *Pyrifera* var. showed greater values of the SPC via HPLC-ESI-QqQ-MS (49.7 mg/g leaf dry weight (d.w.)), flavonols (12.51 mg/g d.w.), flavan-3-ols (7.20 mg/g d.w.), individual phenolic compounds, and antioxidant activity (8970 ± 5 and 465 ± 6 μmol Trolox/g leaf d.w, respectively) than *pomifera* variety. Conventional extraction showed lower amounts of phenolic compounds (7.81 ± 0.03 and 4.64 ± 0.01 mg/g leaf d.w. for flavonols and flavan-3ols, respectively) in comparison to the ultrasound assisted ones.

Conclusions. Ultrasound assisted extraction was more effective technique than conventional agitation extraction for the recovery of phenolic compounds from guava leaves. Suitability of the predicted model was proved comparing predicted and observed values for optimized conditions. Quantification results reported higher concentration of sum of phenolic compound in *pyrifera* variety than in *pomifera* variety. The proposed method could be used to obtain guava leaves enriched phenolic extracts for nutraceutical scope.

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PROCESS OPTIMIZATION OF HESPERIDIN OIL-IN-WATER PICKERING-EMULSIONS STABILIZED BY CHITOSAN PARTICLES

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Keywords. hesperidin, chitosan, response surface methodology, shelf-life stability, droplet size

Introduction. In recent decades the preparation of Pickering emulsion has attracted much attention due to a wide range of its useful applicability in cosmetic, food and pharmaceutical industries (1).
The aim of the present study was to investigate the effects of formulation factors i.e. chitosan concentration, lecithin concentration, and oil-to-water (O/W) ratio on the physical stability of the emulsions stabilized by chitosan particles. The emulsions were prepared using a rotor-stator homogenizer and their mean droplet size and stability was evaluated by means of response surface methodology (RSM).

Materials and Methods. Different concentration of soybean-lecithin and chitosan partciles were tested to prepare Pickering emulsions. The emulsions were prepared using a rotor-stator homogenizer (Ultra-Turrax® IKA T25, Labotechnik, Germany) with homogenization speed (10,000 rpm) at room temperature, and the mean droplet size ($d_{3,2}$) and emulsion stability index (ESI) were examined with the multi-sample analytical centrifuge (LUMiSizer, LUM GmbH, Berlin, Germany). The results of different prepared formulations were evaluated by means of response surface methodology (RSM).

Results. It was found that the optimal formulation conditions is achieved by using chitosan concentration 1.4%, lecithin concentration 5.14% and O/W ratio 1:2 with a high emulsion stability index (ESI) 0.8±0.02 and mean droplet size ($d_{3,2}$) of 504 nm. Therefore, the models explain 98% of the variability in the responses. Pickering emulsion with chitosan particles seems to be a good carrier for the encapsulation of hesperidin and bioflavonoids in general. The morphology of oil droplet stabilized with chitosan particles was characterized using optical microscopy and was found to have a spherical shape with concavities and surface deflations. Detailed microstructures of lyophilized Pickering emulsions were visualized with scanning electron microscopy (SEM) at different magnifications, from 1500× to 3000×, and it was found that the droplets stabilize at a very similar drop-size limit. This suggests that all the droplets have the same bending capacity, independent of their length. It can also be visually observed that a clearly denser organization is obtained for droplets and a looser networking organization with long bonding cross-linking the droplets, revealing the bridging phenomena.

Conclusions. In conclusion, this simple and versatile approach can potentially be applied to the encapsulation of various oil-soluble active compounds for food applications.

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BIOACTIVE COMPOUNDS OF ULTRASOUND TREATED OSMODEHYDRATED CRANBERRIES

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Keywords. cranberry, ultrasound, osmotic dehydration, polyphenols, vitamin C, antioxidant activity

Introduction. Cranberries contain high nutritional value and bioactive compounds such as vitamin C, polyphenols, anthocyanins and flavonoids, which are responsible for the high antioxidant activity. In order to reduce the fruit's tartness, it is necessary to subject it to process with addition of sugar. Hence, the aim of the study was to investigate the effect of ultrasound treatment and osmotic dehydration process on the bioactive compounds such as vitamin C, polyphenols, anthocyanins, flavonoids and antioxidant activity.

Materials and Methods. The frozen cranberries var. *Vacciniumoxycoccus* were examined. Blanching (90ºC, 5 minutes) was applied prior to osmotic dehydration process (OD) in order to damage the hard skin of berries, which is an exchange barrier in mass transfer during processing. Moreover, blanched cranberries were subjected to ultrasound treatment (US, 21 kHz, 3.6 W/g) in 61.5% sucrose solution for 30 and 60 minutes and during osmotic dehydration.The OD process was carried out at temperature of 40ºC for 72 h to obtain acceptable taste of the product. The results were compared with the control sample – cut cranberries subjected to osmotic dehydration. After the osmotic dehydration the total content of polyphenolic compounds and flavonoids was determined by spectrophotometric methods. Moreover, the UPLC method was used to determine vitamin C and DPPH assay to assess the radical scavenging activity. Obtained results were analyzed by the ANOVA procedure.

Results. The results show that blanching and ultrasound treatment caused a decrease or no change in the content of bioactive compounds in cranberries. Moreover, the application of US pretreatment for a longer time (60 minutes) resulted in higher loss of bioactive substances. Futhermore, the osmotic dehydration process of US treated samples further reduced content of: vitamin C by 30-37%, flavonoids by 15-46%, polyphemols by 28-62%; antioxidant activity decreased even twice or thrice in comparison to cranberries before OD process. However, the results were much better (higher bioactive compounds content) when compared to the control sample (cut and OD treated). Additionally, the use of ultrasound waves during the osmotic dehydration for 72 h did not affect the bioactive compounds in cranberries and their results were comparable to the control sample.

Conclusions. The sonication of cranberries prior to osmotic dehydration resulted in the decrease of bioactive compounds, however the obtained results were higher than for the sample subjected to cutting prior osmotic dehydration. Moreover, the use of ultrasound during osmotic dehydration did not impact better quality of the product.

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THE POSSIBILITY OF REDUCING THE SUGAR CONTENT OF OSMODEHYDRATED CRANBERRIES

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Keywords. cranberry, osmotic dehydration, steviol glycosides, saccharose, glucose, fructose

Introduction. In recent years increased consumers' interest in natural, healthy and of high nutritional value foods can be observed. It is widely known that cranberries contain a lot of bioactive compounds, vitamins, minerals and fiber. However, due to tartness the fruit is not edible without appropriate processing with addition of sugar. Rapidly growing number of overweight and obese people imposes reduction of sugar content (1). The solution to decrease the product calories is the use of steviol glycosides for partial replacement of sucrose. Hence, the aim of this work was to investigate the mass transfer phenomena during osmotic dehydration with the use of two different osmotic solutions characterized with similar sweetness.

Materials and Methods. The frozen cranberries var. *Vacciniumoxycoccus* were used in the investigation. Due to hard skin of cranberries, which limits mass transfer, cutting (C) and blanching (BL, 90ºC, 5 minutes) were carried out before osmotic dehydration. The osmotic dehydration process was conducted by dipping the fruits in two solutions: in 61.5% sucrose solution (SA) and a solution with reduced content of sucrose till 30% with 0.1% addition of steviol glycosides (SAG), at temperature 40ºC, for 0, 1, 3, 6, 24, 48 and 72 h. The ratio of osmotic solution to fruits amounted to 4:1. The analysis of the kinetics of cranberries osmotic dehydration was based on the weight loss, the water loss and weight of dry matter. After the osmotic dehydration the content of total sugars, including the content of fructose, glucose and sucrose, was determined by liquid chromatography with refractometric detection using the WATERS SUGAR-PAK I column. Statistical significances were examined with the analysis of variance and Duncan's multiple range tests at $\alpha=0.05$.

Results. The results show that the application of traditional operation before the process had greater impact on the kinetics of osmotic dehydration than the kind of osmotic solution. The use of sucrose solution with steviol glicosides' addition led to reduce the total sugar content of the osmodehydrated cranberries by only 5% and 1% in the case of the sample which before osmotic dehydration was subjected to cutting and blanching, respectively. Whereas, the samples subjected to thermal pretreatment (BL) were characterized with a lower total sugar content by 10% (for SAG) and 15% (for SA) in comparison to cut fruits. Moreover, blanched samples contained higher content of sucrose, which corresponded to solid gain kinetics. Higher content of glucose and fructose was observed in cranberries subjected to nonthermal traditional pretreatment (C) than in blanched (BL) samples.

Conclusions. The use of specific treatment such as blanching before osmotic dehydration and osmotic solution with reduced content of sucrose with steviol glycosides' addition allowed to obtain osmodehydrated cranberries with lower sugar content.

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THE IMPACT OF PULSED ELECTRIC FIELD ON MICROWAVE-ASSISTED AIR DRYING KINETICS AND FINAL PRODUCT QUALITY

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Keywords. drying, pulsed electric field, carotenoid, carrot, electroporation, microwave

Introduction. Methods that can be used in order to decrease energy consumption of drying can be divided into two categories. The first approach depends on shift of utilized drying technology, for instance from air drying to microwave-assisted air drying. The second one is linked to the application of pretreatment step prior to drying. In this case, different techniques can be involved [1]. One of the most promising technique that can be used in order to enhance drying is pulsed electric field (PEF). Therefore, the aim of this study was to analyze the impact of PEF pretreatment on the kinetics of microwave-assisted air drying and selected properties of such processed carrot root samples.

Materials and Methods. Following PEF parameters were used in the study: 1.85_50 (E = 1.85 kV/cm; n = 50 pulses; W_s = 5.6 KJ/kg; Z = 0.04), 5_10 (E = 5 kV/cm; n = 10 pulses; W_s = 8 kJ/kg; Z = 0.67), 5_100 (E = 5 kV/cm; n = 100 pulses; W_s = 80 kJ/kg; Z = 0.70) and 0_0 (intact samples). Selection of the parameters were done on the basis o two criteria: 1) similar electroporation efficiency (5_10 and 5_100) expressed as similar electrical conductivity and 2) similar specific energy input of PEF treatment (1.85_50 and 5_10). Immediately after PEF treatment samples were subjected for microwave-assisted air drying carried out at 40°C, 200W and 2 m/s (perpendicular air flow). The quality of dried carrot was analyzed by the means of total carotenoid content and hygroscopic properties determination. Statistical evaluation of the results were done on the basis of ANOVA procedure.

Results. PEF treatment resulted in reduction of drying time. For instance, drying time of samples treated by 10 pulses at 5 kV/cm (5_10) were 43% shorter in comparison to drying time of untreated samples. What is worth emphasizing, application of higher number of pulses (n = 100) but at the same electric field intensity (5 kV/cm; 5_100) did not case higher drying time reduction than protocol coded as 5_10. Energy consumption of microwave-assisted air drying decreased up to 25% as a result of PEF pretreatment. The hygroscopic properties of carrot samples treated by 5 kV/cm regardless of the number of pulses were similar to the properties of intact dried material. In turn, adsorption of moisture was faster in the case of sample coded as 1.85_50. PEF treated samples exhibited higher retention of carotenoids after drying. Total carotenoids content expressed in comparison to the fresh, intact material in the case of PEF treated samples ranged from 69.6 to 90.0% whereas in the case of untreated dried material it was equal to 60.5%.

Conclusions. Pulsed electric field treatment can enhance microwave-assisted air drying process. This technique allow to maintain higher carotenoid concentration after drying and remain unchanged hygroscopic properties, which are important regarding the storage of the material.

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HIGH PRESSURES HOMOGENIZATION TO MICROENCAPSULATE *L. SALIVARIUS* spp. *SALIVARIUS* IN MANDARIN JUICE. PROBIOTIC SURVIVAL AND IN VITRO DIGESTION.

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Keywords. Encapsulation, homogenization pressures, probiotic survival, in vitro digestion.

Introduction. Homogenization pressures can be used as a technology to microcapsulate probiotic bacteria (3). Encapsualtion of probiotics can maintain survival rates and viability higher over the shelf life compared to non encapsulated cells (1). The aim of this work was to evaluate the effect of microencapsulation of L. Salivarius spp. Salivarius by using homogenization pressures in mandarin juice on the physicochemical properties of the juice, particle size and rheology as well as on the survival of the probiotic and its effect under simulated gastrointestinal conditions.

Materials and Methods. Low pulp mandarin juice was enriched with encapsulated and non encapsulated *L. Salivarius* spp. *Salivarius* (CECT 4063). Probiotic was microencapsulated forming an emulsion with sodium alginate, oil and tween 80. Emulsion was homogenized at 70 MPa with a homogenizator (Panda Plus 2000, GEA). Emulsion was broken with $CaCl_2$ and then capsules were formed. Capsules were added into the juice to 9 log CFU/mL. Physicochemical properties of juices with encapsulated and non ecapsulated probiotic, such as density, water activity, viscosity, soluble solids (TSS) and pH, were determined. Particle size distribution (Mazster sizer 2000, Malvern Instruments, UK) and rheology behavior, (modeled to Ostwals-de-Waele, rheometer Haake RheoStress 1, Germany) of juices were studied too. Counts of viable cells and availability during gastrointestinal simulation of juices were evaluated for the period of 10 days of storage.

Results. Juice with encapsulated *L. salivarius* had lower soluble solids, pH and density; this can be due to the low density of the wall material of the capsule and the minor propotion in juice due to the capsules adition. However it has higher viscosity and water activity. The study of the particle size distribution showed that the juice with encapsulated probiotic had higher particle size and a narrower distribution than the juice with non encapsulated cells. Rheology behavior of the juices evidenced a pseudoplastic behavior and juice with encapsulated probiotic had slightly higher consistence index (K) and lower behavior index (n) than the juice with free cells. Encapsulation had an effect on the survival of the probiotic and on its availability during and after gastrointestinal simulation.

Conclusions. HPH treatment has been effective to microencapsulate *L. salivarius* in juice. Encapsulation of probiotic can contribute to improve its survival.

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ULTRASOUND AS AN INNOVATIVE PRE-TREATMENT METHOD TO EHNANCE DRYING OF PARSLEY LEAVES

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Keywords. Ultrasound, steaming, drying, parsley leaves, lutein, chlorophylls

Introduction. In recent years attempt is made to use ultrasound (US) in order to reduce drying time and thus reduce energy consumption of the process. However, ultrasound may change also chemical and physico-chemical properties of a product. This aspect is especially important in the case of herbs drying due to high amount of bioactive components. Therefore, the aim of this study was to evaluate improvement of the drying process and reduction of energy consumption caused by ultrasound immersive pre-treatment in comparison to immersion and conventional steaming treatment of parsley leaves. Moreover, the changes of total chlorophyll and colour were analysed.

Materials and Methods. Drying of parsley leaves was optimize using three level factorial design and analysed using Response Surface Methodology (Design-Expert v.10; Stat-Ease). Three factors were used: pre-treatment type (ultrasound, steaming, immersion), air temperature (20, 30, 40°C) and microwave power during drying (100, 200, 300 W). Drying time, total specific energy consumption – *TSEC* (includes energy consumption of both pre-treatment and drying), total chlorophyll content and a* colour parameter were analysed. Chlophylls content was determined using UPLC-PDA according to Guzman et al. (1), whereas colour was measured in L*a*b* system using Konica-Minolta CR-5.

Results. The increase of microwave power and air temperature during microwave drying of parsley leaves was accompanied by the decrease of drying time and energy consumption. Moreover, also ultrasound and steaming pre-treatments were characterised by shorter drying time and energy expenditures in comparison to the immersion. Among pre-treatment type, the lowest *TSEC* concerned sonication, whereas the highest energy requirements were associated with steaming due to high energy consumption of this treatment. Therefore, energetic benefits related to shorter drying have been nullified by consumption of energy caused by steam treatment. The retention of total chlorophyll content in dried parsley leaves varied significantly with respect to the pre-treatment type. The greatest differentiation with varied drying conditions was notified in immersed leaves. The lowest chlorophylls content was observed during drying at the lowest microwave power and air temperature. In turn, greenness of dried parsley leaves was not significantly related to pre-treatment step. The highest retention of green colour was connected with drying at the highest intensity.

Conclusions. Ultrasound was more efficient in intensification of the drying and reduction of energy requirements than steaming treatment. The chlorophyll content and colour of parsley leaves were dependent on the drying conditions and pre-treatment step. Therefore, the optimization need to be done before implementation of novel technology.

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THE IMPACT OF PULSED ELECTRIC FIELD ON ENERGY EFFECTIVENESS OF AIR-DRIED CARROT

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Keywords. drying, pulsed electric field, energy consumption, carrot, electroporation

Introduction. Very often drying process is preceded by the pretreatment step in order to enhance its kinetic. Application of conventional pretreatment methods is linked to many disadvantages, which makes them incompatible with basic principles of sustainable development. The utilization of pulsed electric field (PEF) as a nonthermal pretreatment step prior to drying, can be considered as one of the most promising tools which positively can impact on drying kinetic and quality of final product. Therefore the aim of this work was to analyze the drying kinetic and energy consumption of dried carrot pretreated before drying by pulsed electric field.

Materials and Methods. Pulsed electric field pretreatment was carried out in a prototype reactor in following variations: 1.85_50 (E = 1.85 kV/cm; n = 50 pulses; W_s = 5.6 KJ/kg; Z = 0.04), 5_10 (E = 5 kV/cm; n = 10 pulses; W_s = 8 kJ/kg; Z = 0.67), 5_100 (E = 5 kV/cm; n = 100 pulses; W_s = 80 kJ/kg; Z = 0.70) and 0_0 (untreated carrot). The parameters of PEF were selected on the basis of the similar energy delivered to the sample (1.85_50 and 5_10) and similar effectiveness of electroporation (5_10 and 5_100) expressed by the similar cellular disintegration index Z (similar electrical conductivity). After PEF treatment carrot samples were subjected to air-drying performed at 70°C and 2 m/s. During drying the energy consumption and mass changes of the samples were registered. Drying rate was calculated on the basis of Midilli et al. (1) model. Moreover, the effective water diffusion coefficient was computed in accordance with simplified Fick's 2nd law of diffusion. The mathematical modeling was evaluated on the basis of R^2, RMSE, χ^2 and CRV. In order to evaluate obtained data ANOVA and Pearson's correlation procedure was employed.

Results. Drying time of PEF treated samples was reduced up to 33.6% in comparison to untreated samples. In turn, the energy consumption was decreased up to 20%. The utilized Midilli et al. [1] model fit very well to experimental data – R^2 varied from 0.997 to 0.999, RMSE ranged from 0.0026-0.0150 and χ^2 ranged from 0.000007 to 0.000243. The coefficient of residual variation varied from 1.5 to 5.6% depending on the processing parameters. Moreover, the drying rate of PEF treated material at the very beginning of the drying process was higher than in the case of untreated samples. Pulsed electric field resulted in relevant increment of the effective water diffusion coefficient by 45% in the case of 5_10 and 5_100 dried carrots. Statistical analysis proved that the effective water diffusion coefficient in a relevant relationship with electrical conductivity (r=0.997; p<0.05).

Conclusions. Pulsed electric field treatment can reduce the drying time and thus it can decrease the energy consumption of drying. Moreover, the electrical conductivity measurement can be used to determine not only the electroporation effectiveness but also to forecast the effective water diffusion coefficient.

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RELATIONSHIP BETWEEN BREADMAKING QUALITY, THERMOMECHANICAL PROPERTIES AND SIMPLE TECHNOLOGICAL TESTS FOR EVALUATION OF VITAL WHEAT GLUTEN THROUGH PCA

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Keywords. Principal components analysis (PCA), vital wheat gluten, breadmaking, Mixolab™, simple tests.

Introduction. The breadmaking industry requires better understanding of the quality of vital wheat gluten (VG) used as an ingredient. The vitality of VG is generally tested by technological and baking tests using wheat flour fortified with VG. However, these tests usually require a long time for their realization. Therefore, the development of simple test may be an alterative in gluten quality evaluation, reducing costs and time. Thus, the aim of this work was to evaluate VG quality through baking, thermomechanical and simple tests, and also to use principal components analysis (PCA) as a statistical tool to determine which simple tests relate better with thermomechanical responses and breadmaking quality of VG.

Material and Methods. For this work, two commercial vital wheat glutens (VGA and VGB) were used to fortify control wheat flour at 5 and 7 % levels. Thermomechanical properties were evaluated using a Chopin Mixolab™, following AACCI method 54-60.01 (1). The baking test was realized through the straight dough method (2). Loaf specific volume was measured by AACCI method 10-05.01 and crumb firmness by AACCI method 74-10.02 (1) during shelf life (9 days). Simple tests were expansion and extensibility tests developed by the authors. Both of these tests used wet gluten prepared in a Perten Glutomatic™, by AACCI method 38-12.01 (1). The expansion test was carried out by baking the wet gluten ball (3). The extensibility test used a plate with marks in cm, to allow extension by the weight of the wet gluten until its complete drying. Principal components analysis (PCA) was carried out in the Pirouette 3.11 software (InfoMetrix™, Bothel, WA, USA) only with the results that presented significant difference by Tukey's test ($P < 0.05$).

Results. We observed that the loaves made with 7 % VGA had the highest specific volume and lowest firmness during storage. Vital wheat gluten addition to wheat flour contributed to improve dough viscoelastic quality for breadmaking evaluated by thermomechanical properties. When VGA was added to wheat flour, its dough showed increased dough development time and gluten network stability, while the addition of VGB did not tolerate long periods of mixing, and its gluten network weak rapidly in the overmixing. Simple tests showed differences between VGA and VGB, indicating differences in their viscoelastic properties, reinforcing the results obtained by the Mixolab™. VGA had better expansion characteristics and lower extensibility than VGB, reflecting in the increase of bread volume, as the gluten network from VGA would tolerate more gas pressure during proofing. By PCA, there were technological differences between VGA and VGB, showing that the characteristics related to more elastic gluten were associated to VGA; and VGA presented better technological characteristics than VGB.

Conclusions. We can conclude that the flour mixes with VGA improved the dough technological quality and produced better quality bread compared to flour mixes with the addition of VGB. Furthermore, simple tests can be used to assess vital wheat gluten quality, reflecting its viscoelastic properties. Through PCA, we can see that the expansion test relates well with VGA and the extensibility test with VGB, confirming the thermomecanical results, so simple tests can be used to assess vital wheat gluten quality, reflecting its viscoelastic properties and breadmaking quality.

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EFFECT OF PROTECTANTS ON THE STORAGE STABILITY OF FREEZE-DRIED LACTIC ACID BACTERIA

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Keywords. Freeze-drying, Lactic acid bacteria, Survival rate, Storage stability

Introduction. Lactic acid bacteria (LAB) are widely used as starters for various food products. Some LAB, however, are destabilized after dehydration and subsequent storage, and thus, stabilizing effects of various protectants have been investigated intensively. It is known that some animals (*e.g.*, tardigrade and chironomid) can survive after dehydration; they have a large amount of disaccharide in the dehydrated state. In fact, many studies have demonstrated that disaccharides (*e.g.*, sucrose) are effective protectants for dehydrated biomaterials (enzyme and LAB). More recently, we found that a leech capable could survive at the extremely low temperature in liquid nitrogen (-196°C) more than 24 h (1). In addition, it was confirmed that the leech has a large amount of carnosine after the freeze-thawing. Taking this into account, there is a possibility that carnosine plays a role of stabilizer to freeze-dried LAB. The purpose of this study was to understand effects of carnosine, sucrose, and carnosine-sucrose mixture on the storage stability of freeze-dried LAB.

Materials and Methods. *Lactobacillus paracasei subsp. paracasei* JCM 8130^T (RIKEN BioResource Center, Japan) was employed as a LAB, and it was incubated in MRS broth at 37°C for 24 h. Protectants were dissolved in PBS, and mixed with the cell suspension (1×10^{10} CFU/ml). As the results, 20 mM carnosine, 200 mM carnosine, 400 mM sucrose, and 20 mM carnosine with 400 mM sucrose formulations were obtained. The formulations were freeze-dried at a pressure below 70 Pa with increasing temperature from -35°C to 5°C over a period of 29 h. The freeze-dried samples were stored at 37°C for 4 weeks. Survival rate of LAB was calculated as a percentage of log CFU/ml after the storage to log CFU/ml before freeze-drying.

Results. There was no survival detected for control (non-additive sample). The highest survival rate was 200 mM carnosine, followed in order by 20 mM carnosine with 400 mM sucrose, 20 mM carnosine, and 400 mM sucrose. It was found that carnosine has a significant stabilizing effect for the freeze-dried LAB. The stabilizing effect of carnosine decreased by the reduction of carnosine added. Carnosine-sucrose sample had higher survival rate than each individually added protectant. This result indicates that the combination of carnosine and sucrose exerted a synergic stabilizing effect on freeze-dried LAB.

Conclusions. This study demonstrated that carnosine and carnosine-sucrose mixture were a significant stabilizer of freeze-dried *Lactobacillus paracasei subsp. paracasei*. To understand the stabilizing mechanism is one of next subjects of this study.

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DEVELOPMENT OF EGG PRODUCT'S PRESERVATION IN THE LAST 25 YEARS

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Keywords. Preservation, egg products, development, heattreatment, minimal processing

Introduction. In our study the opportunities to preserve egg products are presented, highlighting the developments of the last 25 years.

Materials and Methods. Thermal and non-thermal preservation technologies and in product allowed preserves for production of liquid egg products are described and compaired. The microbiological risk reduction and influences to sensorial and techno-functional quality of the different technologies are highlighted.

Results. Several methods are described in international literature of food preservation, as well inventions and patents are registered for egg processing. In our review different published thermal and nonthermal methods and patents are summarized, which originate from the last 25 years.

Conclusions. In our study is shown that inactivation of pathogens and spoilage microbes is solved by application of uniformed, very similar technological parameters in industrial circunstances. In turn, several research results are available to develop more effective, original properties preserving technologies.

EFFECT OF FREEZING CONDITIONS ON BLOCK FREEZE CONCENTRATION ASSISTED BY CENTRIFUGATION APPLIED TO BLUEBERRY JUICES

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Keywords. centrifugation, freeze concentration, blueberries, juices, solutes

Introduction. Blueberry juices are nutritive juices with a high content of water, and from cryoconcentrate blueberry juices the consumers only need to add water as the final step of production to obtain a high-quality product. Freeze concentration (FC) is an important method to concentrate solutions and liquid foods and compared to other technologies (evaporation and membrane separation) has some significant potential advantages for producing a high-quality final concentrate because the subzero temperature used in the process result in a minimal loss of volatiles (Amran et al., 2016). Innovations to FC have been associated more commonly with innovations in the one-step systems, such as block FC or progressive FC, than conventional FC configurations (suspension crystallization), because of the simpler separation step (Miyawaki et al., 2012). The alternatives of assisted techniques applied to block FC to improve the efficiency of processing are important in achieving commercial viability. An alternative is using an external driving force such as centrifugation (Petzold & Aguilera, 2013). In this way, centrifugation has been proposed by Bonilla-Zavaleta et al. (2006) in frozen pineapple juice to separate ice from concentrated juice, while Luo et al. (2010) obtained ice crystals of high purity during the freezing concentration of brackish water. Thus, centrifugation is an alternative to improve the efficiency of block freeze concentration applied to solutions such as fruit juices (Petzold & Aguilera, 2013; Petzold et al., 2015).

Materials and Methods. Two types of freezing (radial and unidirectional) and two freezing temperatures (-20 and -80°C) were applied to obtain a concentrate from frozen blueberry juice using centrifugation (1600 RCF for 10 min at 20°C) to enhance the separation in three cryoconcentration cycles and were analyzed physicochemical properties and process parameters for each treatments. This procedure was performed in three cycles, in each cycle collecting the concentrate being used as an initial concentrate for the next stage of cryoconcentration. Physicochemical properties as soluble solids (°Brix), pH, density, color and total polyphenols were determined for fresh juice, ice and concentrated for each treatment and compared with concentrate obtained by rotary evaporator.

Results. All treatments indicated an increase in soluble solids, density and total polyphenols, except pH, which was maintained constant in all samples and changed the color of light purple to dark purple. Specifically, unidireccional freezing treatment at -20°C is the best treatment because showed the highest values after the third cryoconcentration cycle, because the solids content in the concentrated fraction increased 4 times compared to the initial solids content of fresh juice, presented increase from 12 to 48°Brix and reaching 70% efficiency, 0.78 (kg solute/kg initial solute) of recovered solute and 63% of concentrate. Similarly, an important retention of total polyphenols content with a yield close to 86% in final cryoconcentrate sample, compared to concentrate by rotary evaporator with less to 32% of retention.

Conclusions. Unidirectional treatment at -20°C presented the best conditions in terms of physicochemical properties and process parameters to obtain a concentrate by freezing concentration rich in bioactive components and centrifugation is an effective technique to remove the concentrated solution of the matrix ice. The performance of this technique applied to blueberry juice was attributed to ice matrix acting as a porous solid through which the concentrated solution percolates through drainage channels of the ice improved by the centrifugal force.

EFFECT OF FERMENTATION ON THE CONTENT OF FREE AND BOUND PHENOLIC COMPOUNDS IN TOFU-TYPE PRODUCTS

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Keywords. tofu, fermentation, isoflavones, soybean, LAB (Lactic acid bacteria)

Introduction. The tradition of preparing soy foods, typical of Asian culture, has been spread worldwide in the last years. Thousands of studies (*in vivo* and *in vitro*, with animals and human subjects) have shown that soybeans and soy components have many health-promoting effects, some of them related to soybean phenolic compounds (isoflavones), which can also improve nutritional, organoleptic, technological and shelf-life characteristics of soy foods. Despite recent advances, the study of lactic acid bacteria (LAB) and their functional activities in soy based products is still an emerging field of research but it has been shown that fermentation of soybeans enhanced the bioavailability of isoflavones due to the faster absorption of soy isoflavones aglycones (1). Moreover, various forms of isoflavones have been shown to possess different antioxidant activities. The aim of the study was to investigate the effect of LAB fermentation on free and bound phenolics of tofu, and to evaluate their transference rate from soybean flour to tofu.

Materials and Methods. Soymilk fermentation was carried out by specific strains of *Lactobacillus casei* and *Lactobacillus acidophilus*. Free and bound phenolic compounds from soybean, traditional tofu and fermented tofu were studied by HPLC-DAD-ESI-MS using a PFP core shell column.

Results. The analysis of isoflavones allowed the identification of fifteen compounds, eight aglycones and seven glycosylated derivatives, with an increased aglycones/glycosylated ratio in fermented tofu compared to soybean flour and traditional tofu. Soybean flour and tofu samples showed significant differences in terms of total isoflavones content; in particular traditional and fermented tofu showed a reduction of isoflavones of 13.4% and 24.2% compared to soybean flour, respectively. Moreover, glycoside concentration was lower in fermented tofu if compared with soybeans flour and traditional tofu (the ratio of aglycones/glycosylated isoflavones was 0.34 and 2.55 for the traditional and fermented tofu, respectively). Soybean flour and traditional tofu presented a similar content of bound phenolic compounds (mainly phenolic acids), instead fermented tofu showed a higher bound phenolic content (34 % higher than traditional tofu).

Conclusions. LAB fermentation lead to an increase in the content of aglycone isoflavones and bound phenolic compounds enhancing bioactivity and promoting beneficial effects on human health. Thus, lactic acid bacteria are very promising sources for novel products and applications, especially those that can satisfy the increasing consumer's demands for natural products and functional foods.

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USING FT-NIRS PARAMETERS IN A BEEF CARCASS GRADING MODEL

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Keywords. Beef, Grading, Yield, Quality, FT-NIRS.

Introduction. The Argentine beef value chain requires actions to provide important solutions to issues such as the lack of agreement of meat qualities and the absence of accurate information about the product measured by reliable beef grading and yield systems. The objectives of this work were to use the FT-NIR methodology for determining a grading and yield system to allow rapid classification of carcasses and assess the beef quality for consumption and export produced in the province of Entre Rios, Argentina.

Materials and Methods. A total of 142 carcasses from British breeds steers, young steers and cows were dissected to obtain the special hindquarter (*pistola*) and 7 major cuts weights. 1" thick steaks of *M. Longissimus dorsi* were used for conventional physic and chemical analyses. Subcutaneous fat thickness, ribeye area, marbling, pH, moisture, proteins, lipids (LC) and total collagen contents (CC), Warner-Bratzler shear force (WBsf), lean meat color CIE Lab, total loss and the diffuse reflectance spectra were obtained by FT-NIRS (BRUKER - MPA. Germany). To improve spectral data, an optimization procedure was performed to evaluate R^2 and RMSECV (Root Mean Square Error of Cross Validation) of the applied mathematical pre-treatment using the software OPUS 7.5 (1) to obtain the best prediction equation for each parameter.

Results. NIR prediction scores pH (R^2=0,48; RMSECV=0,15); LC (R^2=0,37; (RMSECV=0,58); WBsf (R^2=0,08; RMSECV=1,58); L* (R^2=0,79; RMSECV=1,48) and CC (R^2=0,21; RMSECV=0,08) defined a three level grading system: "*Premium*" (pH≤5,8; 2≤LC≤4%; WBsf ≤4 Kgf; CC ≤0,35%; 30≤L*≤38), "*Elegida*" (pH≤5,8; LC without restrictions; 4≤WBsf ≤5 Kgf; CC ≤0,40%; 30≤L*≤43) and "*Estándar*" (without parameters restrictions) for steer/young steers. Two levels "*Selecta*" (pH≤5,8; 1≤LC≤6%; WBsf ≤6 Kgf; CC ≤0,40%; 30≤L*≤43) and "*Estándar*" (without parameters restrictions) were defined for cows. As for the major cuts weight NIRS prediction (R^2=0,53; RMSECV=2,63), a five level grading system for beef yield was determined (1>40 Kg; 34≤2≤41 Kg; 27≤3≤34 Kg; 20≤4≤27 Kg; 5<20 Kg). Although the WBsf prediction equation obtained the lowest R^2 value of all the studied parameters, the grading system using NIR predictions classified carcasses in a similar way when compared with classification using real data. The beef yield grading showed carcass proportions obtained with NIR data similar to those obtained on the basis of real data. Quality and yield parameters from steers and cows utilized in this study are within the range of values reported in previous studies of similar breeds and production systems in Argentine cattle herds.

Conclusions. Results show that the use of FT-NIRS measures for the implementation of grading and beef yield systems in slaughterhouses may offer a reliable alternative. Further studies are required to increase the predictive accuracy in order to provide all sectors involved in the supply chain with the necessary reliability. According to the results, quality and lean meat yield parameters of animals slaughtered in Entre Ríos are similar to those categories, breeds and productive systems of Argentine.

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PHOTO-INDUCED MODIFICATION OF FOOD PROTEIN STRUCTURE AND FUNCTIONALITY

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Keywords. Ultraviolet, pulsed light, photoreaction, protein.

Introduction. Proteins are major target polymers for photoreactions due to abundance of endogenous chromophores, ability to bind exogenous ones, and rapid reactivity with other excited state species. As food structure and functions are the result of the status of food constituents, photoinduced structural modification of food proteins can lead to new product characteristics or improved functionalities.
The aim of this presentation is to discuss possible applications of light radiation to modify food protein structure, inducing changes in their technological and biological functions.

Materials and Methods. Structural changes of food proteins, including egg white, gluten and enzymes, were induced by exposure to selected UV and pulsed light treatments under different a_w conditions and in the prersence of other food ingredients (sugars, polysaccharides). Structural properties of proteins were analysed by absorption spectroscopy, dynamic light scattering, free sulfhydryl groups determination, SE-HPLC and SDS-PAGE. The possibility to exploit photo-induced modifications to steer protein solubility, thermal stability, activity at water/air/oil interface, catalytic activity and immunoreactivity was also studied.

Results. Light processing was shown to improve the technological performance of proteins by modulation of rheological, film, emulsifying and foaming properties of proteins. Similarly, significant effects of light on activity of enzymes and reactivity of allergens were demonstrated. The photo-response of proteins dramatically changed when they were embedded in crowded and complex matrices such as foods. The occurrence of a food supra molecular structure selectively favoured or hindered specific photo-reactions. Under these conditions, there was plenty of possibility to photo-induce protein reactions with other food components, further leading to unexplored possibilities to steer protein functionality.

Conclusions. Advances in light processing have made these technologies available, sustainable and of easy integration into food industries. Light processing is generally exploited as a non-thermal alternative to conventional disinfection methods but offers advantages well beyond it. The intense photo-reactivity of proteins as well as the large variability of the deriving structures indicates a wide potential of light radiation in modifying functionality of food proteins and protein-rich foods.These aspects certainly represent a challenging research area which would require exploration.

POTENTIAL OF ANTIMICROBIAL BASED MICROEMULSIONS AND HIGH-PRESSURE HOMOGENIZATION ON THE SHELF-LIFE AND SAFETY OF APPLE-STRAWBERRY EXTRACT

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Keywords. high pressure homogenization, antimicrobial microemulsions, fruit extract, quality, safety

Introduction. Since high pressure homogenization (HPH) and natural antimicrobials are recognized as potential tools to increase the safety and shelf-life of fruit and vegetable juices, the principal aim of this research was to investigate their potential to increase the quality and safety of a fruit based extract. In particular, the natural antimicrobials were used as microemulsion since the literature underlines that nano and micro particles in water-based delivery systems can enhance their antimicrobial activity.

Materials and Methods. The fruit extract was obtained mixing apple and strawberrie extracts (ratio 2:1). This was produce in lab conditions and divided in 6 different batches. The first batch was treated at 200 MPa for 1 and 3 cycles by using a Panda homogenizer (Gea, Parma, Italy); the second one, before the application of the pressure treatment, was added of 150 ppm of a microemulsion of hexanal, E(2)-hexenal, and citral (ratio1:1:1) obtained by HPH according to the method proposed by DKS Aromatic (Milan, Italy). The third one, before to be subjected to HPH treatments, was inoculated with pathogenic (2 log cfu/ml) and spoilage microrganisms (3 log cfu/ml). The fourth batch was added of the microemulsion and the target microorganisms, inoculated at the levels previously described. The fifth batch was represented by the extract added of the microemulsion while the final one was the juice treated at 0.1 MPa. All the samples were stored at 5, 10, 25°C and analyzed immediately after the application of all the treatments and over time to evaluate the microrgamism cell loads, pH, colour and volatile compounds of the juices (GC/MS/SPME).

Results. The microbiological results showed that yeasts represent the main spoilage agents due to the physico-chemical features of the extract. On the contrary, lactic acid and pathogenic bacteria did not have growth chance at that pH, indipendently on the storage considered temperatures. About the applied treatments, the most severe pressure level, also in combination with the microemulsion, allowed to reduce the yeast deliberately inoculated under the detection limit. The application of a hyperbaric treatment at 200 MPa for 1 cycle permitted to reduce the inoculated yeasts of a logaritmic cycle, while the combination of this level of pressure and the microemulsion reduced the inoculated yeasts under the detection limit. The results collected over the sample storage at 25°C showed that the presence of the microemulsion, also in combination with the pressure, significantly incremented the product shelf-life of at least 2 weeks. The storage of the samples at 5 and 10 ° C further increased the shelf-life of the samples. Regarding the pH, the hyperbaric treatment did not significantly affect this parameter in the high pressure treated juices. Concerning colour data, the application of the HPH treatment to the extracsts incremented their brightness, contrarily to the addition of the antimicrobials. The GC/MS/SPME analysis permitted to identify more than 40 molecules belonging to several chemical classes.

Conclusions. The data obtained within this research outlined the great potential of the natural antimicrobial based microemulsion considered, alone or in combination with HPH, to increase the shelf-life of an apple-strawberry extract satisfying the need of the industry to storage product at room temperature.

EFFECT OF HIGH PRESSURE CARBON DIOXIDE ON THE STORAGE QUALITY OF FRESH APPLE JUICE

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Keywords. HP-CO_2, polyphenoloxidase, quality, apple juice, pasteurization

Introduction. Consumption of fresh fruit juices has risen over the last years, due to the increasing demand for healthy and fresh-like food. These products present high safety and quality issues, due to microbial growth, chemical reactions and enzymatic activity (1). Different non-thermal technologies have been proposed to increase the satbility of these fruit derivatives. Among them, the use of high pressure carbon dioxide (HP-CO_2) seems to be very promising. During the HP-CO_2 treatment, food is in contact with pressurised CO_2 at temperature/pressure conditions above or below the critical point (31.1°C, 7.38 MPa) (2). Significant inactivation effects of HP-CO_2 on different microorganisms have been demonstrated while condrictory data are reported on enzyme inactivation. The effect of HP-CO_2 on fresh apple juice polyphenoloxidase (PPO) and on its storage quality was studied in this research.

Materials and Methods. Filtered apple juice was HP-CO_2 treated at different pressures (0-18 MPa), temperatures (20-45°C) and treatment time (0-30 min). PPO inactivation parameters such as minimum residual activity (*RA%*), apparent inactivation rate (k) and decimal reduction time (D_p) were calculated to compare treatments. The treatment allowing the minimum PPO residual activity to be reached while maintaining temperature, pressure and treatment time as low as possible was selected. Apple juice samples submitted to this treatment were stored for 15 days at 4°C. During storage, browning degree (assessed spectrophotometrically), sensory attributes and microbial loads (total, lactic acid bacteria, yeast and mould counts) were monitored. Data were compared with those relevant to a pasteurized (15 s at 72.1°C) and to an untreated apple juice (control).

Results. PPO HP-CO_2 inactivation increased with treatment temperature, pressure and time. However, complete inactivation was not reached. The treatment at 12 MPa and 35°C for 10 min allowed to obtain the minimum *RA%* (20%) at the mildest combination of treatment parameters. In HP-CO_2 treated samples, browning resulted lower than in control, due to the partial inactivation of PPO. After 15 days of storage, the microbial load of HP-CO_2 treated samples (2 Logs) was about 4 Logs lower than that of control. HP-CO_2 treatment did not modify sweetness and acidity of apple juice. Fresh-apple flavour of HP-CO_2 treated samples resulted significantly higher than that of pasteurized juices and not different from that observed in the control.

Conclusions. HP-CO_2 treatment allowed to partially inactivate PPO and native microflora of apple juice, while maintaining product fresh-likelihood. HP-CO_2 could thus be considered a valuable green technology for the shelf-life extension of fresh apple juice.

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FRACTIONING AND PURIFICATION OF ANTIHYPERTENSIVE PEPTIDES FROM QUINOA (*CHENOPODIUM QUINOA* WILLD.) PROTEIN HYDROLYSATE ACCORDING TO HYDROPHOBICITY (SOLID PHASE EXTRACTION)

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Keywords. quinoa, peptides, hydrophobicity, *in vitro* ACE inhibition

Introduction. For the past years, there has been a growing interest in the study of bioactive compounds from nutritious foods. Scientific literature focused on the protein fraction has shown that its bioactive peptides could potentially have benefits to human health, particularly for the prevention of hypertension, being one on the major risk factors associated to cardiovascular diseases. Angiotensin converting enzyme (ACE), a key enzyme involved in the mechanism of hypertension, have been inhibited by the action of some bioactive peptides. Nevertheless, peptides from traditional grains such as quinoa have not been studied according to hydrophobic fractionation regarding its potential inhibition of ACE. The objective of this research was to study the hydrophobic fractionation of quinoa protein hydrolysate (QPH) and test the *in vitro* inhibition of ACE.

Materials and Methods. Quinoa protein hydrolysate (QPH) (57% protein content) was fractionated in order to obtain peptides according to hydrophobicity. Hydrolysate was fractionated in ascendant elution of acetonitrile (ACN) in water (v/v) (water, 10%, 20%, 30%, 40%, 50% y 60% ACN) by solid phase extraction (SPE), obtaining 7 different fractions. After this stage, fractions were analyzed by HPLC-RP in order to identify peaks associated to peptides distributions presents in each fraction. Lowry method was used to quantify protein content. Prior checking their bioactivity, ACN present in the samples were eliminated under vacuum concentration. Then, the fractions were tested (*in vitro)* for the inhibition of angiotensin converting enzyme (ACE) by using captopril as positive control. IC_{50} value was obtained from the fraction that produced the highest inhibition.

Results. SPE, using 10% ACN produced the major fraction of peptides (determined by Lowry method), followed by 20 and 30% ACN. These fractions also showed the highest chromatographic peaks (HPLC- RP). From all tested fractions (at 0.1 mg/mL in water), 10% ACN showed the highest inhibition of ACE and the $\%IC_{50}$ value was close to 0.13 mg/mL.

Conclusions. By using SPE it was possible to fractionate the QPH peptides based on hydrophobicity. The highest fractionated peptide mass was obtained by using the 10% ACN, which in turn was also the fraction that presented the highest *in vitro* inhibition of ACE. Future studies will be conducted to sequence the selected fraction in order to potentially relate their structure and functionality.

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ANTIMICROBIAL EMULSIONS: EFFECT OF TYPE AND CONCENTRATION OF ENCAPSULATING AGENT IN STABILITY AND DROPLET SIZE

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Keywords. Capsul®, Maltodextrin, antimicrobial emulsions

Introduction. Food emulsions are considered as new possibilities in design of active ingredients (1), which could increase shelf-life of fresh foods, due to using antimicrobial agent (AA) as lemongrass essential oil (LEO) and its active compound (citral). The aim of this study is evaluated the effect of antimicrobial: encapsulating agent proportion in physical stability, color and droplet characterization of emulsions to use as active ingredient.

Materials and methods. Emulsions were obtained using homogenizer at 10000 rpm for 2 min, containing alginate (1%w/w) as matrix, LEO and citral (1%w/w) as AA (concentration that inhibit microbial growth), maltodextrin and Capsul® as encapsulanting agents in proportions (antimicrobial:encapsulant) 1:1, 1:2, 1:3 and 1:4, adjusting at pH 5.5. Average and distribution droplet size, physical stability during storage and difference of color between different formulations were determined.

Results. Results showed a decrease in droplet size of emulsions prepared with Capsul® ($<1\pm0.6\mu m$) compared to those made with maltodextrin ($1.5\pm0.8\mu m$), independently of antimicrobial: encapsulant proportion and antimicrobial agent used, just like for polydispersity index. Despite this, emulsions with Capsul® were less stable, observing instability mechanisms of flocculation/coalescence and creaming at 40h of storage at 4ºC, meanwhile maltodextrin addition not showed instability at the same time. However, emulsions instability increased as increasing concentration of the encapsulating agent and not depended on antimicrobial agent. Differences of color between the different emulsions were observed, but are not noticeable by the human eye.

Conclusions. Take into account these results, the addition of maltodextrin in a relation 1:1 were the best encapsulating agent for both type of antimicrobial agents studied. Therefore, further studies are related to the application of the selected emulsion on fresh foods.

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ANTIMICROBIAL FREEZE DRYING INGREDIENT: EFFECT OF ENCAPSULATING AGENT IN PHYSICAL PROPERTIES

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Keywords. Capsul®, Maltodextrin, antimicrobial ingredient

Introduction. Design of active ingredients is an innovative food processing, which could increase shelf-life of fresh foods, by using antimicrobial agent (AA) as lemongrass essential oil (LEO) and its active compound (citral). The type of encapsulating agent is one of the most important parameter that could affect physical properties of the freeze-dried ingredient. The aim of this study is evaluated the effect of type of encapsulating agent on physical properties of freeze-dried emulsions as potential active ingredient.

Materials and methods. Emulsions based on alginate (1%w/w) as matrix, LEO and citral (1%w/w) as AA (concentration that inhibit microbial growth), maltodextrin and Capsul® as encapsulanting agents in proportions (antimicrobial:encapsulant) 1:2 and 1:4, adjusting at pH 5.5, were obtained using homogenizer at 10000 rpm for 2 min. Powdered ingredient was obtained by freeze-drying. Physical parameters such as color, humidity, microstructure by SEM, chromatograms by FTIR, wettability time and oxidative stability during storage time (4°C-11%HR) using rapydoxy were performed.

Results. Powdered ingredient was obtained from microemulsions (droplet size of ~1.0±0.8μm, independently of encapsulating agents its concentration used and type of antimicrobial agent). Color, chromatograms and stability oxidative during storage time were not affected both type of encapsulating agent and its concentration. Physical properties such as wettability time, humidity and microstructure of powdered ingredient was principally affected by type of encapsulating agent ($p>0.05$), where maltodextrextin showed the highest wettability time (50 min) and lowest humidity (2%). Non significant differences ($p>0.05$) on physical parameters were obtained considering the type of antimicrobial agent.

Conclusions. Addition of maltodextrin in a relation 1:4 were the best encapsulating agent for both type of antimicrobial agents studied. Therefore, further studies are related to the application of the selected active ingredient on fresh foods.

SENSORIAL PROFILE ASSESSMENT OF DIFFERENT COMMERCIAL GUACAMOLES

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Keywords. Avocado, guacamole, organoleptic properties, sensorial analysis

Introduction. Guacamole is arguably the most famous sauce worldwide, which is an avocado-based dip. There are plenty of guacamole recipes which are commercialized in diverse formats and packings. Consumers are becoming more health conscious searching for more natural products free of chemical additives which reserve the sensorial properties from the original fresh product. Therefore, a sensorial study of different commercial guacamoles has been carried out in order to evaluate how the preservation method affects the organoleptic properties.

Materials and Methods. Sample set was intended to be most representative possible covering a wide variety of products categories found in commercial markets. The study was conducted with a total of 6 different guacamole brands with two different preservation treatments. In parallel, an avocado puree was laboratory-made with 4% of water as standard. Avocado puree and commercial guacamole samples were analyzed by a panel of 12 expert assessors with experience in sensory analysis belonged to the staff of the Research and Development Functional Food Center. Assessment took place in a standard analysis chamber with natural light under controlled temperature of 24 ºC. Samples were sniffed and tasted in different sessions. After the familiarization with the product, the judges generated sensory terms individually. Finally, 33 attributes were selected by consensus in order to describe avocado puree and guacamole sensorial properties. The panelists used a 10 cm unstructured scale to rate the intensity of each attribute. The left extreme of the scale indicate a null intensity of the descriptor and the right extreme the maximum values.

Results. Avocado puree was characterized by a notable fruity flavor with notes of fresh, green, stem, vegetal and nutty. These attributes were considerably attenuated in the guacamole samples as consequence of the appearance of new flavors such as onion, garlic, tomato, pepper, spicy or fresh herbs due to the ingredients used in the recipe. However, those guacamoles preserved by means of high pressures reserved the main organoleptic properties of avocado better than those in which a sterilization method was applied. Among the samples studied, significant differences were observed in the attributes evaluated which provided different sensorial profiles. The differences found allowed a significant discrimination between samples preserved by the two preservation methods tested based to the sensorial data.

Conclusions. According to the assessment's judges, the most regarded samples were those preserved by means of high pressures due to the good balance between varietal avocado attributes and characteristic features provided by the ingredients added to the pulp to obtain a flavored guacamole.

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PHENOLIC CONTENT AND ANTIOXIDANT CAPACITY OF AVOACADO PUREE AND COMMERCIAL GUACAMOLES

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Keywords. avocado, guacamole, phenolic content, antioxidant capacity

Introduction.Fruits and vegetables are a good source of phenolic compounds which are regarded as phytochemical components due to their antioxidant properties. Recent studies revealed that avocado has beneficial effects on health due to the prevention and amelioration of diverse diseases due to its chemical composition. The guacamole formulation involves several vegetables rich in phenolic compounds, therefore a study of the phenolic content and antioxidant capacity have been carried out among commercial guacamole samples.

Materials and Methods. The study was conducted with a total of 6 different guacamole brands and with an avocado puree as reference. Before the phenolic extraction process, 1 g of each sample was submitted to a defatting process. Then, phenolic compounds were extracted from the defatted residue three times with 10 mL of a solution of methanol/water (80:20 v/v) by sonication for 10 min at room temperature. A subsequent centrifugation of samples was carried outand supernatants were pooled. The extracts were concentrated under vacuum and reconstituted in 2 mL of water. The final extracts were filtered and stored at -18ºC until analysis. The extractions were carried out by duplicate.The total phenol contents were determined according to the Folin-Ciocalteu procedure and the antioxidant capacity was evaluated by different antioxidant methods such as FRAP, TEAC, DPPHand ORAC.

Results.Avocado puree showed high values of total phenol content. Although, this content enhanced in all guacamole samples analyzed showing significant differences in those guacamoles commercialized under the denomination “fresh guacamole”. Consequently, the antioxidant capacity values were also higher in guacamole samples than in avocado puree. Regarding to different antioxidant methods tested, it was found better correlations among those methods based on a single electron transfer (SET) reaction: DPPH, TEAC and FRAP. On the other hand, the total phenols index of the samples were not correlated to the antioxidant values, which indicates that there are other components different to phenolic compounds such as synthetic antioxidants which contribute to the antioxidant capacity of samples.

Conclusions. Both avocado puree and guacamole are an important source of phenolic compounds with antioxidant properties. Among commercial guacamoles, those denominated as *“fresh guacamoles”* showed a significant increase on the total phenol index.

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FOAMING PROPERTIES OF SUSPENSIONS OF β-LACTOGLOBULIN AND POLYSACCHARIDES, IN PRESENCE OF SUCROSE OR POLYOLS

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Keywords. foam, β-lactoglobulin, polysacharide, sucrose, polyols

Introduction. Foams are multiphase systems consisting of a gaseous phase dispersed in a liquid phase. These systems are inherently unstable and by manipulating the interface composition it is possible to accomplish certain kinetic stability for the film that covers the bubbles. Proteins and polysacharides are used for dispersions stabilization by acting on the surface or modifying the continuous phase characteristics.(1,2) In food systems, these biopolymers also interact with other food components, such as sugar. Polyols can be used as sucrose replacers in order to produce products that might be consumed for diabetic people(3). Thus, the aim of this work was to study the stability of foams formed by protein and polysaccharides in the presence of sucrose or polyols.

Materials and Methods. Stock solutions containing β-lactoglobulin (β-lact), carageenan gum (CG) or locust bean gum (LBG) and a sweetener (sucrose, maltitol or sorbitol) were prepared at pH 7.0, in range of (1.0-1.5% w/v) for β-lact and (0.0-0.5% w/v) for polysaccharides and sweeteners. The proportion of each component in the mixture was determined according to the simplex-centroid mixture design. Measurements of mean particle size, zeta potential, surface tension, flow curve, foaming capacity and foam half-life time were performed.

Results. Mixtures containing CG presented higher values of apparent viscosity and mean particle size than for mixtures containing LBG. The zeta potential values were negative for all mixtures due to the presence of the negative charged β-lact at each treatment. However, when present, the CG exerted a dominant effect over the zeta potential, since it is an anionic polysaccharide. The interfacial tension and the foaming capacity were affected by the combined effect of gums and sweeteners. Considering the effect of exclusion volume, the protein was concentrated at the interface lowering the interfacial tension and increasing the foamability.

Conclusions. By manipulating the concentration of each component, foams with specifics characteristics might be produced. The substitution of sucrose by polyols appears as a promising alternative for foam products made for people with special nutritional needs.

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COULD BEE POLLEN BE A NUTRITIOUS INGREDIENT IN GLUTEN-FREE BREAD?

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Keywords. bread, gluten-free, bee pollen, polyphenols, antioxidant activity

Introduction. Bread is the most studied among all gluten-free (GF) products. Despite the considerable advances made in improving gluten-free breads a lot of work has to be done to overcome some major quality problems related not only to the replacement of gluten, but also to the not satisfactory nutritional profile. Thus, enhancing the nutritional quality of GF breads through the use of different natural compounds as a source of antioxidant and nutritional improvers has gained significant interest. Hive products (honey, royal jelly, pollen, and propolis) are usually perceived as natural food supplements and, among these, bee pollen (BP) has become quite popular and, thus, could be proposed as functional ingredient in gluten-free bread making (1).

Materials and Methods. *Gluten-free formulations.* GF control was prepared using a conventional gluten-free formulation based on: 50% commercial rice flour, 50% corn starch, 1.5% guar gum, 1.5% psyllium fiber, 6% sunflower oil, 90% water, 3% yeast, 1.8% salt and 3% sugar. For the preparation of the pollen-enriched GF breads, bee pollen was added at 5 different levels of supplementation (from 1% to 5%, flour basis). All ingredients were blended following a straight dough breadmaking process. *Bread measurements.* Analysis of moisture, ash, lipids, and proteins were carried out following AACC International Approved Methods. The residual sugars level (glucose, fructose, sucrose and maltose) were determined and quantified by HPLC as described previously by Lefebvre, Gabriel, Vayssier, and Fontagné-Faucher (2). Bioaccessible phenol determination was carried out by conducting an *in vitro* digestive enzymatic mild extraction that mimics the conditions in the gastrointestinal tract according to the procedure of Glahn, Lee, Yeung, Goldman, and Miller (3) and adapted by Angioloni and Collar (4) for breads. The enzymes used to simulate the gastric and intestinal digestion were pepsin and bile/pancreatin solution, respectively. The same extracts were also used to determine the radical scavenging capacity of breads using the DPPH method (5), adapted.

Results and Conclusions. The work is in progress at the moment. Results for discussion will be available as a poster presentation at the Symposium venue.

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THERMO ULTRASONIC PRETREATMENT REDUCES GUAVA FREEZE-DRYING PROCESS TIME WHILE INHIBITING ENZYMATIC BROWNING

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Keywords. guava, feeze-drying, total process time, enzyme inactivation, total color change

Introduction. From a nutritional perspective, guava fruits are excellent source of antioxidants such as ascorbic acid, carotenoids and phenols, which meet an important role in the prevention of chronic and degenerative diseases (1). Healthy eating has become one of the most important factors in food choice among governments and consumers. One of the barriers for increasing fruit and vegetables consumption is the time required to prepare them. Thus, it is not surprising that if it comes to fruit, consumers require product available in many outlets most of the year, suitable for many uses, with long shelf-life and not messy (2). When guava is cutted and prepared to be lyophilized is affected for undesirable enzymatic browning, which reduces the consumer acceptance due to the high color changes and in worst cases flavor differences between the fresh and dried product. Lyophilization is considered an important technique to retain most of the nutritional quality, taste, shape, size, color of dried products and to extend their shelf life. Some of the issues in the application of this technique are the long process time and the energy consumption (3). Ultrasound (US) is one suitable technique to reduce the total freeze drying time and simultaneously to inhibit enzymatic browning. US vibrating energy promotes an enzyme inactivation by cell lysis a modification in the structure of the fruit slices. The aim of this research was to find the correct combination of both mechanical and thermal treatments that allow the reduction of total process time, enzymatic browning and total color change of freeze-dried guava slices.

Materials and Methods. Slices of ripe guava were pretreated in a thermos-ultrasonicated (TUP) bath varying exposure time (5-10 min) and temperature (65°C). Enzymatic extracts from an aliquot of sonicated fruit slices were obtained according to Morales-Blancas et al. (2002) modified protocol (4). Finally, the activity of polyphenoloxidase (PPO) and peroxidase (PO) were measured in a spectrophotometer as the absorbance change (min-1) for 420nm and 470nm (4,5).For freeze-drying, the remaining slices were placed on shelves at 20°C and cooled until their temperature decreased to -40°C and then warmed under vacuum until 40°C. The total process time was calculated comparing the time with and witouht pre-treatment. The total difference between fresh fruit and dehidated product, was measured with a portable spectrophotometer colorimeter Konica Minolta (CR-700, Tokio, Japan) in the CIELab color space. Total color difference (ΔE *) was calculated, as follows in equation (1)(6).

$$\Delta E^* = \sqrt{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2} \quad (1)$$

Results. After the TUP the total process time for the lyophilization of guava showed a decrease of 20.0±3% with both level of exposure times. At the same time, the reduction of PPO activity was 36.0±2% and for PO activity was 99.5±% for the TUP of 65°C and 10 minutes of US exposure time. The decrease in the total color change for the samples after freeze drying was non-significant, but after 30 days of storage the color of the sample whitout the TUP were whitish than the treated ones. The reduction in the total color change was 44.0±1% for 5 min and 50.0±0.7% for 10 min of exposure time. This means that the freeze-dried TUP samples after 30 days of storage had a color closer to the normal color of the fresh fruit.

Conclusions. The pretreatment proposed is an effective option to reduce the total process time and enzyme activity, improving the final product quality of guava dehydrated slices. Other complementary studies are necessary to have a better understanding of the phenomena occurred with the thermosonic pretreatment.

MICROWAVE ASSISTED HIGH MOISTURE TREATMENT IMPACT ON RICE FLOUR BREADMAKING PROPERTIES

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Keywords. microwaves, high moisture treatment, rice, gluten – free, bread making

Introduction. Rice flour is a main raw material in gluten-free industry as the absence of gluten type proteins and high starch content predestinate this cereal for bakery prurposes. On the other hand relatively low protein content and the characteristics of the starch results in poor nutritionally balanced products with significantly differing textural and staling properties.

Materials and Methods. Indica variety of rice was chosen for flour obtaining. Initial moisture was increased up to 20% and 30% and microwave assisted heat–moisture treatments with radiation of 2450 MHz and 1000 W power was applied within different treatment cycles (2, 4, 6, and 8 min) to flour. The rice flour in bread making recipes was substituted with treated flour in 30 and 50 %. Starch physical properties were measured and the impact of heat-treated flours on gluten-free bread physical properties was evaluated. The microwave absorptivity of rice flour depending on its water content was established.

Results. Microwave assisted heat–moisture treatments induced significant changes in pasting properties as well as in the crystallinity and microstructure of treated flours. These effects were related to the water content of the flour and the time of microwave radiation exposure. There was a significant corelation observed between the viscoelastic properties of dough made from treated flours and the specific volume of obtained breads. There was no significant change within crumb and crust colour of bread made with addition of microwave treated flour. The microwave treatment results in delay in staling – the hardness of breads after 7 days were decreased in comparison to control.

Conclusions. Microwave assisted heat–moisture treatment appears as clean label alternative for significant improvement of gluten-free rice flour breads. Physical treatment supported by microwave radiation within high moisture conditions resulted in advanced microscopic changes facilitating achievement of wheat bread texture.

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EFFECT OF FREEZING ON QUALITY OF ORGANICALLY GROWN APPLES

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Keywords. apple, freezing, mechanical properties, phenolic compounds

Introduction. An increasing interest is given to organically produced vegetables and meat. While it is recognized the organic procedures on the absence and/or low presence of phytochemicals and environmental contaminats, still under debate is their rol on other quality attributes including the healthy properties and the technological functionalities. Within the SUSORGANIC project, studies to evaluate the impact of technological actions including drying and freezing on organically produced fruits and vegetables are carried out in order to define the suitability to be processed and/or to optimize the technologies to the organic raw materials and improve their final quality. Aim of this study is to evaluate the impact of freezing on organically grown apples quality. Prior to freezing apples have been subjected to different pretreatments (dipping or vacuum impregnation); results echnological irquality

Materials and Methods. Organically grown (OA) Golden Delicious cv. apples with similar initial quality characteristics and starch index or maturity grade were used. Quality (°Bx, acids content, antioxidant properties, phenolic contents, colour and mechanical properties) characteristics before and after freezing were investigated and compared to those evaluated on conventionally grown apples (CA) of the same variety. The effects of three pre-treatments were studied: dipping in lemon juice solution, vacuum impregnation in lemon juice and in water. Lemon juice solution was made of water and freshly made lemon juice to reach a citric acid concentration of 0.5%. Quality characteristics of the samples were evaluated on the raw materials, after pre-treatments and after freezing and frozen storage (-40°, 15 and 30 days).

Results. Pretreatment with lemon juice allowed to preserved the colour of both the CA and OA samples with no significant differences. Moreover, CA and OA did not show significant differences on total phenolic content (TPC) and antioxidant activity and only the apples subjected with vacuum impregnated with lemon juice (VI L) that showed values slightly higher than the other samples.
OA showed firmness values slightly higher than the corresponding conventional ones.
After freezing significant changes occurred on all the quality characteristics under investigation up to 15 days while no additional changes occurred in the following storage in frozen state. The higher firmness of OA was confirmed as well.
Pre-treatments in lemon juice solution resulted to better preserve the quality and healthy characteristics of frozen OA and CA due to the presence of antioxidant and of other bioactive compounds especially when vacuum impregnation was applied.

Conclusions. This study highlights the suitability of OA to be processed by conventional and innovative technological actions. The use of lemon juice allowed in organic food processing as alternative to the conventionally used citric acid to made up solutions for pre-treatments has been also highlighted. This could offer interesting opportunities to fruit and vegetable processing in the organic food processing sector.

VALIDATION OF THE HEDONIC THRESHOLD METHODOLOGY IN DETERMINING THE COMPROMISED ACCEPTANCE THRESHOLD

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Keywords. affective threshold, sensory threshold, precision, accuracy, robustness.

Introduction. The compromised acceptance threshold (CAT) indicates the intensity of the stimulus in which the acceptance of the product becomes significantly altered. This new affective threshold is determined by Hedonic Thresholds Methodology (HTM) and has several applications. However, it is necessary to evaluate whether or not the results provided by CAT determination methodology are reliable. In this context, we aimed to measure and assess the levels of analytical performance associated with precision, accuracy, and robustness of CAT results.

Materials and Methods. Precision was evaluated on three levels: repeatability, intermediate precision, and reproducibility. Accuracy was measured by comparing the hedonic scores of a sample with stimulus intensity referring to CAT and a control sample. Robustness was measured by evaluating the stability of the methodology outcome after reducing the number of consumers in the team.

Results. The methodology met the pre-established criteria, being accurate in assessments carried out consecutively (repeatability), in tests separated by a given period of time as well as with different consumer teams (intermediate precision), and in tests carried out in different facilities (reproducibility). The methodology presented suitable accuracy, though slightly conservative, which may be desirable. The methodology was also shown to be robust as it allowed the reduction of team members from 150 to 70 consumers.

Conclusions. In this context, the methodology was validated and presented reliable results as well as high precision, accuracy, and robustness.

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EVALUATION OF THE PARAMETERS OF A PROTEIN ISOLATED BLACK QUINOA (Chenopodium quinoa Willdenow) VARIETY COLLANA

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Keywords. black quinoa, *Chenopodium quinoa Willdenow*, protein isolate, pH.

Introduction. The grain of black quinoa is a protein-rich food. However, despite its good nutrient content, these are not fully available. It is therefore develop various processes to isolate or remove the Proteins (Protein isolated), that improve the availability of proteins, gives a good functionality and a low content of anti-nutritional factors. The objective of this research work was to evaluate the parameters for the removal of the protein isolated black of quinua variety Collana and characterize the physico-chemical properties and identify the best conditions of removal to increase the performance of the protein isolated.

Materials and Methods. The grains of black quinoa, variety Collana was acquired of the Department of Puno, Peru. It separated the shell of the seed by hand and then were crushed using a hammer mill, the product ground was classified by particle size using a set of vibratory mesh strainers (Nº 80). For the protein isolated it is used methodology of precipitation isoeléctric (pH: 3, 4 and 5),where the flour previously defatted, was dried heavy and suspended in a relationship flour:distilled water (1:15) subsequently worked with the parameters established, this solution is led to conditions of temperature and pH required for each test obtaining a precipitate with some soluble components (fiber, carbohydrates and others) in the first extraction, the supernatant was stored in a beaker and took a second extraction alkaline where you proceeded to precipitate the protein with the different points of the design are established isoelectric reduced the pH of the supernatant with 0.1 N HCl to obtain the precipitate the protein isolated. Finally, the precipitate is proceeded to dry for 24 hours. The experiments were conducted under a central composite design with 3 central points, the independent variables were: alkaline pH (8, 9 and 10) and temperature (20, 25 and 30°C). Which were applied on the dependent variables: performance, solubility and purity.

Results. The results showed that the grains of quinua negra do not present significant differences when comparing the results of the physico-chemical characteristics evaluated total ash, crude fat, crude fiber, carbohydrates (2.62, 3.43, 2.21, 73.01 g/100g, respectively) with the records of other varieties. The variables pH and temperature exert significant effects on the performance of Extraction of protein. The yield of extraction increases with low temperatures and pH's minimum for the isoelectric point (PI) 3, 4 and 5, peak performance of the protein was to pI 3 and was reached in pull parameters of pH 8 and temperature 20. The protein content decreases with increasing temperature and decrease with the pH. The optimal parameters the protein isolated of black quinoa present a maximum content in the performance for the PI 3, for the PI 4 and for the PI 5 of 94.62, 79.74 and 50.46 % being the most optimal parameters which precipitated to PI 3.

Conclusions. The yields obtained at temperatures greater than 30°C decrease and pH less than 8 these increases. On the other hand, the dependents variables that developed a better fit and that was used to evaluate the operation of removal was the performance of protein content. The factors that influenced significantly on the response variables were pH and temperature.

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EVALUATION OF NON-THERMAL TREATMENT ON TEXTURAL AND COLOR PROPERTIES OF PIECES OF AVOCADO (Var. Hass) DURING STORAGE TIME

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Keywords. ultraviolet ligth, color parameters, firmness, storage time

Introduction. Actually consumers preferer natural foods and similar fresh products. VI gamma products is an answer to this demand. Avocado is a fruit very sensible to deteriorative reactions, and represent the most important postharvest and economical loss (1). Heat treatments are the most useful thecnique to reduce microorganisms and enzymatic reactions. The objective of this work was evatuate the application of ultraviolet (254 nm) on avocado pieces, and your effect on physical, chemical and textural characteristics during storage time at 4 ºC.

Materials and Methods. Fresh avocado variety Hass were obtained in local market in phisiologycal ripeninig. The fruits were washed, peleed and cut in pieces. Ultraviolet (UV) light at 254 nm was employed. Different times (5, 10 and 15 min) of UV were applied on avocado pieces in order to identify the lapso appropriated to extend shelf-life of cut fruit. pH, solid content and color characteristics were determined by potenciometry, refractometry and photocolorimectric methods, respectively. Texure changes due UV treatment were evaluated emploting a texturometer (TA-XT Plus Texture Analyzer). Avocado pieces without UV treatment were employed as control sample.

Results. During storage time, without treatment avocado showed decrease in pH values. Treated samples did not presented pH variation in 10 days at 4ºC. Solid content changes were not observed in treated and non-treated samples. Ultraviolet application in times above 10 minutes produced a firmness reduction of avocado pieces. According the lamda wave of radiation employed, it could produce a damage in cellular wall of fruits, represented in avocados more soft. During storage time at 4ºC all samples presented important changes in firmness parameter (above 60%). Control sample showed the lowest luminosity values at 10 days of storage time at 4 ºC. Non-heat treatment employed promoted the fruit green tonality, represented by lower values of chromatic parameter a* at time zero. At longer ultraviolet time lowers a* data were obtained. This parameter showed slight increased during storage at 4 ºC. Cordenate b* presented small changes in relation with UV time, however, did not showed important changes during storage. These results could indicate that exposition fruit times evaluated in this work, were not enough long to promote degradation on natural pigment of avocado pieces. It is interesting to note, that non-heat treatment could be a new technique to obtain food products less susceptible to deteriorative reaction in order to diversify the IV gamma fruits.

Conclusions. Changes on firmness and color characteristics during storage time were evaluated at different times of ultraviolet radiation on avocado pieces. Identify appropriate UV time play a relevant role in order to limit deteriorative reaction as lipid oxidation and degradation natural pigments. In same way, these results could contribute to diversify products in market. the evaluation and identification new process of non-heat treatment to extend shelf-life constitute an opportunity to understand the behavior and process of sensible fruits.

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DEVELOPING A NEW LOW CALORIES BEVERAGE BASED ON GREEN COFFEE

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Keywords. Beverage, green coffee, low calories, consumer preference

Introduction. Consumers demonstrate a growing interest toward herbal beverages based on bioactive compounds (e.g: chlorogenic and caffeic acids) with declared slimming, antioxidant and preventive effects against diseases (1,2). Our aim was to formulate a new low calories beverage made from green coffee, known to have high chlorogenic acid concentration (3).

Materials and Methods. A multi-step approach was applied including: a) identification of green coffee and sucrose content able to determine the best overall pleasantness; b) replacement of sucrose with the natural sweetener Stevia to reduce caloric intake in the final product; c) evaluation of the pleasantness and sweetness of white jasmine and cinnamon to use as additional ingredients; d) final formulation with all considered ingredients (green coffee, Stevia, cinnamon, white jasmine); e) Analysis of bioactive compounds; f) evaluation of product shelf life. The study was based on the implementation of different experimental designs (DoE) aimed to identify the effect of the interaction of the ingredients selected on the overall pleasantness, assessed by discriminant and descriptive analysis sensory tests. The "Analysis of Response Surface (RS)" was applied to sensory responses to drive the sequence of the sensory evaluation test throughout the creation of the new beverage.

Results. In the beverage with the highest overall pleasantness the use of Stevia as a replacement of sucrose allowed a reduction of 25% in caloric content. The chemical characterization of the formulation highlighted a significant concentration of bioactive compounds (chlorogenic, caffeic and caftaric acids), also supported by shelf-life analysis.

Conclusions. The new beverage represent an opportunity for market development targeted to healthy consumers.

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PHYSICOCHEMICAL AND SENSORY ATTRIBUTES OF HEALTHIER SOLUBLE COCOAS FORMULATED WITH CANE SUGAR DERIVATIVES

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Keywords. soluble cocoa, cane sugar, sugar alternatives, functional food, jaggery, brown sugar

Introduction. New consumer trends are marked by consumer preference for healthy foods. Sugar-rich foods are not usually among this group, since an excessive intake of sugars is related to different health disorders such as metabolic diseases or tooth decay. However, the use of refined sugar in the food industry continues to be an extended practice due to its particular organoleptic and preservative properties, for which some substitutes such as sweeteners are not always appropriate. Sugarcane derivatives have more similar properties to refined sugar since they consist mainly of sucrose. In addition, these non-refined sugars such as cane honey, jaggeries or brown sugars also contain significant amounts of phenolic compounds with antioxidant capacity (1). There is also evidence that some components present in the sugarcane juice and the resulting products may inhibit the growth of cariogenic bacteria. Sugarcane derivatives may be especially interesting in the case of high sugar concentrated products, which is the case of soluble cocoa powders. Therefore, the aim of the present study was to formulate a soluble cocoa with enhanced antioxidant properties as a result of partial or total substitution of white sugar by sugarcane alternatives.

Materials and Methods. Soluble cocoas were formulated with white sugar, granunated jaggery, brown sugar, or either a 1:1 (w/w) mixture of white sugar and granulated jaggery. Several ratio sugar:cocoa (w/w) were tested (50:30, 60:20, 70:10). Products were characterized physicochemically by determining their moisture content (x_w), water activity (a_w), hygroscopicity, solubility, particle size distribution, colour and texture. Antioxidant properties were evaluated by obtaining the total phenols and flavonoids content and the antioxidant capacity by the ABTS and DPPH methods. Product acceptance was also assessed by a semi-trained sensory panel.

Results. All formulated products had a quite similar aspect; however, results evidenced that some physicochemical characteristics such as moisture content, hygroscopicity, colour or particle size were affected by sugar replacement. Despite the cocoa powder itself already contains a significant amount of antioxidants, introducing the non-refined sugars in the soluble cocoa formulation significantly increased the antioxidant properties of the product in all cases. As expected, it was the use of granulated jaggery that produced the most significant increase in the antioxidant properties; however, since the organoleptic properties of this ingredient are the most different to white sugar, total replacement of white sugar with granulated jaggery received the worst evaluation by the taste panel.

Conclusions. Results confirmed that it is possible to improve the functional properties of soluble cocoa products by partially or totally replacing white sugar with sugargane derivatives. However, some quality parameters related to powder compactness and solubility can be affected according to the higher moisture and hygroscopicity values obtained for some products. Changes in other attributes such as colour or solubility have also been confirmed not only instrumentally but also by the sensory panel, these determining consumers' acceptance. The most interesting product from the nutritional point of view was obtained by totally replacing white sugar with granulate jaggery; however, brown sugar formulated soluble cocoas or partial replacement with jaggery had better acceptance.

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STUDY AND OPTIMIZATION OF VACUUM IMPREGNATION OF POTATO STICKS WITH AROMATIC ESSENTIAL OIL

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Keywords. Vacuum impregnation, potatoes, rosemary essential oil, innovative aromatic potato

Introduction. Vacuum impregnation (VI) has been recognized as a promising technology for the introduction of solutes into the internal structure of some porous food products, exploiting a mass transfer known as hydrodynamic mechanism (1). In comparison to the more traditional dipping treatments, VI allows to obtain a deeper and more homogeneous distribution of solutes into the tissues and it is, therefore, interesting for the production of products enriched with vitamins and minerals or other bioactive compounds with nutraceutical and/or functional activity. The aim of this research was to study and optimize the VI of potato sticks with water solutions of rosemary essential oil, for the increase of the stability of minimally processed potato sticks during refrigerated storage, and the improvement of the sensorial properties of the final fried product.

Materials and Methods. The modification of the physico-chemical characteristics and aromatic compounds of the impregnated sticks have been assessed during storage. Potato sticks (70x10x10 mm) were impregnated (60±10 mbar, 30 min) with water solutions of rosemary essential oil at different concentrations (from 0 to 12%), packed in polypropylene (PP) trays and then subjected to shelf life studies. During the storage at 4°C, the microbial stability, colour, texture, moisture, O_2/CO_2 concentration in the packages headspace and aromatic profile of impregnated samples and a fresh cut untreated one were evaluated. Moreover, a sensorial test was carried out on the samples after frying for 0, 7 and 14 days of storage.

Results. The weight gain of potato promoted by VI was in the range of 6-14 %, depending on the concentration of rosemary essential oil. The rosemary essential oil concentration gradients of impregnated potato sticks were detected by GC analysis and sensorial test. The treatment did not affect the microbial stability, texture, moisture, O_2/CO_2 concentration of packaged potatoes, but deteriorated their colour.

Conclusions. VI is a promising technology to obtain an innovative aromatic minimally processed potato product.

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CHARACTERIZATION OF A RED–PURPLE EXTRACT FROM *ALTERNANTHERA* SP. BY HPLC-ESI-MS-QTOF

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Keywords. natural colorant, betalains, antioxidant, polyphenols, food additives

Introduction. The use of natural pigments and antioxidants instead of synthetic ones is receiving increasing interest in the food industry due to the health promoting effects of natural substances. Recently, in response to this trend, healthy functional foods and cosmetic products for human health and safety have been gradually expanded. The aim of this work was to investigate the diversity of compounds present in *Alternanthera brasiliana* and *Alternanthera tenella*, including betalains and polyphenols. Both species of native plants could be a source of suitable material for functional food production, specifically for acting as natural food additives.

Materials and Methods. Experiments were carried out with two different species, *Alternantera brasiliana* and *Alternanthera tenella* maintained in greenhouse. The vegetal material (0.1 g of leaf or stem) was extracted at 4 ºC. The supernatant was filtered and them was used for betalains and polyphenols analysis. Aliquots of each sample were injected into the HPLC-DAD-ESI-QTOF. The analysis was performed on an Agilent 1200 series HPLC (Agilent Technologies, Waldbroon, Germany), comprised of a quaternary pump (G1311A) with integrated degasser (G1322A), an autosampler (G1367B), a thermo stated column compartment (G1316A) a diode array detector (DAD) (G1315B) and a hybrid mass spectrometer quadrupole-time of flight via an electrospray ionization source (ESI) with JetStream technology (Agilent Accurate Mass QTOF LC-MS, Waldbronn, Germany) in series in the same chromatographic line. The compounds were monitored at 280 nm (polyphenols) and 538 nm (betalains), while mass spectra were acquire with electrospray ionization and the TOF mass analyzer in both positive (betalains) and negative (polyphenols) mode over the range m/z: 100-1000. Total polyphenol content was determined by Folin-Ciocalteau method (1). FRAP assay was carried out to determine the iron- reducing capacity of each extract (2).

Results. When working in positive mode, a number of compounds was separated from the leaf and stems identified as betalains. A. tenella showed the same betalain profile than A. brasiliana, both for leaf and stem. When working in negative mode, a number of polyphenolic compounds were found; hydroxibenzoic acids, hydroxycinnamic acids, flavones and flavonols were identified and characterized on the basis of their accurate MS and MS/MS information.

Conclusions. The betalains found in the extracts showed a relatively simple and well defined pigment profile. Polyphenols were diverse with presence of different groups and multiplicity of derivatives in both plants, which may be an indication of a highly promising antioxidant and bioactive potential.

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ULTRASOUND-ASSISTED EXTRACTION OF MATE TEA LEAVES (*Ilex paraguariensis*). STUDY OF POLYPHENOL CONTENT AND ANTIMICROBIAL ACTIVITY

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Keywords. Yerba mate, ultrasound-assisted extraction, polyphenol content, antimicrobial activity

Introduction. Yerba mate (or mate tea) is an aqueous infusion widely consumed in South American countries. It has been largely studied due to multiple properties attributed to its phenolic compounds like antioxidant, anti-inflammatory, therapeutic, anti-rheumatic, diuretic and antimicrobial. Most conventional polyphenol extraction methods suffer from some drawbacks like small extract amount, high temperatures involved and the use of high amounts of organic solvents, which are undesirable limitations for the food industry. The objectives of the present work were to evaluate different ultrasound assisted ethanol extraction (UAE) conditions at low temperature, which yielded the highest phenolic content (PC), to compare the effectiveness of the proposed method with other commonly used techniques, and to evaluate antimicrobial properties of the extracts against different relevant microorganisms.

Materials and Methods. Yerba mate **e**xtractions were carried out in a 600 mL-double wall cylindrical vessel connected to a thermostatically controlled water bath (HAAKE, Model Rotovisco RV12, Germany). Two successive ultrasound assisted extractions (600 W, 20 kHz, 95.2 µm, absolute ethanol, 25°C) were applied to 20 g of yerba mate leaves (coarsely ground or "canchada", twigs-free) which were gently provided by a local industrial supplier (Apostoles, Argentina). Treatments were selected according to a Box-Behnken type experimental design. Response Surface Methodology (RSM) was used to study the effect of extraction time (*Time*, 10, 15 and 20 min) and liquid/solid ratio (ethanol *Volume*, 100, 150 and 200 mL) on PC. For comparison purposes, 20 g of yerba mate were subjected to either traditional extraction (TE, 5 min infused in boiling distilled water) or two successive stirring extractions with ethanol (AE, 100 mL, 25°C, 4 h). All extracts were membrane filtered (0.45 µm). In addition, UAE´s were evaporated (rotary evaporator, 50°C, 20 min) and resuspended in water (37 % $^{w}/_{w}$; a_w= 0.99). Extracts were analyzed for PC (expressed as mg of galic acid equivalents per mililiter, GAE/mL), using the Folin-Ciocalteau reaction. UAE antimicrobial activity was evaluated for *Listeria innocua* ATCC 33090, *Escherichia coli* ATCC 35218 and *Salmonella* Enteritidis MA44 inactivation in culture media under agitation (37°C, 24 h).

Results. The effect of the variables *Volume* and *Time* on PC was expressed by means of a second order polynomial model (R^2_{adj}: 97.0 %). The pure quadratic term *Volume*^{2} was the most significant one influencing PC ($p<0.001$), impairing a remarkable curvature to the response surface, followed by the linear term *Volume* ($p< 0.001$) and the cross-product term *Volume*Time* ($p<0.01$). The significance of the effect of each variable on PC showed that *Volume* resulted the most important factor. Response surface and contour plot revealed that the highest PC value (3.3 mg GAE/mL) was obtained for *Volume* 150 mL and *Time* 10 min, conditions which were set as the optimal for further studies. UAE was significantly more effective than TE (0.78 mg GAE/mL) and AE (0.73 mg GAE/mL) methods, providing the highest PC. Microbiological challenge studies revealed that UAE completely inhibited *L. innocua*, *E. coli* and *S.* Enteritidis after 24 h of incubation.

Conclusions. UAE method resulted highly convenient for polyphenol extraction from yerba mate leaves as it yielded high PC at ambient temperature and low treatment time. Additionally, it allowed complete inhibition of relevant microorganisms in culture media. Further research is required in the near future to find the correspondent minimal inhibitory UAE concentrations and to extend these results to real food matrixes.

NOVEL KIESELGUHR- AND PVPP-FREE DOWNSTREAM PROCESSING OF CRUDE BEER

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Keywords. Chill and permanent haze; ceramic hollow-fiber membrane; PVPP; prolyl oligopeptidase; rough beer.

Introduction. The colloidal instability of beer is mainly due to the interaction between proteins and polyphenols. The main reason that has so far limited the application of crossflow microfiltration (CFMF) for beer clarification is that the average permeation flux is highly dependent on the initial turbidity of beer, as well as its ®-glucan and arabinoxylan content and molecular mass distribution, and what more it is about one fifth of that achievable in the conventional kieselguhr-filters. Little attention has been given to the colloidal instability of the resulting microbiologically safe and clear beer permeate. A novel combined cold sterilization and polyvinylpyrrolidone (PVPP) stabilization process was previously tested on an industrial pale lager (1). Such a process was further tested using novel 0.8-µm ceramic hollow fiber (HF) membrane modules (2). Its subsequent transfer to a 100% barley-malt beer enabled the 1.4-µm asymmetric membrane module to be regarded as a real valid alternative to conventional powder filters owing to quite a high steady-state permeation flux and minimum decline in permeate quality parameters (3). The main aim of this work was to check for the effectiveness of the commercial enzymatic preparation Brew Clarex® (BC) to replace the conventional use of PVPP in the stabilization of quite a colloidally unstable craft beer and obtain a beer permeate ready to be aseptically filled.

Materials and Methods. A blonde ale produced from spelt and malted barley by a craft brewery was used. It was precentrifuged and stabilized by using a commercial enzymatic preparation BC (DSM Food Specialities, Delft, NL), or crosslinked PVPP Starfilter SR (Bohemi Chemicals, Zibido San Giacomo, MI, I) of re-usable grade. Then, it was clarified using the bench-top plant, described previously (3). Several total recycle clarification tests were carried out under constant temperature (10°C), transmembrane pressure difference (2.4 bar), superficial velocity (2.5 m s^{-1}), and periodic CO_2 backflushing. All analyses were performed using the European Brewing Convention methods.

Results. The enzyme preparation BC was able to improve the colloidal stability of the craft beer tested. In the accelerated aging tests used here (i.e., sensitive proteins, alcohol chill haze, and turbidity at 20 and 0°C), such a treatment was equivalent to PVPP one; while the two combined ones resulted in greater colloidal stability with respect to each single treatment. Precentrifuged and enzyme-stabilized beer was finally microfiltered in order to assess the limiting and average permeation fluxes, as well as the predicted shelf life of the resulting "crude" beer.

Conclusions. The downstream process of rough can be simplified and accelerated by resorting to a maturation step in the presence of exogenous proline-specific proteinases followed by rough centrifugation, CFMT across 1.4-⌠m ceramic HF membrane modules and final dead-end filtration through sterile 0.45-⌠m cartridges.

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OPTIMIZATION OF OSMOCONVECTIVE DEHYDRATION WITH VACUUM PULSES INTO AGUAYMANTO FRUITS (Physalisperuviana L.)

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Keywords. aguaymanto, osmotic dehydration, response surface, sucrose.

Introduction. Aguaymanto (*Physalis peruviana L.*) is currently the subject of several investigations from agronomical aspects to therapeutic; so a point of interest is to know the time when its physical and nutritional properties remain stable or no significant losses occur during stage post-harvest and processing. Then the aim of this research was to optimization of osmoconvective dehydration with vacuum pulses with a basis in physicochemical characteristics of aguaymanto fruits (*Physalis peruviana L.*).

Materials and Methods. It wasdeveloped one osmotic dehydrator equipment for this purpose, where aguaymanto fruits were processed by immersion in sucrose syrups, 40 to 70° Brix,at a pressure between 400 to 620 mm Hg,times of 2 - 10 hours, a temperature of 40°C and agitation of
60 rpm. Next convective drying was carry on at 60°C in a stove. It was determined the concentration of total soluble solid, acidity and vitamin C and finally the process parameters were optimized with a multiobjective response surface method.

Results. Total soluble solids (TSS) content in the syrup affects directly in water loss over 65° Brix. In the final product, according to the process conditions, solids gain was between 3.75 to 25.96 %, content of vitamin C showed values of 7.22 to 14.04 mg / 100 g, TSS between 55.80 and 70.73° Brix, acidity from 3.81 to 5.44 and humidity from 11.02 to 24.53 %.

Conclusions. Through the response surface methodology the best combination of variables for osmoconvective dehydration process with vacuum pulses was established to sucrose concentration of 65° Brix, 540 mmHg vacuum pulse and 3 to 4 hours; minimizing the moisture content and maximizing the retention of vitamin C and SST content.

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FORMULATION AND DRYING OF ALGINATE BEADS CONTAINING LACTASE: STABILITY, MICROSTRUCTURE AND CONTROLLED RELEASE

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Keywords.alginate beads, encapsulation, enzyme stability, β-galactosidase, microstructure.

Introduction. Several applications of β-galactosidase (lactase) have been reported in recent years, such as the valorization of cheese, the improvement of ice creams creaminess, and the production of lactose-free fresh dairy products for lactose intolerance people (1). However, enzyme stability upon treatment and dosification can be improved. In this context, β-galactosidase encapsulation in hydrogels represents a promising tool. Nevertheless, typical alginate-Ca(II) shows some technological disadvantages such as low resistance to thermal processes and its uncontrolled release, but the combined use of alginate with sugars and/or other biopolymers can be used to overcome these. The aim of this research was to improve the stability of lactase subjected to different thermal treatments by using different formulations. Also, the controlled released has been studied.

Materials and Methods. Alginate-Ca(II) beads with β-galactosidase (*Aspergillus oryzae*, 0.775 mg/mL) were generated using the dropping method (2), using 1% w/v alginate with or w/o 20% w/v trehalose, 0.25% w/v of arabic or guar gum. The beads were subjected to different thermal treatments (vacuum and freeze-drying, freezing and freeze/thaw cycles). Enzyme activity was evaluated by o-nitrophenol (ONP) assay at 420 nm. ONP release at 33°C was studied as a function of time. The beads were characterizated by measuring: size, shape, $a_{w,}$, X_w, glass transition, melting and cristalization temperatures by DSC, transversal relaxation times and water self-diffusion coefficients by LF-NMR. The microstructure characterization was performed at the LNLS SAXS2 beamline in Campinas, Brazil, working at $\lambda = 0.1488$ nm, wave vector range: $0.08\ nm^{-1}<q<1.6\ nm^{-1}$, and by SEM-FEG.

Results. Lactase was successfully encapsulated on alginate-Ca(II) beads. The inclusion of trehalose, guar gum or Arabic gum did not improve the enzyme activity recovery after bead generation in comparison to alginate-Ca(II) beads without secondary excipients. However, trehalose inclusion was critical for activity preservation towards freezing and dehydration. Guar gum supplemented systems were those with higher remaining activity among all beads systems. The glassy matrix formed upon freezing and drying in beads containing trehalose was confirmed by DSC and LF-NMR analysis. The presence of secondary excipients affected the microstructure, showing rods with smaller crosssectional radius R and with lower compactness within the rods (α2) than alginate-Ca(II) beads. However, there were no significant changes in rods interconnection (α1). The release mechanism of ONP was dependent of formulation, showing up to three-fold differences among systems.

Conclusions. Formulation affected lactase stability towards freezing and drying as well as microstructure and release of the beads.

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EFFECT OF POST-HARVEST PULSED LIGHT TREATMENT ON THE RESPIRATION RATE OF GRAPES: MODELLING AND VALIDATION

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Keywords. Pulse light, Modified atmosphere packaging, Respiration rate, numerical models

Introduction. The quality and shelf-life of packed fresh produce is strictly related to the dynamic of the gas composition, namely O_2, CO_2, and ethylene, in the head space of the packages. Therefore, the challenge is to control the head space composition and, hence the respiration rate of fresh produce during storage. However, several factors can affect the dynamic of the head space gas composition including harvesting time, presence of injury due to handling, microbial infection level, type of sanitization technique, and storage conditions (e.g., temperature, humidity), among others. In this framework, numerical simulation could be applied to predict the dynamic of the head space composition, as well as to select optimal conditions to be adopted during post-harvest treatment, storage, and handling of fresh produce. The aim of this paper was to develop and validate a mathematical model describing the effects of both Pulsed Light (PL) treatment and film permeability on the dynamic of the concentration of O_2 and CO_2 in the head space of packages during the passive modified atmosphere packaging of fruit.

Materials and Methods. A 2D numerical model describing the mass transport of O_2, CO_2 in the packages as a function of both diffusivity and film permeability was developed. Simulations were performed on three different films with high (MRX), medium (PPCX) and low (PSF530) permeability. The computation of both O_2 and CO_2 mass transport equations was performed using an implicit finite difference method (Crank Nicolson) solved with Matlab® (v.R2012b). For the validation of the model, experimental data on the respiration rate of table grape were collected. Samples of grapes were exposed to PL treatments at fluences from 1 to 12 J/cm^2 before being packed in passive modified atmosphere packaging, and then stored 10°C for up to 10 days.

Results. Results demonstrated that the model set up is able to predict the dynamic of the head space gas composition of either untreated and PL treated grape during storage in packages with films of different permeability. The concentration of O_2 increased with storage time, while that of CO_2 decreased accordingly. Changes in the head space composition were, besides the storage time, dependent on the film permeability and PL fluence applied.

Conclusions. The developed model can represent a valuable tool to predict the concentration of O_2 and CO_2 in the head space of packages during the passive modified atmosphere packaging of fruit. Further work is necessary in order improve the capability of the model to predict the dynamics of the gas composition in more complex systems, where, for example, the influence of the ethylene production is also taken into accout.

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FATTY ACIDS PROFILE AND VISCOSITY OF SUNFLOWER OIL TREATED WITH OZONE

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Keywords. sunflower oil, ozone, unsaturated fatty acids, two dimensional gaschromatography, viscosity

Introduction. Ozone is an emerging eco-friendly technology (1) and the ozonation of vegetable oils has been proposed in food and cosmetic industry for antimicrobial pourposes (2). In this work, the effect of ozonation at different time periods on the fatty acids profile and viscosity of sunflower oil has been investigated.

Materials and Methods. The Hellaster ozone generator GZ-K1000 with corona discharge was set up at a fixed voltage of 220 V and constant flow rate of 78 Lh^{-1}. The generated ozone/air mixture was led to a reaction vessel where ozone was bubbled through a batch of sunflower oil equal to 150 g at increasing time periods (1, 3, 5 minutes and 20 hours) at room temperature. The analysis of unsaturated and saturated fatty acids in pure and ozonized sunflower samples was performed using the Agilent GCxGC system with CFT flow modulator and FID detector[3]. The viscosity was also measured with the Thermo Scientific Haake Viscotester 550. All of the data were analysed by one-way analysis of variance (ANOVA) using the R software 3.0.3 version.

Results. Some authors report that the ozone reaction mechanisms in sunflower oil occur through linoleic acid[4]. In this regard, the trygliceride fatty chain profile in the ozonated oil showed a gradual decrease in the amount of linoleic acid as a function of time, reaching a decrease of 21% after 20 h of treatment. On the contrary, the saturated fraction, in particular palmitic acid, was higher up to 14%. The Criegee mechanism (2) can explain the reaction with ozone and the formation of ozonide, species of lower molar mass as well as species of higher molar mass. Moreover, it is interesting to note that the ozone treatment did not affect the amount of the unsafe trans fatty acids. Looking at viscosity which is usually measured to evaluate the fluid texture, results showed a statistically relevant ($P \leq 0.001$) increase of viscosity up to 47% after 20 h of ozone treatment confirming that viscosity is a function of the moleculardimensions (2).

Conclusions. Ozonation could be considered a tool to modify the fatty acid chains without the presence of unsafe trans fatty acids. In addition the lower degree of insaturation and the presence of compounds higher in molar mass contribute to increase the viscosity of sunflower oil which may be a suitable ingredient for new formulations.

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STUDY OF THE KINETICS OF DRYING OF OCA (OXALIS TUBEROSA MOL) AT LOW TEMPERATURES ASSISTED POWER ULTRASOUNDS

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Keywords. Oca, drying low temepratures ultrasounds

Introduction. The oca (oxalis tuberosa MOL) is a tuber that has been part of the diet of Andean people, is rich in starches, resistant starches and antioxidants, one of the important processes for consumption and conservation is drying, this operation has developed naturally using low temperature, radiation and humidity highlands of the Peruvian Andes, The aim of this study was to determine the kinetics of drying slices of oca red keny variety using low temperatures such as those found in the Peruvian Andes and assisted with ultra sounds to enhance drying kinetics.

Materials and Methods. The oca (oxalis tuberos MOL) they have been acquired of the National Agricultural Research Institute Puno Peru, The oca were equilibrated with different saturated salt solutions to 20°C. Water activity was measured with a dew point hygrometer Aqualab^{R} series 3 TE (Decagon Devices, Inc., Washington, USA), Moisture was determined by AOAC method 945.15 (2000) For testing drying has built a laboratory prototype controlled ARDUINO MEGA ^{R} the equipment allows weight control, air velocity, temperature and relative humidity and ultra sound power. They have been used slices of oca with con 0.008215m of radius and 0.0018m of height, operating parameters drying procees were speed cold air 3m/s, temperatures 15, 10, 5°C and 75Khz, 50Khz, 25Khz and 0Khz ultrasound frecuency Is determined variation of total mass with a balance Metler Toledo (±0.0001) (Mettler-Toledo, Inc., USA.) the volume was analyzed with images which were acquired with a photo series canon reflex digital camera 360 (canon inc. USA) and were processed with functions and scripts implemented in Matlab 2015a.

Results. The drying rate curve shows that there is a significant difference in drying times still the best treatment is 11,280 seconds to 15°C and 75 khz of power ultrasounds, retention levels show that water moisture equilibrium for the operating conditions is 0.10 (Kgw/kgss), moisture Monolayer calculated with the BET model, is 0.041 (Kgw/kgss) the optimal effective diffusivity for 15°C and 75 khz is 1.0086E-10 m^2/s.

Conclusions. Low temperatures conducive to the highlands of the Peruvian Andes, are economically more viabes that the use of hot air, and reduced drying time curves therefore the design and construction of equipment to standardize operations drying high value tuberculos with high nutritional value it's possible as an alternative technology solution.

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COMPARISON OF DIFFERENT METHODS FOR MEASURING THE CELL DISINTEGRATION IN PLANT TISSUES AFTER PULSED ELECTRIC FIELD TREATMENT

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Keywords. Pulsed electric field, Plant tissue, Cell disintegration, Impedance measurement

Introduction. Pulsed electric fields (PEF) is a frequently used method to modify plant tissue by cell disintegration with specific advantages for product quality and efficiency of food production processes (1). The appropriate selection of the treatment parameters such as the electric field strength and the specific energy input are of particular importance for the resulting degree of cell disintegration in the plant tissue. Different methods are available for the quantification of the cell disintegration. However, depending on raw material characteristics and tissue modification achieved by the PEF treatment, the appropriate method or combination of methods has to be applied in order to gain meaningful information. Therefore, the cell disintegration of various raw materials was investigated comparing different analytical methods.

Materials and methods. Apples, carrots, tea leaves and rocket salad, were PEF-treated using different electric field strength and specific energy input levels (0,4-0,8 kV/cm; 0,2-2,0 kJ/kg) applied with exponential decay pulses in a batch PEF unit. The treated samples were analyzed with respect to their impedance, the water release after centrifugation, the cell viability after staining and the electrical conductivity after extraction. The impedance measurement and the determination of the cell disintegration index was performed according to the method described by Angersbach and Knorr (2). For the determination of the water release by centrifugation, 2-4 g of sample was weighed into a tube with a thin layer of cotton and centrifuged for 10 min at 700 rcf. For texture measurement, the cutting force of a sample was determined by cutting with a blade or grid. For staining, samples were shaken in propidium iodide (PPI) for 1 min, subsequently the samples were analyzed under the fluorescence microscope. The conductivity was measured after an aqueous extraction at 80°C for 20 min.

Results. To determine the cell disintegration effect of a PEF treatment in whole plant tissue with a firm structure (e.g. pieces of carrot, apple, potato), the impedance measurement shows meaningful and reproducible results. For samples with a higher degree of mechanical cell disintegration (e.g. fruit mash), the measurement of the water release by centrifugation was the most suitable methods. The measurement of the cutting force delivered very sensitive information on the modification of tissue structure and texture and was suitable for analysis of whole plant tissue with a firm structure (carrot, apple, potato). For treated tea leaves and rocket salad the measurement of conductivity after extraction delivers an indirect information about the level of cell destruction. The staining method didn't show any satisfactory results, the staining with fluorescent propidium iodide didn't allow a quantification of cell disintegration since surface effects in sample preparation and manipulation play a major role.

Conclusions. Different methods for investigation of cell disintegration have been compared and have been shown to be suitable for the quantification of PEF effects depending on the raw material and sample characteristics. Impedance measurement shows a high reproducibility and seems to be an appropriate method for both scientific analyses and practical applications in industrial environments. In addition, indirect methods such as the determination of the cutting force were shown to give results of high sensitivity.

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THE QUALITY OF WHOLE WHEAT BREAD, GRAHAM BREAD AND WHITE BREAD TREATED BY RADIOFREQUENCY HEATING

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Keywords. bread spoilage, radiofrequency treatment, whole wheat bread, graham bread and white bread.

Introduction. Food decay by spoilage microorganisms causes considerable economic losses and constitutes a health risk for consumers due to the potential to produce toxins. Effective preventive measures and intelligent preservation methods have been put into place to reduce food spoilage and to prolong food shelf life.

Radio frequency (RF) treatment is one of the most promising antimicrobial methods in food products due to rapid heating, deep penetration depth, and leaving no chemical residues. The number of the possible applications for radio frequency (RF) heating of foodstuffs has grown in the last ten years. It has been explored in various food processing operations, such as pasteurization, sterilization, blanching or defrosting, insect disinfestations in various fresh fruits and dry nuts. Also, microbial and pest reduction by RF heating has been studied in many food products such as meat, milk and dairy products, fruits, vegetables and bakery products.

The efficacy of radiofrequency treatment on mould control and the effects on the quality parameters (moisture content, porosity, elasticity, acidity and texture) in the case of the whole wheat bread, graham bread and white bread were studied.

Materials and Methods. For RF treatment applying was used a 27.12 MHz RF laboratory system. The RF treatment was applied for three different temperatures (60°C, 80°C and 100°C). The different types of breads were packaging and heated at different temperature applying RF treatment. Samples were incubated at 25°C and monitored for 20 days in order to establish the efficacy of the treatment against moulds development. The samples were evaluated through visual estimation of the degree in which the slice bread surface is covered by fungal mycelium.

Quality bread assessement was made through physico chemical analysis made in accordance with the methods set out. The samples were analysed at 6 different moments (T0- initial moment, T3, T5, T10, T14, T20, which means after 3, 5, 10, 14 and 20 days after RF treatment).

Results. Depending on the type of bread and temperature, the fungal growth was achieved differentially. In the case of white bread the development of fungi started with the 11th day for the samples treated at 100°C compared with graham bread which has no fungal development even after 20 days for the same treatment. In terms of the quality parameters it was observed that in the case of graham bread and whole wheat bread the firmness suffers minor changes compared with white bread. The elasticity of the white bread samples decreases significantly from the T14 moment to the T20 moment, approximate 25%. For all tested samples, the moisture content was not affected significantly.

Conclusions. The results are promising and show that RF heating could be a good perspective for increasing shelf life of bread**.**

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EFFECT OF CONVECTIVE DRYING MICROWAVE AND PLANTAIN DOMINICO HARTON PRECOOKED (MUSA AAB Simmonds)

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Keywords. Convective drying, microwave, plantain flour, physicochemical properties

Introduction. Colombia produces 37 million tons of plantain year, domestic consumption is 98%. The banana is one of the most popular foods in Colombia, his nutricional contribution is given in carbohydrates and minerals and vitamins (1). Low supply of products is presented, among the most common is the fresh, pre-cooked and flours for casting. Traditionally plantain has dryed by conventional methods, there is little research on other drying techniques and less on the drying kinetics of the Dominico Hartón (2) This study aims to evaluate the variables physiochemical the dominico hartón plantain precooked by two drying techniques (microwave-oven Mw and hot air drying-SAC).

Materials and Methods. The Dominico-Harton plantain (Musa AAB Simmonds) was purchased from a local market of Armenia (Colombia), was selected the 3 - 4 days after harvest, material were peeled and cut in slices. Then, pre cooked in three lots at 5, 10 and 15 min, steam, immersion and microwave, precooked slices were subjected to drying, by two methods: Hot Air drying (SAC) and microwave drying (Mw). The SAC was performed at 60°C and recording time mass every 30 minutes, use a furnace WTB binder. Mw drying was performed registy pulses 900 watts 30 seconds, with 2 min reposes (reading is recorded after standing). Dried samples were subjected to analysis of pH, titratable acidity, humidity, aw, Brix, color and texture.

Results. Drying slices Dominico Hartón by two systems: hot air drying and microwave, significant differences were detected in terms of moisture and a_w. The biggest difference presents moisture variable in the convective system was more or less 13% for 120 min, because a seal or crusting occurs, which retards the flow of water from the matrix to the environment, while the MW at 180 sec record an average humidity of 8%, because the flow is more uniform and a_w of samples are 0.7 to 0.6 MW and for SAC. This response causes texture structures dried mw less hard than with SAC (2.3 N vs 5.82 N). SAC drying is a slow process, requiring high outside temperatures to generate the required concentration differences. As a result, the heat transfer mechanisms and material during the process depend on the inherent drying air (temperature, mass velocity, humidity, flow characteristics, etc.) and product (moisture, shape, structure, variables etc.).

Conclusions. The major treatment slices plantain Dominico Harton, was conducted using precooked microwave for 30 seconds, followed by drying with five pulses each MW 30 sec, which achieved a 0.7 aw and texture 2.3 N / M2. mw

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HIGH QUALITY CRANBERRY JUICE PROCESSING

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Keywords. cranberry, antioxidants, pasteurization, sterilization, homogenization.

Introduction. Worldwide production and consumption of blueberries have increased significantly over the last decade due to their beneficial health effects. Blueberries are rich in fiber, potassium, vitamin C, iron, calcium and organic acids, apart from containing high amounts of polyphenols with antioxidant activity. Among others, blueberries are credited with ability to reduce the incidence of cardiovascular disease and certain types of cancer, apart from improving memory and alleviating urinary tract disease symptoms (1). However, blueberries functional properties can be ameliorated by antioxidants degradation under adverse processing conditions, such as high temperature, the presence of oxygen or a drastic change in the environment pH. According to this, the present study aims to evaluate the impact of different stabilization treatments on physicochemical, microbial and antioxidant properties of blueberry juice during its storage at room temperature or under refrigeration.

Materials and Methods. Whole frozen black blueberries were thawed before crushing and crushed blueberries were depectinisated at 50 ºC for 150 min with a commercial enzyme preparation. Then, the mixture was passed through a 0.7 mm diameter sieve to separate juice from bagasse and the juice was submitted to different stabilization treatments: sterilization at 120 ºC for 15 min (ST) and pasteurization at 75 ºC for 2.5 min with and without previous homogenization at 150 MPa (PAST and HOMG, respectively). Both treated and untreated juices (NT) were packed into sterile jars and stored at room temperature or at 4°C for up to 30 days. At different times along storage samples were analyzed in terms of microbial content (aerobic microorganisms, molds and yeasts), physicochemical properties (Brix, pH, color, turbidity and suspended pulp) and antioxidant activity. Refrigerated juices were also subjected to a sensory analysis.

Results. From a microbiological point of view, all the juices stored at room temperature resulted, with the exception of sterilized juice, unsuitable for human consumption within 5-7 days. Neither the pH nor the Brix of refrigerated juices were significantly affected by the stabilization treatment or the storage time. Contrary to what expected, HOMG juice showed the highest values of suspended pulp and the lowest values of turbidity. Regarding the antioxidant activity, NT juice reached the highest value at the end of cold storage. Among heat treated juices, PAST ones showed the highest ability to inhibit radical DPPH. With regard to color, all the juices had reddish to brown color. Furthermore, color change calculated from CIEL*a*b* coordinates increased with the storage time under refrigeration in ST and NT samples, but remained constant in both types of pasteurized samples. From the results of sensory analysis, homogenization and further pasteurization led to a better valued by consumers juice.

Conclusions. Blueberry juice stabilization by mild pasteurization and further storage at 4 ºC keeps organoleptic properties similar to those of untreated juice and ensures that microbial growth is within the limits established by the regulations. In addition, previous homogenization greatly improves consumer acceptance.

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MATRIX ENGINEERING FOR THE DEVELOPMENT OF A FUNCTIONAL SNACK FROM APPLE AND GRANULATED JAGGERY

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Keywords. granulated jaggery, vacuum impregnation, osmotic dehydration, air drying, freeze drying, antioxidants, apple snack, functional food.

Introduction. The use of refined sugars in the food industry is widely extended because of their technological and organoleptic properties. However, refined sugars have low nutritional value and their excessive intake results in metabolic disorders and increased tooth decay incidence. White sugar replacement by sweeteners in food formulation is a common practice but it results in technological problems or impairment due to the growth of spoiling microorganisms. In this context, unrefined products derived from sugarcane such as cane honey, jaggery, panela and brown sugar arise as alternative common sugar substitutes. Although imparting colour to the food, their relatively high content in compounds with antioxidant capacity (basically phenolic compounds of flavonoid type) in comparison to that of white refined sugar (1) makes non-refined sugarcane derivatives interesting ingredients to improve food functionality. Based on all of the above, the present study aims to develop a low moisture functional snack from apple (cv. Granny Smith) and granulated jaggery by means of matrix enginnering techniques, such as vacumm impregnation (VI), osmotic dehydration (OD) and their combination, and further stabilization by air drying (AD) or freeze drying (FD).

Materials and Methods. Apples were cutted in 65 mm external diameter, 20 mm internal diameter and 5 mm thick rings. Isotonic solution of granulated jaggery was employed as impregnating liquid and VI experiments involved submitting the system to 50 mbar for 10 min and to atmospheric pressure for 10 min more. OD of both fresh and vacuum impregnated samples were conducted with hypertonic granulated jaggery solutions under agitation for 3 h and at 25 ºC in one step (OD1, by immersion in a 50 Brix solution) or in several steps (OD2, by hourly increasing the osmotic solution concentration from 30 to 50 Brix). In order to reduce their water content and increase their stability, samples were submitted to AD at 60 ºC for 24 h or FD for 24 h. Analytical determinations were performed at the end of each unit operation in order to assess changes in main the physicochemical properties (x^w, a_w, Brix, colour and texture) and the improvement in the antioxidant ones (total phenols and flavonoids content and antioxidant capacity by both DPPH and ABTS methodology).

Results. Osmotic dehydration in several steps proved to be the most effective matrix engineering technique for incorporating the antioxidant compounds present in the granulated jaggery into the apple structure. Regarding the stabilization technique, both AD and FD similarly increased all the antioxidant properties analyzed. However, FD samples showed minor changes in optical properties and less hard and crunchier texture than AD ones.

Conclusions. Although apples themselves had a great content of antioxidant compounds, mainly quercetin and ascorbic acid, the application of an osmotic dehydration step with granulated jaggery solutions by progressively increasing the osmotic gradient resulted in a significant improvement in their antioxidant properties. Further dehydration by either hot air drying or freeze drying allowed achieving even higher values and confirmed that antioxidant components added to the samples were more resistant to the processing conditions than the naturally present ones.

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PHYSICOCHEMICAL PROPERTIES OF ENCENILLO MONOFLORAL HONEY FROM HIGHLANDS ANDEAN ZONES IN BOYACÁ, COLOMBIA

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Keywords. encenillo, colombian honey, physicochemical properties, volatile compounds, gas chromatography/mass spectrometry

Introduction. Honey is the natural product with sweetening properties more widely known, is produced by bees from the nectar of flowers and secretions from the plants (1). Its physicochemical properties depend on the season of harvest, environmental factors prevailing in the harvest period and the biogeographic zone where applicable, (2). Can originate from a single or several plant species and its composition is dependent on the floral origin. Can originate from single or multiple plant species, and its biochemical composition is affected by the floral source. The aim of this work was foused in the study of *Weinmannia tomentosa, Don.*

Materials and Methods. honey samples from highlands andean zones in Boyacá, Colombia, were characterized based on melissopalynology, sensory attributes, composition, physicochemical properties of color, rheology, thermal and themophysical analysis, separation and identification of volatile compounds.

Results. Pollen grains at the samples were greater than 45%, conferring a quality of monofloral. Color pfund (69,0 ± 1,00), pH and total acidity3,87± 0,04; 31,8 ± 1,40 meq/kg, still within the standard limits, electrical conductivity 0,525 ±0,004 mS/cm, moisture, (20,1± 0,43 g/100), ash 0,198 ± 0,002 % Reducing sugars (69,7 ± 0,17g/100 g), total phenols (1570 ±14 mg/kg A.Ga), flavonoids, 129,4 ± 1,20 mg/kg Fl. Q.). Tabouret´s index 3,75 ± 0,06 based on 1,35 ± 0,03 relationship fructose/glucose and 0,604 ± 0,050 water activity. Honey show a Newtonian´s behavior. GC/MS evaluations show 25 volatile compounds, between alcohols (7), aldehydes (4), ketones (4), esters (1), hydrocarbons (3), furans (2), nitriles (1), derived sulfide (1) and terpenes (2)

Conclusions. The study is related as a model for characterization of types of honey and consolidated as the first research on unifloral honey in Colombia.

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REVALUATION OF SOYBEAN HULLS VALUE CHAIN

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Keywords. peroxidase, soy cultivar, soybean hulls, by-products valorization.

Introduction. Soybean peroxidase could be extracted from soybean hulls, a by-product of soybean meal production. This enzyme finds application in several industrial processes and its isolation improves the value of the entire soybean manufacturing chain, extending soybean hulls intended uses. Different studies on this topic have been previously reported from the University of Windsor, using soybean cultivars of Canadian origin (1). Furthermore, it has been described a strong correlation between Ep allele and peroxidase expression (2). Here we reported the Ep genotyping in different soybean varieties widely cultivated in Italy.

Materials and Methods. We collected 5 soybean samples among the main varieties cultivated in northern Italy, in collaboration with one of the biggest national docking companies (CerealDocks). To discriminate between the ep/ep and the Ep/ep and Ep/Ep genotypes a rt-PCR has been performed. The forward primers used for the assay were both already described (2) while a common reverse primer was designed in a conserved region. Genomic DNA was extracted from 0,5g of ground soybean seeds using ION Force DNA Extractor FAST (Generon). DNA was subjected to the rt-PCR in 25 µL of final reaction containing 12,5 µL of the Hydra SYBR qPCR Master Mix (Biolab) and 5 pmol of each forward and reverse primers. The reaction consisted of incubation at 95°C for 2 min followed by 35 cycles of 95°C for 1 min, 53°C for 45 seconds and 72°C for 1 min. We tested each sample with the two primer combinations to discriminate between recessive homozygote (ep/ep) and heterozygote (Ep/ep) or dominant homozygote (Ep/Ep) genotypes.

Results.Starting from these representative samples, we demonstrate that all of them display an Ep/ep or an Ep/Ep genotype, strictly correlated to the peroxidase expression. These soybean varieties are therefore suitable candidates for a deeper investigation regarding the enzymatic activity levels.

Conclusions. The obtained results allow to estimate the metric tons of soybean hulls that are potentially available for the peroxidase extraction in northern Italy, with the double benefit of a large-scale extraction as well as a revaluation of this by-product.

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A NEW IN SERIES BATCH MEMBRANE FILTRATION STRATEGY TO FRACTIONATE GOAT COLOSTRUM PROTEINS

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Keywords. Goat colostrum, membrane filtration, proteins, peptides

Introduction. Colostrum is the first secretion from the mammary gland after parturition and constitutes the initial nutrient supply for newborn goats. Colostrum contains fat, proteins (including immunoglobulins, enzymes and bioactive peptides), lactose and minerals, which are all of nutritional importance (1). In the last years, functional foods and nutraceutical companies showed an increasing interest in protein fractions from milk and dairy products. Because of that, colostrum and dairy by-products have been considered as important sources of this kind of compounds. Consequently, different extraction/concentration technologies were established in order to obtain protein-enriched fractions. Membrane filtration is one of the most promising sustainable technologies that makes it possible to obtain different enriched fraction from colostrum (2). In this study, membrane filtration of skimmed goat colostrum was performed using in series microfiltration (MF), ultrafiltration (UF), and nanofiltration (NF) ceramic membranes, with a view to developing a sustainable process to obtain different protein and/or peptide fractions.

Materials and Methods. Goat colostrum from first day post partum was obtained from Murciano-Granadina goats, supplied by an experimental farm in Granada (Spain). Goat colostrum was skimmed by centrifugation. Filtration experiments were performed at lab-scale using a lab-scale membrane plant (Prozesstechnik GmbH, Basel, Switzerland). In series MF- UF-NF membranes were used to fractionate the skimmed colostrum.

Results. A low cross-flow velocity was selected to allow operation at minimum transmembrane pressure to limit the effects of membrane and/or deposit layer compaction, which could alter membrane selectivity. A temperature of 30ºC was applied during membrane filtrations for all the membrane steps. A membrane with a 0.2 µm pore-size was used successfully to separate caseins from other protein components. In series UF-NF membranes separate whey proteins from sugar-compounds and salts.

Conclusions. The results showed that the proposed strategy is able to separate the studied compounds according to the molecular size.

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RECOVERY OF PHENOLIC COMPOUNDS FROM OLIVE OIL MILL WASTEWATERS BY A MEMBRANE SEPARATION APPROACH

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Keywords. Olive oil mill wastewaters (OMWW), membranes, nanofiltration, phenolic compounds.

Introduction. Olive oil mill wastewater (OMWW) represents the main environmental problem in the olive oil production process. The treatment and disposal of these effluents is a critical task due to the heterogeneity of their physicochemical characteristics and the large volumes by-produced that need storage and displacement. One of the major factors of the environmental impacts caused by OMWW is the high concentration in polyphenols, because they present phytotoxicity, refractoriness, toxicity against aquatic organisms or suppression of soil microorganisms, and they are difficult to decompose (1). The management of OMWW from two-phase mill olive oil production remains an unsolved problem in the Mediterranean Basin, particularly in Andalusia region where this agro-industries are one of the main engines of the economy and huge quantities of this wastewater are produced. The present study aimed at evaluating the potential of a membrane process to recover the phenolic compounds from OMWW. The adoption of a new economic model, the Circular Economy, that promotes closing-the-loop of product lifecycles through enhanced recycling and re-use, is driving attention to by-products and waste valorisation. This is especially relevant in the case of the food production chain, considered one of the main waste producers.

Materials and Methods. OMWW samples were obtained from local two-phase olive oil mills. Different pretreatment processes were examined: natural sedimentation, coagulation-flocculation with poly-electrolytes and centrifugation. Thereafter, the supernatant was driven to nanofiltration (NF) with a novel polymeric membrane (DK, Osmonics). Experiments were performed at lab-scale using a bench-scale membrane plant (Prozesstechnik GmbH, Basel, Switzerland). NF membranes were used to fractionate the phenolic compounds and their content was evaluated by HPLC-DAD-MS.

Results. The different pretreatmtents led to diverse yield in the final polyphenols fractionation. Both coagulation-flocculation and centrifugation permitted the best yield in terms of higher suspended solids separation upon the least loss of the polyphenolic content and their subsequent major recovery in the retentante stream of the NF membrane. HPLC-DAD-MS analyses were able to identify and quantify 21 phenolic compounds, some of them in the oxidized form. The presence of the last ones is due to the activity of the enzymes that exist in olives that lead to the hydrolysis of phenolic compounds during the milling of olives, changing the initial composition.

Conclusions. The filtration system of OMWW provided purification of water and concentration of phenolic compounds. These preliminary results encouraged further experimental research in order to optimize the filtration process to obtain the best recovery of phenolic compounds from OMWW and the use of the obtained water for irrigation scope.

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EXTRUDED SNACKS PRODUCED FROM BILBERRY PRESS CAKE

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Keywords. Drying, extrusion, organic, berry by-products, snack

Introduction. In the juice industry, the press cake left after juice extraction may account for up to 20% of the initial weight of the berries or fruits. To increase the commercial value and reduce waste it is reasonable to process this side stream into value-added products. Blueberry press cake has been reported to contain >42% of phenolic compounds present in the berries (1). The choice of processing methods and conditions affect the characteristics of fruit and vegetable products such as micronutrient and textural properties (2). Therefore, the aim of the study was to evaluate the feasibility of different drying techniques, combined with extrusion, for converting berry press cake and cereals into value-added food products.

Materials and Methods. Bilberry presscake was dried using Hot Air Drying (HAD) or Microwave assisted hot air drying (MWD) to a residual moisture content of 18%. The dried material was milled into powder, which was subsequently added to a whole grain rye formulation and extruded into puffed extrudates using a twin screw extruder. Two levels of bilberry powder were added (10 and 25%, w/w). Physical characteristics of bilberry powders were evaluated (moisture content, water activity, particle size distribution) and the extrudates were further evaluated regarding degree of expansion, density, texture and sensorial properties (un-trained panel). The retention of phenolic content was monitored throughout the whole processing chain.

Results. Bilberry powder produced using HAD and MWD were similar in their characteristics but shorter drying time was needed for MWD than HAD (215 vs. 360 min). The large difference in processing time did not affect the retention of phenolic componds. In the extrudates, the total phenolic content was highest with higher berry content as expected, and the MWD samples had a slightly higher content than HAD samples. Addition of 10% bilberry powder resulted in the highest degree of expansion and lowest crispiness index, and sensory evaluation indicated that 10% of bilberry powder addition resulted in the most favourable texture in terms of porousity/fluffiness and hardness. Overall, there was a trend that the HAD samples were a bit more liked than the MWD samples.

Conclusions. The use of by-products from the berry processing industry provides a model for bringing back valuable compounds into the human food chain and enables production of environmentally sustainable and value added products. The study showed that the combination of drying and extrusion are promising techniques for production of extruded cereal snack products, containing berry press cake, in line with organic production principles.

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IDENTIFICATION OF PHYTOCOMPOUNDS AND EVALUATION OF THE IN VITRO EFFECTS OF PHENOLS, SAPONINS, STEROIDS, ALKALOIDS AND TANNINS EXTRACTED FROM THE LEAVES AND FRUITS ON INSECT PESTS OF RICE, SORGHUM, COMMON BEANS AND COWPEA IN STOCKS

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Keywords. Cereals, legumes, phytocompounds, pest insects, mortality rate and germination capacity

Introduction. Common bean, cowpea, rice and sorghum are highly nutritious and widely consumed particulary in South-Kivu and generally in R.D.Congo. They are good sources of nutrients such as proteins, vitamins, minerals, complex carbohydrates and polyunsaturated free fatty acids. The farmers are facing very high postharvest losses due to the insect pests attack. The objective of this study was to identify the phytocompounds from plants with insect characteristics and evaluate the in vitro effects of phenols, saponins, steroids, alkaloids and tannins extracted from the powders of leaves and fruits from *Capsicum frutensens*, *Tagetes minuta*, *Jathropha curcas*, *Moringa oleiphera*, *M. aquatica*, *R. comminus*, *H. galeopsifolium*, *Carica papaya*, *Ageranthum conyzoides*, *Cymbopogon citratus*, *Ocimum basilicum*, *Ocimum gratissimum* and *Tephrosia vogelii* on insect pests of rice, sorghum, common beans and cowpea in stocks.

Materials and methods. Phytocompounds extracted from these plants were used at different concentrations. D0 was the negative control constituted of water, D1 concentrated dose, D2 first dilution, the second dilution D3. The positive control was the malathion, a synthetic chemical, with different concentrations.

Results. The results show that phenols, saponins, steroids, alkaloids, tannins and others phytocompounds were highly, moderately and weakly identified in the different plants depending on a plant and another one. Alkaloids, saponins, phenols, steroids, quinones and tannins were strongly present. There was no significant difference between the mortality of the *S. oryzae*, *Callosobruchus maculate* and *Sitophilis zeamays* caused by malathion compare to the extracted phytocompounds and plants with insecticides characteristics, except the *Acanthoscelides obtectus* insect pest in common bean stocks. The average mortality rate of *A. obstectectus* caused by malathion was 61.667 ± 38.889% followed by 48.056 ± 33.865%, 46.389 ± 27.101% and 45,000±28,9240% respectively caused by the extracted phytocompounds from the *T. minuta*, *T. vogeli* and *C. frutescens* for the different concentrations. D1 showed an average of 75,238%, 64,127% for D2 and 50,159% of mortality rate for D3. Plants with insecticide characteristics have controlled over 40% of *S.oryzae*, *Acanthoscelides obtectus*, *Sitophilis zeamays*, *Sitophilus oryzae* and over 50% of *Callosobruchus maculatus* insect pest in cowpea stock. Insect pest mortality rate increased with increased duration of contact of the insect pests with the phytocompounds. A high rate of germination was observed at D1 for all phytocompounds.

Conclusion. These phytocompounds should be used in control of pest insects in stock of the common bean, cowpea, rice and sorghum due to their capacity in controlling them and they are also economical, ecological and have health benefits.

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SENSORY EVALUATION OF UVAIA BY-PRODUCT BASED FRUIT BAR BY CATA QUESTIONS

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Keywords. native fruit, fruit bar, chocolate, residue

Introduction. Fruit industries generates high amounts of solid by-products that many times are considered a disposal problem to the producers. However, these residues can still have interesting compounds to human nutrition and can be used by other food industries. The aim of the present study was to evaluate the sensory features of a fruit bar made with pulp and by-products from uvaia, a Brazilian native fruit, by check all that apply (CATA) questions.

Materials and Methods. One hundred and twenty six consumers (62% female and 38% male) evaluated fruit bars formulations made from uvaia (*Eugenia pyriformis*). Seven uvaia fruit bar formulations were produced from pulp (FL-P); pulp + wet by-product (FL-PWB); wet by-product (FL-WB); pulp + large dried by-product (FL-PLDB); large dried by-product (FL-LDB); pulp + small dried by-product (FL-PSDB); small dried by-product (FL-SDB), sugar, glucose syrup and pectin. Sensory tests were performed to evaluate the acceptability of the final product through hedonic scale of 9 points: extremely disliked (1) to extremely liked (9). A novel sensory method, Check all that apply questions, was applied: The assessor was invited to select from a list all the terms that described each sample. CATA question data was analyzed by Cochran's Q test and multiple factor analysis. Partial Least Square regression was performed in order to make a correlation between CATA data and overall liking

Results. Mostly, formulations containing the fruit pulp were preferred by consumers. P, PSDB and PLDB were the samples that presented the highest overall liking scores, with scores around 7. Considering the form that the by-product is applied in the formulations, consumers slightly disliked the formulations made with wet or large dried by-product. In that manner, considering this study, there is an indicative of preference for formulations with the small dried by-product.The terms most frequently cited in CATA were fruit aroma, practical, healthy, it can be eaten anytime, acid, heterogeneous appearance, high fiber content and pleasant aftertaste. CATA results suggests a positive influence of attributes such as "sweet", "fruit flavor" and "pleasant aftertaste" and a negative influence of attributes such as "bitter", "bitter aftertaste" and "bad aftertaste" on uvaia fruit bar acceptance by the consumers.

Conclusions. The results express the market potential of fruit bars made from uvaia pulp and by-products, being an alternative to the add value to the residue that is generated by the fruit processing chain. CATA questions was a good tool to understand consumer's perceptions about the products. Nevertheless, improvements can be done, such as changing the proportion of pulp/by-product. These changes should be able to reduce the perception of bad or bitter aftertastes by the consumers.

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EFFECTS OF CHITOSAN/PROCYANIDIN BASED COATINGS ON QUALITY OF FRESH BLUEBERRIES DURING STORAGE

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Keywords. Procyanidins, chitosan, edible coating, bluberries, antioxidant activity

Introduction. Blueberries are known to be rich in bioactive compounds, including flavonoids, anthocyanins and phenolic acids. Neverthless fresh berry fruit deteriorates rapidly due to water loss, mold growth (?) and ripe decay (1). Edible coatings were used as an alternative way of preservation because of their ability to reduce moisture loss, solute migration, respiration and transpiration rate, to maintain firmness and generally delay senescence (2). Many studies have investigated the effects of chitosan coatings on the quality, safety and antioxidant activity of fruits. .The aim of this work was to evaluate the efficacy of an innovative edible coating, based on chitosan from mushrooms and procyanidins exract from grape seeds, on fresh blueberry quality maintenance.

Materials and Methods. Two different coating solutions were prepared, each of them contained 1.5 % (w/w) of glycerol, 0.20% (w/w) of Tween® 20 and 1% (w/w) of lactic acid, solved in distilled water. In the first solution, chitosan from mushroom was added in a quantity of 1% (w/w); the second coating solution was prepared by combining chitosan from mushroom (1% w/w) and procyanidins extract from grape seeds (0.8% w/w). Whole blueberry fruit were dipped in the coating solutions, in two steps, blueberries dipped in distilled water with the same procedure were used as control. After a dehydration period of 90 min at 25° C coated berry samples were placed in plastic trays (PET) closed in micro-perforated bags (PLA) and stored at 4°C for 14 days. On coated blueberry fruits some chemico-phisical characteristics (weight loss, pH, dry matter, colour and firmness), antioxidant activity (ABTS method) and microbial growth were evaluated at 0, 2, 4, 6, 10, 14 days of storage.

Results. For weight loss, pH and dry matter no differences were detected, among the control and the differently coated berry samples at each considered storage time. Both coating types induced a general lower lightness and a more blue colour in blueberry samples as compared with control one. Chitosan and chitosan + procyanidins coatings better maintained berry fruits firmness as compared to control ones until 14 days of storage. As expected the use of coating caused a slight increase in the antiradical activity that was the highest in blueberries coated with chitosan + procyanidins. Microbiological analysis results indicate that all the considered samples resulted below the spoilage threshold for total mesophilic bacteria, yeasts, molds, lactic acid bacteria and total coliforms, during the whole period of storage.

Conclusions. The used innovative coatings showed a positive effect mainly on maintaining the firmness and increasing the antioxidant activity of blueberry samples. Results from this study demostrated the efficacy of new type of coating ingredients (chitosan and natural procyanidins) to maintain the overall quality of fresh blueberries during storage.

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NUTRITIONAL VALORIZATION OF OLIVE OIL INDUSTRY BY-PRODUCTS IN INTESTINAL CELL CULTURE

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Keywords. polyphenols, Caco-2 cells, cytotoxicity, inflammation, metabolome

Introduction. Food processing of cereals and vegetables creates a rather voluminous amount of by-products, which often contain a high concentration of phytochemicals. The use of extracts from food by-products as ingredients in food production could be a strategy to develop functional foods. In this context , the first step is the demonstration of a positive biological activity of the extracts themselves. The aim of this study was to evaluate the effect of an extract of olive industry by-products in cultured intestinal cells(Caco-2).

Materials and Methods. After quantification in term of phenols content and antioxidant activity, the water extract of the olive oil by-product has been supplemented at different concentration to Caco-2 cells. The effect on cell viability and vitality has been assessed, then the anti-inflammatory and metabolomic effects have been investigated using ELISA assay and nuclear magnetic resonance.

Results. The water extract of the olive by-product has a high polyphenols content and antioxidant activity When supplemented to Caco-2 cells, it exhibits important biological effects on cell viability, inflammation and metabolome.

Conclusions. This approach represent the first step for the formulation of new food products. Based on these results, the extract will be used to produce a new food that will be tested on Caco-2 cells to verify whether it retains the positive effects observed in the extract.

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BIODEGRADATION STUDY OF SLOW RELEASE WASTE-BASED FERTILIZER: MICROSCOPIC AND FT-IR CHARACTERIZATION

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Keywords. capsules, fertilizer, yerba mate waste, urea, slow-release

Introduction. Yerba mate is a tea-like beverage prepared with dried, minced leaves and stems traditional from Southamerica. A huge amount of yerba mate powder (YMP) [1] is produced as a byproduct of yerba mate production. This waste offers advantages of being cheap, abundantly available, renewable, and biodegradable, acting as a rich source of mineral and organic matter. Fertilizers are vital input materials that limit agricultural production. Exponential population growth and diminishing arable land have motivated people to utilize larger quantities of chemical fertilizers. In this work, urea (U) encapsulated in a slow release YMP system was used to alleviate these problems.

Materials and Methods. Yerba mate powder was donated by the Instituto Nacional de la Yerba Mate (INYM, Argentina). Sodium alginate 2% w/v (Cargill, Argentina) was prepared in water. Different amounts of YMP and 2 g of urea (Anedra, Argentina) was dissolved in 100 mL of alginate solution. Then, the blend was forced with a peristaltic pump at 45 rpm (Gilson Minipuls 3, France) into a silicone tube (3 mm diameter) to drop into a calcium chloride solution (0.5 mol/L) (Biopack, Argentina) for 1 min. The capsules obtained were dried in a forced air oven (GMX 9203A PEET LAB, USA) at 70°C until constant weight. Biodegradation studies were performed burying capsules in fine mesh (1 mm) nylon bags (Gasatex, Argentina) 5 cm below the soil surface (35-40 % humidity, Terrafertil, Argentina,) in pots stored under controlled conditions of temperature at 4, 20 and 30°C. After different incubation periods (up to 90 days), the remaining capsules in the cup were picked out, cleaned, dried at 105°C for 30 min and weighted. Urea content was determined by the ureasesalicylate method (Byosystems, Spain). Soil pH (Hach, sensION 3, USA) was measured each time in all beakers. Degradation process effect on capsules was characterized by microbial assays, Environmental Scanning Electron Microscopy (ESEM, FEI, Quanta 200 microscope, Netherlands), Fourier Transform Infrared Spectrometry (FT-IR, Nicolet IS-10, Thermo Scientific, Inc, EEUU) and the spectral analysis was performed with the software Omnic version 9 (Thermo Scientific).

Results. Urea released and biodegradation were affected by temperature. Biodegradation was 100% at 20 and 30°C at 60 and 40 days, respectively. Urea was totally released at 30 days at 4°C and at 10 and 5 days for 20 and 30°C, respectively. Microstructure changes and microbial development were observed by ESEM in accordance with bacterial ang fungal kinetic growth. FT-IR confirmed some structural changes due to degradation process.

Conclusions. Yerba mate waste is a promising organic source for producing a low-cost and eco-friendly compound fertilizer. The systems demonstrated to be biodegradable and released the total encapsulated urea in soil.

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SOYBEAN QUALITY AND INTERFERENCE IN PROTEIN LEVEL, HUMIDITY AND pH OF TOFU AND OKARA

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Keywords. tofu, soy protein; grain quality; okara

Introduction. Tofu is a product that is obtained from the soya extract by adding acids or salts to protein precipitation, and which has smooth, soft and elastic texture. The tofu protein content is more intimately related to the soya extract protein than to the grain protein itself, once the protein present in the extract is completely clogged in the form of tofu. the present work aimed at evaluating the tofu protein level, humidity and pH interference and the protein level of okara due to soya beans quality.

Materials and Methods. Soyabean of cultivar BRSMG 790A, crop 2014/2015 and 2015/2016 were used, from Empresa de Pesquisa Agropecuária de Minas Gerais – EPAMIG, Uberaba, MG. The experiment was assembled in DIC with six treatments and four repetitions. Tofu was obtained by dihydrated calcium sulphate coagulation. The influence of both crops and the presence or absence of bugs in the grains on the proteic fraction of tofu and okara, their humidity and pH were evaluated. The proteic fraction was obtained by determining the total nitrogen percentage of the sample according to Kjeldahl method described by AOAC (1) and multiplied by the average factor 6,25. Humidity was determined by the gravimetric method by using heat in which it was determined weight loss of the material when exposed to heat (105°C) up to obtaining constant weight according to AOAC.[1] The pH was determined by using digital potentiometer. The experiment was analysed by ANOVA.

Results. There was significant difference ($p<0,01$) in the tofu protein level when comparing crops and bug damaged grains. Tofu from crop 2014/15 produced from grains free from bug damages showed 9,91% proteins with 50% of non damaged grains and 50% of damaged grains, showed 8,55% of protein and only with damaged grains the level of protein was 7,98%. On crop 2015/16, the level of protein of tofu was higher than the one in crop 2014/15, but with no significant difference among the treatments in average of 10,08%. There was no significant difference to tofu humidity in both treatments with average of 81,73%. Concerning to pH, there was difference among crops, crop 2014/15 showed an average pH of 6,16, relatively higher than the one of crop 2015/16 that showed an average pH of 6,33. There was no significant difference for tofu humidity in both treatment with and an average of 81,73%. The protein level of okara showed significant difference among crops, but proportionally inverted to the tofu protein level. Okara´s average protein level for crop 2014/15 was 34,28% and crop 2015/16 was 31,68%.

Conclusion. Tofu quality was higher when using grains from crop 2015/2016, regardless the presence of bug damages, as it showed higher level of proteins and pH, so it is recommended to use new grains for tofu preparation

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BREWER'S SPENT GRAIN AS RAW MATERIAL IN PRODUCTION OF VALUE-ADDED CORN SNACK PRODUCTS

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Keywords. corn grits, brewer's spent grain, nutrive value, snack products

Introduction. Brewer's spent grain (BSG) is the major by-product of the brewing industry, which is available in large quantities throughout the year, but its main application has been limited to animal feeding. BSG is a lignocellulosic material containing about 17% cellulose, 28% non-cellulosic polysaccharides, chiefly arabinoxylans, and 28% lignin. Because of that, it can be also serve as an attractive adjunct in human nutrition (3). The aim of this research was to investigate the potential of BSG application in production of value-added corn snack products.

Materials and Methods. Corn grits used in this study was kindly provided by the mill Đakovo of the "Žito" Company Ltd. Osijek, produced in 2014. BSG was kindly provided by Osijek Brewery d.o.o., Osijek, (produced in 2013), and pectin by „Kandit" Ltd. Osijek. BSG was dehydrated in laboratory oven Memmert UFE 500 at 60°C, and milled at laboratory mill IKA MF10 with 2 mm sieve. Mixtures with 0, 5, 10 and 15% d. m. of added BSG were extruded in the laboratory single screw extruder (19/20 DN, Brabender, Germany) at following parameters: moisture content (15%), temperature profile (135/170/170°C), screw compression ratio (4:1), round die (4 mm), and 1% d. m. of added pectin with the aim of production of corn snack products. Obtained extrudates were air-dried overnight and milled in laboratory mill IKA MF10 with 1 mm sieve before the analysis. Chemical composition (standard ISO methods), resistant starch (RS) (1), total, soluble and insoluble dietary fibre (TDF, SDF and IDF) (2), total polyphenols content (TPC) and antioxidant activity (DPPH) (4) were determined.

Results. The obtained results showed that the addition of BSG to corn grits caused significant increase of IDF content and slight increase of SDF and RS contents. Furthermore, products with BSG had a higher amounts of protein, ash and fat, and in accordance with this lower content of raw carbohydrates. Results for total polyphenols showed that the addition of BSG in corn grits proportionally increased their contents, but decreased antioxidant activity (DPPH).

Conclusions. According to obtained results it can be concluded that the BSG as inexpensive by-product of brewering industry can be successfully incorporated in corn grits with the aim of production nutritionally more valuable corn snack products.

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APRICOT KERNELS – IMPORTANT FOOD BY-PRODUCT

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Keywords. apricot kernels, by-product, extraction, bioactive components

Introduction. Nowadays, a tendency for reducing food industry waste is becoming more prominent due to a growing interest for utilization of food industry by-products for various purposes. These by-products contain many potentially useful substances and they could become significant raw materials in the production/development of new products. Apricot kernels as by-products of processing are a valuable source of bioactive components like amygdalin, tocopherols, phenolic compounds and fatty acids. Some of them were studied in this research.

Materials and Methods. Apricot kernels were obtained from Association of fruit brandy producers (Kneževi vinogradi, Croatia). The initial oil content in apricot kernels was determined by Soxhlet extraction system using *n*-hexane as a solvent. Crude oil was obtained by cold pressing of apricot kernels on the laboratory screw press, and its oil quality parameters, namely, peroxide number, free fatty acids, moisture, insoluble impurities, iodine number and saponification number were determined. Furthermore, oil from apricot kernels was obtained also by supercritical CO_2 (SC-CO_2) extraction at pressure of 300 bar, temperature of 40°C and CO_2 mass flow of 2 kg/h. The oil was collected every hour during extraction process (total extraction time was 5 hours). The oils obtained by screw pressing and with SC-CO_2 were analysed for fatty acid composition, total tocopherols and amygdalin concentration. The apricot kernel extract was produced using 50% ethanol solution and was analysed for antioxidant and antibacterial activity, as well as amygdalin concentration. Antioxidant activity of extracts was determined by DPPH method. Antibacterial activity was conducted against four test bacteria strains: *Bacillus subtilis*, *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Escherichia coli*. It was assessed in terms of minimum inhibitory concentrations by a modified broth microdilution method. Fatty acid composition was determined by gas chromatography with flame ionization detector (GC-FID). Tocopherol concentrations were performed on reversed-phase High Performance Liquid Chromatography (HPLC) with fluorescence detection (FLD) and amygdalin concentration by HPLC with UV detection.

Results. The initial oil content in apricot kernels was 49.60%, and moisture content 6.87%. The moisture content in crude cold pressed apricot kernel oil was 0.13%, peroxide number 0.49, free fatty acids 1.78, insoluble impurities 0.46%, iodine number 103.45, and saponification number 192.11. Concentration of total tocopherols during SC-CO_2 extraction decreased from first collected fraction to the last, precisely from 2.52 mg/g of oil to 0.50 mg/g of oil. However, the concentration of total tocopherols in cold pressed apricot kernel oil was significantly lower (0.94 mg/g of oil) compared to SC-CO_2 oil, while α-tocopherol was not detected. Fatty acid composition showed prevalence of palmitic, oleic (cis-9) and linoleic (cis-9,12) acid, specifically 5.93%, 57.33% and 33.81% in all SC-CO_2 extracts, which showed a great similarity to values of oil obtained by cold pressing (5.48%,

FOOD IRRADIATION IN THE THIRD SECTOR - DEVELOPMENT AND VALIDATION OF QUESTIONNAIRE TO STANDARD MEASURING INSTRUMENT FOR EVALUATION OF ACCEPTANCE AND SENSORY ANALYSIS OF IRRADIATED FOODS.

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Keywords. food bank, food irradiation, food waste, questionary,sensory analysis.

Introduction. Despite the poverty in the world, a third of all food produced in the world is wasted. The energy of ionizing radiation in food expresses many positive results, such as validity and insect infestation control increased. The food banks are organizations that act at various points of food chain to collect and distribute food to the needy. Banks of food and new technologies to preserve and guarantee quality are courses of action requested by FAO (1). So, the aim of this study was to initiate a partnership between irradiation and the food bank through the development of a questionnaire to evaluate and disseminate the knowledge and acceptance of Individuals in the food bank in Brazil. In addition, this study aimed to standardize the basis for future research questionnaire assessment of irradiated foods. The questionnaire was applied in Ceagesp food bank in the biggest center of food in Brazil.

Materials and Methods. For the construction of the questionnaire as a measuring instrument, a comprehensive and rigorous literature review was made (2). It covered qualitative research, Questionnaires, sensory evaluation and food irradiated. Three stages of pre-tests - were necessary and related fields of experts were consulted.

Results. According to each pre test performed (3 done) were made necessary alterations in the questionnaire and it was tested again until 95% of respondents did not report doubts.

Conclusions. 30 % of participants of Ceagesp bank had already heard of the Food irradiation, but did not know about the mecanism, so they rejected the idea to associate with radioactivity and danger. The video showed and application of the questionnaire propriamete disseminated the idea of security. All individuals declare understand the goal of treatment and accept buy and consume irradiated food after them.

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DISTRIBUTION OF FREE AND BOUND PHENOLIC COMPOUNDS AND ALK(EN)YLRESORCINOLS IN WHEAT ALEURONE ENRICHED FRACTIONS

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Keywords. Wheat aleurone, phenolic compounds, alk(en)ylresorcinols

Introduction. Aleurone is a single cell layer at the inner site of the bran. It contains most of the minerals, vitamins, phenolic antioxidants, and lignans of the wheat grain. Novel milling and dry-fractionation techniques have recently allowed for full-scale separation of aleurone cells from the other layers of wheat bran, yielding a fiber rich concentrate which potentially contains many of the "whole grain kernel bioactives" (1). Because of that, the main objective of this study was to investigate the content of free and bound phenolic compounds and alk(en)ylresorcinols of two commercial wheat aleurone enriched fractions.

Materials and Methods. Wheat aleurone enriched fractions were obtained by Buhler technologies from wheat by-products. The studied aleurone fractions were enriched in 65-72 and 85-90 % of aleurone layer. To extract the free and bound phenolic compounds, the protocol of Verardo et al. (2) was used. The phenolic compounds were determined by HPLC-DAD-ESI-MS. Alk(en)ylresorcinols were extracted with dichloromethane and determined by GC-MS.

Results. The analysis by HPLC-DAD-ESI-MS of free and bound phenolic compounds permited the identification of several phenolic compounds. The results showed that *p*-coumaric and ferulic acids were present in higher concentrion in the sample with higher ratio of aleurone layers. Contrary, the sample with the lowest content of aleurone fraction reported higher amounts of oligomeric forms of ferulic acid.
Alk(en)ylresorcinol analysis by GC-MS allowed the identification of 14 alkyl(en)resorcinols. As expected the C19:0 and C21:0 were the most aboundant alkylphenols. Their concentration was higher in the sample with the lowest aleurone ratio.

Conclusions. These results confirmed that the aleurone fraction is a good source of phenolic and alkylphenolic compounds being able for the formulation of enriched foods. Moreover, these data confirmed that aleurone layer is very rich in simple phenolic compounds, instead intermediate layer contains higher amounts of alk(en)ylresorcinols and oligomeric phenolic acids.

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AIR CLASSIFICATION AS GREEN TECHNOLOGY TO PRODUCE FUNCTIONAL BUCKWHEAT FLOURS

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Keywords. Buckwheat, phenolic compounds, air classification

Introduction. Buckwheat seeds serve as a rich source of flavonoids and have been considered a good dietary source of rutin. However, it also contains other flavonoids, such as quercetin, hyperoside, quercitrin, epicatechin, orientin, vitexin, isovitexin, and isoorientin (1). Cereal and pseudocereal milling processes generate large amounts of cereal by-products that have usually been used in zootechny or as raw material for the extraction of bioactive compounds using solvents or expensive processes. The aim of this study is to propose air classification as a green technology for the production of buckwheat flours using the whole grain and avoiding by-products production.

Materials and Methods. The samples were harvested in an experimental field in Campobasso (Italy). Buckwheat was pin-milled (whole meal). After that, the whole meal (WM) was micronized and air-classified into coarse fraction (CF) and fine fraction (FF). The most represented particle size of coarse and fine fraction was in the range 120-470 and 45-120 µm, respectively. To extract free and bound phenolic compounds, the protocol of Verardo et al. (2) was used. The phenolic compounds were determined by HPLC-DAD-ESI-MS.

Results. The analysis by HPLC-DAD-ESI-MS of free and bound phenolic compounds allowed the identification of several phenolic compounds. The results showed that total free phenolic compounds, contrary to other cereals, decreased in coarse fraction. Contrary, fine fraction contained similar or higher phenolic content than whole meal. However, buckwheat coarse fraction resulted naturally enriched in some flavan-3-ols, dihydroxy-trimethoxyisoflavan and rutin.
The same trend was also confirmed for total bound phenolics; in fact their content decreased in coarse fraction, but procyandin A and vitexin content increased.

Conclusions. These results confirmed that the distribution of phenolic compounds in buckwheat achene is different if compared to other studied cereals. The buckwheat coarse fraction obtained after air classification resulted naturally enriched in some flavan-3-ols and rutin; because of that air classification is a green process that is able to produce buckwheat flavan-3-ols and rutin enriched fractions that could be incorporated into food formulations to obtain enriched/functional foods.

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A NEW FUNCTIONAL VEGETABLE OIL NATURALLY ENRICHED IN LYCOPENE

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Keywords. Tomato, olive oil, sustainability, functional food

Introduction. Virgin olive oil and tomatoes represent two key-elements of Mediterranean diet and the fundamental role is related to their nutritional and healthy properties. In particular, both of these products owe their beneficial effect in the presence of many compounds such as phenols, for olive oil, and carotenoids (β-caroten and lycopene), for tomatoes (1,2). Moreover, it is known that the simoultaneous assumption of virgin olive oil and tomatoes increase their single antioxidant effects, with a synergic action. As a matter of fact, on the nutritional viewpoint, it has been demonstrated that the bioavailability of lycopene is 3 to 5 times increased when tomatoes are consumed with virgin olive oil (3). For all the reasons mentioned above, the co-processing of olives and tomatoes, by mild physical methods only, could be useful for the production of sustainable functional and sustainable food, as they do not employ solvents. The oil appears really interesting from a compositional point of view, both in terms of sensory and nutritional properties; thus, it can constitute an interesting and innovative proposal for the market. The setting up of this new functional product could be included in a virtuous interaction between supply chain and industrial sector, already known as industrial symbiosis (4), that reflects recent European strategies on decoupling economic growth from environmental impacts.

Materials and Methods. In line with what mentioned above, a co-milled olive oil has been produced extracting with tomatoes, only using mechanical processes, without using any added solvent. Subsequently, the vegetable oil obtained has been characterized and evaluated, in terms of hydrolytic and oxidative status. Moreover, the amount of antioxidant compounds (coming from olives or tomatoes) has been determined, through the qualitative and quantitative analysis of phenols and carotenoids. The sensory evaluation of the product has been conducted by a panel of trained judges, according to EU Reg. 1227/16 (5).

Results. The data obtained inherent the hydrolytic and oxidative status were within the limits defined for virgin olive oil; however, the co-milled olive oil cannot be labeled as virgin olive oil, according to its definition. The amount of antioxidants detected in the co-milled olive oil suggests that the tranfer of carotenoids from tomato to the olive oil, obtained only by mechanical extraction, can be desfruited for a natural enrichment of the oil; thus, this product represent a good alternative to the use of syntetic molecules to be added to refined olive oils.

Conclusions. The present investigation suggests the possibility to use tomatoes for co-milling with olives to obtain an innovative functional food, a vegetable oil that is naturally enriched in antioxidants, especially in carotenoids. This new product might be marketed as a "condiment produced using olives and tomato by-products" or " olive oil dressing enriched in lycopene".

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DOES FOOD TECHNOLOGY HAVE A ROLE IN TACKLING FOOD WASTING? THE CASE OF FRESH-CUT SALAD

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Keywords. wasting risk; consumption probability; rejection probability; survival analysis; fresh-cut salad; temperature

Introduction. Around one-third of the globally produced food is annually discarded worldwide. Domestic waste makes the largest contribution, varying between 15 and 30% of the all purchased food. Fresh and processed fruit and vegetables account for one-third of these losses. Reducing food losses is crucial to guarantee food security and sustain the world's limited resources. Almost all discards are nowadays disposed of or used for energy and value-added compounds recovery. However, it can be inferred that food processing could also contribute to decrease food wasted by consumers. This research aims at evaluating the potential role of food technology in steering food waste. To this purpose, the effect of storage conditions on the risk of food to be wasted by consumers was investigated. In particular, the case of a highly wasted food, i.e. fresh-cut salad, was considered.

Materials and Methods. Packed fresh-cut salad was stored at 8 or 12°C and analysed for wasting risk. The probability function of food to become a waste $P(W_t)$ at the storage time t was defined as the product of the consumption decision probability $P(C_t)$ and the rejection probability $P(R_t)$ at the time t (1).

$$P(W_t) = P(C_t) \cdot P(R_t) \quad (1)$$

The probability of salad to be selected for consumption was estimated by surveying consumers about consumption distribution during domestic storage; the probability of salad to be rejected by consumers was assessed by measuring consumer rejection of the product stored for increasing time, i.e. by survival analysis. 650 Italian consumers were involved in the study.

Results. Salad stored at 12°C presented 4 days' shelf life and the wasting risk estimated within shelf life was *circa* 13%. Storage of salad at 8°C allowed to extend the shelf life to 7 days, as well as to estimate a twenty-fold lower wasting risk (i.e. 0.7%) within shelf life.

Conclusions. These results suggest the high potential of technological interventions in critically affecting food waste generation at domestic level. The methodology here proposed to quantify the food wasting risk could be extended to several products. Resulting information could represent a useful tool to identify processing and distribution conditions that minimize the wasting risk, developing adequate technological strategies to reduce waste and increase food sustainability.

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WHEAT BRAN OIL: A REAL OPPORTUNITY FROM A BY-PRODUCT?

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Keywords. by-product, durum wheat bran, edible oil, new cereal product

Introduction. The agri-food sector generates significant quantities of by-products and waste, the disposal of which produces negative environmental and economic impacts. The adoption of an industrial symbiosis approach to transfer and share resources between dissimilar industries reflects recent European strategies on decoupling economic growth from environmental impacts.

Materials and Methods. The durum wheat bran was supplied by an Italian producer. Five different bran layers were selected, isolated according to their sieving mesh size during the flour milling process and identified with an increasing number (L1-L5) from the outter to the inner layer, respectively. From each layer, the lipid fraction was extracted by soxhlet procedure (1), using petroleum ether (40-60°C) for 6 h, and the humidity was determined by means of a gravimetric method. Main lipid classes - triacylglycerols (TAG), diacylglycerols (DAG), monoacylglycerols (MAG), free and esterified sterols, free fatty acids (FFA) - and total fatty acid (FA) composition (2) of each lipid extract, were also determined.

Results. The humidity content was higher (~ 15%) in L1 with respect to the other layers, showing the lowest amount in L5 (~ 14%). The lipid content ranged from 8% (expressed in dry basis) (L3) to 5% (L1, L4 and L5). The lipid matter was mainly constituted by FFA (89–94% of total fat), followed by total sterols (3.4–4.0% of total fat), DAG (1.5–4.0% of total fat), TAG (0.6–2.4% of total fat) and MAG (0.7–1.1% of total fat). In general, FFA decreased from the outer to the inner layers, whereas TAG showed the opposite trend; this could be ascribed to a lipolytic phenomena related to an on- going fermentation process. Total FA were mainly constituted by polyunsaturated fatty acids (PUFA; 53–58% of total FA), followed by monounsaturated fatty acids (MUFA; 21–24% of total FA) and saturated fatty acids (SFA; 17–20% of total FA). More than 50% of total FA was represented by linoleic acid (C18:2 n-6; 51–54%); oleic acid (C18:1 n-9) ranged from 19% (L1) to 22% (L5), while the palmitic acid (C16:0) content was about 17% of total FA without significant differences among bran layers.

Conclusions. This preliminary study demonstrated that by-products from durum wheat bran could represent a source of added-value vegetable oil for edible or other uses. The extracted oil could be potentially used as a functional ingredient due to its high content of PUFA and low amount of SFA, with an important contribution of linoleic acid (essential fatty acid). However, to ensure its stability and the preservation of its nutritional and sensory characteristics, the oxidative state control and a shelf-life study of the functional bran oil is necessary.

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INNOVATIVE APPROACHES TO GRAPE SEED OIL EXTRACTION

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Keywords. Grape seed oil, extraction methods.

Introduction. Rising demand of healthy nutritioning and seeking new natural bioactive compound sources give rise to evaluation of agro-industrial wastes. Grape marc is one of the prominent waste material revealing from wine and fruit juice industry in millions of tonnes each year. Its rich bioactive ingredients enable these residues to be a good source for food, cosmetic and pharmaceutic industries. Grape seeds constitute 38% to 52% of grape marc (1), and contain a healthy and delightful oil up to 20%. Since bioactive compounds of grape seed oil (GSO) are too sensitive to some conditions (high heat, high pressure, etc.), making the correct decision of extraction method plays a crucial role in order to maintain their existence. Although, cold press method was used to carry out a non-destructive extraction since decades, developing technology in food industry brought out new effective methods (enzyme assisted aqueous, supercritical fluid assisted, ultrasound assisted, microwave assisted and etc.). This review was designed to explain these new approaches to grape seed oil extraction in detail.

Conclusions. Cold press is the most preferred oil extraction method from grape seeds due to its non-destructive structure for the degradable sensitive bioactive materials. Although extracted oils have high quality ingredients when used this method, low extraction yield prompt oil producers to seek some other developed methods which give higher oil yields. Even though the oil yield of solvent assisted methods (goldfisch, soxhlet and etc.) are significantly higher than cold press, possible remained solvent residues into the extracted oil may threat to human health and so its commercial future. Therefore, it has been developed some solvent-free and aqueous treatments such as enzyme-assisted aqueous, ultrasound-assisted and microwave-assisted extractions. These alternative methods were mainly focused on the extraction of oil by disruption of cotyledon cell walls and oily membranes with different ways (2,3). It has been using several methods to extract GSO from past to present and selection of correct method was decided due to future usage area of extracted oil. Two crucial point exist in this decision that are high extraction yields and being non-destructive for the sensitive bioactive materials. It's expected that the massive improvement in food technology provides innovative, safer and more efficient GSO extraction methods in the future.

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LC-DAD/ESI-MS/MS CHARACTERIZATION OF PHENOLIC COMPOUNDS OF PISTACHIO (*Pistacia vera* L.) HULL

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Keywords. LC-MS/MS, pistachio hull, phenolic compounds

Introduction. Pistachio hull is a good source of natural phenolic compounds. However, it was accepted as a food by-product from pistachio production. But, cardioprotective and vaso-dilation capacities of these nutritional ingredients has started to attract the interest of the food industry and herbal medicine nowadays.

Materials and Methods. Hulls from the Kirmizi pistachio cultivars (1 kg hull) were obtained from the pistachio processing factory in Gaziantep, Turkey. The extraction of phenolic compounds was carried out according to Konstantinidis (1) after some modifications. Hull extracts were filtered through a 0.45-µm pore size membrane filter before injection. An Agilent 1100 HPLC system (Agilent Technologies, Palo Alto, CA, USA) operated by Windows NT-based ChemStation software was utilized; the HPLC equipment was used along with a diode array detector (DAD). The detail of LC-DAD/ESI- MS/MS conditions were explained in our previous researches (2, 3).

Results. A total of 11 phenolic compounds (gallic acid, protocatechuic acid, catechin, epicatechin, rutin, eriodictyol- 7-*O*-glucoside, naringin, luteolin, eriodictyol, quercetin, and naringenin) were identified and quantified in of pistachio hull sample. Gallic acid, catechin, rutin, and eriodictyol-7-*O*-glucoside were the most abundant phenolic compounds hull. Total concentration of phenolic compounds was 10,547.4 mg/kg in hull extract (10,122.4 mg/kg).

Conclusions. Gallic acid was the prominent phenolic compound identified in sample. As for the flavonoids identified in this study, catechin, rutin, and eriodictyol-*7*-*O*-glucoside were the most dominant compounds. The four major phenolic compounds could be used as chemical markers of pistachio hull of Kirmizi variety.

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ORGANIC STRAWBERRIES SHELF LIFE IMPROVING USING CONTROLLED ATMOSPHERE

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Keywords. organic strawberries, controlled atmosphere, refrigerated storage, shelf life

Introduction.The shelf life of strawberries is usually terminated by high physiological activity after harvest and finally fungal decay. Refrigeration and controlled atmosphere are widely used to reduce spoilage and extend the shelf-life of strawberries (1). The aim of this study was to establish the shelf- life and to determine the best storage practices for a better quality of organic strawberries.

Materials and Methods. Storage experiments consist in putting 200 g organic certified strawberries cultivar "Regina" (*Fragaria ananassa*) in perforated by hand PET trays. The trays were deposited at 3°C (control sample) and also in three different controlled atmosphere: 5% O_2, 10% CO_2, 85% N_2 with 75% relative humidity at 3°C (I.); 5% O_2, 15% CO_2, 80% N_2 with 75% relative humidity at 3°C (II.); 5% O_2, 10% CO_2, 85% N_2 with 95% relative humidity at 3°C (III.). These experiments were conducted along 5 weeks. Physical-chemical parameters (fruit calibre, pH, titratable acidity, water activity, soluble solids, respiration and transpiration rate measurement, firmness); nutritional parameters (antioxidant capacity, ascorbic acid content, total polyphenols content), also total aerobic count and yeasts and moulds were measured.

Results. Decay of organic strawberries was reduce significantly. The first signs of visible mold development in organic strawberries appeard in the 14th day for control samples, in the day 25th for experiments I and III. Experiment II showed a shelf life of 32 days. Experiment was stopped for each organic strawberry sample when visible mold appear on their surface. Variation of some important quality parameters is summarized and it is given in table below.

Sample	Storage temp	Shelf	Ascorbic acid content reducing	Antioxidant capacity reducin	Total polyphenols content reducing
Control	3	1	5	30	8
I - 5% O_2, **10% CO_2**, 85% N_2 with 75%	3	2	11	44	16
II - 5% O_2, **15% CO_2,** 80% N_2 with 75%	3	3	11	40	11
III - 5% O_2, **10% CO_2**, 85% N_2 with 95%	3	2	4	42	15

Conclusions. All organic strawberry samples stored in controlled atmosphere presented significantly reduce of decay and shelf-life was extended as compared to the control. Also, organic strawberries stored in 5% O_2, 15% CO_2, 80% N_2 with 75% relative humidity at 3°C presented an improved shelf life as compared to the other two storage conditions of controlled atmosphere. Therefore this could be used in extending shelf life and to reduce quality deterioration of organic strawberries.

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EFFECT OF CHILLING TEMPERATURE STORAGE ON SOME BERRIES POSTHARVEST PERIOD

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Keywords. organic berries, refrigerated storage, shelf life, quality parameters

Introduction. Berries are highly regarded on account of their attractive colors, unique flavors, delicate textures, and especially their numerous health benefits (2). Also, it is widely recognized that berries are rich in phenolic compounds. In addition to flavonols commonly found in berries, anthocyanins are dominant in dark-skinned berries, such as blackcurrant (*Ribes nigrum*) and bilberry (*Vaccinium myrtillus*) (1). The objective of this study was to determine which are the best storage practices for improved quality of wild and cultivated berries.

Materials and Methods. Blackcurrants (*Ribes nigrum*), bilberry (*Vaccinium myrtillus*) and raspberries (*Rubus idaeus*) analysed in this study were harvested and selected for integrity of fruits. Storage tests consist in putting 200 g of fruits (wild and cultivated) in perforated PET trays by hand, that were then storaged in different chilling temperatures (3°C and 5°C) for several days until spoilage. Different quality parameters were measured: physical-chemical, nutritional and microbiological parameters.

Results. The experiments were conducted along 17 days (both 3°C and 5°C) for blackcurrants; 11 days (both 3°C and 5°C) for bilberry and 4 days (both 3°C and 5°C) raspberries. Variation of some quality parameters is given in table below. Also microbiological analysis have been performed.

Sample	Storage temp	Storage period	Ascorbic acid content variation	Antioxidant capacity variation	Total polyphenols content variation
Blackcurrants	3	17	-4	-76	-76
	5		-6	-77	-77
Bilberry	3	11	-10	+19	+47
	5		+7	+24	+44
Raspberries	3	4	+7	-10	-15
	5		+9	-14	-7

Conclusions. The berries deposited at 3°C presented a decreasing number of colony forming units and the physical – chemical parameters degraded slower than the samples stored at 5°C. Regarding the other analyzed parameters, it is a variation which could be base on different maturity degree of fruits at starting point which is very difficult to establish according to the color of fruits for these species.

Acknowledgements: Financial support for this project is provided by funding bodies within the CORE Organic Plus FP7-ERA-NET-618107 Ensuring quality and safety of organic food along the processing chain and with cofounds from the European Commission UEFISCDI - ERA NET for Romanian Partner USAMVB - "Innovative and eco-sustainable processing and packaging for safe and high quality organic berry products with enhanced nutritional value" EcoBerries.

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INCIDENCE OF KETOSIS IN DAIRY COWS AND ITS INFLUENCE ON MILK QUALITY

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Keywords. dairy cow, ketosis, milk quality, early lactation

Introduction. Thanks to genetic selection, progress in nutrition, management and milking technology improvements, cow mammary gland can produce a much greater volume of milk as the calf is able to consume.Selection of cows with higher production and the burden associated with nutrition, reproduction and the environment may affect not only quantity but also composition of milk (2). Of course, all these factors cause financial losses and have huge impact on farming economics. One of the main causes is decreased average number of lactations - in Slovakia about 2.20 years for Holstein-Fresian cattle (1), which is a result of high incidence of metabolic disorders, especially ketosis in early lactation. The present study is aimed to capture the signs of ketosis (particularly in sub-clinical form) and their influence on milk composition.

Materials and Methods. Twenty-onehigh-yieldingHolstein-Friesian dairy cows in early lactationwere used. Blood samples for biochemical and haematological analysis were collected from *vena caudalis mediana*. Haematological, energetic and mineral profiles were determined. Milk samples were collected at morning milking, and stored at 6°C. Analyses of milk composition was performed (levels of lactose, fat, protein and calcium). Results were evaluated by statistical program GraphPad Prism 5.0.

Results. Increased level of beta-hydroxybutyrate in blood (above 1.2 mmol/L) was observed in six cows (30.0%). Suspicion of subclinical ketosis in these individuals is supported by decreased levels of calcium and phosphorus, by reduction in red blood cell count and by low hematocrit. Reduced fat level (38.0% of subjects), protein level (19.0% of subjects), lactose content (5.0% of subjects) and calcium level (38.0% of subjects) were observed. However, only lower lactose and calcium content was determined in milk from cows with subclinical ketosis.

Conclusions. Based on these results it can be concluded that milk quality parameters were affected by ketosis of dairy cows, particularly content of lactose and calcium. The lack of other constituents of milk may be associated with other disorders, occurring in the period after birth, which is the most difficult stage in terms of metabolic burden of the organism.

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PHENOLIC COMPOUNDS OF NATIVE COOKED POTATO (*Solanum tuberosum* L.) BENEFICIAL TO HUMAN HEALTH

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Keywords. Native cooked potato, phytochemicals, cancer, diabetes, chlorogenic acid.

Introduction. The pattern of consumption of potatoes (*Solanum tuberosum* L.) worldwide involves a cooking process that affect the concentration and bioavailability of phenolic compounds (secondary metabolites) that have been shown to prevent degenerative diseases of human health (1).

Materials and Methods. It was identified and quantified phenolic compounds in native, yellow-fleshed potatoes Huagalina grown at two experimental sites in Santiago de Chuco, La Libertad Region, Peru. The peel from freeze-dried slices was carefully separated from the flesh with a scalpel, and both were ground separately to a fine powder and then cooked by vapor for 15 minutes Extraction was obtained from the cooked peel and flesh separately, with extraction solution: 50% methanol, 50 % deionized water and 0.5 % acetic acid (2). Fifteen secondary metabolites were monitored using the Ultra Performance Liquid Chromatography system coupled to mass spectrometry (UPLC-MS / MS). A calibration curve (from 0.1ng to 100μg) was generated using the respective standards of each metabolite to determine the absolute quantification. The generated data were analyzed in the software "MassHunter Workstation" VB 06.00, to obtain the peak areas for each secondary metabolite and the results were expressed in mg/100 g of dry tissue. Principal Components Analysis (*PCA*) was performed using XLSTAT 2015 Software (Digital license).

Results. Only thirteen metabolites were detected. The highest content of secondary metabolites (mg/100g DW) were: Chlorogenic acid (302.18 ± 32.40), neochlorogenic acid (87.89 ± 11.87), caffeic acid (50.48 ± 5.25) and vanillin (49.81 ± 3.21). The PCA scores show that the highest concentration of metabolites was found in the cooked peel of both cultivars.

Conclusions. Cooked potato native Huagalina contains sufficient bioactive compounds to be considered a preventive health promoter for the population**.**

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HEALTH-PROMOTING AND ANTI-INFLAMMATORY PROPERTIES OF POMEGRANATE: THE LATEST EVIDENCE FROM THE LITERATURE

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Keywords. pomegranate juice, ellagitannins, inflammatory diseases, anti-inflammatory properties

Introduction. Ellagitannin (ET)-rich fruits as pomegranate have demonstrated positive health properties related to oxidative stress and inflammatory effects. Interest in dietary (poly)phenols, including ETs, considerably intensified after the recognition of their potential health benefits. A recently published study has suggested that urolithin A, gut microbiota-derived metabolite of ETs, increased the lifespan of roundworms by a half and improved muscle function in rodents (1).

Materials and Methods. This work provides a brief overview of the evidence from *in vivo* studies investigating potential anti-inflammatory effects of pomegranate, with an emphasis on fruit-derived juices. This summary was compiled by examining studies identified from databases as PubMed focused on inflammation and/or inflammatory-associated conditions. Inflammation is a complex biological response to tissue injury or infection. Chronic inflammation has been shown to be involved in the onset and development of a range of diseases, as arteriosclerosis, obesity, diabetes, and neurodegenerative diseases.

Results. The number of peer-reviewed journal articles is greatly increased in the last years, and several human clinical trials are in progress (https://clinicaltrials.gov/). To date, research studies on the promising health effects of pomegranate have advanced rapidly. Most of the published works are related to prostate cancer, diabetes, and atherosclerosis; few researches are focused on other pathological conditions. Intervention studies have been carried out using pomegranate juice or whole fruit (poly)phenol extracts.

Conclusions. The present summary of the current science indicates that pomegranate juice shows promising potential for reducing inflammatory-related conditions by the improvement in anti-inflammatory responses. Therefore, consuming pomegranate juice, as part of a healthy balanced diet, should be encouraged.

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EFFECT OF CONSUMPTION OF RED WINE PRODUCED BY FRIENDLY TECHNOLOGY TO THE BIOCHEMICAL PARAMETERS OF PROBANDS IN THE DEPENDENCE TO GENDER

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Keywords. red wine; alcohol; health; gender

Introduction. In the last decades, many studies not only suggest but even confirm the beneficial effects of wine on human health. Moderate alcohol consumption is up to 30 g of alcohol per day for men and 10 – 15 g of alcohol per day for women. Some studies suggest that the beneficial effects of alcohol consumption are higher in men than in women, but many studies show similar effects in both genders.

Materials and Methods. The aim of this study was to investigate the effect of red wine consumption on the lipid profile and glucose in the group of male (13 men aged 34 – 64 years) and the group of female (11 women aged 28 – 57 years). Research consisted of moderate red wine consumption for 6 weeks. The dose of alcohol ranged from 200 to 300 mL per day of red wine Lemberger (Winery Masaryk, Slovakia). The blood samples were obtained after overnight fasting and were collected at baseline and after three days, three weeks and six weeks of wine consumption.

Results. Differences between male and female subjects were reflected in the results of different biochemical parameters in the dynamics of wine consumption. We found out that while in females the total cholesterol level did not change significantly and had a predominantly downward trend, for male subjects we observed at the beginning the slight increase of the levels, which, however, after 6 weeks of consumption significantly decreased from an initial value of 5.75 ±1.32 $mmol.L^{-1}$ to 5.35 ±1.25 $mmol.L^{-1}$ ($p < 0.05$). LDL-cholesterol changed significantly only in the group of female. Level of this lipid parameter decreased significantly during the six weeks of consumption of Lemberger from an initial value 3.37 ±0.68 $mmol.L^{-1}$ to the lowest 2.99 ±0.61 $mmol.L^{-1}$, which was recorded in the third week of consumption ($p < 0.0001$), but statistically significant differences versus baseline we monitored after three days and six weeks of consumption ($p < 0.01$). In the group of male, we did not observe such significant changes, but it should be noted, that the men had changes in LDL-cholesterol downward direction and all the values were in the range of benchmarks. In the group of female, HDL-cholesterol increased to 2.05 ±0.6 $mmol.L^{-1}$ after six weeks of consumption from baseline of 1.7 ±0.69 $mmol.L^{-1}$, and the difference was statistically significant ($p < 0.05$), in the group of male, its level changed first significantly after three days of consumption of steep increase (1.46 ±0.61 $mmol.L^{-1}$, $p < 0.05$), and for the next six weeks, it was the significantly increase (1.59 ±0.5 $mmol.L^{-1}$, $p < 0.01$).

Conclusions. The results of our study prove the supposition publised in different surveys. To the complex understanding of this topic are necessary further researches.

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DIGESTIBILITY COMPARISION BETWEEN TRADITIONAL GASTRONOMIC FORMULATIONS AND SUBMITTED TO INNOVATIVE COOKING PROCESSES

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Keywords. *In vitro* digestion, protein digestibility, NMR, food products, vacuum sealed cooking system.

Introduction. Foods are complex matrices where the most important molecules are called nutrients. To allow nutrient absorption, food must be digested and the different components hydrolyzed to smaller constituents. Cooking is an important variable that affect nutrients digestibility, in particular proteins digestibility. In fact, mild heat treatments increase protein digestibility, while severe heat processes decrease it. On this basis, the aim of this study was to evaluate and compare the protein digestibility in food products obtained by traditional or innovative vacuum sealed system cooking.

Materials and Methods. Different meat-based food products, obtained by traditional or innovative vacuum sealed system cooking, have been digested *in vitro*, and the resulting digesta analyzed by spectrophotometric methods or by nuclear magnetic resonance. In particular, the latest technique permits to evaluate, in a semi-quantitative manner, proteins and peptides released during digestion, providing a global vision of the process.

Results. Results obtained underline the importance of the food matrix as determinant of protein digestibility. Overall, the innovative vacuum sealed system cooking increases food digestibility, although differences related to the food products are evident.

Conclusions. The results obtained will enable the development of "food with increased digestibility", particularly devoted to specific subgroup of the population at higher risk of malnutrion, such as elderly.

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EVALUATION OF PACKING SOLUTIONS FOR EXTENSION OF POSTHARVEST SHELF LIFE OF RAMSONS (*Allium ursinum* L.)

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Keywords. *Allim ursinum* L., packaging, shelf life, temperature

Introduction. Ramsons (*Allium ursinum* L.) or, as usually called wild garlic, is a leafy wild plant occurring in forest in early spring. *A.ursinum* is traditionally used for culinary and medicinal purposes due to its distinct garlic-like scent originating from sulfur containing compounds that are the most characteristic constituents in Allium species (1). *A.ursinum* is usually marketed at green markets and more recently in supermarkets tied in bunches and immersed in water but this practice results in very short shelf life and significant losses caused by leafs wilting and yellowing (2). Experiments aimed at investigation of possibilities for extension of shelf life of ramsons with different packaging solutions were conducted.

Materials and Methods. *A. ursinum* was collected in the forests of Fruška Gora mountain (Vojvodina, Serbia) in April 2016. Ramsons leafs were packed in vacuum and in plastic boxes with and without spraying with water and kept in conditioned storage chambers at 0, 5, 10 and 20°C for 14 days or until the deterioration of a critical sensory property under the level acceptable for the market. Weight loss, wilting, rottening and yellowing indecies, color difference and the content of sulfur were determined in ramsons samples.

Results. Packaging of ramsons in boxes retarded the wilting, rottening and yellowing processes of ramsons leafs in comparison to the leafs that were not packed. Packaging also reslted in higher preservation of sulfur content in ramsons leafs, especially at higher temperatures. Pakgaing of ramsons leafs in vacuum packages was proven not to be feasible due to initiation of anaerobic fermentation processes in leafs causing complete deteoriation of leaf tissue and loss of ramsons marketability in a very short period.

Conclusions. Packaing of ramsons results of extension of its postharvest shelf life, but its packaging in vacuum results in fast deteoriation and is not applicable.

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TECHNOLOGICAL PROPERTIES OF ANTIMICROBIAL EDIBLE FILMS BASED ON FISH GELATIN ENRICHED WITH LAE (ETHYL-N^{A}-DODECANOYL-L-ARGINATE)

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Keywords. Antimicrobial edible films, fish gelatin, LAE, spoilage microorganisms

Introduction. Fresh and chilled fish are very susceptible to colonization and development of spoilage. Pathogenic microorganisms such as. *Listeria* spp. and *Pseudomonas* spp which are bacteria dangerous to consumer health (1). LAE (ethyl-Nα-dodecanoyl-L-arginate), an antimicrobial compound recently developed, is synthetically produced from lauric acid, L- arginine and ethanol, and it has been shown to have surfactant and antimicrobial activities (2). One way to apply antimicrobials on to the food surface is through an edible coating. In the present paper, fish gelatin has been evaluated as a possible alternative to bovine gelatin. The objective of this research was to analyze the effect of LAE on the technological propertie of edible films based on fish gelatin.

Materials and Methods. Fish gelatin commercialized was provided by LAPI GELATINE (Empoli, Italy), glycerol was supplied by Sigma (Barcelona, Spain). LAE (85 % purity) commercialized as Mirenat-P/100 was provided by Vedeqsa Grupo LAMIRSA (Barcelona, Spain). Different concentrations of LAE were added to the film forming solution to obtain films with 0,5 %, 1 %, 5 % and 10 % LAE (g of LAE/100 g of dry gelatin). In addition solutions without LAE were prepared as control films. All films were plasticized with 2.4 % glycerol (0.30 g of glycerol/g of dry Gelatine). Films were prepared on glass plates under controlled environmental conditions (15 h, 27 °C and 75 % RH). For antibacterial activity, films with four concentrations of LAE were assessed against four groups of pathogenic bacteria: *Listeria inocua*, *Aeromonas hydrophila*, *Shewanella putrefaciens* and *Vibrio alginolyticus* which were provided by the Type Culture Collection Spanish (CECT University of Valencia-Spain).

Results. Preliminary results showed that LAE is effective against the growth of studied bacteria groups. The greater inhibition was observed with the highest concentrations of LAE. In tests of antibacterial activity, discs edible films based on gelatin lost their structure at 30 °C (incubation temperature of bacteria). However, the entire area where films were placed showed no bacterial growth. According to scientific literature (3) the antimicrobial activity of LAE is due to its action as cationic surfactant on the cytoplasmic membrane and outer membrane of Gram-negative bacteria and denaturation of proteins in the cell membrane and cytoplasm of Gram-positive one.

Conclusions. According to preliminary tests, the LAE retards the growth of *Aeromonas hydrophila, Shewanella putrefaciens, Vibrio alginolyticus* and *Listeria inocua.* The LAE surfactant action makes it a powerful antimicrobial agent. Because of its thermoreversibility, fish gelatin is ideal for application in chilled fish, which would help retard bacterial growth on the food surface.

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COMBINATIONS OF HIGH PRESSURE PROCESSING AND HEAT TREATMENT: SAFETY AND PROTEIN STRUCTURE OF LIQUID EGG WHITE

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Keywords. HHP, minimal processing, egg white, protein, heat treatment, differencial scanning calorimetry

Introduction. HHP technology is one of the most promising nonthermal processes. Several food products like sliced ham, or fruit juices are some of the products currently available on the market. In our study the different combinations of HHP and heat treatments were examined.

Materials and Methods. Samples prepared from homogenized liquid egg white (LEW) were treated in different combinations of high hydrostatic pressure (HHP) and heat treatments. Single HHP treatments at 350 MPa and 450 MPa, 5 min or combined treatments: first: pasteurization: 57°C, 7 min, or long-term heat treatment: 53°C, 6 hours followed by HHP treatment: 350 MPa, 5 min. were applied.

Aerobic mesophilic microorganisms were enumerated immediately after treatments. Protein structure of LEW was examined by differenctial scanning calorimetry (DSC, MicroDSC III).

Results. Results showed that single HHP treatments were effective in reducing initial microbial counts, but heat treatment combined with HHP showed higher effectivity. Combined treatments gave satisfying results in aspects of food safety. DSC method pointed out that infinitesimal reducing of all denaturatable protein can be found in case of evry treatment. However, the quantity of nondenaturated ovalbumin decreased.

Conclusions. Our results pointed out that required food safety aspects can be fullfield with minimal changes of proetein structure by application of HHP and mild heattreatments.

PRELIMINARY TECHNOLOGICAL CHARACTERIZATION OF NOVEL BIFIDOBACTERIAL STRAINS ISOLATED FROM MONKEYS FECES

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Keywords. probiotics, bifidobacteria, monkeys.

Introduction. Bifidobacteria have been isolated from a variety of ecological niches and thay are most frequently associated with the GIT of humans and animals. Studies regarding the microbiota of non-human primates are very scarce. To exert a beneficial effect probiotics, included in a functional food, have to be resistant to the stress sources typical in manufacturing and should be alive in sufficient number throughout the entire shelf-life of the product. The aim of this work was to evaluate the technological performances of novel bifidobacteria isolated from intestine of monkeys, for their potential use in dairy products.

Materials and Methods. Four novel bifidobacterial strains i.e. *B. aesculapii* MRM3/1 and MRM4/2, *B. avesanii* TREC and *B. aerophilum* TRE26 were used (1, 2). Tolerance to oxygen (growth in anaerobiosis/aerobiosis; $O.D_{560nm}$), resistance to frozen storage (-20 and -70ºC, skim milk 20% w/v, 6 months), tolerance to heat stress (50ºC, 10 min, skim milk 10% w/v), resistance to lactic acid (survival capacity in milk pH = 6.5; 5.0 and 4.5, 21 d, 4ºC), tolerance to lyophilization and survival during storage (5 and 25ºC, 2 months) were determined.

Results. *B. aerophilum* TRE26 and *B. avesanii* TREC showed high tolerance to oxygen (survival rate of 95 and 96%, respectively) while *B. aesculapii* MRM4/2 and MRM3/1 were less aerotolerant (survival rate of 57 and 22%, respectively). After 6 months of frozen storage (-70ºC), the cell load reduction was 0.62 and 0.47 $\log_{10}$ CFU/mL for *B. aerophilum* TRE26 and *B. avesanii* TREC, respectively. Both *B. aesculapii* strains were less resistant. When frozen storage was performed at -20ºC, a cell death between 2.0-3.9 $\log_{10}$ CFU/mL was observed. The heat-resistance of the strains was satisfactory for all of them being the most resistant ones *B. aesculapii* MRM3/1 and *B. avesanii* TREC (cell death of 0.13 and 0.15 $\log_{10}$ CFU/mL, respectively). Regarding the resistance to lactic acid it was observed that a small change in pH (from 4.5 to 5) improved the viability during storage. After 21 d *B. avesanii* TREC lost more than 6 $\log_{10}$ CFU/mL at pH 4.5 and 3.8 $\log_{10}$ CFU/mL at pH 5. All the strains showed good tolerance to lyophilization. No cell death was observed for both *B. aesculapii* strains. The survival rate for *B. aerophilum* TRE26 and *B. avesanii* TREC was 92.9% and 87.6%, respectively. When lyophilized cells were stored at 25ºC a cell death between 1 and 2 $\log_{10}$ CFU/g was found, whereas at 5ºC a cell death of 0.13, 0.39 and 0.44 $\log_{10}$ CFU/g was observed for *B. aerophilum* TRE26, *B. avesanii* TREC and *B. aesculapii* MRM3/1, respectively. *B. aesculapii* MRM4/2 was notresistant.

Conclusions. The technological characterization of new potentially probiotic microorganisms, suitable to be added in dairy products, is fundamental. Moreover, the use of new probiotic strains can lead the chance to expand the market of functional foods. The results of the present work underline the strain variability of resistance to environmental stress.

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DEVELOPMENT OF A FRESH PASTA FILATA SOFT CHEESE ADDED OF *Lactobacillus rhamnosus* GG.

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Keywords. pasta filata cheese, probiotics, *Lactobacillus rhamnosus*.

Introduction. Pasta filata cheeses encompass a wide range of cheese varieties such as Mozzarella, Scamorza, Provolone and Caciocavallo. Several challenges are related to the addition of probiotics to Fior di Latte cheese (a high-moisture cow milk Mozzarella cheese), being the most important the survival of probiotic bacteria during cheese making (temperature and time of stretching) and storage. The aim of this work was to adjust technological parameters (acidification of the curd, time and stretching temperature) in order to make a pasta filata soft cheese carrying a probiotic bacterium at levels higher than 10^7 CFU/g during its self life.

Materials and Methods. A control (CC) and a probiotic cheese (PC) were produced in the pilot plant of the INLAIN and vaccum-stored for 15 d at 4ºC. Five probiotic strains were tested for their heat resistance (skim milk 20% w/v, pH 5.25 ± 0.05 at 60ºC, 10 min). Gross composition and pH of cheeses (1, 15 d), microbiological analysis (1, 7 ,15 d), proteolysis (1, 15 d), physicochemical and sensory characteristics (15 d), volatile compounds (15 d), organic acids and sugar profiles (15 d) were determined. Resistance of *L. rhamnosus* GG (as pure culture and in cheese) to survive gastrointestinal digestion was also evaluated.

Results. Among bacteria tested *L. rhamnosus* GG was the most heat resistant strain (cell death < 1 $\log_{10}$ CFU/mL) so it was selected as adjunt culture for incorporation during the manufacture of Fior di Latte cheese. The acidification of the curd was done in 2 stages, under the whey and over the wheying table at ~25°C, until a pH of 5.8 and 5.2, respectively. Stretching was performed over 10 min in water at 80 ± 1 ºC (core temperature of the curd of 62.5 ± 0.05°C). The level of *L. rhamnosus* GG was 7.59 ± 0.00 $\log_{10}$ CFU/mL and 8.57 ± 0.03 $\log_{10}$ CFU/g in milk and curd, respectively. After 10 min of stretching *L. rhamnosus* GG showed a cell death of 0.44 ± 0.12 $\log_{10}$ CFU/g and at the end of ripening its level remains in 7.55 ± 0.09 $\log_{10}$ CFU/g exceeding the level of probiotic bacteria required for a probiotic food. No differences were found in pH and gross composition for both CC and PC cheeses. The addition of *L. rhamnosus* GG increased secondary proteolysis and the production of diacetyl, acetoin and acetic acid. Lactic acid concentration was increased in PC. Differences in cohesiveness, odor, astringency, acid taste, and residual flavor were found. The presence of *L. rhamnosus* GG increased significantly values for odor, astringency, acid taste and residual flavor while cohesiveness was significantly higher in CC. There was significantly less cell load reduction when the probiotic was incorporated into the cheese matrix after gastric, duodenal and intestinal digestion.

Conclusions. This work demonstrates that the setting of the technological variables (acidification of the curd and time and temperature of stretching) was satisfactory in order to maintain the viability of *L. rhamnosus* GG during cheese making and storage at 4ºC. Hot stretching during cheese manufacture caused slight log reductions 0.44 $\log_{10}$ CFU/g and no viability loss was observed during refrigerated storage. The probiotic strain remained above 7.55 $\log_{10}$ CFU/g during its shelf life and exhibited high resistance to gastrointestinal digestion.

ANTIFUNGAL ACTIVITY OF COMMERCIAL ESSENTIAL OILS OF CINNAMON (*Cinnamomum verum*) AND BAY LEAF (*Laurus nobilis*) AGAINST *Botrytis fuckeliana, Epicoccum nigrum, Curvularia hawaiiensis* and *Aspergillus niger*

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Keywords. antifungal activity, cinnamon, bay leaf, essential oils.

Introduction. Fungal contamination is a chronic problem in food products that exerts a negative effect on their quality and quantity. Pathogenic fungi reduce the yield of major food and cash crops by nearly 20% (1). Moreover, the application of synthetic fungicides has led to a number of environmental and health problems. According public demands is necessary to study natural compounds biodegradable and safe to humans and the environment. Essential oils are especially recommended as one of the most promising for the formulation of safer antifungal agents (2). The aim of this work was to determine the chemical composition of bay leaf (*Laurus nobilis*) and cinnamon (*Cinnamomum verum*) essential oils and to evaluate their antifungal activity against *Botrytis fuckeliana* (isolated from leaf *Vicia faba*) and *Epicoccum nigrum, Curvularia hawaiiensis* and *Aspergillus niger* (isolated from rice caryopsis), in order to obtain ecological biofungicides.

Materials and Methods. The essential oils of bay leaf, extracted from the plant in flower and cinnamon from branches were supplied by the company ESENTIALARÔMS (Lleida, Spain). Chemical composition was performed with a GC/MS (Varian Saturn 2000 apparatus). The essential oil was dissolved, mixed and homogenized by agitation with a previously sterilized PDA growth medium at 45-50ºC (liquid). The essential oil was added at the 300 µg/mL concentration and distributed into Petri capsules. The growth was mesured during 7 and 14 days at intervals of 24 h. To calculate the growth rates (mm.day-1) a linear regression of the radius (mm) as opposed to the time (days) was carried out. The computer software used was Microsoft Excel 2013. Also it was calculated the mycelial growth inhibition at 100, 200 and 300 µg/mL. For each essential oil and fungi, six replicates dishes were used.: The results of mycelial growth were subjected to analysis of variance (ANOVA). Also the intervals Tukey HSD were represented with significant numbers of $P \leq 0.05$.

Results. Adding bay leaf oil into the growth media the inhibition growth was about 15%. While the addition of cinnamon reached inhibitory percentages between 70-80% in *Epicoccum* and *Curvularia* species. Also it was calculated the mycelial growth inhibition at 100, 200 and 300 µg/mL. With these tests it was observed that at 200 µg/mL we obtained similar results, practically the same inhibitory effect as at 300 µg/mL. However, at a concentration of 100 µg/mL, cinnamon drastically reduced its inhibitory potential, losing effectivity.

Conclusions. The essential oil of cinnamon, treating crops and stored food, could be a good alternative to replace the use of agrochemicals. Being more environmentally friendly, safer for the consumer and increasing food products, self-life after harvesting.

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COMPREHENSION OF THE ACTION MECHANISMS OF NATURAL ANTIMICROBIALS AGAINST *LISTERIA MONOCYTOGENES* SCOTT A AS A FUNDAMENTAL TOOL FOR THEIR APPLICATION IN FOOD

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Keywords. stress response mechanisms, essential oils, shelf-life, food safety

Introduction. Essential oils and their constituents are volatile compounds produced by different species of plants as secondary metabolites. Characterized by a strong aromatic impact, they are recognized as safe for the human health from different international food's authority (EFSA, FDA and FSCJ) and are commonly used in the food industry as flavoring agents. Although their antimicrobial properties are well documented, their mechanisms of action and the strategies put in play by microorganisms to avoid their effects are not completely understood. The aim of this work is understand more in depth the metabolic and stress response mechanisms of *L. monocytogenes* SCOTT A in model system after the exposure at sub-lethal concentrations to essential oils (EO) or their bioactive compounds. Understanding these mechanisms will lead to a more conscious use of natural antimicrobials in food systems also for enhancing the food safety due their antimicrobial properties.

Materials and Methods. Pure culture of *L. monocytogenes* SCOTT A, in exponential growth phase, were exposed to natural antimicrobials in hydro -alcoholic solution for one hour. The concentrations used were based on minimal inhibitory concentration (MIC). After the exposure, the effects of the treatments were investigated on the proteome by bidimensional electrophoresis (2DE), followed by MALDI TOF MS/MS approach for the protein identification and by GC/MS-SPME to highlight the volatile profile shifts.

Results. The comparison of the proteome profile with those of the untreated control, showed, independently on the concentration of natural antimicrobials, a shift on the relative abundance of different proteins involved in the energetic metabolism: phosphoglycerate mutase (PGM), dihydrolipoamide dehydrogenase (PDHd), ATP-sintase β-subiunit and carnitine transporter ATP-binding protein (OPUca). The principal component analysis (PCA) of the volatilome underlined a clear clusterization of the samples mainly on the basis of the natural antimicrobial added independently on its concentration. Molecules belonging to pyrazine class, saturated and unsaturated aldehydes, and alcohols significantly affected the clustering of the *L. monocytogenes* SCOTT A samples along PC1 and PC2.

Conclusions. Proteome analysis showed that treatments provoke a negative regulation of energy metabolism both at glycolytic and respiratory levels consisting in an activation of fermenting pathways like the glycerol pyruvic fermentation. These data are supported by the volatilome profile analysis. The data obtained in this study allowed to obtain useful information on response mechanisms of foodborne pathogenic microorganisms to biocide stresses. Morover, these results provide to food industry usefull informations on natural antimicrobials increasing their potential application not only as flavour enhancing, but to augment food safety and shelf-life.

PARTIAL SUBSTITUTION OF POWDERED MILK WITH PEANUT MILK IN THE PRODUCTION OF YOGHURT

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Keywords. peanut beans, powdered milk, peanut milk, ferment, yoghurt

Introduction. Yogurt is part of the family of the fermented milk obtained by the development of lactic bacteria (*streptococcus thermophilus* and *Lactobacillus Bulgaricus*) that are to be seeded simultaneously.

Materials and Methods. Plant material was composed of peanut buy at the market. Peanut milk was extracted in the laboratory. This milk was used as raw material for the production of yogurt. Yoghurt, a dairy food fermented with specific bacteria of *Lactobacillus bulgaricus* and *Streptococcus thermophilus* was processed at 40℃ for 4 hours from reconstituted powdered milk containing up to 15 or 20% peanut milk. Yoghurts were obtained from peanut milk prepared as followed: Beans were soaked in tap water (P/V= 1/5) for 18 hours, preheated by soaking for 20 seconds in hot water (100°C), ground and homogenized in boiling water (P/V= 1/7). The resulted slurry was filtered with 0.18 mm sieve to obtain peanut milk and to prepare corresponding yoghurts. Physicochemical characteristics, yield, sensory evaluation and statistical analysis were performed.

Results. Physicochemical analysis showed that yoghurts containing peanut milk were comparable with reconstituted powdered milk yoghurt in titratable acidity, in pH and richer in protein, ash and nitrogen than reconstituted powdered milk yoghurt. Sensory evaluation showed no significant difference between yoghurts containing peanut milk and reconstituted powdered milk yoghurt in aroma, in texture and in taste, but the yoghurt containing the peanut milk had the best colour and was overall accepted by panellists. Thus, good quality yoghurt can be produced with 20% peanut milk as substitutes for reconstituted powdered milk.

Conclusions. The results obtained show that the reconstituted milk powder can be replaced by 20% peanut milk to produce a good quality yoghurt.

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EVALUATION OF HIGH PRESSURE HOMOGENIZATION POTENTIAL TO MODIFY STARTER YEAST PERFORMANCES FOR SANGIOVESE WINE DIFFERENTIATION AND INNOVATION

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Keywords. High-pressure homogenization, yeast performance, Sangiovese wine, final product innovation

Introduction. The aim of the present research was to assess the effects of high-pressure homogenization (HPH) treatment, applied at level of 80 MPa, to *Saccharomyces cerevisiae* F15, before the inoculation in Sangiovese grape must, on the cell viability, fermentation and death kinetics during winemaking.

Materials and Methods. *Saccharomyces cerevisiae* F15 was treated with HPH at 80 MPa by using a lab-scale Panda homogenizer (Gea, Parma, Italy). The untreated cells were used as controls. The treated and untreated yeast was inoculated in Sangiovese must at level of 6 log cfu/ml. The inoculated samples were stored at 25°C. The chemical characteristics, volatile molecule profiles and the mannoprotein release, during fermentation and in the final products in relation to the initial sub-lethal treatment to the starter culture, were monitored. Also epiflurescence microscope technique was applied to evaluate the physiological state of the cells.

Results. The cell load data and the Epiflurescence Microscope photographs obtained immediately after the hyperbaric treatment showed that the viability of the considered strains was reduced of about 0.5 log cfu/ml confirming the literature data on the extremely high tolerance of yeasts to HPH treatment (1). The growth and fermentation kinetics showed an initial delay of HPH treated cells in the multiplication and subsequently on the fermentation processes. However, the HPH treated cells were able to maintain higher cell loads over the whole fermentation process compared to untreated cells. The physico-chemical analyses of the wine, in relation to the HPH treatment of the starter culture, demonstrated no significant differences in pH and alcohol strenght. By contrast, the initial HPH treatment induced a sensible increase of the fermentable sugar residues, probably due to the inhibition of glycerol-piruvic fermentation by the hyperbaric treatment. The HPH sub-lethal treatment applied induces the mannoproteins release during the fermentation and in the final product. Moreover, the data regarding the volatile compounds profiles, obtained using GC-MS-SPME, evidenced significant metabolic shifts related to the HPH treatment response by *S. cerevisiae* cells. In fact, as evidenced by the Canonical Analysis of Principal Components, the samples obtained with HPH treated cells were significantly different from the control samples, mainly due to the reduction of ethyl acetate and 3- methyl-1-butanol (isoamyl alcohol) content as well as the increase of acetic acid-2-phenyl ethyl ester, octanoic acid-ethyl ester and pentanoic acid-butylphenyl ester.

Conclusions. High-pressure homogenization treatment seems to be a versatile approach for several biotechnological applications including modulation of the metabolic activities and the autolytic phenomena of yeast starter culture in the perspective of innovation and product differentiation purposes.

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SAFETY EVALUATION OF AN INNOVATIVE FERMENTED PRODUCT

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Keywords. Vegan product, lactic acid bacteria, challenge test, autochthonous starters, *Listeria monocytogenes*

Introduction. Recently, the spontaneous fermentation of a nut fermented cheese-like vegan product, hand-made prepared under domestic conditions, has been studied. In particular, lactic acid bacteria (LAB) responsible for the natural fermentation process were identified, revealing a succession of hetero- and homo-fermentative species during fermentation. Some of the autochthonous isolated strains and other commercial LAB strains have been proposed as starters in order to reproduce the domestic process in an industrial-scale fermentation, leading to the definition of an innovative fermented product for vegan market. A crucial aspect for the commercialization of this product is the definition of risk points and the set-up of microbial challenge test to define the safety aspects associated to its production. Given the characteristics of this nut vegan "cheese", the major risk can be associated with the presence of *Enterobacteriaceae* (in particular, *Escherichia coli*) and *Listeria monocytogenes*.

Materials and Methods. In this work, the effect of lactic acid fermentation process and different nut thermal treatment on the survival of *Escherichia coli* and *Listeria monocytogenes* in innovative vegan "cheese" product have been tested. These pathogens have been deliberately inoculated in nuts at high concentration at the beginning of production with different mixtures of autochthonous or commercial LAB starters to detect their cell reduction during product process and storage at refrigerated temperature.

Results. The results showed that the fermentation process could contribute to reduce the survival and proliferation of *E. coli* and of *L. monocytogenes* depending on the LAB starter used. In fact, not all the starters were able to counteract the proliferation of pathogens because the accumulation of organic acids due to their fermentation was not sufficient to reach a safe pH value. In fact, these microbiological hazards have to be prevented through proper and rapid acidification, reaching a pH value lower than 4.4, which can be considered a safe threshold in relation to the growth of *Listeria monocytogenes*, as indicated also by the EU regulation 2073/2005 (1). Moreover, the commercial starter *Leuconostoc carnosum* B-SF-43 (Chr. Hansen) was able to kill Listeria cells from the earliest phases of production, suggesting an effective antimicrobial activity of this strain towards this Gram-positive pathogen.

Conclusions. The use of autochthonous or commercial starter cultures allowed the set-up of a guided vegan "cheese" fermentation process, able to confer to the product some characteristics, such as pH control, necessary for an industrial production, storage and commercialization. Some of the starter cultures proposed were able to counteract the growth and the survival of deliberately inoculated pathogens, enhancing product hygienic quality and limiting the possible risks associated with its consumption.

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MICROBIOLOGICAL QUALITY, BIOCHEMICAL AND PHYSICAL-CHEMICAL CHARACTERISTICS OF ARTISANAL VINEGAR BASED PIERS MANGOES.

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Keywords. Vinegar, fermentation, juice, mango

Introduction. Among tropical products, fruits are considered the most perishable goods. But it is also a sector where there are many technologies and processing methods could significantly reduce post-harvest losses, extend the life of fruit or derivatives, diversifying markets, create jobs and improve the income of actors

Materials and Methods. In traditional vinegar, the choice of raw material is crucial because it affects the quality of the finished product. Mangoes which were the subject of our study are those that are avoided in trade is to say overripe mangoes whose alteration process may be initiated for a good part and some preparations (juices, nectars , jam, etc.) can no longer be considered. Vinegar manufacture is a double fermentation process requiring microorganisms (*Saccharomyces cerevisiae* and *Acetobacter aceti*) as a starter.

Results. The fermentation lasted 47 days. From the microbiological point of view, the elaborate vinegar is exempt from any pathogenic germ. In spite of its relatively low acidity pH approximately 3, its rate of soluble solids brought up approximately 5,4 °Brix, its dry matter of 2,3 %, its density of 1,02 g/l, its rate low of ash of 0,20 % and its slightly superior electric conductivity of the order of 3,83 mS / cm compared with the commercial vinegar. The protein content, of the order of 2,26 % remains high compared with the commercial vinegar. The concentration in mineral elements is of the order of 6,012g for Ca^{2+} and of 2,917g for Mg^{2+}; with a low content in alcohol 0,56 % and a low titratable acidity with regard to the commercial vinegar 5,388 °.

Conclusions. It has been shown that vinegar made from mangoes has physicochemical characteristics and biochemical quite close to our witness (commercial vinegars). But the presence of protein, vitamin C and minerals (Ca^{2+} and Mg^{2+}) confirms the nutritional value of our vinegar compared to the control.

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EFFECTS OF THE ESSENTIAL OIL OF ROSEMARY (ROSMARINUS OFFICINALIS) ON THE CONSERVATION OF TOMATO FRUITS (SOLANUM LYCOPERSICUM L.)

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Keywords. Rosemarinus officinalis, conservation, solanum lycopersicum

Introduction. The fruits and the vegetables provide a source of abundant and cheap energy, nutritive substances of growth, vitamins (A, B6, C, E) and minerals (Ca, Fer, K, Mg, Na6...); their food value is higher when they are fresh, but it is not always possible to make an immediate consumption of it. Although the fruit and vegetables are significant for human health; however, they EP do not uvent being preserved for a long time because of their perishable nature.

Materials and Methods. Tomato was used as a biological material. Thus, to maintain the quality of the fruit and vegetables several strategies were in particular applied the transformation of the tomato fruits sauce, juice, mashed potaties with use of the conservatives in particular essential oils.

Results. For this reason, we undertook this study relating to the Effect of the essential oil of rosemary on the conservation of the fresh tomato fruits, the objective was to determine the shelf life of the fresh tomato fruits and to evaluate the effect of the amounts of rosemary on the biochemical parameters. We also evaluated the effect of the various amounts of rosemary on mushrooms responsible for the deterioration of the tomato fruits in conservation. Stage 0, for the rot gave a high average (5.333Á), for amount 0 at the stages 1 and 4 gave the same result (3.0000 BCD), the results compared to the vitamin C, showed us that amount 2 gave a good content of vitamin C, As for mushrooms responsible for the rot, we found that the mushroom penicillium expansum is more present like pathogenic agent of the tomato fruits in conservation. With amount 0 it represents a total of (19, 44%). With the amount 1(7, 41%), whereas in the box zero mushroom, represents (21, 91%).

Conclusion. Rosemarinus officinalis can be used to preserve solanum lycopersicum during storage at room temperature.

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NEW TECHNOLOGIES APPLIED TO POSTHARVEST EVALUATION OF TOMATILLO (*Fisialis ixocarpa*)

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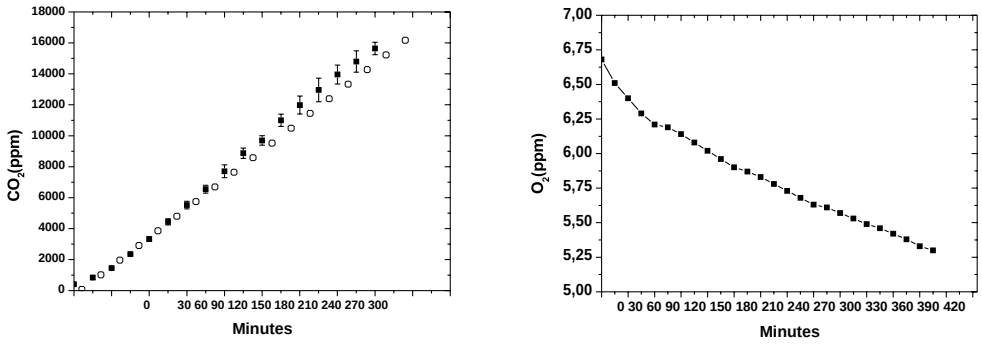
Keywords. Tomatillo, postharvest, sensors

Introduction. The tomatillo (*Physalis ixocarpa* Brot. Ex Horm.) is a species native to Mexico, belonging to the family Solanaceae, is consumed as vegetable in various dishes of Mexican cuisine (1). His life postharvest is short, and its evaluation is done with traditional methods. The objective of this project was monitoreaer the CO_2 and O_2 parameters of frespiration ruit with sensors.

Materials and Methods. Fruits harvested between July to September 2016 were used. The physico-chemical characteristic evaluated was respiration of "Tomatillo". It was performed with sensors that record the variation of CO_2 and O_2. A container of polyethylene terephthalate (PET) 3,5 L total volume, the sample weight was 1,0 kg, head space used for monitoring was 2,5 L. The samples were moinitoreadas for a period 375 minutes; each interval to 15 minute one data was record. The quantification of CO_2 was performed with a Science Cube, KDS-1037 sensor, range 0 - 10.000 ppm Science Cube Studio equipped with see-II software. 3.0.8.2. for recording information. Quantification of O_2 sensor Hach model DBOHQ40D luminicente probe was used.

Results. The figures illustrate the behavior of generation for CO_2 and O_2 consumption, using the sensors described above.



Conclusions. The adoption of this technology allows measurements *in situ* fast and without reagent consumption. This technologies are proposed as methods friendly to environment.

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REAL-TIME PATHOGENIC MICROORGANISMS MONITORING IN UNTREATED WATER WITH NANOWIRE GAS SENSOR DEVICE *(S3)*

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Keywords. environmental, food, untreated water, pathogenic microorganisms, microbiological, purification, e-sensing, nanowire sensors.

Introduction. In untreated water are present pathogenic microorganisms dangerous for the human health that are able to produce a different kind of organic chemicals called Volatile Organic Compounds (VOCs). These compounds can go to constituite a true "olfactory fingerprint" specific to a particular pathogenic microorganism. Through the use of the novel device *S3* it is possible to individualize the pathogenic microorganisms present in untreated water.

Materials and Methods. The *S3* device is equipped with an array consisting of MOS gas sensors constructed with the novel nanowires technology. This kind of sensor has innovative characteristics: the resistance at the high temperatures for a long period of time and the higher surface area for the analysis despite their small size [1]. This gives to the portable device a greater sensitivity, significantly lowering its detection threshold. The S3 data were supported with classical chemical technique like SPME-GC- MS, to identify the VOCs detected by the S3. In order to carry out the analysis, 5 mL of four different samples, drinking water from bottle and tap and two pathogenic microorganisms solutions at the concentration of 500 CFU/mL and 50 CFU/mL, were putted into 40 chromatography vials.

Results. Concerning the S3 tool: the two drinking water samples are the same, furthermore the S3 is able to distinguish between the drinking water and the 500 CFU/mL, 50 CFU/mL pathogenic microorganisms' solutions (Fig. 1). In particular, the 50 CFU/ml solution represents the threshold. The GC-MS-SPME river wastewater analysis showed the presence of indole VOC, it is used as a marker of the water contamination degree.

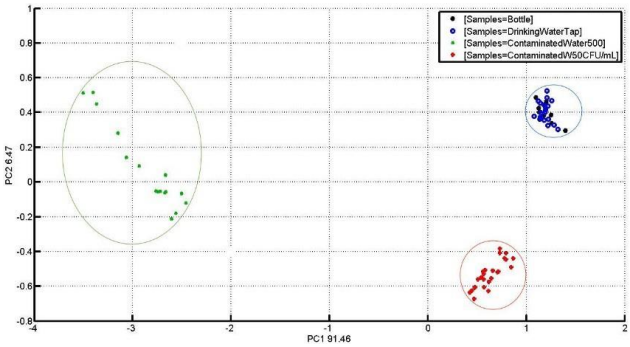

Fig. 1 PCA "Score Plot" about Drinking water (blue and black dots), 500 CFU/mL (green dots) and 50 CFU/mL (red dots) pathogenic microorganisms solution. In addition, it shows a PC1 value of 91.46% and a PC2 value of 6.47%.

Conclusions. In conclusion, the hand-held S3 tool allows on-site simple and rapid distinction between the drinking water and contaminated water. The river wastewater's analysis will be more precise, accurate, sensible and selective if S3 will be implemented with the indole high sensible gas sensor.

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PROBIOTICS PROTECTION BY MICROENCAPSULATION USING IONIC GELATION AND COMPLEX COACERVATION TECHNIQUES.

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Keywords. *Lactobacillus casei*; microencapsulation; complex coacervation; gelatin; sodium alginate

Introduction. Foods containing probiotic bacteria are categorized as functional foods. They are gaining popularity and acceptance by consumers. But, to exert health benefits, the concentration of live probiotic bacteria is required to be at the level of approximately 10^7 CFU/mL of the product at the time of consumption. Protection of them by microencapsulation in many biopolymer materials is one of the methods of improving their viability in functional foods (1,2). Coacervation is a highly promising encapsulation technology in view of its good encapsulation capacity and controlled release of core material from the microspheres by mechanical stress, temperature and pH changes (3). *Lactobacilli* are one of the most abundant probiotic organisms and they have beneficial effects to the gut health in the form of easy digestion, immune stimulation and inhibition of pathogens. The aim of this work was to enhance the thermal resistant of *Lactobacillus casei* using the combination of ionic gelation and complex coacervation techniques as encapsulation techniques.

Materials and Methods. *Lactobacillus casei* was microencapsulated by combining ionic gelation and complex coacervation techniques (4). Gelatin and alginic acid were used as wall and coating materials, respectively. The highest electrostatic interactions between components were evaluated by ζ-potential measurements at different pH values. Also, encapsulation efficiency was determinate. Thermal analysis was done at different combination of temperature-time (50, 75 or 100°C for 10, 25 and 50 min). One gram of microcapsules or 1 mL of the free cell suspension (10^{10} cells mL^{-1}) was transferred in test tubes containing 10 mL of distilled water. After the thermal treatment, the content was cooled to room temperature (25±1°C) and viable cells were enumerated.

Results. At pH values of 3.75, alginate:gelatin mass ratio 1:6 yielded cells encapsulation efficiency of 64.7%, and significantly higher viability of 9.45 log cfu g^{-1}. Gelatin and sodium alginate complex coacervation provided a physical barrier against high temperature, due to after 50 min at 100°C, the microbial count decrease in 3 logarithmic units. The improvement in heat stability after microencapsulation resulted from the lowered water diffusion rate in alginate beads with a higher concentration of biopolymers.

Conclusions. Ionic gelation and complex coacervation techniques using alginate and gelatin could be considered a potential technique to increase probiotic thermal resistant.

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ELIMINATION OF *SALMONELLA* CROSS-CONTAMINATION ON EGGS USING ANTIMICROBIAL COATING

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Keywords. coating; egg; Salmonella; LAE; pectin-alginate; cross-contamination

Introduction. Gastro-intestinal infections caused by *Salmonella* strains, together with *Campylobacter*, are among the most common food-borne diseases in Italy (3). Therefore, it is important to avoid the spreading of bacterial colonization on different type of foods. A common vector of Salmonella are eggs, which can be contaminated by the laying hen (vertical or horizontal infection) or by contact with contaminated eggs of food (cross-contamination) (1). At the moment, the Italian prevention practices to control Salmonella spreading are bacterial controls on laying hens and their environment and eggs brushing before packaging. Other countries allow eggs washing, but this process decreases the shelf-life of the product. This study investigates the efficiency of an antimicrobial coating to avoid *Salmonella* cross-contamination on eggs.

Materials and Methods. First category medium eggs were bought from a local store and contaminated with *Salmonella enteriditis*, by dipping them in a solution containing 1*10^7 cfu/mL bacteria. Afterwards, a gel containing pectin and alginate as polymers was used to create the coating by dipping technique (2) (with or without Lauroyl-Ethyl-Arginate (LAE) as antimicrobial agent) . Eggs were dried and stored at 4° C. On day 1, 3, and 7, eggs were rolled onto 15 mm Petri dishes containing a selective medium for *Salmonella*, to evaluate the microbial charge on the surface.

Results. Bacterial charge obtained by plate counting showed that *Salmonella* surface contamination decreased during the storage period. Non-coated eggs started with 849 cfu per egg, decreasing to 132 and 120 after 3 and 7 days, respectively. Coated eggs showed a bacterial load almost 3 orders of magnitude lower than control. In effect, on day 1, 11 cfu were found on coated eggs and 10 were found on coated+LAE eggs; after 3 days they decreased to 9 and 1 cfu , respectively, and no colonies were found on day 7.

Conclusions. It seems evident that coating the eggs with pectin-alginate polymer drastically reduce the recovery of *Salmonella* colonies from the egg surface. Therefore, the occurrence of cross-contamination would be highly reduced as well. The barrier effect of the coating itself showed to be highly effective even without the addition of antibacterial agents such as LAE. This active packaging may guarantee higher safety for eggs and other foods common carriers of potentially pathogen bacteria.

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EVALUATION OF THREE ESSENTIAL OILS TO COMBAT CARBON THE TOMATILLO (*Fhysalis ixocarpa Brot.)*

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Keywords. Tomatillo, essential oil, severity, *Entyloma australe*

Introduction. The tomatillo (*Physalis ixocarpa Brot. Ex Horm*.) is a specie native to Mexico, have 80 species the genus Physalis belonging to the Solanaceae family, it presents problems such as pests and diseases, commercialization and financing. For the first, the technical assistance is required for better management and increase the yield of this crop. The objective of this work was to evaluate three essential oils against the carbon of the tomatillo.

Materials and Methods. An experiment was set up and a randomized block design was used with seven treatments and three replicates. The application of oils: rosemary, cloves and cinnamon were 5000 and 6000 mg/L, they were applied four times, one week between each application. The effect of essential oils were evaluated with a severity scale elaborated by Tizapantzi et al. (1).

Results. The results obtained showed that variables plant height, stem diameter and yield of the tomatillo crop did not present significant differences between treatments, which indicates that essential oils did not influence on the physiology of plant. However, there were influenced the severity on white carbon (*Entyloma australe*), the best treatment was the essential oil of clove at 6000 mg/L, because of it only showed a severity of 18%, although it was important highlight that the other treatments decreased the severity of the disease by 50%.

Conclusions. The clove essential oil at 6000 mg/L was the one that inhibited in greater percentage the development of the white carbon disease (*Entyloma australe*).

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ACTION OF ELECTRON BEAM ON FUNGAL GROWTH FROM POSTHARVEST PAPAYA

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Keywords. irradiation, fungi, phytossanitary treatment, Carica papaya

Introduction. Hydrothermal treatment is the phytosanitary measure currently used for papayas. However, electron beam irradiation has shown potential to replace that method (2), because it is quick and does not interfere in the quality of the treated products if the appropriate dosage applied. In view of this, electron beam irradiation doses (0, 1, 3 and 5 kGy) were applied on fungi (*Colletotrichum gloeosporioides* and *Phoma caricae-papayae*) cultures and on 'Golden' papaya fruits inoculated with both fungi to evaluate the potential of this technology to reduce diseases of the postharvest papaya rot complex.

Materials and Methods. Golden papayas with caliber 15 were acquired, selected and standardized at the 4th stage of maturation. They were cleaned with sodium hypochlorite (0.5%), air dried and then inoculated with *Colletotrichum gloeosporioides* or *Phoma caricae-papayae*. Fungal strains were cultured in Petri dishes containing potato dextrose agar and incubated at 20°C. After six days of incubation, mycelial disks with 0.7 cm diameter were inoculated at two points. After receiving the disks, the papayas were placed individually in plastic zipper bags (20 x 30 cm) and stored at 22°C The experiment was conducted in a completely randomized design (CRD) using seven replicates per treatment for each fungus, each repetition represented by a fruit with two points of inoculation. A linear electron accelerator (LINAC) was used to inoculate the fruits, with 18 kW of power and energy of 10 MeV, with an up and down electron beam. Electron doses and control were applied namely: T1-control (without irradiation); T2-1 kGy dose; Dose-T3 and T4-3 kGy 5 kGy dose. After that, the papayas were packaged and stored at 22 ± 0.4℃ under 89.5 ± 2.9% RH.

Results. Non-irradiated (control) fruits had lesions twice the size of the irradiated ones. The doses of 1 and 3 kGy did not significantly altered the diameter of the lesions, while the dose of 5 kGy led to smaller lesions. In relation to *C. gloeosporioides*, there was no statistically significant difference in injury size between the irradiated fruits receiving different doses, but the the lesions were smaller than in the control fruits. The fungus *C. gloeosporioides* was more resistant to electron beam irradiation than *P. caricae-papayae*, where the frtuits receiving the dose of 5 kGy were already growing lesions on the third day after irradiation, while those inoculated with *P. caricae-papayae* only showed lesions seven days after irradiation, and growth was reduced. Doses of 3:05 kGy caused burn injury to the peel of the fruit, so this can be considered too high a dosage for 'Golden' papaya

Conclusions. From the the doses tested, 1 kG was effective in reducing the growth of *C. gloeosporioides* and *P. caricae-papayae* and maintaining the quality of fruit, since the doses of 3 and 5kGy caused injuries to the fruit.

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THE MICROBIAL SAMPLING REGIME AND QUALITY OF WATER IN AN IRISH MILK PRODUCTION PLANT

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Keywords. dairy; water quality; sampling regime, sampling efficiency, Ireland

Introduction. Food production plants require large amounts of water. To comply with regulatory guidelines, the microbiological examination of water is routinely carried out. This study analysed microbiological and chemical sampling quality results of the water supply used in an Irish milk production plant over a two-year period. The results of this study identified contamination issues associated with the cooling water in terms of the heterogeneity of both microbiological and chemical concentrations and recommended the inclusion of further sampling parameters to further identify causation factors. For the non-cooled water sampling locations, homogeneity in quality suggested that reduced sampling frequency could be implemented, thus reducing cost. The results of this study propose that in-depth analysis of both microbiological and chemical sampling results within a dairy plant can facilitate in the more cost effective sampling procedures and offer valuable insight into the development of site specific protocols.

Materials and Methods. Four sampling points (SP1, SP2, SP3 and SP4) were tested six days a week (n = 2032) during the years 2014- 2015 and results were compiled for total coliforms, *Escherichia coli*, *Enterococcus* and total bacterial counts (TBC) at 21ºC, 30ºC and 37ºC. Total and free chlorine levels at each of these sampling points were also assessed. The results of sampling (n = 2,032) were categorized by sampling date, location and sampling specification. Prior to statistical analyses, all independent variables were assessed for normality using the Kolmogorov-Smirnov test. The One-way ANOVA test was used to test for associations between nonparametric categorical variables and the Spearman's correlation coefficient test used to test for correlation between quantitative variables. SPSS® 22 was employed for all statistical analyses and the confidence level was set at 95%.

Results. For SP1, a significant negative relationship was found between both free and total chlorine and TBCs at 30°C ($r = -0.451$, $p < 0.001$), demonstrating that chlorination is effective in the reduction of these bacteria. A significant negative relationship was also found to exist between free and total chlorine and coliforms at SP1($r = -0.153$, $p < 0.032$), although, as with the other sample locations, the correlation is weaker. Interestingly, there was no significant correlation found between chlorination levels and *E. coli* ($r = 0.008$, $p = 0.882$) or *Enterococci* ($r = -0.137$, $p = 0.089$) counts at SP1, suggesting that chlorination is not effective in the reduction of these faecal organisms at this particular sampling site.

Conclusion. This research has provided the dairy manufacturing plant with the ability to prioritise efficient, cost effective sampling and improve microbial monitoring across the water reservoirs. This study presents an opportunity for other dairy plants to review their operational procedures for water quality analysis and facilitate in efficient sampling and thus cost reduction.

MUTUALIST INTERACTIONS BETWEEN PROBIOTIC LACTOBACILLI FROM HUMAN ORIGIN AND *Streptococcus thermophilus* IN FERMENTED MILK

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Keywords. probiotic, growth, viability.

Introduction. Probiotic are live micro-organisms which, when administered in adequate amounts, confers health benefit on the host. Strains for human use are preferably of human origin, since they would be better adapted to survive in the hard conditions of the human biome (1). Ensure viability of the probiotic in foods is a technological challenge. The microbial interactions between the probiotic and other micro-organisms are predominantly of competitive or mutualistic nature, whereby can affect either the population level of a given strain or the metabolic activity of that strain. So when the interaction is mutualistic, there is synergism that benefits the probiotic culture. The aim of this study was to check the possible synergism between probiotic *Lactobacillus rhamnosus* and *Lactobacillus paracasei* with two *Streptococcus thermophilus* strains.

Materials and Methods. *Lactobacillus rhamnosus* and *Lactobacillus paracasei* were isolated from stool material of healthy newborns. The strains of *Lactobacillus* and *S. thermophilus* were activated by three successive transfers in MRS broth (Oxoid) or M-17 (Oxoid) and incubated at 36° and 42°C, respectively. At the last sub culture, the cell suspension was centrifuged (6000*g*/5 min.), the supernatant was discarded, the pellet was washed twice with phosphate buffer before re-suspending and set to contain *ca* 10^9 cfu/ml. Eight bottles with 1000 ml of skimmed milk powder reconstituted at 12% were autoclaved at 110°C/10 minutes and cooled to 40°C. Then, each bottle was added 3% pasteurized honey (78°C/6 min.) from *Apis mellifera* multifloral source. The bottles were inoculated with *ca* 10^7 cfu/ml of either the axenic or combined cultures. After homogenization, the content of each bottle was distributed in 10 bottles, each with 100 ml. Then, the bottles were incubated at 38°C in a thermostatic bath for up to nine hours. At regular intervals of 1 hour, one bottle of each sample was taken off for pH measurement. At the start (zero time) and at the end (9 hours) of fermentation, the lactobacilli viability was quantitated by plating in MRS agar (Oxoid) by drop technique.

Results. When growing in axenic culture, *L. paracasei* and *L. rhamnosus* show no potential for acidifying the milk, even after nine hours of incubation. When they were associated with either *Streptococcus thermophilus* 01 or 02, there was an increased in production of acid and thereby coagulating the milk. *S. thermophilus* 02 acidify the milk without being associated with any *Lactobacillus*. Despite its acidification potential, *S. thermophilus* 02 is not the best strain to use as supporter culture, since it did not intereract with the probiotic culture. There was no significant difference on *Lactobacillus* growth (cfu/g) in fermented milk when they were associated with supporter *S.thermophilus* cultures or not. However, we observed that the time required for the formation of colonies in the surface of the MRS agar was higher when they are not associated. This indicates that the interaction between cultures promote more vitality for probiotics. More studies are being made in this direction to further explain this event.

Conclusions. There is stimulation in the metabolism of *L. rhamnosus* and *L. rhamnosus* when growing in the presence of *S. thermophilus* 01 resulting in the skimmed milk coagulation within nine hours of incubation at 38°C.

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INVOLVEMENT OF COOPER IN MALE REPRODUCTION

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Keywords. copper, risk factor, male fertility, spermatozoa, cytotoxicity

Introduction. Copper is an important microelement for the organism, because it has a great positive role in physiological and regulatory processes (1). Its deficiency and toxicity may lead to physiological abnormalities and copper concentration in the body is connected to its concentration in food and environment (2). Male fertility is extremely sensitive to different effects which may lightly disturb spermatogenesis and consequently lead to a decrease in spermatozoa quality and production. The toxic effects of different metals depend on dose, duration, route of administration and species (3). Therefore, our experiment evaluated dose- and time-dependent effects of copper (II) chloride ($CuCl_2$) on the motility of spermatozoa. Furthermore, it was also necessary to examine the possible cytotoxicity effect of $CuCl_2$ on spermatozoa.

Materials and Methods. Bovine semen samples (n = 58) were obtained from 6 adult breeding bulls (Slovak Biological Services, Nitra, Slovak Republic). Spermatozoa were incubated with various concentrations of $CuCl_2$ (3.90; 7.80; 15.60; 31.20; 62.50; 125; 250; 500; 1000 µM) during different time periods (0h, 1h, 2h, 24h). The motility analysis was carried out using a CASA system - SpermVision™ program. The viability of the cells we assessed by the MTT (metabolic activity) assay. Results were evaluated by statistical program GraphPad Prism 3.02.

Results. The initial spermatozoa motility (0h) showed significantly (P<0.001) decreased values at concentrations ≥ 250 µM $CuCl_2$ and concurrently they have a cytotoxic effect on the mitochondrial complex of spermatozoa. The low concentrations (≤ 7.80 µM $CuCl_2$) stimulated the mitochondrial activity of cells and maintained of spermatozoa motility (2h). The long-term cultivation (24h) significantly (P<0.001) reduced the average motility values in all experimental groups.

Conclusions. Based on these results it can be concluded that copper at high doses (in food and environment) acts as a toxic element on the male reproductive system, i.e. spermatozoa motility, and it has a destructive effect on the mitochondrial complex, which is necessary for their life processes. Copper at low doses can use in biotechnological processes in fertilization techniques.

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ANTIBACTERIAL PROPERTIES OF PHBV FILMS WITH CARVACROL OR OREGANO ESSENTIAL OIL IN DIFFERENT FOOD MATRICES

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Keywords. PHBV, film, carvacrol, oregano, antimicrobial activity, foodstuffs.

Introduction. Films incorporating essential oils (EO) have shown antimicrobial activity against most foodborne pathogens in *in vitro* tests. However, when these films were applied to real foodstuffs, significantly higher amounts of the active compounds were necessary to reach similar antimicrobial action (1). The interactions of these compounds with different food components limited their effectiveness as antimicrobials (2). Several authors have reported that the presence of high fat or protein content in the food matrix can inhibit the EO's antimicrobial activity, which suggested that the protective effect of some food components on the bacteria against EO[1]. The aim of this work was to evaluate the antibacterial effect of PHBV films containing carvacrol (CA) or oregano essential oil (OR) in food matrices of different composition, as compared to the effect of those films observed in culture media.

Materials and Methods. Materials: PHBV (8%) was provided in pellet form by NaturePlast (Caen, France). OR was obtained from Herbes del Molí (Alicante, Spain), while CA was supplied by Sigma-Aldrich (Sigma–AldrichChemie, Steinheim, Germany). All culture media were provided by Scharlau (Scharlau, Spain). Stock cultures of *Listeria monocytogenes* (CECT 910) and *Escherichia coli* (CECT 101) were obtained from Colección Española de Cultivos Tipo (CECT, Burjassot, Spain).
Obtention of active bilayer films: PHBV-based films were obtained by compression-molding. To obtain the active bilayer films, one PHBV film was sprayed with the active compound (15% w/w) and it was thermo-compressed with another monolayer. Antimicrobial activity assessment: Agar culture media (*in vitro* tests) and different food products (chicken breast slices, fresh cheese slices, fresh-cut melon and fresh-cut pumpkin) were inoculated with 100 μL of a suspension of *Listeria monocytogenes* or *Escherichia coli* (10^6 cfu/mL) and were coated with the films. Microbial counts were performed before and after 10 days of storage at 10ºC.

Results. PHBV films with CA or EU led to bacterial growth inhibition (between 2 and 4 log cfu/g) in the *in vitro* test as compared to non-coated samples. However, in real foodstuffs, significantly lower growth reductions were observed, depending on the type of food matrix. Thus, the highest antimicrobial activity (2-3 log cfu/g reduction) was achieved in fresh cheese samples and fresh-cut pumpkin inoculated with *E. coli* and, to a lesser extent, in chicken breast samples. Both active film formulations showed limited antilisterial activity in all food matrices tested (less than 1 log cfu/g reduction). In general, CA was more effective than OR as antibacterial, except for fresh cheese samples where OR showed a greater antibacterial activity against *E. coli*.

Conclusions. The development of active films for food packaging applications required *in vivo* tests performed with the specific microorganism inoculated in the food matrix where the film should be applied in order to evaluate the achievement of food safety requirements.

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GELATIN- BASED FILMS WITH RED PROPOLIS EXTRACT, CLOVE (*Syzygium aromaticum*) AND BASIL (*Ocicum basilicum*) ESSENTIAL OILS FOR GROUND BEEF CONSERVATION

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Keywords. Edible films, Active packaging, Antimicrobial activity, Antioxidant activity.

Introduction. Among several sources of active principles, essential oils and propolis extract can be used to produce biodegradable films with a higher antioxidant and antimicrobial activities. Moreover, some active principles can improve physical and barrier properties of films (1,4). These active films have a great potential to be used to increase the shelf life meat products (2). The objective of this research was to evaluate the microbiological and antioxidant activities of gelatin-based films with red propolis ethanolic extract (RPEE) and essential oil (EO) of cloves and basil and to apply these films as packaging of ground beef.

Materials and Methods. Films produced with four formulations: C1 (4% Gelatin + 0.8% RPEE); C2 (4% Gelatin + 0.3% EO Clove); C3 (4% Gelatin + 0.8% EO Basil); and C4 (4% Gelatin + 0.8% RPEE + 0.3% EO Clove + 0.8% EO Basil) were used as packaging of piece of 30g of ground beef (sirloin steak) with 70mm diameter and conditioned at 4 ± 2°C for 10 days. Meat without film was considered as controll. The oxidation of ground beef , was determined using the peroxide value (PV) (Lekjing, 2016), and the microbial counts of aerobic mesophilic, total coliforms and *Staphylococcus aureus* (3), were studied during the days 0, 3, 7 and 10.

Results. All activeted films protected the ground beef against lipid oxidation. During storage at 4 ± 2°C, the PV of meat without protection by film increased from 53 to 156 mEq/kg lipid (Table 1). For ground beef protected with films C1, C3 and C4, PV decrescead for 3th day and increased to 10th day, but remaining lower than for the control treatment. On another side, for ground beef protected with film C2, the lower value was observed for 7th day. On overall, at the 10th day, the treatment C4 proportioned the lower PV value (19 mEq/kg lipid) (Table 1). Regarding the microbiology, on overall, the films were not so much efficient against all studied bacteria during storage at 4 ± 2°C. Films C2 and C3 protected the ground beef only against *Staphylocuccus aureus* (Figure 1-3).

Conclusions. All four formulations of active films exhibit good protection in relation to the lipid oxidation of packed ground beef. Nevertheless, the antimicrobial activity was limited to *S. aureus* and just for treatments C2 and C3. Thus, these films can be applied for protect meat products con high moisture content.

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MICROBIOLOGICAL ACTIVITY AND ANTIOXIDANT ACTIVITY OF GELATIN-BASED FILMS WITH RED PROPOLIS EXTRACT AND MINT (*Mentha piperita L.*) ESSENTIAL OIL

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Keywords. Active packaging, Antimicrobial capacity, Antioxidant capacity.

Introduction. Active packaging for food conservation has gained a particular interest in the development of new materials (1,2), principally when it are prepared using natural products. Among natural additives, essential oils and diverse types of propolis, has awaken the interest of the researchers for its antibacterial and antioxidant properties (3). Thus, the objective of the present research work was to study the antioxidant activity and the antimicrobial activity against Gram (+) and Gram (-) bacteria, in gelatin-based films activated using red propolis ethanolic extract (RPEE) and mint essential oil (MEO).

Materials and methods. Activated films were prepared using six formulations: T1 (4% Gelatin, as control), T2 (4% Gelatin + 2.0% RPEE), T3 (4% Gelatin + 2.0% MEO), T4 (4% Gelatin + 1.0 % MEO + 1.0% RPEE), T5 (4% Gelatin + 0.5 % MEO + 1.5% RPEE) and T6 (4% Gelatin + 1.5 % MEO + 0.5% RPEE). Diffusional test for microbiological sensibility for Gram (+) [*Staphylococcus aureus* (ATCC 29213), *Listeria monocytogenes* (ATCC 4677)], and Gram (-) [*Esherichia coli* (ATCC 25922) and *Salmonella enteritidis* (ATCC 13076)] was tested. Antioxidant activity of films was determined through $DPPH^{\bullet}$, $ABTS^{\bullet+}$ tests, besides the total phenolic content were measured through Folin-Ciocalteau method.
The higher total phenolic content was observed in films T2, but the higher scavenging activities were observed in films T4. These results can suggest that the MEO has no phenolic antioxidant components. Regarding microbiology concerns, no effect was observed against *E. coli* and *S. enteritidis* (Table 2). But, films were efficient against Gram (+) bacteria (*S. aureus* and *L. monocytogenes*), excepted for films T3, suggesting that the MEO has no components with antimicrobial activity. Films T2, T4, T5 and T6 presented activity against these bacteria, being the higher halo value observed with films T2.

Conclusions. Overall, the active gelatin films presented high antioxidant activity, but no activity against Gram (-) bacteria. The results of this work allows to suggest that the antioxidant activity was due to the MEO and RPEE components, being that only RPEE had phenolic compounds. Moreover, the components with antimicrobial activity against Gram (+) bacteria was due to RPEE components.

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ANTIOXIDANT AND ANTIMICROBIAL PROPERTIES OF MICROENCAPSULATED EUGENOL BY SPRAY-DRYING

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Keywords. oleic acid, whey protein isolate, chitosan, microcapsules.

Introduction. Throughout the last years, substantial efforts have been focused on the use of natural antioxidant compounds for the development of novel health-promoting ingredients for the food industry. Eugenol (E) is a natural phenolic compound with effective antimicrobial and antioxidant properties[1]. However, it is difficult to handle due to its limited water solubility. It is also susceptible of losing functionality during its processing. In this sense, the encapsulation technique has recently gained special attention. Whey protein Isolate (WP) is a biopolymer able to entrap hydrophobic compounds successfully. WP together with maltodextrin (MD) can develop a good anionic wall system[2]. The formation of a secondary layer is possible by electrostatic deposition of an oppositely charged polymer, such as Chitosan (CH)[3]. The aim of this work was to encapsulate eugenol by using WP and a double layer composed of WP and CH. Moreover, the effect of the addition of oleic acid (OA) was studied.

Materials and Methods. Dispersions were preparing by dissolving 43% (w/w) of WP:MD solids (ratio 1:42) and 3% (w/w) of eugenol (E-WP), with and without 7% (w/w) of OA (EOA-WP). All emulsions were microfluidized three times with a high pressure homogenizer. The second layer of CH (1% solution, w/v) was added in a CH:emulsion ratio of 1.5:10 (EOA-WPCH). Characterization of spray-dried microparticles was carried out in terms of particle size and optical microscopy, physical stability, encapsulation efficiency, surface oil content and antioxidant and antimicrobial properties.

Results. Free-CH formulations showed monomodal distributions ranging from 1 to 90 µm. The addition of CH provided a bimodal distribution due to the formation of large aggregates, in coherence with the microscopy observations. Encapsulation efficiency was around 95% and 87% in E-WP and EOA-WP, respectively. When CH was included, the extractability of eurgenol was compromised, leading to a low concentration of eugenol available (22%) and the surface oil content increased. Free-CH formulations exhibited remarkable antioxidant (AOX) and antilisteria activity (AM). E-WP and EOA-WP showed AOX values similar to the pure eugenol. WP-CH based formulations exhibited lower AOX and AM values due to the greater amount of entrapped eugenol into these microcapsules.

Conclusions. Microencapsulated eugenol by spray drying using whey protein with or without oleic acid showed interesting antioxidant and antilisterial activity. The development of a second layer with the addition of CH markedly increased the particle size and reduced the functional power of the formulations due to the establishment of CH-WP interactions, which efficiently entrapped eugenol.

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INCREASING SHELF-LIFE OF MARINATED SALMON WITH OXIDIZED STARCH-GELATIN ACTIVE FILMS

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Keywords. Biodegradable films, oxidized starch, bovine gelatin, LAE, marinated salmon

Introduction. Blending with gelatin has been reported to enhance the mechanical behaviour of starch films (1), whereas oxidation could reduce the starch hygroscopic nature, since –OH groups are substituted by carbonyls. Biodegradable films based on an oxidized starch (OS) - bovine gelatin (BG) blend containing the antimicrobial LAE (ethyl lauroyl arginate) could be useful for the preservation of perishable ready-to-eat food products (2). The aim of the present work was to apply OS:BG films with LAE for the preservation and shelf-life extention of marinated salmon.

Materials and Methods. OS was obtained by oxidation with Sodium Periodate (molar ratio with corn starch 1:1). The ratio OS:BG:Glycerol:LAE was 0.5:0.5:0.25:0.013. The films, both with and without LAE, were obtained by casting the dispersions (2 % wt. of polymer in distilled water). The optical properties (L*, h_{ab}* and C_{ab}*) of the films after conditioning at 53 % and 88% RH were measured. The antimicrobial activity of the films against *Listeria innocua* was tested *in vitro* (10^4 CFU/mL, 24 h, 37 ºC), and *in vivo* (45 days at 4 ºC) on inculated (10^2 CFU *L.innocua* /cm^2) or non inoculated samples of marinated salmon, by the enumeration of total viable counts (TVC).

Results. All films showed browning due to the reaction between carbonyl and amino groups yielding Maillard compounds. This was improved by high RH (88 %) and LAE, also giving rise to significantly lower L*, higher redness and greater colour saturation. Films without LAE showed antimicrobial activity, which could be due to the Maillard products, as has been previously reported (3). In the *in vitro* test against *L.innocua*, OS:BG films showed a 2.0 and 1.7 log reduction at 5 h and 24 h of incubation, respectively, whereas OS:BG:LAE films were totally effective. The antimicrobial
activity of OS:BG:LAE films was less extensive in the *in vivo* assays, especially againt *L.innocua*. After 45 days of refrigerated storage, the enumeration of TVC showed log reductions of 3.6 for OS:BG and 4.6 for OS:BG:LAE, whereas these were 1.9 and 1.0, respectively, for *L.innocua*.

Conclusions. The application of OS:BG films, both with or without LAE, proved to be greatly efficient for the preservation of marinated salmon. Since the salmon matrix seemed to interfere with the antimicrobial ability of LAE against *L.innocua*, more extensive microbiological research would be needed.

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SIGNIFICANCE OF SODIUM REDUCTION IN CURED HAM

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Keywords. salt, pork, sodium, ham, cured

Introduction. In order to reduce the NaCl content, other salts can be used to replace it, such as KCl, $CaCl^2$ or $MgCl^2$, which have been used in the production of sauces, Vienna sausages, cheese, bread, cured sausage products, cooked ham, and cured loin.

Materials and Methods. The experimental design considers the elaboration of ham by means of Treatment A, pork shank with 100% NaCl (5 repetitions), and Treatment B, pork shank with NaCl (75%) and KCl (25%) (5 repetitions). The shanks were taken from 5 animals, where the left shanks were subject to Treatment A and their corresponding right shanks were subject to Treatment B. These animals were raised 35 days with their mother, 165 days in pasture and 40 days in corral, where they were fed with a ration of grain, vitamins and minerals. The animals were slaughtered once they reached 9 months of age. The average initial weight of the shanks for Treatment A was 10.28±0,46 kg and 10,28±,069 kg for Treatment B. During the elaboration, the shanks were covered with the corresponding salt during 1.5 days/kg of each piece. After the salting period, the salt was removed, the surface was washed with water and then the pieces were dried. Subsequently, they were kept for 95 days in a cold chamber at 3°C. Finally, in order to achieve the appropriate dehydration level of the product, the pieces were kept at room temperature for 280 days. The processes carried out are based on a Spanish technique for the elaboration of Serrano Ham (3). Na and K measurements were made according to the procedure for determination of sodium, potassium and calcium in food, Flame Atomic Absorption Spectrophotometry. Method AOAC 985.35. PRT-711.02.012. A repetition was carried out for each determination for control, Treatments A and B.

Results. After the chemical analysis of hams and the determination of Na and K values, a lower Na content was observed in Treatment B with 8,74±1,156 % compared to Treatment A with 11,108±1,476 %. In relation to K, Treatment B showed a higher percentage with 3,886±0,542 % compared to Treatment A with 1,586±0,161 %.
According to Armenteros (2) and Aliño et. al. (1), Treatment B with its Na values lies within the recommended range for this type of product.

Conclusions. By means of a salt mixture of NaCl and KCl used in the processing of pork ham pieces, it is possible to produce cured ham with lower Na content without altering the product's chemical and organoleptic properties.

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APPLICATION OF FOURIER TRANSFORM INFRARED (FTIR) SPECTROSCOPY FOR DIFFERENTIATION OF BEEF MIXTURES ADULTERATED WITH MECHANICALLY DEBONED BEEF

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Keywords. Beef, mechanically deboned beef, FTIR Spectroscopy, adulteration

Introduction. Adulteration of meat products by substituting premium-quality meats with low-cost ones for economical, technological and sensorial purposes is considered fraudulent practices all over the world if this substitution is not indicated on the label. For this reason, meat authenticity focusing on determination of fraudulent substitution has been becoming an emerging area of research. Mechanically deboned meats are low-cost and poor quality co-product of the meat industry which are used as a source of fraudulent substitution. The aim of this study was to differentiate mechanically deboned beef (MDB) types, produced from different carcass parts, i.e., chuck, brisket and rib in the raw beef mixtures by using Fourier Transform Infrared (FTIR) Spectroscopy.

Materials and Methods. Beef *Longissimus dorsi* muscle was used as the main meat type, and mechanically deboned beef from chuck, brisket, or rib were added at 0, 5, 10, 20, 40 and 100% (wt/wt) proportions to make raw meat mixtures. For each mixture, spectra were recorded in the mid-infrared region by using ATR.Data were analyzed by hierarchical cluster analysis and principal component analysis.

Results. There are two stages in our study. In first stage, characteristic peaks and regions were determined and alterations with the substituted ratio were identifiedwith naked eyes. The zoomed view of spectra indicated that seven characteristic regions (2980-2800 cm^{-1}, 1760-1710 cm^{-1}, 1480-1360 cm^{-1}, 1290-1210 cm^{-1}, 1210-1140 cm^{-1}, 1140-1020 cm^{-1}, and 1000-900 cm^{-1}) could be used to characterize fraudulent mixtures. Increasing amount of mechanically deboned beef substitution generally resulted in an increase in the intensities of characteristic bands. In second stage, characteristic regions, general spectrum and fingerprint region were evaluated for grouping mixtures into different cluster branches to classify their spectral similarities by hierarchical cluster analysis and principal component analysis. The data obtained from the current study indicated that the FTIR spectra of raw meat mixtures adulterated with MDM at different concentrations showed a clear distribution pattern that enables to detect and identify the kind of adulteration present.

Conclusions. The data obtained from the current study indicated that the FTIR spectra of raw meat mixtures adulterated with MDM at different concentrations showed a clear distribution pattern that enables to detect and identify the kind of adulteration present. This method might be a good option for the meat industry and the food control laboratories to determine fraudulent addition of undesirable meats into the product formulations to overcome the voids in meat authenticity and thus, to contribute with an applicable method to food safety.

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PLANT MILK SUBSTITUTE AS A POTENTIAL PREBIOTIC FERMENTED AND NOT FERMENTED DRINK

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Introduction. Plant milk substitutes from vegetable source are becoming of great interest for both health reasons or ethical choice. After a survey on commercial milk substitutes from raw materials-based cereal, ten products were characterized for their physicochemical, microbiological, aromatic, sensory and prebiotic properties, in order to identify specific product profiles and to find any possible relationships between those profiles and the vegetal source. The milk substitutes were then inoculated with lactic acid bacteria and probiotics, in order to screen for the best fermentation outlook.

Methods. The physicochemical parameters were determined according to the official methods. Volatile molecules were obtained by GC-MS SPME. Proteolytic activity was observed by means of SDS-PAGE analysis. Prebiotic potential was assessed with biochemical analysis of total dietary fibres. Microbial growth and pH values were assayed and monitored through all the period of fermentation. Fermentation of milk substitute was conducted at 37°C for 24 hours under anaerobic condition. The list of vegetable milks tested was including products from soy, rice, oat, durum wheat, millet and KAMUT® khorasan KV. To set up a plant fermented milk several strains were screened, including lactic acid bacteria and probiotics, as *Lb. rhamnosus*, *Lb. plantarum*, *Lb. acidophilus*, *Bifidobacterium bifidum* and *B. longum*.

Results. The pH of commercial non-fermented milks was inversely correlated to the aftertaste. GC-MS profile of durum wheat and millet beverages accounted for the highest concentration of alcohols and aldehydes, while phenols and aromatic groups characterized durum wheat. The prebiotic activity was found in oats, matching the best score, but even in wheat, rice, millet and KAMUT® khorasan. Moreover, in fermented beverages, *Lb. plantarum* showed the best technological outputs, lowering milk substitute pH already after six hours and accounting for the highest bacterial load, and resulted to own the strongest proteolytic activity when tested in soy.

Conclusions. The quali/quantitative differences among plant milk not fermented substitutes mainly accounted to the macro-components. A potential health benefit was specifically associated to oat and one of the products based on KAMUT® khorasan KV. Otherwise, during fermentation with lactic acid bacteria and probiotic the best products were obtained with soy and rice inoculated with *Lb. plantarum*. The strain used showed to be very promising, not solely from the technological aspect, but demonstrating even to better adapt to milk substitute environment and rend make vegetal proteins more suitable for human digestion.

ANTIMICROBIAL EFFECT OF BIOACTIVE GELATIN-CHITOSAN FILMS ON BEEF BURGER

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Keywords. Biodegradables-polymers, edible film, natural extract, beef burger, antimicrobial effect.

Introduction. Microbial growth is generally responsible for the spoilage in meats and meat products together with biochemical and enzymatic deteriorations. In fact, bacterial contamination is one of the main factors determining the loss in fresh meat quality, since these products are very prone to be contaminated with microorganisms if they are not properly preserved and handled (1). Gelatin (GEL) and chitosan (CH) have a good biodegradability, biocompatibility and film- forming ability, besides CH presenting antimicrobial and antioxidant properties. Both biopolymers are excellent vehicles to incorporate bioactive compounds, such as Boldo of Chile (*Peumus boldus Molina)* extract (B), which possesses more than 30 compounds with fungistatic and antioxidant properties (2).

Materials and Methods. Gelatin was dispersed (4 wt%) in distillated water. Medium molecular weight chitosan was dispersed (1 wt%) in an acetic acid solution (1 % v/w). To prepare the composite films, B extracts and glycerol (plasticizer) were added to respective solutions (1 wt%). The resulting formulartions were named as CH100, CH100 + B, GEL50:CH50 and GEL50:CH50 + B. The pure and blended films were prepared by casting technique. On the other hand, bovine meat from the slaughterhouse the University of Sao Paulo, campus of Pirassununga, was processed in the same place for obtaining beef hamburger samples of 6 cm of diameter. The surface of both sides of the samples were coated with the films. Non-coated and coated samples were placed in PET trays and were stored for 10 days in refrigerated conditions (5°C).

Results. Films prepared from pure CH and GEL:CH blend, with or without B extract added, showed their antibacterial effect on beef burgers. All the films significantly reduced the growth of coliform microorganisms (between 2.3-4.8 logCFU/g), when they were applied to the surface of beef hamburgers, compared to non-coated (control) samples (8.0 logCFU/g) ($p<0.05$). Pure chitosan film, without (CH) and with (CH + B) boldo extract led to a significant reduction in microbial load (3.2 logCFU/g and 4.0 logCFU/g, respectively) as compared to non-coated samples (8.8 logCFU/g), for total aerobic count microorganisms ($p<0.05$). Moreover, pure CH, CH + B and GEL50:CH50 films don't allow the growth of S. aureus, whose values remained the same as the day 0 (≈2.2 logCFU/g), compared to GEL50:CH50 + B (3.2 logCFU/g) and non-coated samples (4.0 logCFU/g) at day 10.

Conclusions. Pure chitosan films, with or without B extract, were proved to be effective in the control of microbial spoilage of beef meat hamburgers. The addition of B extract did not improve the antimicrobial activity of GEL50:CH50 blended films. However, safety aspects were improved by all these films, increasing the product shelf life.

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FUNCTIONAL PROPERTIES OF STARCH-PLA BILAYER ACTIVE FILMS CONTAINING CINNAMALDEHYDE

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Keywords. Poly(lactic acid) (PLA), starch, cinnamaldehyde, bilayer films, barrier properties.

Introduction. In a sustainable environment context, PLA is one of the most widely investigated polymers to replace petrochemical plastics used in the packaging field. PLA is a very transparent and biocompatible material but it is also very brittle[1] and highly permeable to oxygen. Starch (S) is another interesting biopolymer, widely available and thus pretty cheap, but very hydrophilic. The combination of both polymers could permit to obtain bilayer films with improved functional properties[2], in comparison with S or PLA monolayer films. Likewise, the incorporation of active compounds, such as cinnamaldehyde (CIN), adds value to bilayers, conferring them antimicrobial and/or antioxidant properties.

Materials and Methods. Amorphous PLA (4060D, Natureworks) was dispersed in ethyl acetate at 10% (w/w) and poured into Teflon plates to obtain monolayer films, with or without CIN (0.25g/g PLA). Thermoplastic cassava starch monolayers were obtained by melt blending and compression moulding. S-PLA bilayers were obtained by thermocompression at 160°C. Tensile properties, water vapour (WVP) and oxygen permeability (OP) were characterized in mono and bilayers using a texture analyser, Payne permeability cups, and OXTRAN SL 1/50 MOCON equipment, respectively. Differential scanning calorimetry (DSC) was used to analyse glass transition temperature (T_g).

Results. S-PLA bilayer films were more resistant than S monolayers but much less than PLA monolayers. CIN incorporation caused a drop in tensile strength, both in PLA monolayers and S-PLA films. However, both PLA and S-PLA films became more extensible with the addition of CIN, with a decrease of the elastic modulus. S molayers showed a high WVP but this was greatly reduced in bilayers when PLA was added. The incorporation of CIN did not notably change the WVP in either PLA monolayers or bilayer films. On the contrary, CIN reduced significantly the OP of PLA monolayers but not that of S-PLA assembly. Thermal analysis of the films revealed that CIN plasticizes PLA monolayer, in agreement with the tensiles behaviour, significantly decreasing the PLA T_g, and diffuses to the S in bilayers, then decreasing the T_g of both S and PLA.

Conclusions. A good adhesion was obtained when combining layers of thermoplastic starch and amorphous PLA, with and without CIN. This active compound contributes to plastizice the films at the same time that it confers them antimicrobial properties. Likewise, a notable improvement of the overall barrier properties was obtained in bilayer films with respect to the monolayers, and so, these active bilayers constitute a promising material for food pacakaging applications.

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IMPROVEMENT OF TENSILE PROPERTIES OF CASSAVA STARCH FILMS BY INCORPORATION OF XANTHAN, GELLAN AND PULLULAN GUMS

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Keywords. Tensile properties, cassava starch, xanthan gum, gellan, pullulan

Introduction. Mainly due to environmental concerns, petroleum based plastics are being replaced by biodegradable polymers (3). Starch-based films exhibit good properties, since they are biodegradable, food compatible, odourless, tasteless, colourless and constitute a good barrier against oxygen transfer. However, its application is limited by their poor mechanical properties and high water vapor sensitivity (1). Combination of starch with other compatible biopolymers can improve these properties (2). The objective of this work was to analyze the effect of xanthan gum, gellan and pullulan incorporation to cassava starch films on their tensile properties, as a function of storage conditions.

Materials and Methods. Films were obtained by solvent casting procedure after the preparation of film-forming dispersions (FFDs). The starch-gum ratios (w/w) in the blend films were 100:0, 90:10, 80:20 and 0:100, while glycerol was added at a polymer: glycerol ratio of 1:0.25. The FFDs were poured into PTFE casting plates and dried for 48 h at 45% relative humidity (RH) and 25ºC. A texture analyser (TA-XTplus, Stable Micro Systems, Surrey, United Kingdom) was used to measure the elastic modulus (EM), tensile strength at break (TS) and elongation at break (E), from the obtained stress–strain curves, according to the ASTM D882 method.

Results. Films obtained with pure xanthan gum and pure pullulan, equilibrated at 75% RH, did not show adequate properties, while pure gellan films were stiffer (higher EM) and resistant to fracture (higher TS), regardless the storage conditions, in comparison with all the studied formulations. In newly obtained films, gum addition to the starch matrix provoked an increase in the EM and TS, except for starch-pullulan blends at high RH, and a decrease in the E. Ageing the films for five weeks induced changes in the starch films tensile properties. Whereas TS increased in pure starch films, it decreased in blend films. As previously reported, starch films tend to crystallize during ageing, giving rise to an increase in the film's stiffness and a decrease of the E, but this phenomenon was mitigated in blend films, depending on the gum ratio in the blend and the storage conditions.

Conclusions. Starch-gellan blend films exhibited the best tensile behavior, taking into account both the initial values of tensile parameters and their stability under different RH and time storage conditions.

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MULTILAYER ACTIVE STARCH FILMS WITH ELECTROSPUN PCL ENCAPSULATING CARVACROL

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Keywords. electrospinning, poly-ε-caprolactone, thermoplastic starch, *Escherichia coli, Listeria innocua*.

Introduction. Electrospinning (ES) technique is being used for obtaining nanofibers especially for medical purposes (1,2) and recently is being applied in the field of food packaging (3). Application of electrospun layers of different polymers (acting or not as carrier matrices for active compounds) onto a film packaging surface, can provide the films with active or tailored functional properties (3,4). The aim of this study was to obtain multilayer active starch films containing an electrospun layer of poly-ε-caprolactone (PCL) encapsulating carvacrol (CA) and characterization of their functional and antibacterial properties.

Materials and Methods. Electrospunable formulations were prepared with 15 wt% PCL in glacial acetic acid and 15 wt.% CA with respect to the polymer. The formulations were electrospun over one side of thermoplastic starch films, followed by thermocompression at 80ºC and 150 bars against a second starch film to enhance polymer adhesion. The obtained multilayer films were analyzed as to CA concentration distribution throughout the film surface, microstructure and oxygen and water vapor barrier properties. Antibacterial activity of the films against *Escherichia coli* and *Listeria innocua* was also tested. Starch films and those electrospun without CA were used as control films.

Results. The ES process provides an uneven CA distribution on the film surface, creating a concentrical concentration gradient. The thermocompresion process applied to the multilayer films does not significantly modify this distribution of CA in the films. Multilayer films exhibited improved values of water vapor and oxygen permeability, compared to pure starch films, because of the ensamblement of layers with complementary barrier properties. Microbial tests of multilayer films with CA revealed a promising antibacterial activity against the two tested bacteria. Nevertheless, swelling of the starch layers in contact with high moisture systems compromises the layers' adhesion and film applicability. Therefore, the application to food systems is restricted to intermediate moisture products.

Conclusions. Multilayer starch films containing electrospun CA showed promising functional and antimicrobial properties to be used as food packaging material for intermediate moisture foods.

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ANTIFUNGAL ACTIVITY OF ALOE VERA GEL/STARCH-BASED COATINGS AND SHELF LIFE EXTENDING OF CHERRY TOMATOES

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Keywords. antifungal activity**,** *in vitro* assays, *in vivo* assays, fresh fruit preservation.

Introduction. Preservation of fruit and vegetable during pre or postharvest periods requires plant protection against attack of different fungus. However, the use of synthetic fungicides is becoming restrictive, and the use of active coatings from edible/biodegradable materials containing natural compounds with antifungal action represent an interesting alternative. In this sense, Aloe vera gel is very attractive due to their composition, rich in anthraquinones, saccharides, vitamins and enzymes. Aloe gel is the colourless mucilaginous gel obtained from the parenchymatous cells in the fresh leaves of Aloe spp. (2). The antimicrobial properties of this natural material have been analysed in several studies. The aim of this work is to obtain starch-based coatings containing Aloe vera gel for their application as an antifungal/preservation agent on cherry tomatoes.

Materials and Methods. The fresh gel of Aloe was obtained under aseptic conditions. Pregelatinized corn starch (Roquette, Spain) was used to obtain coatings by casting method using a ratio aloe vera solids: starch of 1:1. Antifungal activity of Aloe vera gel was analysed through i*n vitro* tests for six fungi (*Fusarium oxysporum; Alternaria alternata; Colletrotrichum gloesporoides; Bipolaris spicifera; Curvularia hawaiiensis and Botryotinia fuckeliana*), the mycelial growth inhibition (MGI) was determined at 7th day (1). Antifungal activity of Aloe vera films against was analysed *in vitro* through the inhibition halo test on agar culture media. *In vivo* test was carried out in cherry tomatoes inoculated with *Fusarium oxysporum*, both before (curative treatment) and after (preventive treatment) the application of the film forming dispersions. Samples were stored for 7 days at 10°C plus 7 days at 25°C, under 85% relative humidity. Inoculated tomatoes without coating were considered as control treatment.

Results. The higher growth inhibition of Aloe vera gel was against *Fusarium oxysporum* CECT 2715 (MGI: 65.16), which was selected for the subsequent assays. Significant differences between treatments with and without coating were observed under different storage conditions. Coatings highly reduced weight loss of the samples during storage. After the 5th day of storage, non-coated tomatoes exhibited soft appearance in 20% of the samples, while tomatoes submitted to preventive and curative coatings exhibited a good appearance. After 10 storage days, all treatments showed fungal attack to a different extent, but at final time (14 days) of storage, every cherry tomatoes of control treatment were affected by fungus, while preventive and curative treatments showed 30% and 40% of non-affected fruits, respectively.

Conclusions. The Aloe vera/starch-based coatings are promising materials to limit fungal decay provoked by *Fusarium oxysporum* and could be an interesting option for improving shelf life of fruits.

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CONTRIBUTION TO THE STUDY OF THE PRESERVATION BY DRYING OF MUSHROOMS *PLEUROTUS OSTREATUS* P969 STRAIN

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Key words. *Pleurotus*, drying, micronutrients, storage, room temperature.

Introduction. The mushroom is a part of the reign of eumycetes, it is an essential organism in the ground preservation of the ecosystems. It transforms the glassy chemical elements which make up the organic matter into other component assimilable by other organisms. Almost all the vegetables need to live in symbiosis with the mushrooms, which help their roots to absorb the water and the minerals.

Materials and Methods. The study was realized in the Food Chemistry laboratory of the Evangelical University in Africa and in the laboratory of the IITA Kalambo at Bukavu. The mushroom used in this study is P969 strain (*Pleurotus ostreatus*) from Rwanda.

Results. Mushrooms make parts of foodstuffs very perishable. With the aim of extending their shelf life, the drying is recommended. In this work, we used two modes of drying: the freeze-drying and the solar drying. After drying, samples were packaged in some newspaper paper and stored during 4 months at room temperature. Some small modifications were observed in the parameters studied before drying and after storage. The pH passes from 6,5 to 6,2, the nitrogen of 0,067 mg at 0,057 mg, the phosphorus concentration decrease of 224 mg at 182,2 mg, the potassium did not change 0,6 mmol, the proteins rate decrease 0,419 % at 0,338 % and the concentration of vitamin C decrease of 9,25 mol at 8,75 mol.

Conclusions. drying of pleutorus mushrooms allows to keep quite the natural properties of these mushrooms; whatever is the type of used drying. And after 4 months. And after 4 months of storage of mushrooms conditioned in the newsprint at room temperature, we can say with certainty which this study allows to reduce the losses postharvest mushrooms.

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THE CHANGES OF FRAGILTY IN SALMON GELATINE-CARBOHYDRATE COMPOSITES APPROCHING THE GLASS TRANSITION TEMPERATURE

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Keywords. salmon gelatine, fragility index, activation energy, film composite

Introduction. Gelatine is one of the most common and widely used biopolymer. Gelatine is a high molecular weight polypeptide obtained by denaturing a naturally derived collagen (1). In the gel state, gelatine oligomers are strongly intertwined, forming a transparent viscoelastic network. As films, the mechanical properties of this material are highly dependent by both, gelatine type (polymer Mw, amino acid profile) and the presence plasticizers used in the preparation of the composites (2). A fundamental aspect that still need to be further investigated is related to the changes in molecular mobility of the systems when the temperature is decreased towards the glass transition temperature (Tg). A concept developed to predict the molecular mobility of polymers called fragility (3) accounts the departure from Arrhenius type behaviour of viscosity changes as a function of temperatures near Tg. This work aims to characterize and to determine the fragility value of salmon gelatine-carbohydrate composites films using gelatine extracted from Salmon Salar skin.

Materials and Methods. Salmon gelatine was extracted from skin (Salmon Salar) by acid-alkaline method (2) and mixed with glucose (180g/mol), sucrose (342g/mol) and maltodextrin (920-1100 g/mol) at weight fraction of 0.2, 0.4 and 0.6. Cold casted (5^{o}C) films was prepared and equilibrated to moisture similar contents (~5% d.w.b. in P_2O_5). Component integration was evaluated by FTIR spectroscopy and 2D Raman imaging. Water sorption behaviour was assessed by Dynamic Vapour Sorption (DVS) and modelled following the GAB, BET and Peleg equations. Tg of each composite was obtained by differential scanning calorimetry (DSC). The activation energy (ΔE) of the glass transition and fragility index (m) was successfully calculated by Vogel-Tammann-Fulcher (VTF) theory and Angell's dynamic fragility concept using Tg values obtained at different heating rates (3).

Results. FITR spectra show a good integration between the gelatine and the various sugars although 2D imaging indicated an inhomogeneous dispersion between components which would be associated from the sugar crystallization. The monolayer value (GAB-BET) decreased from □8% to □4% (w/w) when the carbohydrate concertation increased and was dependant on their molecular weight. At constant moisture content the addition of the sugars lowered the Tg of the composite from □90^{o}C to □30^{o}C, which was also dependant on the sugar molecular weight. The activation energy of the composites at Tg increased with carbohydrate content from 159 kJ/mol until 366 kJ/mol, this was related with the departure from the Arrhenius behaviour in viscosity near Tg. Consequently, the system becomes fragile which is represented by an increased in m value from ~20 to ~50.

Conclusions. The potential correlation between the fragility and composite composition and thermal properties of gelatine-based biocomposites may be used as a tool for the design novel food applications that required a good understanding of molecular dynamics at different storage conditions.

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PREDICTION OF SENSORY SCORES FOR COLOR AND APPEARANCE IN CANNED BLACK BEANS (*Phaseolus vulgaris* L.) USING MACHINE VISION

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Keywords. Canned beans, quality, color, appearance, visual assessment, machine vision, automation.

Introduction. Evaluation of canning quality of beans is commonly carried out by simple visual inspection that is time-consuming and resource intensive, and moreover, biased by the experience of the panelist. The evaluation is further complicated since standard scales to rate visual quality traits of canned beans have not yet been implemented in the trade.

Materials and Methods. In this research, a machine vision system was implemented and tested for automatic inspection of color (COL) and appearance (APP) in canned black beans. Various color and textural image features (average, standard deviation, contrast, correlation, energy and homogeneity measurements from *RGB*, *L*a*b**, and *HSV* color scales) were extracted from drained/washed beans and brine images, and evaluated to predict the quality rates for COL and APP of a group of bean panelists using multivariate statistical models. A total of 150 commercial canned black bean samples from different brands and markets were acquired and used for analysis. Standard color and appearance charts were also proposed based on a 5-points hedonic scale determined by bean quality experts.

Results. In spite of the 'fair' agreement among the sensory panelists for COL and APP, as determined by multirater Kappa analysis, a machine vision data based on partial least squares regression (PLSR) model showed high predictive performance for both COL and APP with correlation coefficients of 0.937 and 0.871, standard errors of 0.26 and 0.38, respectively. When a classification was performed based on both COL and APP traits, a support vector machine model using simple image data was able to sort the canned bean samples into two sensory quality categories of 'acceptable' and 'unacceptable' with an accuracy of 89.7%.

Conclusions. Using simple color and texture image data, a machine vision system showed potential for the automatic evaluation of canned black beans by COL or/and APP as a professional visual inspection.

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DETERMINATION OF 8-HYDROXY-2 DEOXYGUANOSINE IN *PSEUDOMONAS FLUORESCENS* FREEZE-DRIED

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Keywords. Reactive Oxygen Species (ROS), DNA, 8-Hydroxy-2 deoxyguanosine

Introduction. The drying by lyophilisation of microorganisms has some consequence on the viability of the latter. The powder of lyophilized bacteria remains vulnerable on the environmental conditions such as temperature, ultraviolet, reactive species of oxygens.

Materials and Methods. *Bacteria strain.* The Pseudomonas fluorescens BTP1 of Wallon Center of Industrial Biology laboratory (CWBI) was used as the strain in this study. *Photosensibilisation.* The samples (bacterial powder) were exposed to methylene blue (MB) at 40 µM of in Light presence. The methylene blue and an incandescent bulb produce singlet oxygen.

Results. Oxidative DNA damage is involved in the f cell death induced by freeze-dried powder during storage. Cell 8-hydroxy-2'deoxyguanosine (8-oxodG) is widely accepted as a biomarker of the "freeze-dried bacteria" oxidative DNA damage. The aim of this study was to introduce a method for determination 8-oxodG in cell freeze-dried samples using high-performance liquid chromatography with electrochemical detection. In the tested range of 0.5 µmol L^{-1} to 1.0 nmol L^{-1}, the calibration curve was linear (r^2=0.9995) and the limit of detection was 0.05 µmol L^{-1}.

Conclusions. The main purpose of this study was to confirm the hypothesis which supported that DNA also is subject of the oxidation in the same manner as lipids and proteins. The sensitivity of the 2dG was better measured in our operating conditions compared to the 8OH one. The current method was not able to highlight within the limits of detection the presence of the 8OH samples. An additional method would be needed for such to detection. Some scientists describe the tests on the oxidation of the ARN instead of the DNA, which represent an interesting way to explore.

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IMPROVING DISPERSION OF CELLULOSE NANOWHISKERS INTO POLY (LACTIC ACID) THROUGH THE OBTENTION OF PVOH ELECTROSPUN NANOFIBERS

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Keywords. Biopolymers, nanotechnology, poly (lactic acid), cellulose nanowhisker, electrospinning

Introduction. Facing the need to reduce the negative effects on the environment caused by the accumulation of conventional petroleum-based polymers waste, material researcher efforts have focused on the development of new materials based on biopolymers, which are degraded under natural conditions by microorganisms present in environment without leaving toxic or harmful waste into the environment. Nevertheless, some of the properties of these polymers need to be improved, such as excessive brittleness and insufficient barrier properties. The development of nanocomposites has been considered a promising solution to these disadvantages. Over last years, a natural nanofiller that has attracted much interest in order to produce fully renewable and biodegradable nanocomposites is cellulose nanowhiskers (CNW), although its high hydrophilicity and strong hydrogen bond interactions makes it difficult to disperse in hydrophobic media including most widely researched thermoplastic biopolymers, such as poly (lactic acid). Thus, in this work, the alternative proposed is the encapsulation of CNW into polyvinyl alcohol (PVOH), (PV/CNW)n, through electrospinning process.

Materials and Methods. Firstly, electrospinning conditions for obtaining the PVOH nanofibers with CNW (obtained previously by acid hydrolysis) were optimized. Nanofibers with only PVOH, (PV)n, were also obtained owing to study the effect of the incorporation of CNW on PVOH properties. Then, these nanofillers were incorporated into PLA at different concentrations (0.5, 1 and 3% of CNW) as reinforcing material, and PEG as plasticizer, by casting process. A control material with CNW at these concentrations without being electrospun was also developed in order to study the effectiveness of the strategy proposed in this work. Nanofillers (CNW, nanofibers (PV)n and (PV/CNW)n) and nanocomposites were morphologically (SEM and TEM microscopies), thermally (TGA and DSC) and mechanically characterized.

Results. TEM analysis evidenced CNW were completely embedded in the PVOH matrix, and SEM images confirmed the homogeneous distribution of nanoreinforcements (PV/CNW)n into PLA. Thermal analysis revealed thermal degradation processes were not affected and crystallinity degree of PLA was greatly enhanced. Elongation at break results also increased in comparison with nanocomposites with CNW not encapsulated. In general, results showed that the incorporated nanofillers caused changes in the polymer structure.

Conclusions. The incorporation of CNW through its encapsulation into electrospun nanofibers of PVOH is an alternative to achieve a good dispersion f these nanofillers and modify positively some properties of biopolymers.

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PECTIN FILMS CHANGES DURING STORAGE AT VARIOUS AMBIENT CONDITIONS

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Keywords. Pectin films, biodegradable, color, oxygen diffusivity, nanoparticles.

Introduction. Edible films and coatings have been used to increase postharvest shelf life of fresh fruits and vegetables (1,2). The protecting effect of the films is usually evaluated in terms of weight loss, firmness retention, surface color variations, chemical changes, and reduction in respiration and transpiration rates of the product (3,4). Due to the biodegradable nature of the edible films, they can also undergo physical, biochemical, mechanical, and permeation properties changes, which has not been taken into account in the product shelf life studies. The objective of this work was to determine the effect of temperature on the color and oxygen diffusivity of pectin films with and without SiO_2 nanoparticles, during storage at 75% RH.

Materials and Methods. Pectin was extracted from grapefruit peel without purification steps to prepare films containing glycerol (1.5 %) and SiO_2 nanoparticles (0.5 %). Films were stored in chambers at 4, 20 and 35°C at 75 % RH for 6 weeks. Film samples were taken out of the chamber periodically and analyzed for color and oxygen diffusivity. Surface color of the films was evaluated by measuring L, a, and b color values, the total color difference (ΔE) and the yellowness index (YI) using a Minolta Chroma meter. Oxygen diffusivity was simultaneously determined in an experimental set up of four permeation cells (5) at 25°C and 100% RH.

Results. Yellowness index (YI) resulted a good indicator of color change of the films during storage. It implies degradation of the chemical compounds that impart the films color. YI followed a first-order kinetics. Films with and without SiO_2 nanoparticles had an activation energy of 31.98 kJ/mol and 60.80 kJ/mol, respectively. Pectin films containing SiO_2 nanoparticles had an apparent diffusion coefficient of oxygen (D_{app}) lower than fims without nanoparticles. D_{app} showed an increasing tendency at the three studied temperatures. For instance, at 20°C D_{app} of oxygen through the films containing nanoparticles increased from $7.9x10^{-16}$ m^2/s (t=0) to $1.4x10^{-6}$ m^2/s (t= 4 weeks).

Conclusions. YI and D_{app} were significantly influenced by the presence of SiO_2 nanoparticles in the films. During storage, important changes of color and oxygen transport through the pectin films were observed. These results show that the protecting effect of the pectin films in a coated fresh product will evolve during storage.

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OPTICAL, WETTING AND WATER VAPOR PERMEABILITY OF NANOCOMPOSITES FILMS AS AFFECTED BY THEIR MICROSTRUCTURE: THE INFLUENCE OF LAPONITE CONCENTRATION

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Keywords. contact angel, gloss, image analysis, nanocomposites, microstructure, starch.

Introduction. Starch is a good candidate for polymer matrix in nanostructured materials due to its advantage of being cheap, abundant, renewable, biocompatible and biodegradable. However, films based on starch presenting high water affinity, exhibiting further deterioration under conditions of high humidity. It is well know that the physical properties of starch matrix can be affected by the addition of nanoclays. Laponite (Lap) is a nano-clay not much studied in starch-based film. Hence, the aim of this work was studied the effect of Lap concentration on morphological properties of nanocomposite films based on cassava starch and its relation with optical, wettability and water vapor permeability (WVP) properties.

Materials and Methods. Cassava starch was purchased from Yoki Food Industry (São Paulo, Brazil) and was used as biopolymer. Glycerol (Synth, Brazil) was used as plasticizer and Laponite RD (Southerm Clay Products Inc. Reference number 23224) was used as nanoparticle.

Nanocomposites were prepared by casting method with a cassava starch concentration of 4 g of cassava starch/100 g of solution, 25 g of glycerol/100 g of cassava starch and a laponite/cassava starch ratio of: 0, 1.5, 3, 4.5 and 6% (w/w). The films were conditioned in desiccators containing silica gel (0% relative humidity, RH) and saturated solutions of $Mg(NO_3)_2$ (50.3% RH) at 25°C for at least 7 days. Nanocomposites were analyzed using a scanning electron microscopy (SEM model TM-3000, Hitachi) and atomic force microscope (model NT-MDT Solver Next Brand, Russia) at the surface (air and plate drying surfaces). The average roughness (R_a) and root mean square roughness (R_q) were calculated using the software of AFM. Three texture parameters (entropy, fractal dimension and entropy/fractal dimension ratio) were analyzed using the software ImageJ v 1.39 (National Institute Health, Bethesda, MD, USA). The gloss, color, water contact angle and WVP in nanocomposite films were determined as proposed by Valencia et al. and Flaker et al..

Results. Alteration in texture parameters observed by SEM and AFM images confirmed the drastically surface modifications of nanocomposites induced by Lap nanoparticles. This modification could be promoted by interfacial interactions between biopolymer and nanoparticle that occurs in the network structure. It was observed a good correlation between texture parameters with roughness values obtained by AFM images. Modification in texture parameters and roughness values lead to alterations in gloss, color and water contact angle values. Hence, nanocomposite films were darker, yellower and lower hydrophobic with Lap concentration. These results could be explained by the sense that Lap nanoparticles induced a increasing in roughness as a consequence of nanoclays agglomerates in biopolymer matrix. Lap increased the tortuosity in starch matrix and it reduced the WVP values in approximately 17% when compared with control films.

Conclusions. Texture image analysis is an efficient tool to quantify alteration in microstructure of cassava starch films with Lap. The presence of Lap increased the roughness in nanocomposite films, altering gloss, color and wettablity properties. Considering the improvement in WVP, it can be considered that cassava starch-laponite nanocomposite films can serve as a promising packaging in food industry.

CONTRIBUTION TO THE STUDY OF CONSERVATION OF PAPAYA BY DRYING (PHYSICOCHEMICAL AND MICROBIOLOGICAL STUDY -CHIMIQUE DURING STORAGE)

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Keywords. storage, papaya, microbiology

Introduction. In vitro assessment of toxicity tannins and saponines organic and aqueous excerpts of some insecticide plants (*M. aquatica, R.comminus and H. galeopsifolium*) against *Sitophilis zeamays*, devastating bugs of the sorghum stored. Objectives of this survey were to identify the different present chemical compounds in leaves of three plants (M.*aquatica, R. comminus, G. galeopsifolium*) propertied of substances to insecticide effect, to compare the insecticide efficiency of three plant excerpts (*M.aquatica, R. comminus, G. galeopsifolium*) on the mortality of *Sitophilis zeamays* devastating of the sorghum stocked according to the different hours and to determine doses extracted of plants possessing substances to insecticide effect that will control *Sitophilis zeamays* better in conditions of the laboratory of the Evangelical university in Africa situated to the East of the DRC.

Materials and Methods. Papaye was used as a biological material, physico-chemical and microbiology were used to determine quality of product during storage at room temperature.

Results. After the exhibition and the length, we noted that the tanin and saponine excerpts of *H. galeopsifolium* had caused an elevated rate of bug mortality with a general average of 52,778±25, 426 and 50,000±23,272 successively after 72heures of exhibition. The dose 1 of the malathion presented an elevated death rate of bugs (80%), followed of tannin extracts of the plant *H. galeopsifolium* (77,7%), follow-up some saponine extracts the same plant (73%), follow-up of tannins and saponine excerpts of the plant *R. comminus* that had one same death rate of bugs (66,6%) and the dose 0 presented a very weak death rate in relation to others with a general whole of 9,5% after 72 hour.

Conclusion. The tannin and saponine excerpts of the plant *H. galeopsifoliums* remain the best products curators against *Sitophilis zeamays* and alternative against the insecticides of synthesis because they are not expensive and easily obtainable in conditions of the laboratory. The other researchers must continue researches on the devastating others of commodities stocked while leading studies in the same angle.

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SPOILAGE AND QUALITY PROFILES OF RICOTTA PACKED WITH POLY(BUTYLENE SUCCINATE)-BASED MATERIALS

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Keywords. ricotta, PBS packaging, shelf-life, microbial spoilage

Introduction. Packaging plays a fundamental role in the food industry, allowing to preserve food quality and safety. Whatever the material (e.g. plastics, paper, glass..) used, packaging can determine a great share of the environmental impacts associated with food consumption, and contributes to the generation of waste and depletion of resources. Among the bioplastics that are currently being developed and tested by many companies and researchers to provide a more environmental friendly solution for packaging, poly(butylene succinate) (PBS) can be considered a promising polymer from renewable resources. In fact it exhibits balanced performance in thermal and mechanical properties and processability compared with other common plastics. The aim of this work was to test the effects of different PBS packaging materials produced within the FP7 SUCCIPACK project on the microbiological shelf-life and quality parameters of Ricotta cheese.

Materials and Methods. Ricotta cheeses produced by caseificio Mambelli were packed with various PBS-based cups and films (differing in composition and coating layers in order to increase barrier properties) and compared to control products packaged with the traditional material (PP). Products were stored at 4°C and microbial populations, volatile organic compounds (SPME/GC-MS), pH, water activity, color and sensory properties were monitored over over a 15-days storage. Microbial data of the main spoilage microorganisms were also modelled to calculate the products shelf-life.

Results. According to the results of all the experiments performed, none of the tested materials/conditions allowed significant modifications of the chemico-physical and quality parameters thus protecting Ricotta from quality losses in the same way as the reference packaging. On the contrary, the spoilage microflora and the release of volatiles with a potential impact on sensory attributes were significantly affected by the innovative material. Concerning microbial spoilage, different behaviours were observed for the various PBS materials and packaging combinations. Overall, data showed that not only barrier characteristics of packaging, but also its contact with food play an important role on the microbial spoilage. Proper combinations of PBS cups and films resulting in similar or better shelf-life (up to 2-3 days longer) than control packaging were identified.

Conclusions. The comparison of all data suggests that PBS can be effectively employed for packaging of a highly perishable food such as Ricotta. In fact bioPBS cups sealed with coated PBS films proved to be a good combination as resulted in an improvement in the shelf-life compared to the conventional packaging, while preserving all the tested quality parameters.

INFLUENCE OF SMALL SACCHARIDES ON WHEY PROTEINS FUNCTIONALITY IN OIL-IN-WATER EMULSIONS

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Keywords. surface properties, emulsions, trehalose, glucose, sucrose, whey proteins

Introduction. Sugars are common ingredients of food products and are considered to act as weakly interacting cosolvents in the aqueous phase; thus, they can have a direct influence on proteins functionality andinteractions in the bulk phase and at interfaces including the adsorption and formation of colloidal systems. To date there have been no systematic studies on the influence of cosolvents on the adsorption and interfacial characteristics of food proteins. This study was thus aimed at investigating the effect of glucose, sucrose and trehalose on the surface properties and emulsifying activity of whey proteins.

Materials and Methods. To this aim, the continuous phase of a 20% oil-in-water emulsions was added with increasing amounts of glucose, sucrose and trehalose (7.5, 15, 30% w/v). The dispersed phase was represented by sunflower oil and a whey protein concentrate (1% w/v) was used as emulsifier. Emulsions were characterized for their droplet size and distribution, interfacial protein coverage, flow behaviour and physical stability (flocculation and creaming behavior). The protein adsorption at the air/water interface of the aqueous solutions added with the cosolvents under investigation was carried out by surface tension measurements.

Results. Surface tension resulted to be significantly affected by the presence of the sugars; among them, the addition of trehalose caused a decrease of the surface tension at all the concentrations tested, index of an enhanced adsorption of whey proteins at the air/water interface. In emulsions, the small saccharides determined an improvement of the dispersion degree with a shift of the droplet distribution towards smaller particles, which generally determined an enhancement of the physical stability.

Conclusions. Since the interfacial and emulsifying properties of proteins are directly related to their ability to act as emulsifiers, the presence of cosolvents like sugars may alter their functional properties in food emulsions and thus needs to be taken into account by food manufacturers in the design and production of foods.

DYNAMIC AND STEADY-STATE SHEAR RHEOLOGICAL PROPERTIES OF NATIVE POTATOES STRACH GROWN IN PUNO (PERU)

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Keywords. native potatoes, starch gels, rheology, viscoelasticity

Introduction. Potato starch is widely used in food industry as an ingredient in processed products. Although physicochemical and functional properties of potato starch have been reported in prevoius studies; an interpretation of the rheological properties has not been fully elucidated.

Materials and Methods. Starch from native potatoes varieties from Puno (Peru): Imilla Blanca (IB), Imilla Negra (IN), Loc'ka (LK), Occucuri Blanca (OB) and Piñaza (PÑ) were evaluated. Starches were dispersed in distilled water at 4% (w/w), gelatinized at 90°C for 30 min and then gels were cooled to 25°C. For rheological analyses, at 25ºC, a Discovery HR3 hybrid rheometer (TA Instruments, New Castle, DE, USA), with a cross hatched plate-plate geometry (40 mm diameter and a gap of 1 mm) were used. Starch gels were first placed in the rheometer and maintained at rest for 10 min before shearing. The steady-state shear experiments were carried out in the shear rate (γ) range of 0.01-100 s^{-1}. The flow behavior was modeled using the Herschel-Bulkley's model. For viscoelastic properties determination, oscillatory stress sweeps between 0.1-100 Pa were performed at a frequency of 1 Hz to determine the linear viscoelastic range. Then, frequency sweep measurements were carried out at a fixed shear stress value (1 Pa), in the range of 0.01-10 Hz. Storage and loss modulii (G' and G') and complex viscosity (η^*) parameters, were obtained.

Results. Starch gels showed a shear-thinning behavior ($n<1$) with a low yield stress (σ_0). The values of the Herschel-Bulkley model parameters were the highest for LK (σ_0 (1.2 Pa) and k (34.6 $Pa{\cdot}s^n$)) and lowest for OB (σ_0 (0.1 Pa) and k (5.0 $Pa{\cdot}s^n$)). In all cases, starch gels showed that G' modulus values were always higher than those of the G'' modulus, which indicates that starch gels had dominant elastic properties over the viscous ones. The frequency dependence of G' and G" gives valuable information about structure. G' and G" increased while η^* decreased with increasing frequency. Dependence of G' and G'' with frequency were well described by power equations The values of k' and k" ranged from 13.9-31.3 $Pa{\cdot}s^{n'}$ and 9.3-13.1 $Pa{\cdot}s^{n"}$, respectively. The values of n' and n" were in the range from 0.2-0.4 and 0.3-0.4, respectively.

Conclusions. The steady-state shear rheological behaviour of starch gels were well described by the Herschel-Bulkley. The viscoelastic properties of starch gels indicate that such gels can be classified as weak gels. The starch gels prepared from LK starch showed generally the highest values of rheological properties compared with those measured for the other four native starches.

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ANTIMICROBIAL POTENTIAL OF *ALLIUM URSINUM* EXTRACT

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Keywords. *A. ursinum* extract, antioxidant capacity, microdilution method

Introduction. As a source of health benefit compounds Allium species have been used in the traditional medicine for many centuries thanks to its wide- spread distribution and popularity as edible and medicinal plant. The majority of the antimicrobial activity of *Allium* has been recognized for many years. The presence of S-alk(en)yl-L-cysteine sulfoxide is confined essentially *Liliaceae*, and is particularly associated with the *Allium* genera (1). *Allium ursinum*, wild garlic, has been used for many years due to its culinary application as well as in traditional medicine. Several biological activities of *A. ursinum*, plants and extracts, such as antioxidant, cytostatic, antimicrobial, and antidiabetic were reported (2,3). Apart of sulfur-containing compounds, *A. ursinum* has been also reported as a good source of phenolic compounds which contribute to its biological activity.

Materials and Methods. Dry and grounded herbal material was used for extraction. *Allium ursinum* extract was prepared according to Tomšik et al. (2015) using ultrasound assisted extraction in order to increase content of bioactive compounds which may have antibacterial effect. Total phenolic content was determinated using Folin–Ciocalteu reagens, while HPLC-DAD was used for its identification. Antibacterial activity was tested using double microdilution assay against two pathogenic strains: Gram-positive bacteria *Staphylococcus aureus* and Gram-negative bacteria *Esherichia coli*.

Results. Total phenolic content was determinat (1.61 g GAE/100 g DW), while mostly diferente derivates of kaempferol was identified accoriding to literature spectra. Antibacterial activity of ethanolic extracts with 10 and 20% of extract were presented as percentage of reduction compared to control sample. The extracts showed 100% reduction for both contents against *E. coli* and 20% extract content of *S. Aureus*, and 99,2% reduction against S. Aureus for 10% extract content.

Conclusions. Broad spectrum of biological activities, especially antimicrobial, obtained from *A. ursinum* and its extracts, as well as the presence of chemical compounds with high terapeutical potential, makes this plant potential candidate for future development of various functional products and food supplements.

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OBTAINING CELLUSOSE NANOCRYSTALS FROM LIGNOCELLULOSIC BIOMASS OF COFFEE HUSK

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Keywords. Lignocellulosic wastes, cellulose nanocrystals, coffee husk.

Introduction. Lignocellulosic materials are widely available due to their renewable character (1) and their use to obtain useful added value compounds allows for both the elimination of wastes and their revalorization. Coffee husk obtained after de-hulling the coffee cherries during dry processing, constitute a source of lignocellulosic materials, containing about 57% of cellulosic and 22% of lignin components. So, promising compounds derived from cellulose or lignin components of this husk could be obtained. In this sense, cellulose nanocrystals could be found (2), which can be used as reinforcing material for many applications. The aim of this work is to obtain cellulose nanocrystals (CNCs) from coffee husk and to characterize their nanostructure and potential use as reinforcing material for biodegradable food packaging.

Materials and Methods. Coffee husk was provided by Centro Surcolombiano de Investigaciones en Café (Colombia). Coffee husks were treated with a 4 wt% NaOH solution, for 3h at 100°C. The residue was bleached with 1.7 wt% $NaClO_2$, for 4h at 130°C in order to obtain the purified cellulose fraction. From the bleached fibres, CNCs were obtained by acid hydrolysis (with 64 wt% H_2SO_4) at 45°C for 30 min to separate amorphous zones. The resulting CNCs aqueous dispersions were prepared by successive centrifugation, dialysis and ultrasonic treatments. The microstructural analysis of the products at the different steps of the process was carried out by SEM (JEOL JSM-5410, Japan). TEM (JEOL JEM-1010, Japan) was used to analyse the particle size distribution and shape of the obtained CNCs. The X-ray diffraction patterns of the products were also obtained with a diffractometer (XRD, Bruker AXS/D8 Advance).

Results. SEM analysis revealed the different changes occurred in the sample microstructure at the different process steps, allowing for the identification of the process effectiveness. An increase in the crystallinity index of the material was found after the successive steps of the process, the final CNCs exhibiting 95 % of crystallinity. TEM analysis showed the efficacy of the hydrolysis step to give nano-sized cellulose crystals. These exhibited polydispersity in size; length and width were 305 ± 164 and 20 ± 4 nm, respectively, which were in the range found for CNCs from other biomasses (2 to 20 nm in diameter and 100 to 600 nm in length). The aspect ratio ranged between 10 and 20 and so, the obtained CNCs can be considered as good reinforcing material since aspect ratio was higher than 10.

Conclusions. Revalorization coffee wastes to produce CNCs, useful as reinforcement material in different polymer matrices was possible.

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ANTIOXIDANT ACTIVITY AND RELEASE RATE OF α-TOCOPHEROL CONTAINED IN WHEY PROTEIN ISOLATE EDIBLE FILMS

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Keywords. α-tocopherol, WPI, antioxidant, release rate, edible films

Introduction. Edible films have a high potential to carry antioxidants that can provide an increased shelf-life of different packaged food. Active edible films effectiveness is based on the controlled release of the compounds retained in the structural matrix (1). Transparent, odourless and tasteless whey protein isolate (WPI) based edible films have good mechanical properties and are excellent oxygen, lipid and aroma barriers. These films have been used as carriers of different active agents with the aim of extending food products shelf-life (2). The main objective of this work was to develop stable antioxidant edible films based on WPI by incorporating α-tocopherol in the formulation.

Materials and Methods. WPI edible films were formed from water solutions of 10 % (w/w) WPI (Davisco Food International, MN, USA) and 5% (w/w) glycerol (Panreac Química, Spain) as plastizicer. The solutions were heated at 90ºC during 30 minutes in continuous stirring. After cooling, 0.5 and 1% (w/w) α-tocopherol (Sigma Aldrich Co., Germany) was added and the homogeneization was carried out by an ultrasound emulsification process (UP400S, Hielscher, Germany) during 8 minutes in a continuous cycle with 100% of wave amplitude. Films were obtained from the film forming solutions casting on glass dishes at 40 ºC and 45% RH for 18 h in a climatic chamber (Weiss Technick, Germany). The obtained edible films were characterized by humidity, thickness, and microstructure (SEM in a Carl Zeiss Ultra Plus electron microscope). The antioxidant activity was determined following the DPPH method. The release kinetics of the α-tocopherol contained in the WPI films were determined by using ethanol 95% as contact solvent. 3×3 cm WPI film pieces were immersed in 100 ml of the solvent at 25
°C and continuous stirring for different contact times up to 24h. The α-tocopherol released from the films towards the solvent was determined by UV-Vis spectrophotometry at 295 nm.

Results. The α-tocopherol-WPI edible films with 150 µm resulted transparent, uniform with homogeneous smooth surfaces without pores or cracks. While a continuous microstructure was observed for the control WPI films, the presence of α-tocopherol caused a strong matrix discontinuity (lipidic droplets were homogeneously distributed across the film). Both 0.5 and 1% α-tocopherol-WPI films showed a strong antioxidant activity (up to 96% DPPH inhibition). In the analysis of the kinetics of the α-tocopherol migration from the WPI matrix to the solvent it should be noted the high release rate detected in the first 5 h of contact with the solvent. After 20 h the concentration remained constant during the rest of the contact time.

Conclusions. WPI edible films were effective carriers of α-tocopherol. Resulted films from an ultrasound emulsification process were stable and demonstrated to have strong antioxidant activity.

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PHYSICAL PROPERTIES OF PECTIN-ALGINATE-WHEY PROTEIN EDIBLE FILMS

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Keywords. edible films, whey protein, physical properties, thickness, texture

Introduction. Edible films are thin layer(s) of bio-based material formed as a part of food to extend their shelf-life. Whey Protein films are proposed to have good mechanical properties and ability to form transparent films. This study was carried out to understand the effects of combining whey protein, pectin and alginate on some physical and mechanical properties of films.

Materials and Methods. Composites of pectin (Pec) and alginate (Alg) films with different ratios of whey protein (WP) were prepared by using Glycerol (1%), Tween (0.1%) and water as plasticizer, emulsifier and bulk solvent respectively. A total of ten film forming solutions were obtained using mixture design. The films were prepared by casting technique and dried using a ventilated chamber at 25±2°C and 50% RH. The films were conditioned in controlled atmosphere chambers and were characterized for their physical and mechanical properties. The thickness, colour, opacity, tensile strength and elongation at break were investigated. Moreover, the films were observed under optical microscope for homogenity and structure.

Results. All films obtained were observed to be transparent to translucent depending on their composition. Pec:Alg in 1:1 ratio film showed the highest total colour difference but a lower yellowness index. The opacity values ranged from 2.8 to 5.9 Amm^{-1} with the lowest value for 1:1:0 and the highest for 1:1:1 ratio of Pec:Alg:WP respectively. The thickness of the films ranged on an average from 40 to 50µm with the exceptions of 35µm and 64µm recorded for pure pectin and 1:1 Pec:WP films respectively. The tensile strength was highest for Pectin and Pec:Alg films. On the contrary films containing whey protein had lower tensile strength values falling in the range of 10Mpa to 30Mpa, whereasthe percent elongation comparitively increased.

Conclusions. The studied matrices exhibit good film forming capacity, with moderate mechanical strength and visual aspects comparable to synthetic polymers. It is observed that the addition of whey protein concentrate in formulations increased opacity and yellowness index of the films compared to Pec:Alg. Also, with increasing the concentration of WP the tensile strength and Young's modulus were lowered, even with equal amount of either pectin or alginate. These observations indicate that WP has ability to form stand alone films or coatings with Pectin and Alginate. Further barrier characterization will enable to target the application of these films and their suitability for coating fruit, vegetable, cheese and bakery products.

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VIABILITY OF ENCAPSULATED *LACTOBACILLUS RHAMNOSUS* INTO SPRAY-DRIED PODWERS BASED ON WEY ISOLATE PROTEIN

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Keywords. sucrose, maltodextrin, threalose, WPI, cell viability

Introduction. The consumer's demand of probiotic functional food boosts the development of new dried formulations to protect and increase the viability of these bacteria, such as *Lactobacillus rhamnosus*. Spray drying is a widely used technique of microencapsulation, giving rise to high cell survival rates if the optimal drying conditions and the appropiate protectant agents are used (1). In this sense, whey proteins (WPI) and maltodextrin (MD) have been used as coating and protectant agents respectively (2). In addition, the protective effect of low molecular weight sugars such as glucose, fructose and lactose together with whey proteins have been shown to exert positive effects on the survival of *L. rhamnosus* (3). Nevertheless, the protective effect of other sugars such as sucrose (S) or trehalose (T) have not been studied. To this end, the viability of encapsulated *L.rhamnosus* by spray drying using different formulations based on WPI:MD and sucrose or threalose as protective agents was studied as a function of the storage time and the water activity (a_w).

Materials and Methods. Formulations of probiotics products (PPs), based on different blends of WPI:MD (1:2), WPI:MD:S (1:1:1) and WPI:MD:T (1:1:1) containing a proper concentration (10^9 UFC/mL) of *L.Rhamnosus* (CECT 275) were obtained by sray drying (T_{inlet} = 160 ºC and T_{outlet} = 60 ºC). The PPs were stored at 20°C under different water activity (a_w) conditions. The viability of the cells was determined over time (till 8 months) as a function of the a_w (0.11, 0.33, 0.43, 0.69 and 0.75) by means of microbial counts on plates using acidified MRS agar.

Results. At t=0, *L. Rhamnosus* counts were closed to 10^9 log/g, exhibiting a high cell survival after spray drying process in all formulations. This viability throughout time depended on the water activity and composition of the powders. The cell viability decreased in line with the rise of the a_w and the storage time, especially after 154 days of storage at 20ºC. Thus, all formulations stored at the lowest a_w (0.11) exhibited the greatest viability, around 80 % up to 84 days of storage. At intermediate a_w values (up to 0,43), the viability decreased to 65% when storing the samples up to 84 days. For longer storage periods and higher a_w, the survival of the bacteria was markedely affected (survival lower than 40%). The presence of both sucrose or threalose significantly ($p<0.05$) enhanced the cell survival ratio at every a_w studied. Non-significant differences were found between formulations with sucrose or threalose.

Conclusions. To preserve the viability of encapsulated *L. Rhamnosus* for almost 3 months is recommended to incorporate sucrose or threalose as protective agents into the WPI:MD formulation and to store the powders at low water activity and 20ºC.

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AN INNOVATIVE METHODOLOGY TO FABRICATE ANTIOXIDANT ACTIVE PACKAGING

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Keywords. Active packaging, electrospinning, quercetin, antimicrobial, control release

Introduction. Active packaging is defined as a package system that deliberately incorporates components that release or absorb substances into or from the packaged food or the environment surrounding the food to extend the shelf-life, to maintain or to improve the condition of the packaged food (Regulation (CE) No. 450/2009 (29/05/2009)). Such a packaging system plays an active role in food preservation and quality during the marketing process. Antioxidants are well-known compounds with several health benefits such as antimicrobial properties and they can be incorporated to the packaging materials to excert their functional activities[1]. The controlled release of antioxidants from active packaging systems is crucial and depends on the incorporation technique. Electrospinning is a promising technique to fabricate scaffolds with acceptebale mechanical and biological properties[2]. The aim of this work was to fabricate antioxidant active packaging by incorporating quercetin into polymer solution before electrospinning process. Mechanical properties and the release profile of the antioxidant compound from the scaffold were measured and the antibacterial properties of the functionalized scaffold were tested against *Escherichia coli*.

Materials and Methods. For fabrication of the scaffolds we used electrospinning apparatus (Spinbow, Bologna, Italy) consisting of a high voltage power supply (PCM series, Spellman, NY, USA) for charging the polymer solution, a grounded aluminum roto-translating drum (2 mm outer diameter and 13 cm in length) for collecting fibers and a syringe pump (KDS-100, KD Scientific, Holliston, MA, USA) for controlling feed flow rate. Rotation was at 750 rpm and translation velocity at 1000 mm/min. The fluid was pushed out from the syringe with a flow rate of 1.1 mL/h, throughout a 0.25 mm diameter needle with a potential difference of 17 kV. All the samples were obtained using about 1.5 mL of initial solution. The polymer solution was prepared with Poly(L-lactide), PLLA, in 1,1,1,3,3,3-Hexafluoro-2-propanol (HFP) 20% w/v. Three different volumes of quercetin dihydrate in ethanol (5.5 mg/mL) were added to obtain three different quercetin / polymer ratio: 1:4, 1:8, 1:16. The pre-polymer solution was then electrospunned and the collected samples were dried over night in a dessicator. The mechanical properties of the scaffolds were measured using uniaxial tensile test. The release of quercetin in PBS solution from the scaffold was measured using spectophotometer at different times (0.5 , 1, 2, 4, 8, 24, 120, 168 hours and 1 month). Growth inhibition activity of quercetin against *Eschericia coli* was also assessed.

Results and Conclusions. Antioxidant active scaffolds have shown good mechanical properties and quercetin, used as antimicrobial agent, resulted to be released in a controlled manner during the storage time up to 30 days. *E.coli* growth was reduced up to 25% when the highest concentration of quercetin was added to the scaffold. The results of this study confimed that electrospinning can be successfully used to produce scaffolds with antimicrobial properties that are suitable for food packaging.

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EFFECT OF MOLECULAR MOBILITY AND SUPRAMOLECULAR ASPECTS ON OPTICAL CHANGES IN FREEZE DRIED FRUITS

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Keywords. Opacity, glass transition, low resolution NMR, water content, dehydrated fruits

Introduction. The food appearence is depending of interaction between material and incident light, which allow classification in opaques, transparents and translucents products. Translucent materials present some difficulties in optical determination, because, the direct reflectance is related to their environment, so could produce visual changes not representative of material. The food water content and their molecular structure play a relevant rol in appearance perception. The objective of this research was study effect of drying, humidification, and storage time on optical characteristics of freeze dry fruits and their relation to molecular mobility and supramolecular aspects.

Materials and Methods.

Apple, melon and pear were obtained in a local market in Buenos Aires (Argentina). Fruits were washed, peeled and cut in discs (0.5 cm thin, 2.0 cm diameter). Fruit discs were freeze dried, and one part of samples were powdered. Discs and powder fruits were humidified at different relative humidities, then, samples were stored at 45 ºC. Water content, glass transition temperature and molecular mobility were determined. Opacity and color parameters of discs and powder samples were studied by image analysis.

Results. Fresh fruits analyzed showed a translucent behavior, when material water is replaced by air during dehydratation, fruits change to opaque materials. This behavior could be explained by the difference in refractive index of water and air, and their interaction with fruits compounds, which produce light direction variations. During rehydratation of samples, powdered fruits presented translucence, however, disc samples did not show opacity variations. This trend could indicate the structural importance in appearence. The cellular wall (present in disc samples) mantain the air inside fruits generating opacity in disc samples. It is important to note, that translucent behavior started at T-Tg values above 38ºC. In this work, a parallelism between glass transition and opacity decrease were observed. In same way, a direct relation between molecular mobility and opacity property was determined.

Conclusions. Macroscopic appearence is related with molecular aspects, represented by water proton mobility, and supramolecular characteristics, identified by glass transition temperature and water content dependence. The material structure plays relevant rol in food products, their water sorption capacity and appearance.

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TOFU: EFFICIENCY DUE TO SOYBEAN QUALITY

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Keywords. tofu; bean quality; efficiency; soy

Introduction. Soy [*Glycine Max* (L.) Merrill] due to its high level of protein and its versality in food industry has been a lot researched as its technological aspects and new products development. Among the soy products, tofu is one of the most known and consumed. the soy culture economical exploitation is harmed by phytosanitary issues as pest insects especially bugs (Heteroptera: Pentatomidae), considered key pests of culture in Brazil. The bugs may reduce productivity, seed quality, germination, plant embryo rising and delay plant senescence[1]. This study aims at evaluating the efficiency of tofu related to soybean quality by considering the high consumption of tofu.

Materials and Methods. Soya beans from cultivar BRSMG 790A, crop 2014/2015 and 2015/2016, from the company Empresa de Pesquisa Agropecuária de Minas Gerais – EPAMIG, Uberaba, MG were used. The experiment was assembled in DIC with six treatments and four repetitions. Tofu was obtained by coagulations of the extract of dihydrate calcium sulphate. The influence of both crops and the presence or absence of bugs in the beans on the tofu and okara efficiency were evaluated. The efficiency was calculated by the weight of fresh tofu (g). Okara (OK), which is the tofu production residue, was dried in greenhouse at 105ºC until the obtainment of constant weight evaluated in grams. The experiment was analysed by ANOVA.

Results. The tofu efficiency was altered significantly when comparing crops and damages caused by bugs in the grain. Tofu from crop 2014/15 with no bug damages produced 169,725g, with 50% non-damaged grains(GND) and 50% of damaged grains (GD), showed efficiency of 159,35g and only with (GD), the efficiency was 146,15g (p 0,001). On crop 2015/16, the tofu efficiency prepared with non-damaged grains, the efficiency was 199,50g; by adding 50% of (GD), the efficiency was 173,55g and the lowest efficiency was for the exclusively prepared with GD tofu which was 152,52g (p 0,001). As far as the OK production, the average 34.73g was obtained, to the higher the tofu efficiency, the lower the OK efficiency. The average efficiency of crop 2014/15 was lower to the 2015/2016 crop, to all variables 158,41g (p 0,001).

Conclusion. It is recommended to the tofu preparation the use of new and damage free by bug grains to increase its efficiency as these features were influenced significantly by crop and by caused damaged.

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CHARACTERIZATION OF VIRGIN COCONUT OIL EMULSION WITH POLYMERIZED WHEY PROTEIN AS EMULSIFIER

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Keywords. virgin coconut oil, emulsion, whey proteins

Introduction. This study dealt with the preparation and characterization of virgin coconut oil (VCO) emulsion using whey protein polymer as emulsifier to develop butter substitute. The main purpose was to characterize the whey protein polymer-stabilized VCO emulsion, with varying oil concentrations, prepared at room temperature. The appropriate combination of heating time and temperature for whey protein polymerization was determined, the proportion of VCO to polymerized whey protein in aqueous solution that will give a stable emulsion was then obtained, and the resulting emulsion characterized.

Materials and Methods. VCO emulsion, using polymerized whey protein as emulsifier, was prepared and its stability against phase separation was analyzed. Whey protein polymers were formed by heating solutions of 15% (w/w) whey protein concentrate (WPC-80) at 70 °C for 20, 25 and 30 minutes heating time, or WP20, WP25 and WP30, respectively. The polymers formed were characterized in terms of intrinsic viscosity and conductance in aqueous solution. The VCO emulsions were prepared at different oil concentrations. The emulsions, which were of creamy consistency, were characterized in terms of apparent viscosity and stability as well as microscopy.

Results. The WP25-stabilized 80% VCO emulsion was found to have the highest apparent viscosity while both WP25 and WP30 emulsions showed the highest amount of oil emulsified at room temperature. However, after storage at 4 °C, the WP25-stabilized 50% (v/v) VCO emulsion exhibited the highest stability when brought to room temperature, while all other samples exhibited considerable reduction in stability.

Conclusions. Whey protein polymers produced by heat treatment, within the conditions considered in this study, are effective in stabilizing VCO emulsion. Whey protein polymers of appropriate size can effectively prevent oil droplets coalescence and creaming, leading to emulsion stability. Storage conditions and oil concentration influence the stability of the VCO emulsion.

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EFFECT OF THERMOSONICATION ON THE ASCORBIC ACID CONTENT OF FRUIT JUICES

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Keywords. ultrasound; ascorbic acid; nutritional quality; food processing

Introduction. Ultrasund processing applied coupled to a mild heat treatment (thermosonication) is an emerging technology useful to inactivate microorganisms and enzymes in fruit juices. However, the effect of the ultrasound processing on the ascorbic acid content is not clear and the results reported in the literature are contradictory. In this work the impact of thermosonication on the ascorbic acid (AA) content was evaluated in model systems and real fruit juices.

Materials and Methods. Two experiments were conducted. First, degassed aqueous solutions of ascorbic acid (pH 4, 250 mg/L) were sonicated at 25 and 55 ºC. Thermal treatments at the same temperatures were also tasted as control treatments. After that, two commercial packaged fruit juices (mandarin and orange juices) were thermosonicated at 55 ºC. A thermal treatment at the same temperature was also tasted as control treatment. The ascorbic acid content was monitored during the treatments. A one-way ANOVA (ascorbic acid concentration vs. processing time) was run at 95% of significance.

Results. In all cases, the processing time did not show a significant effect on the AA content ($p < 0.05$). That behavior was attributed to previous degassing/deaeration of the samples, which reduced the oxygen content. The results suggest the low oxygen content assumed to be in the samples limits the AA degradation, either by oxidation or by sonolysis.

Conclusions. This work evaluated the effect of the ultrasound processing on the ascorbic acid content of two juices of important commercial value, i.e., orange and mandarin juices. It was proved that the sonication can be combined with a mild thermal processing (at 55 ºC) with the aim to achieve the hygienic quality required for this kind of food products, without affecting the ascorbic acid content, and hence, the nutritional value. Deaeration is proposed as preliminary operation.

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POTATO FORTIFIED WITH CALCIUM

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Keywords. calcium impregnation, pulsed vacuum osmotic dehydration, potato osmotic dehydration, fortified potato.

Introduction. Pulsed vacuum osmotic dehydration (PVOD) process can be used for the development of fortified products of fruits and vegetables, because impregnation with nutrients occurs. The PVOD and the addition of calcium have beneficial effects on the maintenance of the product texture. The aim of the work was to impregnate potato cubes with calcium lactate during PVOD. They were packed with a trilaminated film in a modified atmosphere. The loss of calcium was analyzed after 90 days of freezing at -18°C. Parameters related to texture were determined, as wells as the stability product to microbial spoilage.

Materials and Methods. The potatoes were peeled, cut into 1 cm cubes and were immersed in an aqueous solution of sucrose (40% m/m), sodium chloride (5% m/m), L (+)-ascorbic acid (1% m/m) and calcium lactate (1% m/m). The experiments were carried out at 40 ºC during 1 hour, the first five minutes at 100 mbar and afterwards the atmospheric pressure was restored. The solution to potatoes mass ratio was 4:1 and the solution was stirred at 120±5 rpm. The samples were packed in a trilaminated film (polyethylene-aluminum-polyethylene) in a modified atmosphere (70 % N_2 and 30 % CO_2). For the freezing process, a pilot plant scale tunnel equipment in trays was used. The samples were frozen until reaching a temperature of -18 ºC in the thermal center of the bags. They were stored at -18 º C during 90 days in a commercial freezer.
The texture parameters were determined by a Stable Micro Systems texturometer, model TATX2i. The calcium concentrations were measured by a flame atomic absorption spectrophotometer. Microbial analyses were realized at 0, 30, 60, 90 and 180 days.

Results. The calcium content of the fresh potato (5 ± 1) mg/100g of sample increased significantly after 1 hour of PVOD (179 ± 2) mg/100 g of dehydrated sample. The calcium content was kept practically constant during the ninety days of storage. The addition of calcium allows to preserve the texture of the samples, since it promotes the cross linking of pectin polymers. The firmness remained without significant changes during the period of storage. After 180 days, the samples presented stability to the microbial spoilage (≤ 10 UFC/g). The CO_2 of the modified atmosphere exerted an inhibitory effect on the microbial spoilage.

Conclusions. The PVOD before freezing process improves the nutritional and textural characteristics of the potato and reduces the freezing time with an energy saving.

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OSMOTIC DEHYDRATION OF BANANA SPECIES MUSA PARADISIACA AND MUSA CAVENDISHII

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Keywords. osmotic dehydration, banana osmotic dehydration, Musa paradisiaca, Musa cavendishii

Introduction The Musa cavendishii specie is edible when its fresh but the Musa paradisiaca needs cooking before eating because of its high starch content. Both species belong to the Musaceae family and they are originally from Southwest Asia. The banana species are very rich in potassium and magnesium mineral contents but poor in calcium. With the purpose of improving the nutritional and textural characteristics, calcium was added during the osmotic dehydration. Osmotic dehydration OD consists of partial dewatering and impregnation with solutes of food pieces by immersion in concentrated solutions. In this way, the water activity of the product is reduced extending its shelf-life and nutrients such as minerals can be added. Also, the time of the posterior process necessary for obtaining a stable product such as freezing, drying, freeze-drying, etc., diminishes.

Materials and Methods The bananas were peeled and cut in slices of 5 mm of thickness. The operation conditions of the OD experiences were: sucrose concentration: 40 % m/m, calcium chloride 5 % m/m, ascorbic acid 5 %m/m, citric acid 1 %m/m (55 ºBrix), temperature: 40ºC, mass solution to mass product ratio: 4, and agitation level: 120-130 rpm. The impregnation of calcium of the product, the changes in the soluble solids concentration (º Brix) of the solution and the product and the humidity in both species were determined during the OD time (30, 60, 120 and 180 min). The calcium concentrations in the product were measured by a flame atomic absorption spectrophotometer, º Brix by a refractometer. The humidity was determined by the gravimetric method (A.O.A.C).
The kinetics of OD was studied. Two mathematical models were applied for the adjustment of the experimental data. They were: Crank model, based on the second Fick diffusion law and the Magee empirical model, appropriate for short process times, where the mass transfer occurred mainly by the diffusional mechanism and is proportional to the square root of time.

Results During the first hour of OD both species absorb the mayor quantity of calcium, Musa cavendishii 70 % and Musa paradisiaca 75 % of the total. The Musa paradisiaca specie presents a very low humidity, 14 %m/m, significantly minor than the Musa cavendishii, 77.8 %m/m. Besides, the Musa paradisiaca has a very low concentration of soluble solids, 8.9 º Brix respect to the Musa cavendishii, 22.3 º Brix. After one hour of OD, Musa paradisiaca reaches 27.7° Brix and Musa cavendishii 45.2 º Brix.
The calculated water diffusion coefficients were in the range of 1.12-1.20 $10^{-11}m^2/s$ for the Musa paradisiaca and 0.32-0.50 $10^{-9}m^2/s$ for the Musa cavendishii.
The ascorbic and the citric acids diminish the pH below the optimum for the PPO activity, reported as 6.5-7 by many authors and the enzymatic browning was not appreciated.

Conclusions The OD enhances the organoleptic and nutritional characteristics of the product and extends the shelf-life. The OD models adjust very satisfactorily the experimental data. The difference in the values of the water diffusion coefficients could be attributed to a more open structure of the Musa cavendishii.

VACUUM AND CONVENTIONAL FRYING OF DIPLOID POTATOES SNACKS WITH ANTIOXIDANT PROPERTIES

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Keywords. *Solanum phureja* J., functional food, oxidation, bioactive compounds.

Introduction. Sales of snacks are growing constantly and the main criteria for its election are flavor, health benefits and texture. Fried potatoes are one of the snacks with the biggest commercial success in the world (1), because of that, the development of new products using new varieties of diploid potatoes with antioxidant properties, processed with improved technologies, represent and interesting alternative for consumers (2). The aim of this research was to evaluate the quality attributes of diploid potato snack with antioxidant properties, using vacuum (VF) and convention frying (CF) processes.

Materials and Methods. Diploid potatoes grown in Santa Elena, Antioquia, Colombia, were used. They were cut into chips of 2 mm thick. VF process were made in a frying machine FVJCU001, operated with :
59.4 kPa pressure, 136.3°C oil temperature and 7 min, CF process was made under this conditions: 85.3 kPa pressure, 200℃ oil temperature and 5 min. Quality attributes were analyzed by the following methods: humidity, a_w, peroxide index (IP), antioxidant capacity (total phenolic compounds, DPPH, ABTS), color (CIE-Lab) and texture by testing fracturability.

Results. Diploid potato snacks processed by VF and CF presented humidity levels of 3.4≠0.06% and 17.3±2.7% and a_w values of 0.390±0.02 and 0.460±0.03 respectively, such situation could favor their microbiological stability; oxidative process associated to IP were lower in samples processed by VF than CF (4.4±0.6 and 12.7±1.7 meq H_2O_2/kg d.b., respectively), that could be more sensorial favorable for samples processed by VF. Total phenolic compounds highlight the antioxidant activity in snacks, that value was 10.8±1.3 mg GAE/g d.b for VF and 7.5±1.4 mg GAE/g d.b for CF; the DPPH values (0.49±0.02 and 0.5±0.01 mg Trolox/g d.b) and ABTS values (0.57±0.01 and 0.62±0.02 mg Trolox/g d.b) were similar for both process (VF and CF). The color of the products varies according two regions, one creamy external region, that presented differences in b* chromaticy, for VF (L*:34.8±6.1, a*: 13.6±1.8, b*:7.4±2.8) and CF (L*:38.6±5.5, a*:15.4±3.2, b*:17.5±5.9), and another internal reddish region, in which not found important differences, for VF (L*:34.0±5.2, a*: 14.5±2.2, b*: 7.3±2.7) and CF (L*:32.0±6.4, a*:16.7±2.1, b*:9.8±3.7).
The texture of both products were crunchy, however the VF snack presented a higher fracture strength than CF snack (5.84±1.1 N y 3.83±1.8 N, respectively) and lower fracture strength/distance ratio (1.4±0.3 y 3.5±1.1 mm, respectively).

Conclusions. For processing diploid potato snacks, VF represents a good technological alternative to CF, ensuring excellent quality attributes, better conservation of antioxidant compounds and lower peroxide formation.

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STABILITY OF O/W EMULSIONS BASED ON MORICHE OF THE COLOMBIAN AMAZON

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Keywords. *Mauritia flexuosa* f. L., *Canangucha*, colloidal system, stability

Introduction. The Moriche or Canangucha is the fruit of oil palm *Mauritia flexuosa* from Amazon basin. The fruit contain about 23% of dietary fiber, 26% carbohydrates and 36% lipids with significant active components: phytosterols, tocopherols, carotenes, among others (1). These characteristics makes it a promising product of the region with a potential for agribusiness (2). The aim of the research was to evaluate the stability of an O/W emulsion based on Moriche with the purpose of use in spray drying.

Materials and Methods. Fruits of Canangucha ecotype I from the city of Florencia, Caquetá, Colombia, with maturation grade 4 (3) were used. The emulsion (pulp, water, salt, Tween 80 and Span 60) was formulated containing 9% total solids and BHL 9.5, homogenized at 10000 rpm during 10 min. Subsequently, the physicochemical properties: moisture (X_W), a_W, pH, peroxide index (PI), zeta potential (ζ), spectral absortion index (SAI) and physical: color (L*, a* and b*), viscosity (η) and particle size (D_{10}, D_{50} and D_{90}) were determined, to evaluate its potential use in spray drying.

Results. The emulsions presented good stability without phase separation, its properties being as follows: Xw: 92%; a_W: 0.970±0.003; pH: 6; PI: 0.2 meqH_2O_2/kg; ζ:-29±2; SAI: 1; L*: 49±2; a: 10±0; b: 24±2; η: 856±114 cP and particle size D_{10}: 10±0 µ; D_{50}: 54±2 µ; D_{90}: 109±2 µ.

Conclusions. Moriche based emulsions are favored by both the presence of monovalent ions of NaCl, generating a negative electric potential next to the coions layer and repulsive forces between the oil y particles of great importance that favor their coloidal stability. The physicochemical and physical properties of the emulsion ensure its effective use for spray drying processes.

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NISIN AND LYSOZYME AS INHIBITORS OF STAPHYLOCOCCI FROM VACUUM-PACKED SAUSAGES

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Keywords. deterioration, microbial, antimicrobial.

Introduction. Average summer temperatures are about 36°C in tropical countries. This is the best temperature for growth of most mesophytic micro-organism. Therefore, there is loss of large volumes of this meat product because of deteriorating microbial. Nisin and lysozyme are being used as preservative in meat and dairy products. These have action against Gram positive bacteria, bacterial spores, molds and yeast. The aim of this study was check the potential of nisin and lysozyme inhibits the growth of staphylococci from vacuum-packed sausages.

Materials and Methods. staphylococci was isolated from vacuum-packed sausages. It was activated by three successive transfers in Brain Heart Infusion Broth (Himedia) and incubated at 36°C/24 h. The growth of the last activation was washed with phosphate buffer and the inoculum was adjusted to *ca* 10^6 cfu/mL. Tubes were prepared with Brain Heart Infusion Broth (Himedia) and added with 10, 100, and 1000 ppm of nisin or lysozyme. The tubes were adjusted to pH 5.5 or pH 7.0 by addition of lactic acid (PURAC®).Tubes was prepared under the same conditions, but without antimicrobials for use as background readings. All tubes were incubated at 36°C under aerobic and anaerobic conditions, and the growth measured by optical density (OD_{620}) at time intervals of 0, 3, 6, 12, 24, 30, and 36 hours. The assay was repeated three times and analyzed statistically with significance level of 95% (ANOVA) by de Fischer's test using XLSTAT version 7.5 software.

Results. when the pH of media was adjusted to pH 7.0, nisin reduced the growth of staphylococci until 6 hours of incubation at 36°C in the concentrations of 100 and 1000 ppm. When the pH was adjusted to 5.5 and in aerobic condition, the inhibition occurred until 12 hours. In pH 5.5 and in anaerobic condition, the inhibition was extended until 24 hours. The concentrations of 100 or 1000 ppm of nisin were equal in terms of reduction of growth, but 10 ppm of nisin was not effective. Contaminants micro-organisms contribute to the increase of microbial resistance due mainly to transfer of plasmids (Jay, 2005). Lysozyme did not inhibit the growth of staphylococci in any concentrations, pH, and atmosphere of incubation studied.

Conclusions. nisin at a concentration of 100 ppm or more reduce the growth of staphylococci, when it is associated with pH 5.5 and anaerobiosis, there is an increased of the inhibition. But only these barriers are not enough to completely inhibit the growth of staphylococci. Lysozyme is not effective in any conditions studied.

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DEVELOPMENT OF A SYSTEM FOR BREAD DOUGH EXTRUSION FOR 3D PRINTING

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Keywords. 3D priting, extruder, dough, phase transitions.

Introduction. Nowadays the evolution of 3D printing of food is in a critical moment, because only have been developed systems for easy food transformations. The food cooking and printing needs to improve the extrusion process by using first and second order transitions, with heat and work fluxes, biochemical reactions, even chemical reactions in order to finish a process of food transformation reaching the adequate final sensorial properties (1). The main objective of this work is the develop a 3D printer system of bread and pastry dough, obtaining suitable formulations for extrusion, developing an extrusion equipment, precooking at 100ºC and proposing a control system by infrared.

Materials and Methods. In order to carry out the objective, three experimental plans were performed, A rheological characterization of different dough formulations (Thermo Scientific HAAKE RheoSTRess), Estimation the drying kinetics by using infrared techniques (Optris PI® 160, Optris GmbH) and a design different extruders with cooling jacket and different assemblies with pumps, baths and hot air heating sources.

Results. The results show two formulations suitable for extrusion, excellent control of the drying kinetics by monitoring the surface temperature by infrared techniques (2) and 3D printing assembly for pastry dough. Thus it has been possible to develop an extruder with internal cooling capable of depositing various formulations, develop a 3D dough printing system and print a precooking pastry dough.

Conclusions. It has been possible to develop a drying control system by infrared thermography of bread and pastry dough by monitoring the dough surface. Beside this, by rheological, thermal and kinetic characterization of various pastry and bread dough it has been possible to develop an extruder with internal cooling capable of depositing various formulations and finally it has been developed a 3D printing system on a Rostock printer for bread and pastry dough.

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WAVEGUIDE VECTOR SPECTROMETER FOR FOOD QUALITY RAPID ASSESSMENT

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Introduction. In food, the interaction with the electromagnetic wave can be used to estimate chemical composition, physical structure of products, frequency and temperature, with moisture being the dominant factor (1,2). A Waveguide Vector Spectrometer (WVS) was designed for rapid assessment of main properties of a plurality of food products. The instrument is an Italian patent of the Alma Mater Studiorum, University of Bologna, Italy (N. 1421744, 2016; international application: WO2015/107455A1, 2015). The spectrometer present herein show an innovative potential in reason to the integration of different spectral measurements, both scalar (gain) and vector (gain + phase) analyzer. "Gain" and "phase" spectra can be recognized as the spectroscopic signature of a matrix and are the result of complex propagation and reflection phenomena due to the insertion of the sample under test in the waveguide.

Materials and Methods. The waveguide vector spectrometer (WVS) operates in the frequency range from 1.6 to 2.7 GHz. The system, completely integrated, includes a waveguide, a control unit, a signal generator, a gain/phase comparator, a power supply, and a USB port (for control and data transfer). The information contained in the gain and phase waveforms related to the product dielectric properties are exploited for the prediction of different compounds characterising both on simple liquid solutions and on more complex food products.

Results. Quality parameters of food matrix have been estimated by using linear and multivariate tools. Both gain and phase waveforms appeared to contain information related to the compositional parameters, and typical regions of the explored frequency range were associated. The technique showed to well predict several quality attributes of simple solutions and food matrices with coefficient of determination up to 0.99.

Conclusions. A waveguide spectrometer was set up to estimate food quality parameters in the low range of the microwave spectra, is assembled with few and cheap electronic components. The instrument could be potentially suitable for in line application for food quality monitoring, only thinking simple sample holder changes.

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EVALUATION IN VITRO OF THE INSECTICIDAL ACTIVITY OF SAPONINS STEROID OF MORINGA OLEIPHERA AND JATHROPHA CURCAS EXTRACTS AGAINST THE ACANTHOSCELIDES OBTECUS ADULT INSECT PEST OF BEANS IN STOCK.

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Keywords. Plant Extract, Jathropha curcas, Moringa oleiphera, Acanthoscelides obtectus, Bean

Introduction. To fight against the bean weevil *Acanthoscelides obtectus a major* Phaseolus vulgaris pest of stored beans in Kivu and to reduce non-target exposure to hazardous insecticides and to curb resistant development, alternative controls are required.

Materials and methods. Accordingly, a study on the effect of saponins and steroids extracted from the leaves of *Jathropha curcas* and *Moringa oleiphera* and as well as the commercial organophosphate insecticide, Malathion used as positive control, was conducted in the laboratory of the Evangelical University Africa to compare the efficacy of these two plants and improve conservation of bean products after harvest in controlling weevils *Acanthoscelides obtectus* bean pests.

Results. For this, a complete randomized design with three factors, insecticides plants, plant extracts and dose was used in 3 rehearsals with various doses of steroids and saponins extracted. The saponins extracts caused the highest mortality of 66.6% at a dose 1.5 g / ml followed by steroids extracted with a mortality rate of 64.44% both compared to the positive control Malathion who showed more efficient by eliminating weevils to 75.5% at the dose of 0.4 g / ml. These mortality figures were achieved in 72 hours of exposure. In regards made doses, D1 dose (1.5 g / ml) which was more effective following of the dose, D2 (0.15 g / ml), D3 (0,015g / ml) and D0 last dose. And these doses are all DL50-90. There is no significant difference in mortality caused by *Moringa oleiphera* and *Jathropha curcas* that are 67.77% and 63.3% respectively compared to the positive control.

Conclusions. The different active ingredients identified in different plants, have shown encouraging in general. and can be used as an insecticide.

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INFLUENCE OF PARTICLE COMPOSITION ON AGGLOMERATION BEHAVIOR AND INSTANT PROPERTIES OF FOOD POWDERS

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Introduction. Instant powders are dry, mostly dehydrated products, made for rapid and complete reconstitution in liquid at the consumer level or as intermediates for industrial applications. The reconstitution of a powder can be divided in wetting, submerging, dispersing and dissolving (if soluble)[1]. Wetting and submerging are often the rate controlling steps[2] for the fast reconstitution of a particle system and can be optimized by improving particle formulation and morphology by processes such as agglomeration and coating. When food powders are agglomerated by the means of a binder solution, this results in the partial coating of the agglomerates, which further influences their dissolution behavior. In this study the influence of common carrier or coating materials on particle growth during agglomeration in a fluidized bed and the instant properties (wetting time, sinking behavior) of the produced agglomerates were investigated.

Materials and Methods. For the production of agglomerates, maltodextrin DE 19, OSA-starch and gum Arabic were used as model materials in either commercial form (d_{50} 45 – 120 µm) or spray dried (d_{50} 27 – 32 µm). Dry powders (2 – 2,6 kg) were agglomerated in a pilot scale batch fluid bed processor (AMMAG) by spraying either water or 20 % solutions of the materials (binder/coating) through the integrated atomizing nozzle for 60 minutes. Process conditions were the same for all agglomeration trials and samples were taken every 10 minutes during the process. The agglomerated powders were analyzed for their size distribution (laser diffraction and sieving analysis), bulk density and morphology (SEM, light microscope). Wetting time and dissolution tests were performed with the size fraction 500 – 800 µm.

Results. Binderless agglomeration led to a stable continuous growth for all raw materials in the first 30 minutes of spraying. During the 60 minutes of agglomeration, smallest growth rates were observed for gum arabic resulting in a median diameter of 300 – 400 µm. When biopolymer solutions were sprayed as binder/coating material, continuous growth was observed during the whole process, yielding in bigger agglomerates in the case of maltodextrin applied on gum arabic and OSA-starch as bed material. Using gum arabic or OSA-starch as binder/coating material had no or a negative impact on particle growth compared to spraying pure water. Dissolution time was improved for all agglomerates compared to the starting materials which can be mainly attributed to the increased particle size and favorable morphology of the agglomerates. Agglomerates with a high OSA-starch content or OSA-starch on the surface, showed poor sinkability. Due to the selected analytical method, this also had an elongating effect on the measured wetting time. The sinkability and subsequently the determined wetting time were significantly improved (from >300 sec. to <6 sec.) when the OSA-starch was agglomerated with a maltodextrin solution. The resulting surface coating of maltodextrin led to a fast sinking of the particles resulting in a powder which dissolved in water without stirring.

Conclusions. The chosen carrier material of dried particles, influences the further agglomeration behavior which is relevant for granulation and tableting of powders. In this study the surface material of particles with similar size and morphology governed the sinking behavior of the powder bulk and can thus be optimized by modification through coating.

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EFFECT OF FIBER CONCENTRATED AND DEPHYTINIZED WHEAT BRAN ON BREAD TEXTURE

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Keywords. Dietary fiber, phytic acid, dephytinization, wheat bran, texture

Introduction. Dietary fiber (DF) has still attached attention due to its reported health benefits including the prevention of diseases such as coronary heart disease and certain cancers. Wheat bran has high DF content and is widely used in the baking industry. However, it contains high amount of phytic acid (PA). PA is an antinutrient which has high affinity to interact with protein and multivalent minerals, and reduce their bioavailability. Therefore, consumption of high DF food product may cause health problems for children, pregnant women and elders. Even though some PA degradation is achieved during fermentation in the baking process, a considerable amount remains in bread. Since bread quality depend on the process conditions, these conditions cannot be adjusted for reducing PA content. Therefore, dephytinization of bran before incorporation into food product seems essential.

Materials and Methods. Bran was mixed with distilled water at the ratio of 1:15 (w/v) and the slurries were incubated for 6h at 30 C in a temperature controlled water-bath. The slurries strained in a sieve (opening 250 μ). The remained solids were rinsed with water in order to obtained bran concentrated fiber. Fiber-concentrated bran was dephytinized with fermentation. For fermentation, the bran slurries were mixed 6% (w/w) of compressed bakers` yeast, and fermented for 6 h at 30 °C in a temperature controlled water-bath. For bread making, AACC Standard Method 10-10.03 (1) was used. Total dietary fiber (TDF) content was determined according to AOAC 89 Method No:
991.43 (2). PA content was calculated according to Haug and Lantzsch (3). Texture profile analysis (TPA) of bread was performed and the TPA parameters were determined. Specific volume was calculated as the ratio between the loaf volume (mL) and weight. The total number of cells and total cell area were determined with digital image analysis.

Results. The concentration treatment increased TDF content of bran up to 44.9 % and caused small amount of PA reduction (22.3 %). The dephytinization treatment (fermentation) decreased PA content of bran by 88.1 %. In contrast to the concentration treatment, dephytinization treatment had no effect on TDF content. Wheat bran addition increased hardness, and decreased resilience and cohesiveness of bread crumbs depending on the incorporation level of bran. After concentration treatment, adverse effect of bran was more pronounce, but dephytinization of bran led to a certain improvement. Wheat bran addition reduced the volume yield and specific loaf volume of the bread; and decreased cell numbers and total cell areas, therefore caused a poor crumb grain. Fermentation of wheat bran increased volume yield, total number of cells and total cell area of the bread.

Conclusions. Fermentation was effective at degradation of PA. Further, fermentation improved the negative effects of wheat bran on the bread texture. This study demonstrated that high fiber bread with low PA content and acceptable texture can be produced by the concentrated-dephytinized wheat bran.

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SIDE-STREAM CONVERSION BY INSECTS: EXPLOITING THE CHEMICAL COMPOSITION OF BLACK SOLDIER FLY (*HERMETIA ILLUCENS*) AS A POTENTIAL FEEDSTUFF

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Keywords. food waste, insects, lipid, protein, amino acids

Introduction. Approximately one-third of all food produced for human consumption worldwide is wasted. The current waste management practices are not only costly but also have adverse impact on environment. Insects are able to convert a variety of feedstocks into a more homogenous biomass, being their own biomass (1). In the 'Valoribio' project, financed by Emilia Romagna Region (POR-FESR 2014-2020), black soldier fly (Hermetia illucens) larvae are grown on waste from zootechnical production chain and other food wastes. The aim of the project is to recover fat, protein and chitin fractions from the insect that can be used as feed or to obtain biomaterials to be reintroduced in the agricultural system, to a better global sustainability of the production cycle. The Parma Unit of the project is involved in the isolation and molecular characterization of biomolecules from black soldier fly prepupae, as lipidic, proteic and chitin fractions. Here we present the preliminary results obtained, in terms of characterization of lipidic and proteic fractions.

Materials and methods. black soldier fly was farmed on food by-products and analyzed at the prepupae stage. Proximate composition was determined by official methods, fatty acids were determined as methylesters by GC-MS, amino acids by HPLC/FLD and protein molecular weight by SDS PAGE.

Results. Whole black soldier fly prepupae are composed by 64% water, 12% lipids, 14% nitrogen compounds (including protein and chitin), 7% ashes. The fatty acids profile is characterized by high amount of lauric acid (more than 50% of total fatty acids), followed by miristic (16%) palmitic (10%) and oleic (6 %). The amino acid profile showed a prevalence of glu (11%) ala (10%), asp (9%) leu (7.4%), gly (7.4), tyr (7.4%) val (6.6), lys (6.5%), arg (5.5), pro 5.2), ser (4.9), thr (4.1), Ile (4.1), phe (3.6), hys (3.3), met (1.7). SDS-PAGE using 12.5% acrylamide gels of the black soldier fly aqueous extract showed a major protein bands of 66 kDa, a group of three bands 31-44 kDa, and a band < 14.4 kDa.

Conclusions. black soldier fly prepupae can be considered a good source of biomolecules that can be re- used in feed and biomaterials applications

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