

**ABSTRACT BOOK**



**FSD 2018 3rd Food Structure & Design Conference**

**University of Debrecen, Debrecen, Hungary**

**20-22. September 2018.**

ISBN 978-963-490-0245



## TABLE OF CONTENT

chair's message .....	3
scientific committee .....	4
sponsors .....	5
list of pleanray lectures .....	7
oral presentations .....	10
poster presentations .....	35
author index .....	50

## CHAIR'S MESSAGE

I would like to thank you for your interest in the 3rd Food Structure Design Conference held in Debrecen, Hungary, between 20 - 22 September 2018. This Conference follows the framework of the EU-funded COST Action FA1001, first started in Porto, Portugal in 2014. However a few of the original founding members are retired by now, we hope to involve young researchers into the congress to provide the continuation of this project in the future.

The main aim of the Food Structure Design Conference is to explore the academic and industrial-level scientific understating of food design and engineering with an international interdisciplinary group of scientists and professionals. We also focus on strengthening the understanding of food product design engineering and help the development of innovative and functional food products. Our ambition is to share knowledge and technologies with scientists and the food industry in terms of the design of healthy and functional food products.

The topics of the event include the design of health food products, improving food structure, increasing bioavailability of nutrients in complex structured foods and we also touch upon food marketing. As the field of food science today is increasingly interrelated with health science, works on these interconnected fields will also be presented. Since the University of Debrecen plays an important role in the research and development of food science we pland to present you the scientific work carried out by our colleagues and reinforce the position our research community holds in the field of food science, healthy nutrition, food safety with special regards to developing functional food products.

We have presentations of more than 50 reserachers and professionals form more than 15 countries. I hope you will enjoy presenting your latest research, meeting international colleagues and exploring Debrecen in your free time.

All abstracts, presentation slides, photographs and recordings, which is received permission, will be published at the webpage of congress after the event: <http://fsd2018.unideb.hu/>.

I would like to express my thankfulness to the members of the Organizing Committee for all their hard work and to the members of the Scientific Committee for their efforts. I would like to express my gratitude to Universitas Ltd. for their share in organizing the event.

Finally, I would also like to thank to all participants, speakers, session chairs, sponsors who helped the congress happen.

I hope to see you again in Debrecen, Hungary in the future.

Sincerely Yours,  
Prof. Dr. Zoltán Győri  
Chair of Congress  
University of Debrecen  
Institute of Nutrition

## SCIENTIFIC COMMITTEE

András Salgó, Budapest University of Technology and Economics, Hungary  
Antal Véha, University of Szeged, Hungary  
António Vicente, University of Minho, Portugal  
Béla Kobács, University of Debrecen, Hungary  
Cristina M. Rosell, Spanish National Research Council, Spain  
Diána Bánáti, University of Debrecen, Hungary; Executive and Scientific Director, ILSI Europe  
Gabriela Iordachescu, Dunarea de Jos University, Romania  
Henry Jager, BOKU, Austria  
László Varga, University of Szeged, Hungary  
Laura Piazza University of Milano, Italy  
Lidia Zander, Olsztyn University of Warmia & Mazury, Poland  
Lilia Arhné, University of Copenhagen, Denmark  
Lívía Sarkadi Simon, Szent István University, Hungary  
Maria Margarida Cortez Vieira, University of Algarve, Portugal  
Mustafa Erbas Akdeniz University, Turkey  
Natasa Poklar Urlih, University of Ljubljana, Slovenia  
Péter Sipos, University of Debrecen, Hungary  
Sophie Miquel-Kergoat, MARS Inc., USA  
Zoltán Csiki, University of Debrecen, Hungary  
Zoltán Győri, University of Debrecen, Hungary

## SPONSORS

Chili Hungaria Manufacture

Derecskei Gyümölcsös

Dr. Diósi Gerda

Hajdú Gabona cPlc.

Hubai and Co. Ltd.

Hungarian Ministry of Agriculture

ILSI Europe – International Life Sciences Institute

ISEKI Food Associations

Kabafrost Kft.

Local Government of Hajdúnánás

Nádudvari Élelmiszer Ltd.

Office of Debrecen Municipality

Dr. Prokisch József, Debreceni Egyetem

Radics László mézeskalácskészítő iparművész, népművészet mestere

Servet 2000 Kft. Sárrétudvar

University of Debrecen

VWR International Ltd.

Wessling Hungary Ltd.



**HUBAI**  
ÉS TÁRSAI KFT.



FÖLDMŰVELÉSÜGYI  
MINISZTERIUM



**Kabafrost Kft.**  
„The frozen quality”



<sup>®</sup> **gluku's**  
FREE FROM



**VWR**  
We Enable Science

**WESSLING**  
Quality of Life

## LIST OF PLENARY LECTURES

### HOW CAN FOOD STRUCTURE DESIGN BE A TOOL FOR SUSTAINABLE DIETS

Laura Piazza

[laura.piazza@unimi.it](mailto:laura.piazza@unimi.it)

Department of Environmental Science and Policy

Università degli Studi di Milano

The need to shift to more sustainable diets and food systems is increasingly evident but certainly not simple to achieve. In the past decade, more and more countries have started to incorporate sustainability considerations into their food policies that promote specific food practices. Recommendations include, among other, having a mostly plant-based diet, reduction of red and processed meat, salt content in processed foods and sugar-sweetened beverages.

This scenario requires an assessment of the role of the "Food Structure Design" discipline for the realization of the new objectives. Examples are given showing how the observations made at the nano, meso or macro dimensional level of the structure properties of a food can be a support in the development of new ingredients and in the production of foods that meet the criteria indicated for sustainable diets.

### NEW FOOD NEW FUTURE?

Diána Bánáti

[dbanati@ilsieurope.be](mailto:dbanati@ilsieurope.be)

University of Debrecen, Institute of Nutrition, Egyetem tér 1. H-4032 Debrecen, Hungary

Advancements in science suggest promising solutions for the grand societal challenges. However, the world is changing, population growth, demographic changes, including the growing number of elderly people (often with a cognitive impairment), the epidemic of globesity, the rise of non-communicable diseases (incl. CVDs and Type-2 diabetes), emerging and re-emerging food safety hazards, societal changes, urbanisation etc. are all major challenges for the future.

Diets and consumption patterns are increasingly diversified and polarised. More and more consumers demand food in line with specific values (e.g. ethical values, religious beliefs, animal welfare, methods of processing, environmental impact, health concerns, fair trade etc.), and changing consumer demand is detrimental. Consumers are more and more (health) conscious, request safe, nutritious and 'fresh' products with the longest possible shelf-life, want to have convenient but in the same time 'natural' products on the market. So consumer demand is changing and the new technologies might provide benefits, while being safe (e.g. irradiation and modern biotechnology, PEF and so on), still consumers refuse novel methods of processing as they often misperceive the risk-benefit angle/axis.

Food security issues, how to handle and reduce food waste and in the same time decreasing biodiversity are all issues of concern. We never had safer foods than these days and in accordance with the high food safety standards, the food we process and market in the EU is in accordance/compliance with the highest possible standards. Still, consumers remain concerned and based on their beliefs and

misperceptions, not to mention the misleading information being available via Internet and other media, consider foods to be unsafe, consider industry to be misleading and researchers being biased. The ways consumers interact with the food chain have a profound effect on what is produced and how it is produced.

Conducting scientific research and innovation directed towards safer foods and healthier diets are key measures for dealing with the challenges.

Opportunities in terms of societal challenges, socio-economical issues, novel technologies etc. will be considered in the presentation, with special regard to relevant studies of the EU, EC, OECD, EEA, FAO and other relevant sources.

## BIOTRANSFORMATION IN FOOD - TOWARDS HEALTHFUL CARBOHYDRATES

Christina Vafeiadi

Christina.Vafeiadi@rds.nestle.com

Nestlé Ltd., Nestlé Research, Enzymes - Biology Department, Institute of Material Sciences,  
P. O. box 44., Lausanne 26, CH-1000 Switzerland

Biotransformation is an important technology in food processing. It is inspired by nature and is divided in three technological axes: fermentation, enzymes and probiotics. This talk will give an introduction on how biotransformation is applied in food manufacturing with selected examples. At the second part, a special focus will be given on recent advances of Enzyme Technology for the generation of healthful carbohydrates (low glycemic carbohydrates).

## FUNDING OPPORTUNITIES FOR FRONTIER FOOD SCIENCE AT THE EUROPEAN RESEARCH COUNCIL (ERC)

András Badacsonyi

Andras.BADACSONYI@ec.europa.eu

European Research Council Executive Agency

The aim of the presentation is to introduce the European Research Council (ERC), a major actor in funding excellent science in Europe. Its yearly budget is close to two billion euros per year and the audience will be provided detailed information about the offered funding opportunities and the conditions and requirements of accessing ERC grant schemes. ERC grants, depending on the grant scheme, provide 1.5 – 10 million euros portable grants to individual principal investigators (and their respective research groups) for 5-6 years, giving them the necessary freedom to focus on their research.

A small analysis will also be presented on how "food" related research is present in ERC's portfolio. ERC grant schemes do not have either any pre-set priorities concerning the subject of the research, or any other requirements beyond excellence which is the sole evaluation criterion. Several fields of food research are already well represented among the awarded

grants, and the presentation will also show some examples of the supported research projects.

It will try to refute some rumours around ERC, mainly those concerning applied sciences. The presentation's aims also include gathering feedback from scientists and other people involved in research about how the different food research communities could exploit even better this funding opportunity.

Therefore, the audience is encouraged to enrich the discussion by their questions and comments.

## ORAL PRESENTATIONS

### Section 'Food Structure'

#### DEVELOPING PRE- AND POSTHARVEST TECHNOLOGY FOR THE FRESH FRUIT STORAGE OF TART CHERRY (*PRUNUS CERASUS* L.)

Sándor E<sup>1</sup>, Mihály K<sup>1</sup>, Kovács Cs<sup>2</sup>, Takács F<sup>2</sup>  
karaffa@agr.unideb.hu

<sup>1</sup>University of Debrecen, Faculty of Agricultural and Food Sciences and Environmental Management, Institute of Food Science, Böszörményi út 138., H-4032 Debrecen, Hungary

<sup>2</sup>National Agricultural Research and Innovation Center, Fruit Research Institute, Vadastag 2., H-4244 Újfehértó, Hungary

The estimated losses of fresh horticultural produce in supply chain “from farm to plate” range between 15-40% or more with the highest rate for fruits and vegetables. *Prunus cerasus* (sour cherry or tart cherry) is a traditional and widely used fruit of the Hungarian cuisine, with an annual production volume of 60 000 to 80 000 tons, which is second only to Poland within the EU. Global export rates of fresh sour cherry – fuelled by an ever-increasing demand – keep continuously growing. Tart cherry sports some excellent nutritional features such as high melatonin, vitamin A, beta-carotene and flavonoid content, coupled with sugar content lower than that of sweet cherry. However, the marketability of sour cherry is severely limited due to its notoriously short shelf-life. Hence, in order to realize its inherent economic potential, new, efficient postharvest methods suitable for the Hungarian varieties are needed. Chemical pesticides administered before harvest may decrease the number of decaying fungi on the surface of stone fruits, thereby increasing shelf-life, and biological pesticides can be successful too. The most widely used postharvest technology, is the low temperature storage, which is often combined with modified atmosphere packaging (MAP), i.e., with low O<sub>2</sub> and high CO<sub>2</sub> levels.

The combination of different pre- and postharvest technologies were applied to test their efficiency for decreasing, rotting and increasing self-life of three different tart cherry varieties ('Érdi bőtermő', 'Újfehértói fürtös' and 'Petri'). Fluopyram containing fungicide, moreover biofungicides containing *Aureobasidium pullulans* and *Bacillus subtilis* were tested in preharvest treatment. The effect of cold storage at 0-2°C, in normal and modified (MAP) atmospheres were tested among the postharvest technologies. Fluopyram and *B. subtilis* containing preharvest treatments and MAP increased the self-life most cases, but the results were greatly affected by the variety.

## FOOD AND PROBIOTIC *SACCHAROMYCES* YEASTS: COLONIZERS AND PATHOGENS?

Pfliegler W P<sup>1</sup>, Imre A<sup>1</sup>, Antunovics Zs<sup>2</sup>, Kovács R<sup>3,4</sup>, Majoros L<sup>3</sup>, Dóczy I<sup>5</sup>, Pócsi I<sup>1</sup>  
pfliegler.valter@science.unideb.hu

<sup>1</sup>Dept. of Biotechnology and Microbiology, University of Debrecen <sup>2</sup>Dept. of Genetics and Applied Microbiology, University of Debrecen <sup>3</sup>Faculty of Medicine, Dept. of Medical Microbiology, University of Debrecen <sup>4</sup>Faculty of Pharmacy, University of Debrecen <sup>5</sup>Dept. of Clinical Microbiology, Albert Szent-Györgyi Clinical Center, University of Szeged

The baker's, wine and ale yeast (*Saccharomyces cerevisiae*) is one of the most important microbe species, with uses in food production, biotechnology and as a probiotic/biotherapeutic agent. An increasing number of clinical isolates from this GRAS (Generally Recognized as Safe) species have been recently analyzed for their pathogenicity, virulence factors and genomic signatures of pathogenic lifestyle. In this work, we investigated how exposure to commercial (baking, probiotic, etc.) *Saccharomyces* may be regarded as crucial factor for yeast infections and how these yeasts might become members of our microbiome.

Our dataset used in assessing *Saccharomyces* clinical yeast diversity included 62 isolates from a wide range of patients with various underlying diseases and conditions from a narrow geographical region (East Hungary). These clinical isolates have been subjected to genetic analysis to assess possible relatedness of clinical and commercial (food and probiotic) strains, as commercial yeasts undoubtedly have the possibility to colonize human hosts. Our collection of such yeasts included 32 locally available strains. Clinical-commercial yeast relatedness was proven for dozens of isolates using the similarities of karyotype patterns, PCR-fingerprinting, mitochondrial DNA analysis and multi-locus-sequence typing (MLST). Such commercial-derived clinical yeasts are in part true opportunistic pathogens, but many of these are likely to represent the pool of established and/or transient commensal *S. cerevisiae* in our bodies.

By understanding how and how often food and probiotic yeasts may colonize the human host and by assessing their potential pathogenicity, we may be able to minimize the health risks associated with the use of humanity's most important domesticated microbe, the *Saccharomyces cerevisiae*.

## CRYSTALLIZATION OF FATTY SYSTEMS UNDER SHEAR – THE ROLE OF SHEAR ON THE CRYSTALLISATION PROCESS AND THE PRODUCT MICROSTRUCTURE

Smith PR<sup>1</sup>, Moelants K & Wallecan J  
Paul\_Smith@cargill.com

<sup>1</sup>Cargill R&D Centre Europe, Havenstraat 84, B-1800 Vilvoorde, Belgium.

Much study of the microstructure of fatty foods has been on quiescently cooled systems. However in real life shearing is applied to systems. It is noted that the crystallisation is affected significantly by the application of shear. Therefore new techniques have been

developed in order to investigate the behaviour of fat crystals under sheared conditions. By application of rheology and other techniques we are able to observe how polymorphism and product structure develops in model food systems. In this presentation we examine the effect of shear on the crystallisation of palm oil and cocoa butter. It is seen that control of the shear rate gives opportunities for crystallization and structural control.

Understanding of the mechanisms behind the crystallisation under shear and the subsequent structure building are developed.

We are able to (partially) predict the effect of processing parameters and system composition on crystallization behaviour (a toolbox)

### Section 'Developing new food'

#### APPLYING OF ENZYME COMBINATION FOR DEVELOPING GLUTEN FREE NODDLE PRODUCTS

T. Kovács E<sup>1</sup> and Glattes H<sup>2</sup>  
elisabet@mk.u-szeged.hu

<sup>1</sup>University of Szeged, Faculty of Engineering, Department of Process Engineering  
6725 Szeged Moszkvai krt. 5-7, Hungary

<sup>2</sup>Member of IFA (ISEKI-Food-Association) National Representative Team Vienna, Austria

The importance of “gliadin-free” basic foods keeps growing, therefore non traditional raw materials like pseudo cereals, rice and legumes (yellow pea) can become an important food base of the dietetic, non-traditional pasta products, and suitable for a gluten-free dietary of wheat-sensitive patients too. The quality and amount of protein components in brown rice and yellow pea flours are not sufficient for developing a good dough structure, therefore additives are required like emulsifiers or enzyme. In our experiments we used for developing an acceptable dough structure the enzymes transglutaminase (TG), glucose oxidase (GO) and laccase (LA) in different combinations and in different proportions.

The enzymatic treatment has shown interactions and resulted in new intermolecular covalent bonds. At the pea proteins the main fraction albumins and globulins were involved, and at rice flour the gluteline fractions were cross-linked. It is reported that Laccase catalyzed oligomerization of peptides through oxidation of tyrosine, cysteine or tryptophan residues and the main fraction is the gluteline fractions too. On the basis of electrophoretic examinations we were able to find out a suitable combination of enzymes showing noodle products with a higher quality than products by using only one enzyme.

## 3D PRINTING FOR PRODUCTS WITH PERSONALIZED TEXTURAL PROPERTIES: A CASE STUDY ON THE FOOD STRUCTURE OF MULTILAYERED WHEAT-BASED SNACK

Derossi A, Caporizzi R, Paolillo M and Severini C.

rossella.caporizzi@unifg.it

Department of Science of Agriculture, Food and Environment - University of Foggia, Via Napoli 25, Italy

3D printing is leading to a revolution across many sectors among which the rapid prototyping, the production of spare parts and the regenerative medicine are the most exciting. Based on its great degree of freedom this technology is inspiring food scientists and industries to get food products never though before. Specifically, 3D food printing (3DFP) would allow personalizing foods in terms of design, nutritional properties and sensorial aspects as well. The capability of estimating texture properties of food would furnish a useful tool to reach a high level of personalization if the design of a 3D virtual model would be related to the texture of the 3D printed food.

We have studied as the design of a 3D model and the path of the printer movements during material deposition affect both instrumental and sensorial texture properties. Also, we analysed microstructural properties of the 3D food. To these specific aims we worked on a wheat-based snack with a post-printing cooking in oven at 180°C.

Based on our results, we manufactured a multilayered food product – by using an internal layer of almond cream - personalized for people with swallowing problems and/or elders. In this way we were able to customize the snack both in terms of nutritional compounds and texture.

Even if some studies analysed some textural characteristics of 3D printed products, there are no systematic information regarding the effects of the printing process on the structure and, therefore, on textural attributes.

Results proved that the modification of the food texture by using 3DFP may be possible, being able to match specific desires or requirements. Moreover, the manufacturing of multilayered foods with different physical and sensorial characteristics is a feasible process to improve the level of personalization. Further experiments will be performed to mathematically estimate and validate the texture of novel food.

## IMPACT OF MONOVALENT CATIONS ON PECTIN POWDER STRUCTURE AND TECHNO-FUNCTIONAL PROPERTIES

Einhorn-Stoll U, Kastner H, Drusch S

Einhorn-Stoll@tu-berlin.de

Technische Universität Berlin, Department of Food Technology and Food Material Science, Königin-Luise-Strasse 22, D-14195 Berlin

Pectins are classical structuring agents in food products. They immobilize water and act as thickening and gelling agents. They are isolated from various plant sources and are modified

for different applications using chemical or enzymatic treatments. Nearly all these modifications require a specific pH, which is kept constant by adding for example NaOH.

It is expected that monovalent cations bind to dissociated carboxyl groups, formed during pectin modification, act as spacers and prevent close contact and formation of hydrogen bridges between pectin macromolecules. During drying, this state would be preserved and would determine the powder structure. Fluffier powders should lead to an increase in water uptake. Cations, bound to carboxyl groups, might also affect the pectin gelation process by restricting ionotropic gelation via Ca-bridges.

In this study, pectin samples with similar degree of esterification (main molecular parameter) were prepared either by alkaline or acidic modification. As confirmed by flame photometry, sodium ions were strongly bound to samples during alkaline treatment at pH > 10, but were not present in pectin samples prepared by acidic modification without adding NaOH. Powder property analysis included BET surface, bulk density and thermal analysis. Water uptake was tested by a sorption method. Alkaline treated samples had a higher BET-surface, lower bulk density and higher water uptake than samples from acidic treatment. Thermal analysis showed the differences by an earlier onset of pyrolysis in alkaline treated samples.

Finally, gel formation differed depending on the presence of sodium ions as indicated by characteristic structuring temperatures, determined by oscillation rheology. The gelation process of an alkaline modified pectin started at a lower temperature than that of an acidic treated.

The postulated effects of monovalent (sodium) ions on pectin powder structure and techno-functional properties were confirmed and should be considered for choosing optimum modification methods.

## DESIGNING WHEY PROTEIN-BASED ARCHITECTURES UNDER APPLICATION OF MODERATE ELECTRIC FIELDS

Pereira R. N.<sup>1</sup>, Moreira T. C. P.<sup>2</sup>, Rodrigues R. M.<sup>1</sup>, Teixeira J. A.<sup>1</sup>, Cunha R. L.<sup>2</sup>, Vicente A. A.<sup>1\*</sup>  
avicente@deb.uminho.pt

<sup>1</sup>Centre of Biological Engineering, University of Minho, 4710-057 Braga, Portugal

<sup>2</sup>Department of Food Engineering (DEA), Faculty of Food Engineering (FEA), University of Campinas (UNICAMP); Rua Monteiro Lobato, 80; Campinas-SP; CEP: 13083-862; Brazil

Milk proteins are now at the top of the list of functional super molecules, coupling interesting nutritional and biological properties. These biopolymers offer potential to be designed into structures with discrete morphologies and multi-functionalities. Recently it has been shown that Ohmic Heating (OH) appears as an interesting processing tool to be used on functionalization of important food macromolecules, such as whey proteins. The main goal of this study was to use the unique synergy between electrical and thermal effects of OH to trace and simultaneously interact with the biophysical state of proteins targeting the development of novel food biomaterials. Electric field *in-situ* can control electrostatic interactions of whey proteins during heating, reducing aggregation and maintaining unfolded protein reactive to salt-induced or acid gelation. After a first heating step (at 95 °C for 15 min), and addition of glucono- $\delta$ -lactone (GDL), a homogenous and fully-supported acid gel network composed of WPI and casein was obtained. Acid gelation was developed under constant electric field of 20

V/cm until a final pH of 4.6, which allowed to an inherent increase of the incubation temperature - i.e. from 25 to 78 °C - due to gel development network and change of electrical conductance. With this process casein-whey gels were obtained in less than 2 h with improved water holding capacity ( $\geq 30\%$ ) and mechanical properties comparable to gels produced after long ageing times (normally exceeding 24 h). Application of moderate electric fields during gelation process offers a new opportunity to development of whey protein based 3-D supporting architectures with optimized texture and water-holding capacity through a non-invasive monitoring and self- driven heating process.

#### STRUCTURE OF THE FOOD PREPARED BY LOW TEMPERATURE COOKING

Prokisch J, Sztrik A, Nagy É, Csapó J  
jprokisch@agr.unideb.hu

University of Debrecen, Nanofood Laboratory, 4032 Debrecen, Egyetem tér 1., Hungary

In the last 30-40 years the gastronomy discovered the opportunities and the advantages of the long term, relatively low temperature (45-95 °C) cooking. A kind of this process called “sous vide” (under vacuum) technology. The industrial implementation of this process, the scale up has many challenges.

We developed a new, energy optimised, “sous vide” equipment (Suvi Gastro) with air circulation for this low temperature cooking. The advantage of this equipment is the low energy consumption and the remote controlled and recorded processing for the traceability of the process. The food safety issues can be handled much easier with this new equipment. The application of air instead of the water has many advantages, like the cheaper and more safety operation and easier scale up possibility. We are producing a 20 and 100 kg/day capacity equipment and we are planning to build a 4-10 tons/day chambers.

We demonstrate the application of this system in the processing of meat, vegetables, fruits and bakery products. Furthermore the instrument is suitable for the very long heat treatments. We studied the effect of 2-6 week 75 °C treatment of garlic, apple and different fruits. This treatment resulted black garlic from a normal garlic and black apple from the fresh apple. The changing of colour is not the only changing, the chemical composition and taste change as well because of the Maillard-reaction. The amino-acids and sugars react and the formed molecules have a crucial role in the sensing of taste and there is some indication of positive health effects as well. The produced black garlic was tested with GCMS-Headspace-SPME for identification of changing in the long term heat treatment. The black and the fresh garlic health effects were compared in animal experiments as well.

#### EFFECT OF FLOUR TYPE AND WATER CONTENT IN DOUGH FORMULA ON PHYSICAL PROPERTIES OF STEAMED BREAD

Durak AN, Mutlu C, Koc A, Bilgin DG, Erbaş M  
erbas@akdeniz.edu.tr

Department of Food Engineering, Akdeniz University

Due to the recently arising health issues, healthy nourishment concept gains more importance and this recent perception results with an increase in demand of healthier and minimal processed food production. Steamed bread is considered as a healthier option compared to the bread obtained by traditional oven baking due to its humid baking atmosphere which prevents formation of crust and process contaminants caused by browning reactions such as 5-hydroxymethyl-2-furfural, acrylamide and CML. In the present study, the effects of flour type and water content in dough formula on physical properties of steamed bread during storage were investigated. On this aim, 2 different flour type (wholemeal flour and plain flour with 80% of extraction rate) and 3 different water levels (100, 90 and 80% of maximum water holding capacity of each flour type, determined by farinograph analysis) were used in dough formula and produced bread samples were stored for 3 days. Physical properties of bread samples were then evaluated by moisture content, water activity, specific volume, weight loss, color (L\*, a\*, b\*) and texture profile analyses. Upon using of wholemeal flour, moisture content, water activity, specific volume, weight loss, hardness, a\* and b\* values of steamed bread samples increased, but L\* values decreased. Increasing levels of water in the formula correspondingly increased the moisture content and specific volume and decreased the b\* values of bread samples. In addition, no significant difference observed through storage in the mean of physical and sensorial properties.

Keywords: Steamed bread, Wholemeal flour, Water content, Storage

#### PHYTONUTRIENTS REGULATING CELLULAR PROCESSES AND THEIR HUMAN HEALTH-PROMOTING EFFECTS

Máthe E<sup>1,3\*</sup>, Gerogescu C<sup>2</sup>, Szöke-Kovács R<sup>1</sup>, Neamtu A<sup>1</sup>, Abid A<sup>1</sup>, Mihok E<sup>1</sup>, Diósi G<sup>1</sup>, Cziáky Z<sup>3</sup>, Vígh Sz<sup>3</sup>, Turcus V<sup>4</sup>, Oláh N K<sup>4</sup>  
endre.mathe64@gmail.com

<sup>1</sup> University of Debrecen, 138. Böszörményi Str., H-4032, Hungary,

<sup>2</sup> Lucian Blaga University of Sibiu, 10.Victoriei Bd., Sibiu, 550024, Romania

<sup>3</sup> Nyíregyházi Egyetem, Sóstói út, 31B, H-4431, Hungary

<sup>4</sup> Vasile Goldis Western University of Arad, 91-93. Liviu Rebreanu, Arad, 310414, Romania

Our research is focused on the chemomapping of different plant extracts, while their health-promoting effects associated mechanisms of action are assessed using *Drosophila melanogaster* based genetically sensitized systems. The chemomapping is based on UHPLC-ESI-MS, GC-MS and MALDI-TOF, while for mechanism of action studies are applied genetic, genomic, biochemical and molecular cell biology methods.

We have identified several plant extracts with putative hypoglycaemic and anti-inflammatory phytochemicals. We have also developed genetically sensitized multiple models to study the plant extracts molecular and/or cellular mechanism of action with respect to the regulation of chromatin organization, gene expression, redox potential, metabolic profile, etc. Among the characterized extracts, bilberries and fenugreek were able to reduce hyperglycaemia, insulin-resistance and inflammation.

Identification and characterization of several plant extracts that can significantly reduce hyperglycaemia, insulin-resistance and inflammation will let us formulate novel nutraceuticals that further strengthen the complementary treatment of metabolic syndrome.

## POLYPHENOLS ASSISTED BACTERIOPHAGES FIGHTING BACK BACTERIA

Alaya A<sup>1,2,3\*</sup>, Hakki Boyaci I<sup>2</sup>, Fattouch S<sup>1</sup>, Mathe E<sup>3</sup>  
aleya.amina@gmail.com

<sup>1</sup>Polytechnics Central Private school, 3 Av Mohamed V Le Kram 2015, Tunisia

<sup>2</sup>University of HACETTEPE, Rektörlüğü Sıhhiye, Turkey

<sup>3</sup>University of Debrecen, 138. Böszörményi Str., H-4032, Hungary

Phagotherapy could be an alternative or completer method to substitute antibacterial compounds that has motivated our team carry out research regarding the use of bacteriophages in order to fight back bacterial infestation.

Our study revolved around proving the direct antimicrobial action of plant derived polyphenols together with bacteriophages, and the assessment of possible synergies, using 18 types of newly isolated bacteriophages.

It can be presumed that the normal route of administration exposes the bacteriophages to degradation by the acidity of the gastric and duodenal media. The microencapsulation of the bacteriophages alone or in combination with polyphenols is expected to protect them and to facilitate their "viable and active" release in a distal portion of the digestive tract. Experiments were conducted to master the microencapsulation techniques, and later *in-vitro* tests were performed to monitor the resistance of encapsulated bacteriophages in a simulated gastric fluid and in a simulated bile environment.

Our results are indicating the possible use of polyphenols assisted bacteriophages in order to develop efficient antibacterial agents.

### Section 'Food Analysis'

## INDUSTRIALIZED TEXTURED FRUIT JUICES DESIGN FOR PROMOTION OF HYDRATION IN ELDERLY

Llorente Holgado R , Peral Diez I

rllorente@azti.es

Food Research Division. Fundación AZTI.

Senior population presents specific nutritional and physiological requirements linked to health status that determine the need to develop hydration promoting food products. Due to masticatory difficulties associated with ageing, 11-16% of the elderly and 50% of the assisted population have dysphagia, in many cases is necessary to modify the **texture properties** of food products to assure a safe consumption.

A daily personalized nutrition, through the design of texture modified ready-to-eat food products with high nutritional and sensory quality, plays an important role in disease

prevention and promotion of well-being in the elderly and is a business opportunity for the Food Industry making these food products available at Retail market.

#### OBJECTIVE

The ultimate goal of this study is the development of ready-to-eat textured palatable and pasteurized apple juices to promote hydration in the adult and senior population with dysphagia and study the feasibility of their industrialization.

#### METHOD / DESIGN

Application of formulation techniques to modify and control food texture based in viscoelasticity modulating properties of hydrocolloids in commercial fruit juices. Design of processing parameters and industrial steps was also approached to obtain stabilized prototypes along products shelf-life. Texture and sensory properties were characterized by means of textural (viscosity, consistency and flow) and physico-chemical (colour and appearance) analysis.

#### RESULTS

According to the existing International texture scales for thickened drinks (nectar, honey and pudding), six different formulations of pasteurized modified-textured apple juices were developed at pilot plant scale analyzing sensory profile and texture stability after industrial processing.

#### CONCLUSIONS

There is a lack of commercial ready-to-eat texture modified products to be included in the daily menu of older people or consumers affected by chronic diseases and the ageing process. Availability of texture modified food solutions with improved sensory (flavor, texture) characteristics might have a positive effect in psychological satisfaction and enhance quality of life.

## BIOCHEMICAL AND PUBLIC HEALTH CURIOSITIES OF THE WINES OF TOKAJ

Sipka S<sup>1</sup>, Nagy J<sup>1</sup>, Győri Z<sup>1</sup>  
sipka@iibel.dote.hu

<sup>1</sup>Department of Nutrition, University of Debrecen, Hungary

*Background:* The wines of Tokaj especially those which are prepared by a technique related to “*Botrytis cinerea*” have reached a special international respect for centuries. Now we compared the standardized mortality numbers of inhabitants with cancers and cardiovascular diseases in four wine regions and in one not wine region of Hungary between 2000-2010. In addition we looked for some new biochemical specificities of the wines of Tokaj.

*Methods:* In Tokaj (white wine), Eger (red wine), Balaton (white wine), Szekszárd/ Villány (red wine), Hódmezővásárhely (not wine region) the standardized mortality data of 206 159 persons were compared. Using a biochemical reaction producing chemiluminescence we tested the dominant anti-oxidant or pro-oxidant features of the various types of wines.

*Results:* The significantly least number of cancers occurred in Tokaj, however the number of cardiovascular mortality was the highest here. On the other hand, the fewest cardiovascular mortality took place in the red wine regions Szekszárd/Villány, but showing here and in the

other red wine region ,Eger significantly higher values of cancers . By the indexes of stimulation calculated from the chemiluminescence measurements the anti-oxidant feature of red wines and the pro-oxidant feature of the wines of Tokaj could be determined. Especially the „Aszu of Tokaj” showed a strong pro-oxidant character.

*Conclusions:* The dominantly pro-oxidant effects of the wines of Tokaj and anti-oxidant features of red wines showed inversed effects on the mortalities caused by cancers and cardiovascular diseases.

## GALACTO-OLIGOSACCHARIDES WITH B-1,6/3 GLYCOSIDIC LINKAGES HAVE PREVENTIVE ROLE AGAINST COLORECTAL CANCER IN RAT MODEL

Iqbal S<sup>1</sup>, Qamar TR<sup>1</sup>, Nasir M<sup>1</sup> and Rehman H<sup>2</sup>  
sanaullah.iqbal@uvas.edu.pk

<sup>1</sup>Department of Food Science and Human Nutrition, <sup>2</sup>Department of Physiology, University of Veterinary & Animal Sciences, Lahore 54000, Punjab, Pakistan

**Introduction:** The function of prebiotic galacto-oligosaccharides (GOS) is mainly dependent on its structure, glycosidic linkage among monosaccharides. In present study, novel GOS (non-purified) having  $\beta$ -1,6 and  $\beta$ -1,3 as major linkages were produced from transgalactosylation of lactose catalysed by  $\beta$ -galactosidase from *Lactobacillus reuteri* L103 and were first time used against various biomarkers of colorectal cancer (CRC) in rats.

**Material and Methods:** Male Wistar rats having weight 150-160g were randomly divided into eight groups (G1-G8) 12 rats in each group. Early doses of GOS were started to groups G3-G5 for four weeks, after four weeks groups G2-G8 received four subcutaneous injections of carcinogen 1,2-dimethyl hydrazine dihydrochloride (DMH). Groups G1 (control) and G2 (DMH control) received only basal diet. After DMH administration groups G3-G8 received three different doses (76, 114, 151mg/Kg body weight) of GOS. Groups G3-G5 received GOS before and after DMH injections, while groups G6-G8 were started after DMH injections.

**Results:** Higher dose groups (114 and 151mg) of GOS showed significant reduction in aberrant crypt foci (ACF) formation compared to G2 particularly those groups receiving GOS before administering carcinogenic injections. Group G5 receiving 151mg GOS before DMH injections showed 41.4% of total ACF inhibition, while group G8 receiving 151mg GOS after DMH injections showed 27.3% of total ACF inhibition. Elevated levels of short chain fatty acids particularly butyrate was also observed in cecal and fecal samples compared to G2. Chemo-preventive effects of GOS were also observed on pathogens produced enzymes especially nitroreductase and Azoreductase levels were decreased in higher dose groups of GOS in cecal and fecal samples. GOS also hindered extreme body weight loss due to carcinogenic administration.

**Discussion:** Novel GOS exhibited dose-dependent activity against various biomarkers of CRC. It was also concluded that GOS consumption before incidence of CRC is more effective.

## EVALUATION OF PHYSICAL AND SENSORY PROPERTIES OF BAKERY PRODUCTS MADE FROM HEAT TREATED SORGHUM FLOUR

Sipos P, Nagy R and Gyóri Z  
siposp@agr.unideb.hu  
University of Debrecen, Institute of Nutrition

There is a continuously increasing demand on the gluten free products as the number of people with diagnosed coeliac disease increases, as well as the number of consumers who tries to minimize gluten in the diet concerning about the possible development of intolerance. The general problem with these products is the structure – if it is possible to form a dough what preserves its shape and structure during processing, storing and transform, most cases it is too dense compared to the gluten containing bakery products.

In our experiments we used heat treated sorghum flour for gluten free bakery products, as the heat treatment modifies the structure and dough formatting properties of starch. To improve the sensory and physical properties of sorghum bread and cake sample products we used corn and rice flour, oatmeal and potato, corn and rice starch alone and in combination to evaluate the effect of combination of different kinds of starch. We determined the physical and texture parameters of products after baking and sensory analysis was also performed. We found that the flour composition significantly influenced the physical properties of bakery test products while the differences were negligible in the case of cakes. The conclusions are similar in the case of sensory evaluations: the consumers did not experienced significant differences in the case of cakes, however, in the case of bread the taste, appearance, structure and overall acceptance showed large differences.

## SUITABILITY OF $\beta$ -LACTOGLOBULIN MICRO- AND NANOSTRUCTURES FOR QUERCETIN-LOADING

Simões L S<sup>1</sup>, Abrunhosa L<sup>1</sup>, Vicente A A<sup>1</sup>, Ramos, O L<sup>1</sup>  
livasimoes@ceb.uminho.pt

<sup>1</sup>CEB - Centre of Biological Engineering, University of Minho, Braga, Portugal

$\beta$ -Lactoglobulin ( $\beta$ -Lg) is the major protein fraction in bovine whey serum and when heated above a critical temperature (i.e. denaturation temperature: 76 °C) it undergoes conformational changes followed by subsequent protein-protein interactions, which allows to form micro- and nanostructures. Due to  $\beta$ -Lg bio-based nature, high nutritional value and gelation capacity, it is an excellent material to design delivery systems for transport and controlled release of bioactive compounds. Recently, there has been a growing scientific interest in the use of quercetin due to its biological attributes, including anticancer, antioxidant and antiviral activities. Nonetheless, its use in food products is still limited due to its hydrophobic nature (i.e. poor aqueous solubility), low oral bioavailability (i.e. it is highly degraded under gastrointestinal tract), and stability. Hence, quercetin-loaded micro- and nanostructures may represent a suitable solution to overcome these drawbacks. For this purpose, food-grade micro- and nanostructures were developed by solubilizing  $\beta$ -Lg powder (5 – 15 mg mL<sup>-1</sup>) in sodium phosphate buffer at pH 6, followed by thermal heating at 80 °C for

15 min. Subsequently, several quercetin concentrations, ranging from 0.01 to 0.08 mg mL<sup>-1</sup>, were added to  $\beta$ -Lg micro- and nanostructures being their association efficiency (AE) and loading capacity (LC) assessed by high-performance liquid chromatography with fluorescence detection (HPLC-FL).

Additionally, the effect of quercetin in particle size, polydispersity index (PDI) and surface charge (S) of such structures was evaluated by dynamic light scattering (DLS). Quercetin loaded  $\beta$ -Lg micro- and nanostructures were characterized by a low PDI (i.e. < 0.2) and relative stability (i.e.  $S \approx -20$  mV). Microstructures showed particle size values ranging from 264.5 to 281.3 nm ( $p > 0.05$ ), while nanostructures range from 91.1 to 100.3 nm ( $p > 0.05$ ). HPLC data showed AE ranging from 87.7 to 92.7 % as the quercetin concentration increased from 0.01 to 0.08 mg mL<sup>-1</sup>, but no statistical differences ( $p > 0.05$ ) were found. The highest ( $p < 0.05$ ) LC (i.e.  $6.094 \pm 0.432$ ) was obtained for  $\beta$ -Lg nanostructures loaded at 0.08 mg mL<sup>-1</sup> of quercetin. These findings show evidence that  $\beta$ -Lg micro- and nanostructures may be used as suitable delivery systems for hydrophobic compounds (e.g. quercetin), but more studies are needed to prove it.

## CHEMICAL RISK ASSESSMENT OF HUNGARIAN BEEKEEPERS HONEYS

Czipa N

czipa@agr.unideb.hu

Institute of Food Science, Faculty of Agricultural and Food Sciences and Environmental Management, University of Debrecen, H-4032 Böszörményi út 138, Debrecen, Hungary

Toxic element concentrations (Al, As, Cd, Cu, Fe, Pb and Zn) were determined in 140 Hungarian mono-floral honey samples (acacia, linden, sunflower, rape, chestnut, forest, silk grass and facelia) by inductively coupled plasma mass spectrometry (ICP-MS). Forest honeys showed the highest Al, Cd, Cu, Fe and Zn contents followed by chestnut honeys. The highest As content was measured in an acacia honey and the highest Pb concentration was determined in a rape honey.

The risk assessment was carried out based on PTDI values of Joint FAO/WHO Expert Committee on Food Additives (JECFA) using three population groups (child with 30 kg bw, female with 60 kg bw and male with 90 kg bw) and honey consumption of 30 g/day. According to the calculations, the risk values were under 1 in case of every examined honey samples, therefore the consumption of these examined honeys may not cause any public health problem. The PTDI of As and Pb have been withdrawn in 2011 by the Committee; therefore the calculation of risk was not possible. Both metals have serious effects on the human body and unfortunately several examined honey samples contained these metals. Examining the highest Cd concentration (a forest honey sample from Vas County) the risk value was 26.7 in child population. From this honey a child should consume about 800 mg to reach a risk of 1.

## PRODUCTION OF NANOSIZE SELENIUM PARTICULES IN YOGURT AND ITS APPLICATION IN FOOD AND FOOD SUPPLEMENTS

Prokisch J<sup>1</sup>, Sztrik A<sup>1</sup>, Nagy É<sup>1</sup>, Csapó J<sup>1</sup>  
jprokisch@agr.unideb.hu

<sup>1</sup>University of Debrecen, Nanofood Laboratory, 4032 Debrecen, Egyetem tér 1., Hungary

Elemental selenium is considered as the less toxic of all selenium forms and in the same time supplementation with its nano-size particles has the same or better bioavailability. We developed and patented a technology to produce nano-size (100-500 nm) elemental selenium by using probiotic yogurt bacteria in a fermentation procedure. We solved the industrial scale of production, the selenium enriched yogurt powder is applied in different food supplements: Lactomicrosel, Pajzs-komplex, Cardio-komplex and food products: milk powder and cottage cheese dessert. The novelty in the technology was the direct applicability for the food enrichment with a healthy selenium enriched bacteria. The technology developed is a manufacturing process which enables forming of a suspension as well as a powder containing valuable Se spheres having unique characteristics. Material prepared in such a way can be used in the agricultural and food industry as food or feed additive and additive of fertilizer.

The nano size elemental selenium has the lowest toxicity and it has good bioavailability. We tested our biologically produced selenium nanospheres in soil, plant, in animals and humans too. One part of our studies focused on the bioavailability, the others on the toxicity. It was tested in plant tissue culture, where extremely high concentrations (over 2900 ppm) were detected in the tobacco plant without any toxic symptoms. Furthermore the highest nano Se concentrations resulted the highest yield and the plants were greener and lived twice longer. The application of nano Se in feed was tested in different animal experiments. We used chicken and hen where we had a prove on the efficiency of nano Se comparing the organic and inorganic selenium supplements. The eggs were bigger and contained more selenium than the same concentration from selenized yeast (seleno-methionine). Furthermore in an other experiment we add T2 mycotoxin to hens and in an other treatment the same concentration T2 and nano Se together. We realized that the nano Se eliminated the toxic effect of T2 toxin.

## OPTIMISATION OF GLYCOSIDASES FOR RELEASE OF AROMAS FROM STRAWBERRY GLYCOSIDES

Gaborieau S<sup>1 2</sup>, Cendres A<sup>1</sup>, Persillon C<sup>3</sup>, Pallas S<sup>3</sup>, Renard M G C<sup>2</sup>  
stephane.gaborieau@inra.fr

<sup>1</sup>Atelier du fruit, 7 rue des Pommerets, 21 600 Longvic-FRANCE 9  
2UMR408 Sécurité et Qualité des Produits d'Origine Végétale, INRA, Avignon University F-  
84000 Avignon, France

<sup>3</sup>Proteus, 70 Allée Graham Bell, 30000 Nîmes, France

In fruits a portion of potentially aromatic molecules are bound to sugars, so that they are not volatile and do not contribute to aroma. Glycosidases are a promising way to release this aromatic potential in fruits, especially in strawberries, and thus offer a solution to limit addition of (synthetic) aromas in fruit products. However, these enzymes are usually sensitive to the concentration of sugars and to low pH. Fruits are therefore not the most adapted media for these enzymes. An optimization of glycosidases by enzyme engineering was therefore carried out with two main aims. The first is to increase their activity in the fruit conditions and the second is to limit side activities that may affect color and texture of fruit products. Indeed, anthocyanins in strawberries are glycosylated and the aglycones lose color rapidly, and the commercial enzyme used for glycosidic activity has also a pectinolytic activity which destroys the texture of fruit purees. The Shuffling<sup>®</sup> method was selected to decrease the sensitivity to sugars and to increase activity. After screening two new enzymes are kept, one (F1) with a low sensitivity to sugars and another (F2) with a higher specific activity. F1 lost only 27% of its activity in a sugar solution (18% of fructose, 16% of glucose and 11% of sucrose) instead of 80% for the parental enzymes, and F2's specific activity was increased by 50% compared to parental enzymes. Texture and color were not affected by the new enzymes. Different concentrations were tested for an incubation time of 90 minutes and for a temperature of 40°C (optimal temperature of engineered enzyme) to identify minimal required enzyme concentrations. Enzyme denaturation by pasteurization was also studied to ensure that the new enzymes will belong to processing aids.

#### MORPHOLOGICAL STUDY OF RICE STARCH GRANULES DURING *IN VITRO* DIGESTION

Fernandes JM<sup>1\*</sup>, Madalena DA<sup>1</sup>, Pinheiro AC<sup>1</sup>, Vicente AA<sup>1</sup>

\* jmichel@ceb.uminho.pt

<sup>1</sup> Center of Biological Engineering, University of Minho, Braga, Portugal

Starch is the main sugar source present in staple foods, making it one of the most studied compounds in food industry. Understanding starch hydrolysis during digestion processes and the resulting glucose release can be important to strategically modulate starch digestion/glucose absorption processes. For this reason, rice starch digestion was performed using the harmonized *in vitro* gastrointestinal method and its structure analysed using fluorescent microscopy for correlation with the glucose release during the process. Briefly, white rice was cooked in an electric pan and passed through a food grinder. Samples were placed in a shaking water bath at 37 °C and submitted to oral, gastric and intestinal phase, with addition of fluids, enzymes and salts accordingly. Samples were collected at the final of the oral phase (2 min) and each 30 min afterwards. These were stained with fluorescein-isothiocyanate and prepared for fluorescent microscopic analysis. In our initial samples, rice starch granules (RSG) were visible in high quantities with well-defined hexagonal shape and size between 50 to 56 µm. After 60 minutes RSG dimensions or quantity did not change significantly. However, after 90 minutes, RSG degradation was evident and RSG size decreased to 45 µm. In the end of the gastric phase substantially lower RSG quantities were visible. RSG degradation peak occurred at 150 minutes. This result was correlated with the maximum percentage of released glucose (11.7 %) and hydrolysed starch (37.3 %) achieved in the same

period. Until the end of the digestion, lower quantities of RSG were observed presenting undefined structure and sizes. By the end of digestion 37.3 % RSG was hydrolysed and size decreased approximately 20 %.

This work has allowed to describe, both qualitatively and quantitatively, the fate of a food (rice) during digestion, thus establishing the procedure for further determinations under different conditions, rice types and cooking methods.

### Section 'Developing new food constituents'

#### CAN WE DEVELOP PREDICTIVE POWER FROM THE PATTERNS OBSERVED IN COMPLEXITIES SURROUNDING FOOD?

Baranyi József

jozsef.baranyi@gmail.com

Institute of Nutrition, University of Debrecen, Hungary

Since the turn of the century, technological and IT-advances have made “big data” reality also in food-related areas, such as food design, distribution and consumption. The resultant data deluge has turned the attention of food professionals to computational methods, who need to understand not only the difference that LOTS OF DATA make but also the mathematical concept of COMPLEXITY. It is not simply “complicatedness” but an emerging property of an evolving system, let it be the network of food ingredients or the global food trade, where the LINKS between the constituents of a system are more numerous and, in some way, more important than the constituents themselves.

Application of network science is a good example for this development. Long gone the time when quantitative methods of food science were identified with statistical description of large amount of observations. Very few attempts were made for the sake of mathematical modelling, which however is a must for converting any discipline from descriptive to predictive science.

Changing consumer demands and food safety issues (such as that of minimally processed and Ready-to-Eat / convenience foods), generated a need to develop new laboratory techniques, among them the various “-omics” technologies. In the meantime, the originally simple models became more complex, with disparate variables, data sources and emerging patterns that could not be predicted from the parts – a typical property of complex systems.

We point out in this talk that understanding food-related complexities, from micro to macro level, is one of the major topics that food professionals need to pick up, to satisfy consumer demand, to solve global food security, distribution and safety problems, to reduce food waste and to contribute to the health of an aging population.

ROLE OF CELLULOSE CRYSTALS ON THE FORMATION OF FLAXSEED OIL IN WATER PICKERING  
EMULSION OBTAINED FROM ULTRASONIC PROCESS

Meirelles A A D, Lelis A L R C<sup>1</sup>, Cunha R L\*

\* rosiane@unicamp.br

phone number: +55 19 3521-4047

Department of Food Engineering, School of Food Engineering, University of Campinas; Rua  
Monteiro Lobato, 80; 13083-862; Campinas – SP, Brazil

\* rosiane@unicamp.br

phone number: +55 19 3521-4047

The pharmaceutical and food industries have increased their investments in the use of natural compounds as substitutes of synthetic additives. This study aimed to understand the stabilization mechanism of flaxseed oil-in-water emulsion using cellulose crystals (CCrys) as stabilizing particles. CCrys is great option of *generally recognized as safe* (GRAS) compound for the food industry and can be possible to use to protecting the flaxseed oil, which is a rich source of  $\alpha$ -linolenic acid. We prepared coarse emulsions stabilized by CCrys using rotor-stator (10,000 rpm/3 min) followed by ultrasonication process to obtain fine emulsions (535 W/ 4 min). An emulsion control was prepared under more intense processes conditions in rotor-stator (10,000 rpm/ 3 min and 13,000 rpm/ 3 min). We evaluated the effects of the volume fraction of the oil phase (10, 15 and 20% w/w) and CCrys particles concentration (2.5, 3.75 and 5% w/w) on the emulsion properties. Particles used to prepare emulsions presented bimodal size distribution which one size peak was observed in the micrometric scale (5  $\mu$ m) and another one on the nanometric scale (300 nm). All emulsions present negative charge, high viscosity and good kinetic stability (28 days). Any reduction on the interfacial tension between flaxseed oil and water was observed indicating that the effects of electrostatic repulsion (from -25mV to -30mV) and viscosity increasing (from 109 mPa.s to 469 mPa.s) with oil volume fraction and CCrys concentration were important mechanisms for emulsion stabilization. The largest microcrystals increase the viscosity of the continuous phase while small particles adsorbed in the oil-water interface preventing the droplets coalescence. The flaxseed oil droplets were surrounded by cellulose nanocrystals, which was a consequence of Pickering-type stabilization. Emulsions stabilized with cellulose crystals showed properties and characteristics for the protection of lipophilic compounds that could be applied in areas including food and cosmetics applications.

Keywords: cellulose, microcrystals, nanocrystals, stability of emulsions, flaxseed oil, ultrasound processing

PRODUCTION OF HIGH NUTRITIONAL VALUE FUNCTIONAL FOOD, UPDATE1 BREAD, WITH  
THE SUPPLEMENTATION OF THE WHEAT FLOUR WITH HIGH PROTEIN CONTENT FOOD ROW  
MATERIALS

Csapó J<sup>1,2</sup>, Schobert<sup>3</sup> N

csapo.janos@gmail.hu; www.mek.unideb.hu

<sup>1</sup>University of Debrecen, Faculty of Agricultural and Food Sciences and Environmental Management, Institute of Food Technology, HU-4032 Debrecen, Böszörményi út 138.

<sup>2</sup>Sapientia Hungarian University of Transylvania, Faculty of Miercurea Ciuc, Department of Food Science, RO-4100 Miercurea Ciuc, Piata Libertatii 1.

<sup>3</sup>Norbi Update Lowcarb Zrt., HU-2016 Leányfalu, Móricz Zsigmond utca 167. norbi@norbi.eu; webshop@update1.eu

**Abstract.** During our research we added extracted soya bean meal, egg white powder, gluten, wheat sourdough and bamboo fibre to the wheat flour in order to increase the quantity of the essential amino acid and the biological value of the wheat protein, producing such functional, health protecting, health preservative food product, which is suitable to satisfy the essential amino acid requirement of human, assuming normal nutrition. Furthermore we could produce such a food, which on the one hand is suitable to confine or prevent the essential amino acids malnutrition symptoms, on the other hand, when is applied alone, to provide the consumers needs. During our work we determined the protein content and amino acid composition of the wheat flour and the additives were used at the bread baking, and in the bread, baked with supplemented (Update1 bread) or not supplemented (normal bread), and the quantity of the Maillard reaction products (hydroxy-methyl-furfural). We calculated the biological value of the protein of different breads, and evaluated the sensory characteristics of the produced functional food and the fortified bread, supplemented with high essential amino acid containing additives.

**Keywords:** defatted soya bean meal, egg white powder, gluten, supplementation, essential amino acids, biological value of protein, Maillard reaction, amino acid analysis, fortified bread with high essential amino acid content.

## PRODUCTION OF SELENIUM ENRICHED MILK AND DAIRY PRODUCTS

Juhász<sup>1</sup> Tóth R, Csapó J<sup>1,2</sup>

csapo.janos@gmail.hu

<sup>1</sup>University of Debrecen, Faculty of Agricultural and Food Sciences and Environmental Management, Institute of Food Technology, HU-4032 Debrecen, Böszörményi út 138.

<sup>2</sup>Sapientia Hungarian University of Transylvania, Faculty of Miercurea Ciuc, Department of Food Science, RO-4100 Miercurea Ciuc, Piata Libertatii 1.

**Abstract.** Until the middle of the last century selenium was considered to be toxic, but recently it turned out to be a micronutrient with important physiological effects, whose lack impedes the functioning of several enzymes, while in the case of a prolonged deficiency, diseases processes can also occur in the body. Hungary belongs to the selenium deficient regions in Europe, therefore, our aim was to contribute to the improvement of selenium supply of the

population through increasing the selenium content of milk and dairy products. A daily supplementation of 1-6 mg organic selenium to the feed of dairy cows increases the selenium content of milk from the value of 18 µg/kg to 94 µg/kg in 8 weeks, decreasing again to the initial value in 6 weeks after stopping the supplementation.

After producing various products from control milk (18 µg/kg selenium content) and the selenium enriched milk (53 µg/kg) obtained from dairy cattle fed on a feed supplemented with 2 mg selenium/day, we concluded, that the selenium content of selenium enriched milk compared to the products produced from the control milk increased from the value of 18.6 to 58.5 µg/kg in the case of yogurt, from 66.0 to 138.1 µg/kg in the case of Telemea, from 80.8 to 163.7 µg/kg in the case of Orda and from 88.6 to 200.0 µg/kg in the case of semi-hard cheese obtained by mixed-coagulation. The selenium content of whey also increased significantly (from 8.8-9.7 µg/kg to 20.1-25.8 µg/kg), which could also be used as a food for people or feed for animals. According to our calculations, the selenium requirements of the developing organism could be satisfied by the consumption of 2-3 dl selenium enriched milk until the age of 8 and with 4-6 dl selenium enriched milk until the age of 20.

Keywords: selenium, supplementation with selenium, selenium enriched milk, cheese, dairy products

#### FUNGAL MYCELIA: POTENTIAL BIOBASED FOOD PACKAGING MATERIALS

Tacer-Caba Z<sup>1</sup>, Varis J, Lankinen P<sup>2</sup>, Mikkonen, KS

<sup>1</sup>zeynep.tacer-caba@helsinki.fi, jutta.varis@helsinki.fi, pauliina.lankinen@gmail.com,  
kirsi.s.mikkonen@helsinki.fi

<sup>1</sup>Department of Food and Nutrition, University of Helsinki, P.O. Box 66, Finland

In recent years, there is an increasing concern related to environment and sustainability. Therefore, design of new materials with recycled resources, wastes and/or novel biobased raw materials is a current trend, although applications in food packaging are still limited. The concept of edible mycelium based materials, in which materials are produced by the complex network of fungal mycelia growing on a natural substrate, is an interesting opportunity and among the most promising alternatives to replace synthetic food packaging materials. Increasing the material strength and extending the product life cycle are two major areas of interest in mycelium based materials development. Thus, it is hypothesized that different substrate systems and production methods (with and without homogenization) may be effective in the design of mycelium based materials. *Pleurotus ostreatus* and *Ganoderma lucidum* based mycelium materials were evaluated for their physical (density, water absorption), morphological and mechanical properties, i.e., viscoelastic moduli as function of temperature. DMA (Dynamic Mechanical Analysis) as a versatile methodology was used for determining their mechanical properties. The characteristics of mycelium-based materials and their potential to be used in various applications will be discussed.

FREE FOODS  
(FOODS WITHOUT A DIFFERENT KIND OF NON-EXPECTED INGREDIENTS)

Tamás Szigeti  
szigeti.tamas@wessling.hu  
WESSLING Hungary Ltd. 1045 Budapest, Anonymus u. 6. Hungary

Nowadays a significant part of the food consumers are looking for different kind of “free” products, which are doesn’t contain several food ingredients. Usually this ingredients can be proteins, flavours, dyes, even inorganic compounds too. Due to the widespread growing human allergy, the demand of “free” food products is higher and higher.

The claim for “free” food product may be based on several personal life style, life quality, religion customs and health protection aims. Between the “free” foods we can find meat industrial food products without pig flesh (Halal, Kosher products), without fish and shellfish ingredients (paralbumin and other proteins), without oil seed crops, without gluten form constituents etc. The manufacturing of this “free” products based on the appropriate choosing of raw materials and needs a high level isolation technic from other non-free product making equipment lines.

The producing of other group of “free” food products are more complicated, than mentioned above. The manufacturing of these food group starts using ordinary raw materials, and to achieve the “free” status of end product needs to apply special physical and chemical procedures to extract the non-expected ingredients from the raw commodity during the manufacturing process. For example such foods are the non-caffeinated coffee, the non-alcoholic beer, the lactose free milk and milk products and other “free” and depleted food products.

I have to take a significant note: The personal meaning of terminology of “free” status is depending on the professional knowledge. For the laic people the “free” word means definitely zero value, namely the non-expected component isn’t exist in the food. Nevertheless for professionals of food technology and/or chemical analysis, the “free” marker means only a very low concentration, but not necessarily a zero amount. The difference between too approximation is significant. In the public speech used “zero tolerance” is a superstition dressed in scientific costume, not more.

Section ‘Food structure and marketing’

A LITERATURE REVIEW OF THE CONSUMER ATTITUDES TOWARDS FUNCTIONAL FOODS

Kiss M<sup>1</sup>, Szakály Z<sup>1</sup>  
<sup>1</sup>kiss.marietta@econ.unideb.hu

Several research studies have already examined attitudes towards functional foods but the wide range of available products, the significant heterogeneity of attitudes internationally, and the diversity of the applied research methods make the comparison and generalization of them remarkably hard. This presentation aims to organize these studies according to specific standpoints, and based on this, draw generalizable conclusions. Based on the literature review we can state that attitudes towards functional foods are positive worldwide, with a positive effect on their purchase and consumption. There are, of course, international differences both in attitude factors playing a significant role in this positive effect, and also in their composition. These differences can be attributed primarily to the different development stages of markets. However, we can state that the most important attitude factor everywhere is the reward from using functional foods (health protection and promotion, well-being, good performance and mood) that has to be stated simply and obviously towards the consumers in promotional messages. Besides this, social necessity (including medicine-like effects) of and confidence in functional foods also influence the intention for consumption, thus, the healing effect can also be a useful buzzword in promotional messages. In less developed markets – such as Hungary – confidence includes the belief in the safety of products indicating the fact that where consumers are not familiar with these products, perceived risks can be a strong barrier to consumption. Therefore, a key role of promotional messages in those markets is the reduction of perceived risks. It is worth to note, however, that functional foods cannot be seen as a homogeneous food category, thus the importance of different attitude factors may vary from one food type to another. Additionally, consumers cannot be seen as one, homogeneous group, therefore different promotional messages developed according to the attitude-based segments will be effective.

## CONSUMER ATTITUDES TOWARD RED BEETROOT – A NETNOGRAPHIC INVESTIGATION

Papp-Bata Á<sup>1</sup>, Szakály Z<sup>1</sup>

<sup>1</sup>bata.agnes@econ.unideb.hu

<sup>1</sup>Institute of Marketing and Commerce, Faculty of Economics and Business, University of Debrecen

There is a growing interest in the biological activity of red beetroot and its potential utility as a health-promoting and disease-preventing functional food. As an ideal source of nitrate, beetroot ingestion provides a natural means of increasing in vivo nitric oxide availability and has emerged as a potential strategy to prevent endothelial functions. Furthermore, its other components, e.g. betalain pigments, display potent antioxidant, anti-inflammatory and chemopreventive activity. However, functional food market is constantly changing, consequently, food companies have to monitor changes in consumer attitudes in order to find the best way to communicate health information about their products and meet consumer expectations. Since the use of online communities is widespread nowadays, internet became an extremely important source of information depicting consumers' habits. Netnography is a novel branch of ethnography that analyses the behaviour of individuals on internet by using online marketing research techniques. The aim of our study was to identify motivational

backgrounds and distinguish population groups on the blogs, forums and other online communities, based on their comments and attitudes related to functional foods, focusing especially on beetroot products.

Based on our results, motivational factors related to beetroot consumption can be grouped as follows: culinary variation, traditional/old family tradition and health-conscious consumption. Faith and trust in information about health effects, family patterns and traditions play an important role in beetroot consumption. Depending on its beneficial health effects, consumers can be divided into four categories of trust: trustworthy, skeptical, uninteresting and rejectioning.

In addition to research and development and innovation, consumer awareness and knowledge expansion play a prominent role in promoting the market success of beetroot foods. However, one of the major difficulties and challenges in online communities is the transmission of reliable, intelligible and credible information to skeptical and uninteresting consumers.

This work was supported by the EFOP-3.6.2-16-2017-00003 project.

## SECONDARY SCHOOL STUDENTS' DEMAND FOR CHANGING NUTRITION STYLE AND THE CONSIDERATION OF FOOD LABELS

Kiss VÁ, Fehér A, Soós M, Szakály Z  
kiss.virag.agnes@econ.unideb.hu

University of Debrecen, Faculty of Economics and Business, Institute of Marketing and Commerce

The food considering- and nutrition trends are becoming more and more researchable fields within the medical, social and economical spheres. On the one hand, health industry is occupying a greater and a more extended area in the consumer market. On the other hand, the indicators and predictions regarding nutrition and food consumption are both concerning points for medicals. Young people are a highly important target group, due to their influenceability and economical role.

Current study is a part of a research that measures the nutrition and food selecting habits of secondary school students. In a previous phase - based on the examined samples- we have already divided four consumer groups. Along the health- and environmental conscious, ethical, authentic, patriot and individualist values they are the fashion avoiding conscious, responsibility counters, passive lower graders and the conscious individualists. The aim of this study is to present the mainly preferred nutrition trends of this independent group of secondary school students who is highly impacting in food buying habits.

## CIRCULAR ECONOMY IN THE BROILER INDUSTRY

Tamás J<sup>1</sup>, Szóllósi N<sup>1</sup>, Borbély J<sup>1,2</sup>

tamas@agr.unideb.hu

<sup>1</sup>University of Debrecen, Department of Water and Environmental Management, H-4032

Debrecen, Böszörményi str. 138. Hungary,

<sup>2</sup>BBS Biochemicals, H-4225 Debrecen 16, Hungary

Reorganization of linear into circular economy is a hot topic, challenging most of the industries including agricultural livestock production (Ward SM 2016). The number of pigs, cattle and chicken in EU Member States in 2009 was estimated as 1.2 billion and producing 1.6 billion tonnes of manure (Source: FAOSTAT). Recently poultry meat becomes more important as animal protein source in the EU-28 member countries, consumption per person shows the highest increase as 180% from 1980 to the year of 2010 (Animal Task Force, 2017). The poultry industry produces ca. 110 million tonnes of deep litter manure, defining as waste causes serious environmental impact, and requires implications of developed new treatment technologies to transfer it into a recycled raw material, mainly useable as an organic fertilizer, soil nutrient. Many technologies are developed for these purposes; life cycle assessment (LCA) allows prioritising them.

In the recent presentation the role of volatile ammonia in the poultry manure is discussed. The goals of new technologies are to standardize the nutrient stabilization, to reduce pathogens and odours. One of the main sources of manure comes from the chicken industry. In general the density of birds in the house is 15 pieces per square meter. The volume of deep litter used at the beginning in addition with the manure including moisture produced during 7 week growing period (light broiler) reaches 30-35 kg/squaremeter. The nitrogen content is high in the litter which fact requires two considerations. First point is to reduce the ammonia in house during growing process. Ammonia volatilization under aerobic and anaerobic manure decomposition occurs. Production of ammonia in the litter increases the pH, thus causing leg injuries. Second point is that due to high nitrogen content the poultry manure requires specific treatment before is used as fertilizer to avoid the nitrate pollution.

## ANALYSING CONSUMER'S PERCEPTION AND BEHAVIOUR TOWARDS GOAT MILK PROCESSED PRODUCTS IN DEBRECEN REGION

Csapó Zsolt<sup>1</sup>, Csapóné Riskó T<sup>2</sup>

<sup>1</sup> csapo.zsolt@econ.unideb.hu, <sup>2</sup>risko.tunde@econ.unideb.hu

<sup>1</sup> University of Debrecen, Faculty of Economics and Business, Institute of Applied Economics, 138 Böszörményi Str, Debrecen, Hungary, 4032

<sup>2</sup> University of Debrecen, Faculty of Economics and Business, Institute of Marketing and Commerce, 138 Böszörményi Str, Debrecen, Hungary, 4032

Healthy nutrition begins with the production of high quality meat and dairy products. Besides the main branches of animal husbandry (poultry, pig, cattle) there is a need for the branch of small ruminants on the market. The milk and meat of small ruminants serves as a basic food-source in the Balkans, while in Hungary these products are “luxury” consumer goods. The production level of sheep and goat branches within the whole agricultural production shows a continuous decrease in the last few years in Hungary, in 2015 it was less than 1 percent. The consumption of sheep and goat milk was only a few decagrams by the estimation of Kukovics and Jávör in 2002 in Hungary. The low consumption of sheep and goat milk products can be explained by the fact that as processed food only cheese and cottage cheese are available on the Hungarian market. Although in other countries, like in France and Italy there is a wide range of processed goat and sheep milk products (Szakály et al., 2017).

Among the many benefits of goat milk, regularly consuming it enhances the body’s ability to use iron and boosts regeneration of haemoglobin, making it a safe and natural way to treat osteoporosis and combat anaemia. Its high levels of zinc and selenium also help prevent neurodegenerative diseases (<https://draxe.com/goat-milk/>).

The main objective of our empirical research is to analyse the consumer’s perception and behaviour towards goat milk processed products in Debrecen region. The research methods include blind testing of different processed goat, sheep and dairy milk products. Blind testing is carried out in different age groups like young, middle-aged and old generation. In order to explore the stereotypes regarding processed goat milk products an online survey is carried out.

## COELIAC DISEASE - GLUTEN-FREE CATERING IN HUNGARY

Csapóné Riskó T<sup>1</sup>, Benyovszki B<sup>2</sup>

<sup>1</sup> [risko.tunde@econ.unideb.hu](mailto:risko.tunde@econ.unideb.hu), <sup>2</sup> [benyo1994@gmail.com](mailto:benyo1994@gmail.com)

<sup>1</sup> University of Debrecen, Faculty of Economics and Business, Institute of Marketing and Commerce, 138 Böszörményi Str, Debrecen, Hungary, 4032

<sup>2</sup> University of Debrecen, Faculty of Economics and Business, former BSc student

Coeliac disease is an immune reaction to gluten, a protein found in wheat, barley and rye. The prevalence of coeliac disease in Western countries is around 1% of the population, but it is substantially increasing in other parts of the world. Coeliac disease is known to affect all age groups, including the elderly. More than 70% of newly diagnosed patients are above the age of 20 years. As coeliac disease is a serious medical condition with lifelong implications, a definitive diagnosis is essential. The only treatment for coeliac disease is lifelong adherence to a strict gluten-free diet. The gluten free diet is not a simple undertaking and involves lifestyle changes. People eat together; mealtimes are also social events when people come

together. An empirical research (Bachelor thesis research) has been carried out in Spring 2018 in Hungary. The aim of the research was to investigate the eating out possibilities and behaviour of people with coeliac disease, as well as to explore their satisfaction with gluten-free restaurants nowadays in Hungary.

The study revealed that

- majority of respondents regularly visits restaurants, so they are potential guests just like “healthy” people;
- in case of eating out together if there is a person with coeliac disease in the group, they surely chose a restaurant where she/he can safely eat gluten-free;
- eating out alone is not common, so restaurants should focus on people with certain food intolerance and allergy as well;
- when choosing a restaurant the most important aspects are: it should be certified gluten-free, quality of service, price, location, menu;
- there is a lack in gluten-free restaurants in Hungary;
- respondents are not satisfied with the gluten-free restaurants;
- respondents collect information online when choosing a restaurant;
- respondents are willing to pay more and to travel further away for a certified gluten-free restaurant.

## POSTER PRESENTATIONS

### EVALUATION OF ZIZIPHORA CLINOPODIOIDES ESSENTIAL OIL AND WHEY PROTEIN ISOLATE (WPI) COATING ON EXTEND SHELF LIFE AND LISTERIA MONOCYTOGENES CONTROL IN CUBE BEEF

Vanaki E, Noori N, Nima Babolani M, Rahmani F  
elmiravanaki1368@gmail.com

Department of Food Hygiene and Quality Control, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran

*Ziziphora clinopodioides* is the plant species that belonged to the *Lamiaceae* family and have significant antibacterial activity. Whey protein isolate (WPI; >90%) have been used as a coating solution for improving food quality and extending shelf life of some perishable foods. In this study ziziphora clinopodioides essential oil (EO) obtained by hydrodistillation method and chemical composition determined by GC/MS. Different concentrations of ziziphora clinopodioides essential oil (0, 0.6% and 1% v/v) were added to WPI solution. The initial inoculation of *L. monocytogenes* was 3.05 log cfu/g. cubic beef coated by WPI containing different concentrations of ziziphora clinopodioides EO and were packaged and stored at 4°C and total viable count (TVC), Psychrotrophic, pseudomonas spp. and *L. monocytogenes* were investigated in 0, 3, 6, 9 and 12 days of storage. The GC/MS results showed 22 organic compound representing 97.29% of total identified EO and thymol (30.67%), borneol (12.78%) and p-cymene (7.92%) were major compound of ziziphora clinopodioides EO. Result of this study showed that TVC of control treatment in 6<sup>th</sup> of study and the treatment coated with 0.6% and 1% of ziziphora clinopodioides EO in 9<sup>th</sup> and 12<sup>th</sup> of study, respectively, were exceed than 7 log cfu/g that showed a significantly antimicrobial effects and extend shelf life on the antimicrobial coated treatments. Also results showed Psychrotrophic and pseudomonas spp. count were significantly decreased in cube beef coated with WPI containing 0.6% and 1% ziziphora clinopodioides EO in comparison to control samples during study period. *L. monocytogenes* on 12<sup>th</sup> of investigation showed a 2.15 and 2.59 log cfu/gr reductions due to coated the cube beef with WPI contain 0.6% and 1% ziziphora clinopodioides EO in comparison to control treatment and demonstrated control effect of ziziphora clinopodioides EO on *L. monocytogenes* in cube beef stored at 4°C. In conclusion, results of this study revealed WPI coating containing ziziphora clinopodioides EO can increase shelf life and safety of cube beef.

### STUDY ON THE EFFECT OF ALGINATE-CHITOSAN MICROENCAPSULATION ON SURVIVAL OF *LACTOBACILLUS CASEI* AND *BIFIDOBACTERIUM LACTIS* IN PROBIOTIC ICE CREAM

Rahmani F<sup>1\*</sup>, Gandomi H<sup>1\*</sup>, Agh M<sup>1</sup>, Noori N<sup>1</sup>  
\*fatemerahmani904@ut.ac.ir

<sup>1</sup> Department of Food Hygiene, Faculty of Veterinary Medicine, University of Teheran, Teheran, Iran

Due to the health effects of probiotic bacteria on humans, the use of them in food products is increasing. Microencapsulation is one of the methods applied to improve the survival of probiotics during food storage and gastrointestinal passage as well. In this study the effect of microencapsulation with alginate-chitosan was evaluated on survival of *Lactobacillus casei* and *Bifidobacterium lactis* in probiotic ice cream during 90 days of frozen storage. During the storage period, the amount of the bacteria in all groups decreased. Free *Lactobacillus casei* count showed decrease of 1.2 log compared with 0.2 log reduction in microencapsulated group. The reduction rate in free and microencapsulated *Bifidobacterium lactis* was 1.64 log and 0.57 log respectively. The survival rate of free *Lactobacillus casei* was 6.4% at the end of the storage period, however in microencapsulated bacteria the survival rate increased to 62.2%. The survival rate of free *Bifidobacterium lactis* was 2.3% comparing to 26.7% in microencapsulated group. The organoleptic evaluation of the samples showed that microencapsulation has no unfavorable effects on organoleptic properties of the ice cream. In conclusion, microencapsulation with 45 alginate-chitosan improved the survival of probiotic bacteria and its potential application in food systems could be suggested.

Keywords: Microencapsulation; Alginate; Chitosan; *Lactobacillus casei*; *Bifidobacterium lactis*; Ice cream

#### MICROBIOLOGICAL STATUS OF GOMOLYA CHEESES PRODUCED BY SMALL-SCALE DAIRIES

Petróczki FM<sup>1</sup>, Woode BK<sup>1</sup>, Törös G<sup>1</sup>, Nagy NS<sup>1</sup>, Béri B<sup>2</sup>, Peles F<sup>1</sup>  
petroczi.flora@agr.unideb.hu

<sup>1</sup>. Institute of Food Science, Faculty of Agricultural and Food Sciences and Environmental Management, University of Debrecen, Böszörményi street 138, 4032 Debrecen, Hungary

<sup>2</sup>. Institute of Animal Science, Biotechnology and Nature Conservation, Faculty of Agricultural and Food Sciences and Environmental Management, University of Debrecen, Böszörményi street 138, 4032 Debrecen, Hungary

Cheese production requires high technological hygiene standards to produce high quality and safe food. Hygiene indicator microorganisms can represent a picture of the microbiological status of foodstuffs and their environment. In this study, we aimed to assess the microbiological status of gomolya cheeses produced by small-scale dairies, and to determine the amount of some indicator microbes (coliform bacteria, molds), and the *Staphylococcus aureus*. A natural and five flavoured (garlic from two producers, dill, onion, dill-garlic) gomolya cheeses were examined in two repetitions. The samples were bought in the shops of manufactories, and from a festival, between July and September 2017. The results showed that in the examined gomolya cheeses the amount of coliform bacteria was around  $3.98 \pm 1.42 \log_{10}$  CFU/g; mold count was  $1.74 \pm 0.37 \log_{10}$  CFU/g; and *S. aureus* count was  $3.79 \pm 1.12 \log_{10}$  CFU/g in average, respectively. We also found that except for a garlic flavored gomolya cheese from one producer, the number of coliform bacteria exceeded the limit set in regulation 4/1998 (XI. 11.) EüM. Except for the onion flavored gomolya cheese, the mold count remained below the limit of refusal for all samples. In addition, only the natural and the garlic flavored

gomolya cheese from one producer contained less than 1000 CFU/g *S. aureus*. During our investigations, we have often found values above the limit, which may indicate the inadequate microbiological status of the samples tested. In this study there are preliminary results; further studies are needed to gain a better understanding of the microbiological status of the finished products.

#### EFFECT OF SUGAR REPLACEMENT BY SOLUBLE DIETARY FIBRE ON DOUGH CONSISTENCY AND TEXTURE OF GLUTEN-FREE CUPCAKES

Krupa-Kozak U<sup>1</sup>, Drabińska N<sup>1,2</sup>, Rosell C<sup>2</sup>, Piłat B<sup>3</sup> and Jeliński T<sup>4</sup>

<sup>1</sup> Department of Chemistry and Biodynamics of Food, Institute of Animal Reproduction and Food Research of Polish Academy of Sciences, Olsztyn, Poland; u.krupa-kozak@pan.olsztyn.pl

<sup>2</sup> Food Science Department, Institute of Agrochemistry and Food Technology (IATA-CSIC), Paterna, Valencia, Spain; crosell@iata.csic.es

<sup>3</sup> Chair of Food Plant Chemistry and Processing, University of Warmia and Mazury in Olsztyn, Poland: beata.pilat@uwm.edu.pl

<sup>4</sup>Department of Chemical and Physical Properties of Food, Institute of Animal Reproduction and Food Research of Polish Academy of Sciences, Olsztyn, Poland; t.jelinski@pan.olsztyn.pl

Despite advances in the quality of gluten-free baked products (GFP), they are characterised by unsatisfied technological properties, unbalanced nutrients content and reduced content of dietary fibre (DF). DF has important physiological functions and can modify the rate at which nutrients are absorbed. This study aimed to evaluate the impact of DF replacing sugar in gluten-free cupcake (GFC) formulations on the dough pasting characteristics, texture profil and energy value.

In experimental GFC, whole sugar was replaced by dietary fibre (inulin, FOS or Synergy 1). The pasting behaviour of GFC dough was evaluated using a Rapid ViscoAnalyser (RVA). GFCs were baked in the laboratory conditions and their chemical composition was analysed using the standard methods. Textural profil of GFCs were assessed using TA.HD Plus Texture Analyser.

Compared to control cupcake, sugar raplacement by DFs did not affect the peak viscosity measured by RVA but decreased significantly ( $p < 0.05$ ) the final viscosity of all experimental GFC doughs. Compared to control cupcake, GFC with DF had similar fat and proteins content but significantly ( $p < 0.05$ ) reduced energy value due to reduced carbohydrates content. Texture profile analysis indicated that comparing to control cupcake, GFC with DF were harder, except for GFC with FOS that was similarly soft. Moreover, GFC with FOS was characterised by attractive golden crust compared with control and other GFC. All GFC with DFs were characterized by small pores properly distributed.

In conclusions, GFC with FOS was distinguished for its desirable texture and lower calory content. Nevertheless, further nutrients and sensory analysis are needed to assess the quality of GFCs as well as human studies to propose a product usefulness in counteracting the development of obesity.

The research was funded by KNOW (Leading National Research Centre) Scientific Consortium: "Healthy Animal - Safe Food"(decision of Ministry of Science and Higher Education No. 05-1/KNOW2/2015

## PRODUCTION AND CHARACTERIZATION OF GELLAN AEROGEL MACROSPHERES USING SUPERCRITICAL CO<sub>2</sub> DRYING

Viganó J, Freitas GF, Meirelles AAD, Cunha RL, Martínez J.  
julianevigano@gmail.com

Department of Food Engineering, School of Food Engineering, University of Campinas, Campinas 13083862, SP, Brazil.

Aerogels are a class of new materials, which have high porosity and surface area, and low density. Polysaccharides based aerogels have potential application in food, biomedical, and pharmaceutical applications due to their biodegradability, loading capacity of target compounds and controlled release. Based on that, the purpose of this work was to produce and characterize gellan aerogel microspheres using supercritical CO<sub>2</sub> drying. Solutions of gellan were prepared at 0.5, 0.75 and 1% (w/w) and heated for 30 min at 90 °C. CaCl<sub>2</sub> solutions were used as crosslinking agent varying the ionic strength (0.03, 0.06 and 0.09 M). Then, the polymeric solution was pumped (1 mL/min) and dripped through a nozzle (0.58 mm) into the crosslinking solution. Microspheres were collected once gelled and subjected to solvent exchange, in which they were progressively immersed into ethanol/water mixtures (10, 30, 50, 70, 90 and 100%, v/v) for one day, except the last step that was repeated three times. Finally, the microspheres were dried with a continuous supercritical CO<sub>2</sub> flow at 40±1 °C and 12±0.5 MPa. The surface and shape of the hydrogel, alcogel and aerogel particles were examined by electron microscopy, and the data were processed by ImageJ image software. The reduction of the particle size between the processes was calculated and expressed as relative shrinkage. The hydrogel microspheres presented drop shape, and the circularity was 0.81±0.04. The increase of gellan concentration increased de hydrogel microspheres size, which ranged from 2.30±0.03 to 2.90±0.03 mm. The overall shrinkage (0.69-0.79) decreased as the gellan content increased. The aerogel microspheres size ranged from 1.15±0.02 to 1.519±0.10 mm. Supercritical drying is considered the best option for obtaining aerogel. Nevertheless, the shrinkage was larger than the observed in aerogels from other polymers. So, the study of techniques to reduce the gellan aerogel shrinkage is considered perspective for further works.

## WATERPROOF COATINGS FOR HYDROPHILIC FOODS

Avelar Z<sup>1\*</sup>, Maciel F<sup>1</sup>, Silva P<sup>1</sup>, Paulico L<sup>2</sup>, Miranda C<sup>2</sup>, Vicente A A<sup>1</sup>  
\*zsb.avelar@gmail.com

<sup>1</sup> Centre of Biological Engineering, University of Minho, Braga, Portugal

In the food industry, the incorporation of dry or poorly hydrated food components in hydrophilic food matrices has only been possible through the use of two-compartment packaging systems, designed to maintain the components separated until their consumption. The main purpose of this research is to provide a solution to this long-standing problem, through the development of hydrophobic coatings, allowing the incorporation of food components with low water activity (e.g. cereals) in hydrophilic foods.

In this work, coatings were applied on chocolate spherical breakfast cereals by spray application. Briefly, a defined quantity of cereals were placed inside of a coating pan, in constant agitation and the coating was applied directly on cereals by spray application. The samples were analysed by their stability in water, swelling and textural properties, after a determined period of time (generally 47 days). It was found that a formulation containing beeswax and cocoa butter presented full stability in water (i.e., cereals coated with this formulation remain intact during the defined period of time). After 47 days in water, in a sample of 10 cereals from a single coating assay containing this formulation, 8 of them presented a mean value of swelling of  $0.60 \pm 0.24$  %, which is very close to the typical value of swelling for dry coated cereals (0 %). The textural profile analysis of this sample allowed to observe the existence of force peaks, correspondent to the fraction of a crispy cereal, in spite of the existence of more attenuated force peaks when compared to those observed in the compression profile obtained from dry coated cereals. These results indicate that these cereals may have preserved some of their crispness after the test period.

The loss of textural properties of food components with low water activity will, this way, be reduced by this technology.

#### THE EFFECT OF SELENIUM TREATMENT ON MAIZE AND SUNFLOWER PLANTS IN NUTRIENT SOLUTION AND SOIL-PLANT SYSTEM

Kovács B<sup>1</sup>, Nagy K, Lévai L, Várallyay Sz, Soós Á, Papp-Topa E, Bódi É  
kovacsb@agr.unideb.hu

<sup>1</sup>Institute of Food Science, Faculty of Agricultural and Food Sciences and Environmental Management, University of Debrecen

Selenium is one of the most important element, because selenium is an essential microelement, a vital component of antioxidant system of organism. Deficiency of selenium is connected with emergence of many diseases among others the heart and vascular system, furthermore the tumorous diseases. It's dangerous nature to plants and human bodies derives from the narrow appropriate concentrations of the selenium. In the periodical system, selenium has the narrowest tolerance concentration range that is essential and toxic contents are close to one another.

In our experiments we tried to evaluate the uptake and the mobility of selenium in nutrient solution, moreover soil-plant systems (rhizoboxes). The applied plants were: a monocotyledon (maize, *Zea mays* L.) and a dicotyledon (sunflower, *Helianthus annuus* L.). Selenium was applied in the form of selenite ( $\text{Na}_2\text{SeO}_3 \cdot 5\text{H}_2\text{O}$ ) and selenate ( $\text{Na}_2\text{SeO}_4$ ) in ultrapure water, the required concentrations were calculated for selenium. The applied selenium was in the case of selenite (1, 10, 100 mg kg<sup>-1</sup>) and selenate (0,1, 1, 10 mg kg<sup>-1</sup>) respectively, whereas there was no selenium treatment on the control crops ( $\emptyset$ ). Each treatment was applied in three repetitions and in calcareous chernozem.

On the basis of our results the selenium content of plants was increased significantly by the effect of selenium treatments. This increase of selenium concentration was more intensive by the effect of selenate treatment than by the effect of selenite treatment applying the same level of treatment. The selenium concentration of shoot and root samples was analyzed respectively. Se content was higher in roots than in shoot samples in the case of maize and sunflower as well. This shows that the selenium accumulation in roots was more intensive than in shoots of the applied plants among the applied conditions.

#### THE GAMMA RADIATION MODIFIED ROTTENING FUNGAL POULATION AND SHELF-LIFE OF THE TART CHERRY (PRUNUS CERASUS)

Mihály K.<sup>1</sup>, Kovács Cs.<sup>2</sup>, Takács F.<sup>2</sup>, Sándor E.<sup>1</sup>  
mihaly.kata@agr.unideb.hu

<sup>1</sup>University of Debrecen, Faculty of Agricultural and Food Sciences and Environmental Management, Institute of Food Science, Böszörményi st. 138., H-4032 Debrecen, Hungary

<sup>2</sup>National Agricultural Research and Innovation Center, Fruit Research Institute 4244 Újfehértó, Vadastag 2., Újfehértó, Hungary

Sour cherry (*Prunus cerasus* L.) fruit has high importance in Hungary, being the second of production volume, and high percentage of export. Because of a limited period of harvesting time, therefore appropriate technology would be desired to develop to preserve high quality sour cherry fruits. Half of the market loss of sour cherry is due to various postharvest diseases. To control postharvest fungal pathogens, many studies have focused on a chemical approach. Irradiation is a highly efficacious phytosanitary treatment which utilizes ionizing radiation from radioisotopes (gamma rays), electron beam or x-rays to disrupt the genetic material of the pest or microorganism infesting food, causing either sterilization or death of the target organisms

Three Hungarian sour cherry varieties (Érdi bőtermő, Újfehértói fürtös and Petri) were used to test the effect of gamma ionizing radiation. Harvested fruits were treated with three different doses (0.5; 1; 2 kGy). We also The effect of the radiation for the shelf life and the surface and rotting mould populations were observed. Fungal identification was based on morphological and molecular characters. We concluded that the 1 kGy dose was the most effective treatment for the 'Újfehértói fürtös' and 'Petri' varieties, resulting the decrease of the fruit decline during the two-week shelf-life experiment. More than half of the treated sour-cherries remained intact.

Acknowledge: Work was supported by the Innovation Laboratory Ltd, Budapest and NAIC Fruit Research Institute, Újfehértó. The publication is supported by the EFOP 3.6.1-16-2016-00022 project. The project is co-financed by the European Union and the European Social Fund. The work/publication is supported by the EFOP-3.6.3- VEKOP-16- 2017-00008 project. The project is co-financed by the European Union and the European Social Fund.

## COMPARISON THE MINERAL CONTENT OF WINTER WHEAT IN HUNGARY IN THE LAST FEW DECADES

Ungai D<sup>1</sup>, Győri Z<sup>2</sup>  
ungai@agr.unideb.hu

<sup>1</sup>: University of Debrecen, Institute of Food Science H-4032 Böszörményi str. 138., Debrecen, Hungary

<sup>2</sup>: University of Debrecen, Institute of Nutrition H-4032 Egyetem square 1., Debrecen, Hungary

Wheat is our basic crop in the food industry, which has been playing a decisive role not only in everyday meals but also in economic life for centuries. The good quality of Hungarian wheat was famous in Europe, even in the 1800s. In later times, since the end of the 1800s, due to the growing population, the aim was to raise yields and to produce drought-resistant and disease resistance species, which has flintier grain and firmer stalks.

In the last few decades, significant changes have also been made in the case of wheat production in Hungary, thanks to the use of intensive agrotechnical elements in the crop production. The question is simply how the systems can influence the development of certain quality indicators, including, of course, the content of the mineral content of winter wheat, which basically determines and influences both nutritional and feeding value.

Because wheat grain and the flour prepared from it play an important role to our daily nutrition. Numerous researchers report data on the mineral content of winter wheat. Recently, this topic is key important, because the intensification of agricultural production pointed the view of micro- and macroelements. So nowadays the notion of quality includes the mineral element content and their adequate ratios. The element content is determined by genetically and environmental factors, but the technology of agriculture has an important role as well. The aim of this study was to compare the concentrations of different mineral elements, in the wholemeal samples, from different years, because many literature suggested that the mineral content of wheat declined to about half from 1942 to the present day.

Taking into account this fact, the possibility has been raised that it is worthwhile to set up these old Hungarian varieties, setting the right mixing rate to increase the amount of minerals, naturally in such a way that the typical values of the baking quality parameters are not reduced.

In conclusion, it can be stated that, with high yields, the monitoring of mineral content is also an important factor today.

## THE ELEMENT CONTENT OF PROPOLIS TINCTURES BY THE VOLUME OF THE EXTRACTION SOLVENT

Soós Á<sup>1</sup>, Bódi É<sup>1</sup>, Várallyay Sz<sup>1</sup>, Molnár Sz<sup>2</sup> and Kovács B<sup>1</sup>  
soos.aron@agr.unideb.hu

<sup>1</sup>University of Debrecen, Faculty of the Agricultural and Food Sciences and Environmental Management, Institute of Food Science, Debrecen

<sup>2</sup>Eszterházy Károly University, Food and Wine Research Centre, Eger

Propolis is a product of honeybee (*Apis mellifera* L.), which is an adhesive material. It is used as an inner cover of the hive, moreover antimicrobial effects are also substantial. Propolis has an increasing popularity nowadays. It can be found in nutritional supplements, ointments, toothpastes, or mixed with honey, but the most widespread product is the ethanol extract of raw propolis. Tinctures can also be made at home but there is no unified recipe for the product. The accessible methods offer different ethanol concentrations, extraction time, and moreover different volume of the extraction solvent.

The element content of the extraction product was checked from a raw propolis of Hungary based on different extraction solvent volumes, namely 2.5 ml, 5 ml and 10 ml ethanol solution (double amount to each other) added to 0.5 g of raw propolis. Different concentrations of ethanol (80 and 100%v/v) and different extraction times (1 hour, 1 day, 1 week, and 1 month) were also checked with the aforementioned volumes, but the results of them were averaged. The element content of the tinctures were measured by inductively coupled plasma optical emission spectrometry and inductively coupled plasma mass spectrometry after microwave assisted digestion.

It was shown that the two times extraction volume dissolve higher amount of minerals. The decrease in most of the element concentrations were less than 50%, if a double volume was used. The average decrease of the elements in different treatments were between 27.2% and 51.7% in case of strontium and cadmium, and the mean of decrease in case of all the elements were 43.7% compared to the double volume of solvent treatments.

Based on the results the extraction solvent volume has an effect on the element content of propolis tinctures and the element content is not in linear relationship with the additional solution.

## INFLUENCE OF OIL AND PROTEIN TYPE ON THE STABILITY OF MODEL INFANT FORMULA EMULSIONS

Furtado GE, Carvalho AGS, Hubinger MD  
furtado.gf@gmail.com

Department of Food Engineering, School of Food Engineering, University of Campinas,  
Campinas, SP, Brazil

Considering the frequent need to develop new formulations that contain functional appeal to meet the scientific and technological demands, the objective of this study was to evaluate physical properties and stability of model infant formula emulsions composed of different types of oils and proteins. Formulations containing 20, 30, 30 and 40 g L-1 protein, oil, lactose and maltodextrin, respectively, were prepared using either whey protein isolate (WPI), whey protein hydrolysate (WPH), WPI+Lactoferrin (LF) or WPH+LF. The oil phase was composed of high oleic sunflower oil (HOSO), or a mixture of HOSO with medium chain triacylglycerols (MCT) or coconut oil (CO) at a ratio of 75:25 w/w. Water soluble components were dissolved in deionised water, then emulsions were previously homogenized in a rotor-stator (16,000 rpm/3 min) followed by passage through a double stage high pressure homogenizer (30/5 MPa), for 2 cycles. Droplets size, microstructure, viscosity and creaming stability of emulsions were evaluated. Regardless of the type of oil, all WPI emulsions remained stable for 1 day of storage. WPH emulsions were completely unstable from the first minutes, however, WPH + LF mixture allowed to obtain stable emulsions during the first hour. The good stability of the systems containing WPI was related to the smaller droplet sizes and the monomodal size distribution. LF addition may have promoted a greater interaction between droplets, reflecting in systems with higher viscosity. These stable emulsions could be further spray dried to be used as functional infant formulas.

Keywords: protein, emulsion, infant formulas.

Acknowledgments: FAPESP 2017/08130-1

#### RESEARCH OF RHEOLOGICAL PARAMETERS OF MARINATED TOFU

Diósi G, Jevcsák Sz, Kiss G, Nagy V, Máthé E

diosi@agr.unideb.hu

University of Debrecen,

Faculty of Agricultural and Food Sciences and Environmental Management,

Institute of Food Technology

H-4032 Böszörményi Street 138, Debrecen, Hungary

Nowadays, the Tofu (soybean) is a kind of „meatball”. The most popular „meatballs” are soybeans, Tofu which is easy to obtain and easy to make. However, the good quality Tofu requires good quality soy. The history of Tofu came from China, its name is also used in Chinese. Usually the Tofu is used as a substitute for sour cream, cottage cheese, cheese. The soybean contains water-soluble proteins, therefore it has high protein content. Its taste is neutral, it adapts well to seasoning, can be flavored.

In our research we pickled Tofu, we used oil and water pickles with different spices (red paprika, salt, Italian seasoning – basil, oregano, rosemary mix, garlic, ginger). Every pickles were 2,5 m/m exception

the salt pickles (oil, water) which were 7,5 m/m. The time of pickled was 1 day (24 hours). We used TA.XT Plus texture analyzer (the speed: 10,0 mm/s, distance: 25 mm)

The results of marinated Tofu: Force of the natur Tofu was 905 g, average force of water-based pickled Tofu was 368 g, average force of oil-based pickled Tofu was 388. The salty oil-based Tofu was softer than the salty water-based Tofu. In the garlic/red paprika oil pickled the Tofu was softer than in the water-based. In taste, the oil-based pickleds Tofu were better than the water-based pickle Tofu, but the Italian seasoning and the ginger flavored Tofu had stronger taste than the others.

In the future, we suggested these Tofu for pasta, re-use of such fillers in marinated Tofu recommended: stuffed pasta, ravioli, tortellini.

## ESTIMATION OF BREAD-MAKING QUALITY ON THE BASIS OF RHEOLOGICAL PROPERTIES

Boros N<sup>1</sup>, Gyóri Z<sup>2</sup>

nboros@eng.unideb.hu

<sup>1</sup>University of Debrecen, Faculty of Engineering, Department of Environmental Engineering

<sup>2</sup>University of Debrecen, Institute of Nutrition

The cereals provide about 60% of the world food production. Wheat is unique in the sense that several products for human consumption can be produced from it, but various baking products require wheat flours with different quality. The characterization of protein content and protein composition of flour, as well as the investigation of the rheological properties of dough are necessary to determine the suitability of wheat flours for producing certain baking products.

The aim of this research was to study the connection between the rheological properties (farinograph, alveograph, and extensigraph) and bread-making quality of winter wheat cultivars with different protein content. Eight cultivars were studied: Hunor, Kondor, KG Bendegúz, KG Kunhalom, KG Széphalom, Pannónia NS, Brutus, and Antonius. The falling number of flour samples was adjusted at 250 s by malt flour addition. We prepared dough samples according to the ICC standard No. 131 using 2000 g wheat flour. Loaf volume was measured by rapeseed displacement method after one hour resting at room temperature. We measured loaf weight by a precision scale. Loaf height and crumb firmness parameters were determined three hours after baking, when the loaves were totally cold. To determine crumb firmness a TA.XTplus texture analyzer (Stable Micro Systems Ltd., Godalming, Surrey, UK) was used according to the AACC Method 74-09. The test was carried out on a 25 mm thick slice of the loaves.

Loaf height showed strong correlation neither with extensigraph nor alveograph parameters. Among farinograph parameters water absorption and dough development time were found as determining factors considering this parameter. We could estimate fairly well loaf height on the basis of water absorption of flour ( $r = 0.78$ ,  $r^2_{adj} = 0.59$ ). However, we got the best results if we took water absorption, dough development time, and wet gluten content parameters into consideration as well. Loaf weight could be predicted by using an extensigraph parameter, resistance at a constant extension of 5 cm at the 90 min test. But in this case the estimation error was really high (6.3 g). To improve the reliability of estimation we should have involved both water absorption and gluten index properties into the equation. Loaf volume could be predicted by the protein content of flour ( $r = 0.58$ ), but the error of estimation was relatively high (126 cm<sup>3</sup>). By involving farinograph and extensigraph parameters into the equation, it was possible to increase the accuracy of estimation. According to the investigation conducted to determine the connection between the force needed to compress the bread slice by 40%

and the studied rheological parameters, we established that the firmness of breadcrumb could be predicted. Primarily the farinograph and alveograph properties of dough samples had significant effects on the firmness characteristic of breadcrumb.

## CHARACTERISATION OF FOOD-GRADE WATER-IN-OIL-IN-WATER (W/O/W) EMULSIONS STABILISED WITH DIFFERENT BIOPOLYMERS AS POTENTIAL MATRIXES FOR ENCAPSULATION

Eisinaite V, Zutautas P, Zigmantaviciute A, Vilimaitė V, Kersiene M, Leskauskaite D  
daiva.leskauskaite@ktu.lt

Department of Food Science and Technology, Kaunas University of Technology

Water-in-oil-in-water emulsion is a system made of one lipid and two aqueous (inner and outer) phases, separated by two types of interphases that need to be stabilised. Because of this structure W/O/W emulsions are used to encapsulate bioactive and sensitive food ingredients in the inner water phase. The objective of this study was to investigate the influence of different type and concentration of biopolymers on the stability of W/O/W emulsions and on the release behaviour of the black chokeberry extracts entrapped in the inner water phase of emulsions.

W1/O was made from water solution of the black chokeberry extracts (W1) emulsified with rapeseed oil with polyglycerol polyricinoleate (3 – 6 %) as hydrophobic emulsifier (O). W2 phase was made from different types and concentrations of biopolymers. In this study, milk, egg, pea proteins (2 – 10 %) or carboxymethylcellulose (0,25 – 0,35 %) were used for the stabilisation of the outer aqueous phase.

W/O/W emulsions were characterised by creaming stability, average droplet size and distribution, rheological behaviour and encapsulation efficiency of the black chokeberry extracts.

In most cases, W/O/W showed shear-thinning behaviour and dominant elastic character. The double emulsion stabilized with carboxymethylcellulose as thickening agent of W2 phase provided smaller droplets and higher viscosity than other emulsions containing proteins in the outer water phase. These double emulsions exhibited stronger encapsulation properties as well.

The current study reveals that W/O/W emulsions containing carboxymethylcellulose in W2 phase and black chokeberry extracts in the W1 phase can be used as a proper tool for the encapsulation of bioactives.

## PEPTIDES RELEASED DURING IN VITRO GASTROINTESTINAL DIGESTION OF ACID AND RENNET INDUCED GELS FROM LITHUANIAN BLACK AND WHITE COWS MILK

Kubiliute M <sup>1</sup>, Kersiene M <sup>1</sup>, Leskauskaite D <sup>1</sup>, Larsen LB<sup>2</sup>  
milda.kersiene@ktu.lt

<sup>1</sup>Department of Food Science and Technology, Kaunas University of Technology,

<sup>2</sup>Department of Food Science, Aarhus University

Bovine milk, fermented milk drinks and cheeses are the most abundant sources of biologically active peptides. Ingestion of bovine milk by humans causes that bioactive peptides are evoked from delivered proteins during the course of digestion. Milk processing can influence the proteins digestibility and generation of peptides during digestion. Therefore, the objective of this study was to evaluate acid and rennet induced gels obtained from Lithuanian Black and White (LBW) cows milk as a natural source of peptides with biological activity. Differences in protein degradation and peptide generation were studied for two dairy gels having a similar composition but differing by their mode of coagulation.

The gels were prepared from LBW cows milk either by acid coagulation (with lactic acid bacteria) or by rennet coagulation. In this study *in vitro* digestion method proposed by INFOGEST was used to simulate the conditions in gastrointestinal tract. Samples were taken before digestion and at different times during 4 hours of *in vitro* digestion corresponding to the gastric and duodenal phases. Fluorescamine assay was used to determine the free amino groups content in the gastrointestinal fluids. Peptides were separated and analysed according to the LC-MS/MS method.

The differences in the kinetics of protein hydrolysis during digestion of acid and rennet induced coagulation have been determined. The rennet gel led to the formation of lower levels of free amino groups after 4 hours of *in vitro* digestion than the acid gels. Peptides profile analysis showed that acid and rennet gels produced from LBW cows milk were great source of bioactive peptides (mostly ACE inhibitors). Peptides formation have started during gelation process of milk proteins, however the profiles of peptides derived from different casein fractions depended on the gelation agent.

#### DEVELOPMENT OF MATZO MADE OF WHOLEMEAL RYE FLOUR

Véha A, Szabó PB, Zakupszki Z

veha@mk.u-szeged.hu

University of Szeged, Szeged, Moszkvai krt. 57

The aim of my thesis is the development of a matzo made of wholemeal rye flour, which helps in healthy nutrition for the customer's and more economical from production's point of view. The main aim of the product development is to increase the nutrient content by the raise of mineral and fibre content. The thesis made up of two parts. The first part contains the religious background, the description and the production technology of the matzo. The second part of my thesis contains the necessary measurements and their results for product development. Based on results of examinations it can be ascertain that the new product shows more advantageous values of the fibre content's and the prime cost's point of view.

## ANTIMICROBIAL POTENTIAL ACTIVITY OF LACTOBACILLUS FROM KASHK-E ZARD:THE IRANIAN TRADITIONAL DAIRY-CEREAL FERMENTED FOOD

Mashak Z<sup>1</sup>  
Mashak@kiaou.ac.ir

<sup>1</sup> Department of Food Hygiene, Karaj Branch, Islamic Azad University, Karaj, IR Iran

Nowadays, microbial food safety is an increasing public health concern worldwide, especially in developing countries. A large variety of traditional fermented foods are globally produced and consumed. Fermentation is one of the most practical, economic and enhancing organoleptic and nutritional quality of fresh foods. One of the Iranian fermented foods is traditional dairy-cereal type that named Kashk-e Zard. During fermentation, the pathogens growth as well as other spoilage organisms are frequently inhibited through antimicrobial components produced by lactic acid bacteria (LAB) strains. This study was to apply established in vitro tests to evaluate the antimicrobial activity of the *Lactobacilli* isolated from kashk – e zard.

In material and methods, Sampling were done on 23 samples of Kashk-e Zard. Enumeration and isolation were surface-plate cultured on MRS agar (37°C / 72 hrs), and also biochemical tests. Antimicrobial activity of isolates were assessed against four intestinal pathogens (*E. coli* ATCC 700728, *S. aureus* ATCC 29737, *L.monocytogenes* ATCC 19115 and *S. typhimurium* ATCC 19430) using well diffusion test. Finally, Kinetic study was conducted with a bacteriostatic activity in vitro in the presence of *Lactobacillus* supernatants. The results showed average enumeration values of *Lactobacillus* in Kashk-e Zard was  $2.84 \times 10^5$  CFU/mL. Based on the fermentation profile, seven categories of *Lactobacillus spp.* were identified. *L. casei* was the predominant category of them. Antimicrobial activity of the *Lactobacillus* strains isolated had the strongest growth inhibition against *E. coli*, *S. aureus*, *L. monocytogenes* and *S. typhimurium* were respectively shown by *L. corustorum*, *L. plantarum*, and *L. casei*. Antagonistic activities of *L. alimentarius* against *E. coli* and *S. aureus*, and *L. rhamnosus* against *L. monocytogenes* and *S. typhimurium* were at the lowest levels. In addition, kinetic study revealed a significant bacteriostatic activity of *Lactobacillus* supernatants. In conclusion: Kashk-e Zard seemed to have probiotic properties, deserving further studies.

## CHANGES OF MICROELEMENT CONTENT OF GREEN PEA AND MAIZE BY MOLYBDENUM ENRICHMENT

Bódi É, Várallyay Sz, Soós Á, Kovács B  
bodieva@agr.unideb.hu

University of Debrecen, Faculty of Agricultural and Food Sciences and Environmental Management, Institute of Food Science, 4032 Debrecen, Böszörményi str. 138. Hungary.

In this study, the changes of microelement content of maize (*Zea mays*) and green pea (*Pisum sativum*) by molybdenum enrichment was investigated.

The plants were grown at the experiment station of Nagyhörösök, where different levels of soil contamination conditions are represented. Mo was added to the soil as

$(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$  in three different concentrations as follows: 90, 270, 810 kg ha<sup>-1</sup> and control for our reference. The treatments were arranged in a split-plot design with two replications. Wet digestion with nitric acid and hydrogen peroxide was applied during sample preparation of these plants.

Elemental analysis was carried out by inductively coupled plasma optical emission spectrometry (ICP-OES) and inductively coupled plasma mass spectrometry (ICP-MS).

As we supposed the molybdenum concentration has been risen significantly in plants, however there was a difference between the Mo concentration of different plant's part. This increment was most intensive in the case of maize leaves. It was stated in the case of green pea, that a greater amount of Mo was found in stems than in seeds in the case of all treatments. Mo concentration of stems in the case 90 and 270 kg ha<sup>-1</sup> treatments is more than twice and in the case of 810 kg ha<sup>-1</sup> treatment was approximately three times Mo concentration of seeds.

In addition the Mo treatments effected on the uptake of other microelements too. It was observed that in most cases the molybdenum encouraged the uptake of boron, manganese, zinc and hindered the accumulation of iron and copper which are in harmony with the scientific literature.

## STRUCTURAL CHARACTERIZATION AND RELEASE PROFILE OF OMEGA-3 FATTY-ACIDS ENCAPSULATED IN NANOEMULSIONS

Nunes R<sup>1</sup>, Bourbon A<sup>2</sup>, Martins J T<sup>1</sup>, Pastrana L<sup>2</sup>, Vicente A A<sup>1\*</sup>

\*avicente@deb.uminho.pt

<sup>1</sup>CEB-Centre of Biological Engineering, University of Minho, 4710-057 Braga, Portugal

<sup>2</sup>INL- International Iberian Nanotechnology Laboratory, Av. Mestre José Veiga s/n, 4715-330 Braga, Portugal

Omega-3 ( $\omega$ -3) fatty-acids are functional compounds with various benefits such as reduction of cardiovascular diseases. However, these fatty acids degrade quickly, present low water solubility and an unpleasant aroma, which make essential their encapsulation. The encapsulation (e.g. nanoemulsion production) process can change structural properties, which can affect the behavior of the system when applied to food matrices and within the gastrointestinal tract.

The objective of this work was to characterize oil-in-water bio-based nanoemulsions with  $\omega$ -3 using lactoferrin as a natural emulsifier, when submitted to different drying processes.

Nanoemulsions were produced using high-pressure homogenization (5 cycles, 20,000 psi) using 2 % (w/w) lactoferrin and 5 % (w/w)  $\omega$ -3. Nanoemulsions were dried by nanospray-drying (Nano Spray dryer B-90HP, Buchi) and freeze-drying methods. Physical and morphological properties were evaluated using dynamic light scattering (DLS) and transmission electron microscopy (TEM), respectively. Circular dichroism (CD) and FTIR-ATR were used to assess possible structural and chemical changes after dry treatments. Moreover,  $\omega$ -3 release profile was studied in ethanol (20 % and 50 % (v/v)) at 25 °C (simulation of food matrices) and at pH 7.4 and pH 2 at 37 °C (simulation of different gastrointestinal phases).

DLS results showed that original size ( $\approx 170$  nm) and zeta-potential ( $\approx +30$  mV) of nanoemulsions was not achieved after nanospray-drying process probably caused by protein agglomeration. CD and FTIR-ATR results revealed lactoferrin structural modifications after drying processes as well as a reduction of  $\alpha$ -helix and  $\beta$ -sheet content, being this effect more evident on nanospray-drying samples. FTIR-ATR results showed shifts of the amide I and amide II bands in both drying processes samples. At 20 % ethanol,  $\omega$ -3 began to release after 48h which could allow nanoemulsions incorporation in food products such as ice cream and mayonnaise.

This work provides useful information to design nanoemulsions aiming lipophilic compound encapsulation for food applications.

## AUTHOR INDEX

➤ Alaya A. . . . .	17
➤ Avelar Z. . . . .	38
➤ Badacsonyi A. . . . .	8
➤ Bánáti D. . . . .	7
➤ Baranyi J. . . . .	24
➤ Bódi É. . . . .	47
➤ Boros N. . . . .	44
➤ Caporizzi R. . . . .	12
➤ Czipa N. . . . .	21
➤ Csapó J. . . . .	26
➤ Csapó Zs. . . . .	32
➤ Csapóné Riskó T. . . . .	33
➤ Dias Meirelles A. A. . . . .	24
➤ Diósi G. . . . .	43
➤ Einhorn-Stoll, U. . . . .	13
➤ Erbas M. . . . .	15
➤ Fernandes J. M. . . . .	23
➤ Furtado de F. G. . . . .	42
➤ Gaborieau S. . . . .	22
➤ Holgado R. L. . . . .	17
➤ Iqbal S. . . . .	19
➤ Juhászné Tóth R. . . . .	27
➤ Kersiene M. . . . .	45
➤ Kiss M. . . . .	29
➤ Kiss V. Á. . . . .	31
➤ Kovacs B. . . . .	39
➤ Krupak-Kozak U. . . . .	37
➤ Leskauskaite D. . . . .	45
➤ Mashak Z. . . . .	47
➤ Máthé E. . . . .	16
➤ Mihály K. . . . .	40
➤ Papp-Bata, Á. . . . .	30
➤ Petróczki F. . . . .	36
➤ Pfliegler V. . . . .	11
➤ Piazza L. . . . .	7
➤ Prokisch J. . . . .	15,22
➤ Rahmani F. . . . .	35
➤ Sándor E. . . . .	10
➤ Simoes L. S. . . . .	20

➤ Sipka S.....	18
➤ Sipos P. ....	20
➤ Smith P.....	11
➤ Soós Á.....	42
➤ Szigeti T.....	29
➤ T. Kovács E. ....	12
➤ Tacer-Caba Z.....	28
➤ Tamás J. ....	32
➤ Ungai D. ....	41
➤ Vafeiadi C.....	8
➤ Vanaki E. ....	35
➤ Véha A. ....	46
➤ Vicente A. A. ....	14,48
➤ Viganó J.....	38



