# IV. International Conference on Food Science and Technology

# Book of Proceedings

FOODCONF

SCIENCE, TECHNOLOGY & INNOVATION

Budapest
Hungary
2022.

10-11th of June
MATE, Buda Campus

# 4th FoodConf - International Conference on Food Science and Technology

10 - 11 June 2022

## Book of abstracts

Edited by:
Lilla Szalóki-Dorkó
Ildikó Batáné Vidács
Pradeep Kumar
Andrea Pomázi
Attila Gere





Published by
Élelmiszertudományért – Oktatási, Kutatási, Fejlesztési Alapítvány
Address: 2060 Bicske, SPAR út 0326/1.
Tel.: +36(70)576-9115
Website: http://foodscience.org.hu
E-mail: iroda@foodscience.org.hu

ISBN 978-615-01-5422-0

Budapest, 2022

# 4th FoodConf - International Conference on Food Science and Technology

10 - 11 June 2022

**Organized by**

MAGYAR AGRÁR- ÉS ÉLETTUDOMÁNYI EGYETEM
Élelmiszertudományi és Technológiai Intézet

Institute of Food Science and Technology,
Hungarian University of Agriculture and Life Sciences

4

Scientific Committee on Food Science
Scientific Committee on Agricultural and Biological Engineering
Scientific Committee on Horticulture and Food Science
of the Hungarian Academy of Sciences

Foundation of Food Science

Budapest, 2022

## Scientific Committee

**Co-Chairs:** Livia SIMON-SARKADI (Hungary)
József FELFÖLDI (Hungary)

**Members:**

László ABRANKÓ (Hungary)
Nóra ADÁNYI KISBOCSKÓI (Hungary)
Éva GYÖRGY (Romania)
Attila HEGEDŰS (Hungary)
Gabriella KISKÓ (Hungary)
Zoltán KÓKAI (Hungary)
András KORIS (Hungary)
Francesco MARRA (Italy)
Miklós NEMÉNYI (Hungary)
Quang D. NGUYEN (Hungary)
Michael SCHLOTER (Germany)
Zoltán SYPOSS (USA)
Vijai Kumar GUPTA (UK)

## Local Organizing Committee



**Chair:** László BARANYAI

**Members:**

Ildikó BATA VIDÁCS
Mariann CSÓKA
Lilla SZALÓKI-DORKÓ
Csilla FARKAS
Attila GERE
Pradeep KUMAR
Csilla MARCZIKA SÖRÖS
Máté MOLNÁR
Andrea POMÁZI
Anita SOÓS
József SURÁNYI
Rita TÖMÖSKÖZI FARKAS
Viktória ZSOM MUHA

# Table of content

# Conference Program

| | | |
|---|---|---|
| Friday, 10 June | 09:00 – 18:00 | Arrival and registration |
| | 10:00 - 10:30 | Opening ceremony |
| | 10:30 – 12:00 | Plenary Session |
| | 12:00 - 13:00 | Lunch |
| | 13:00 – 14:15 | Scientific sessions<br>Food Analysis and Quality Control<br>Food Technology |
| | 14:15 - 14:55 | Coffee Break / Poster Session |
| | 14:55 – 16:10 | Scientific sessions<br>Food Microbiology<br>[HU] Ipar 4.0 |
| | 16:15 - 16:50 | Coffee Break / Poster Session |
| | 16:50 – 18:20 | Scientific sessions<br>Food Physics<br>[HU] Alumni |
| | 18:30 - 21:00 | Gala dinner |
| Saturday, 11 June | 10:00 – 11:00 | Scientific sessions<br>Food Analysis and Quality Control<br>Nutrition / Food Safety |
| | 11:30 - 12:00 | Closing / Poster Award |
| | 12:00 - 13:00 | Farewell lunch |

## Friday, 10 June, 2022.

09:00 am – 06:00 pm: *Registration*
*(K building, main entrance)*

10:00 am - 10:30 am: *Opening Ceremony*
***Livia Simon Sarkadi,*** conference chair, MATE
***József Felföldi***, conference chair, MATE
*(K building, Ceremony Hall)*

| **Invited speakers** | |
|---|---|
| **Plenary Session** | Chairs: ***József Felföldi*** *and* ***Livia Simon Sarkadi***<br>*(K building, Ceremony Hall)* |
| 10:30 - 10:55 | ***Zoltán Syposs***<br>The role of Quality and Food Safety in Industry 4.0 |
| 10:55 - 11:20 | ***Francesco Marra***<br>Digital Knowledge Transfer for the Food Community |
| 11:20 - 11:45 | ***Quang Duc Nguyen***<br>Technological innovations for realization of sustainable food production especially in the situation of energy crisis and high inflation rate |
| 12:00 - 13:00 | **Lunch break**<br>*(K building, Ceremony Hall)* |
| **Session 1:**<br>**Food Analysis and Quality Control** | Chair: ***László Abrankó***<br>*(K building, room K3)* |
| 13:00 - 13:15 | ***Maciej Ditrych, Tomasz Szczygieł, Sylwia Ścieszka, Kamil Królak, Anna Michalska, Katarzyna Dybka-Stępień, Anna Otlewska, Edyta Kordialik-Bogacka***<br>Bio-preservative potential of commercial fruit juices |
| 13:15 - 13:30 | ***Majd Elayan, Csaba Németh, Munkhnasan Enkhbold, Adrienn Tóth***<br>The Effect of Storage on Fortified Liquid Egg Products Properties |
| 13:30 - 13:45 | ***Meltem Boylu, Géza Hitka, György Kenesei***<br>Effects of Meat Substitution with Oyster Mushroom on the Quality Characteristics of Sausages |
| 13:45 - 14:00 | ***Zoltán Kókai, Melinda Bálint, Blanka Bérczi***<br>Sensory evaluation of fruit tea infusions with the Napping method |
| 14:00 - 14:15 | ***Nóra Adányi, Krisztina Majer-Baranyi***<br>Mycotoxin determination by immunosensors |

| | |
|---|---|
| **Session 2:**<br>**Food Technology** | Chair: ***László Friedrich***<br>*(K building, room K2)* |
| 13:00 - 13:15 | ***Adrienn Varga-Tóth, Csaba Németh, Majd Elayan, Munkhnasan Enkhbold, Attila Nagy, Annamária Barkó, Tamás Csurka, István Dalmadi, László Friedrich***<br>Development and investigation of a prebiotic egg white based drink |
| 13:15 - 13:30 | ***Reem Mourad, Barbara Csehi, Erika Bujna***<br>Studying the shelf-life of a probiotic fermented egg white milk product |
| 13:30 - 13:45 | ***Thanh Tung Pham, László Baranyai, Lien Le Phuong Nguyen, Adrienn Tóth, Csaba Németh, László Friedrich***<br>Effect of Cassava Starch Coating Blended with Gelatin and Plasticizers on Egg Quality During Storage |
| 13:45 - 14:00 | ***Gergő Szabó, Zsuzsanna Horváth-Mezőfi, Mónika Göb, Lien Le Phoung Nguyen, Tamás Zsom, Géza Hitka***<br>Modified Atmosphere Packaging of 1-MCP treated Fresh-Cut Apple |
| 14:00 - 14:15 | ***Arijit Nath, Attila Csighy, Krisztina Albert, Krisztina Takács, Emőke Szerdahelyi, Abraham Amankwaa, Asma Yakdhane, András Koris***<br>Hydrolysis of milk proteins by Different classes of Protease: Antioxidant capacity, Antiangiotensin activity, Allergenicity activity |
| | |
| 14:15 - 14:55 | **Coffee Break / Poster Session**<br>*(K building, Ceremony Hall and corridor)* |
| | |
| **Session 3:**<br>**Food Microbiology** | Chair: ***Csilla Mohácsi-Farkas***<br>*(K building, room K2)* |
| 14:55 - 15:10 | ***Éva Laslo, Éva György, Károly-Arnold Unguran***<br>Food associated stress tolerance of allochthonous bacteria with antibiotic resistance originated from dairy products |
| 15:10 - 15:25 | ***Gabriella Kiskó, Anna Jánosity, Anja Klančnik, Sonja Smole Možina, Andrea Taczmanné Brückner, József Baranyi***<br>Effect of bacterial growth phase on the resistance to antimicrobials |
| 15:25 - 15:40 | ***O. Haykir, Cs. Mohácsi-Farkas, T. Engelhardt***<br>Applying Redox Potential Measurement Based Method in the Study of the Enhanced Heat Resistance |
| 15:40 - 15:55 | ***Kamil Królak, Edyta Kordialik-Bogacka, Sylwia Ścieszka, Tomasz Szczygieł, Katarzyna Dybka-Stępień, Anna Otlewska, Maciej Ditrych***<br>Antimicrobial potential of chokeberry and blackcurrant juices against Bacillus spp. Bacteria |

| | |
|---|---|
| 15:55 - 16:10 | ***Andrea Taczman Brückner, Ivett Juhász, Vivien Dancs, Hajnalka Erdős, Botond Surányi, Tamás Kocsis, Gabriella Kiskó***<br>Removal of Pseudomonas aeruginosa biofilm in plastic bottles filled with different beverages |
| **[HU] Szekció 4: Ipar 4.0** | Elnök: ***Nguyen Duc Quang***<br>*(K épület, K5 előadó)* |
| 14:55 - 15:00 | ***Nguyen Duc Quang***<br>Köszöntő |
| 15:00 - 15:25 | ***Abrankó László***<br>Élelmiszerek fehérjéinek minősége, biológiai értéke |
| 15:25 - 15:50 | ***Robot-X Hungary Kft.***<br>Robotok alkalmazása az élelmiszeriparban |
| 15:50 - 16:15 | ***Baranyai László***<br>Mesterséges intelligencia és adatbányászat az élelmiszeriparban |
| 16:15 - 16:50 | **Coffee Break / Poster Session**<br>*(K building, Ceremony Hall and corridor)* |
| **Session 5: Food Physics** | Chair: ***László Baranyai***<br>*(K building, room K2)* |
| 16:50 - 17:05 | ***Zsanett Bodor, Balkis Aouadi, Csilla Benedek, Zoltan Kovacs***<br>Revealing water spectral pattern changes in sunflower honey as a result of heat treatment using NIR |
| 17:05 - 17:20 | ***David Tjandra Nugraha, Annelies Postelmans, Wouter Saeys***<br>Depth-resolved optical characterization of dry aged beef meat and the relationship with quality properties |
| 17:20 - 17:35 | ***John-Lewis Zinia Zaukuu, Abena Boakye, Tenge Theophilus, Adjei-Boateng Daniel, Antoinette Simpah, Selassie Kaanan, Tetteh Eric, Lois Adofowaa, Ellis William Otoo and Ibok Oduro***<br>Developing rapid monitoring methods for fish, yoghurt and cowpea using near infrared spectroscopy |
| 17:35 - 17:50 | ***Zinabu Hailu Siyum, Tung Pham Thanh, Eszter Vozáry, Tímea Kaszab, Lien Le Phuong Nguyen, László Baranyai***<br>Monitoring of Banana Optical Properties by Laser Light Backscattering Imaging Technique during Drying |
| 17:50 - 18:05 | ***István Kertész, Danya Brito, Tímea Kaszab***<br>Development of an ultrasonic monitoring system for milk coagulation |
| 18:05 - 18:20 | ***Uwe Pliquett***<br>Electrical impedance for food characterization |

| **[HU] Szekció 6: Alumni** | Elnök: ***Kovács Zoltán*** *(K épület, K5 előadó)* |
|---|---|
| 16:50 - 17:15 | ***Mészáros Ádám*** Az élelmiszermérnöki tudás hasznosítása a dinamikusan változó hazai és nemzetközi környezetben |
| 17:15 - 17:40 | ***Király László*** Időtálló komplex élelmiszermérnöki szemlélet |
| 17:40 - 18:05 | ***Friedrich László*** A jövő élelmiszermérnöke |
| 18:05 - 18:20 | Alumni beszélgetés |

18:30 - 21:00: *Gala Dinner*
*(K building, Ceremony Hall)*

## Saturday, 11 June, 2022.

| | |
|---|---|
| **Session 7:**<br>**Food Analysis and Quality Control** | Chair: ***Zoltán Kókai***<br>*(K building, room K3)* |
| 10:00 - 10:15 | ***Mohannad AlOudat, Livia Simon Sarkadi, Hedvig Hidvégi, Anikó Balog-Sipos Szőcze, Andrea Lugasi***<br>Comparison of organoleptic characteristics of ready-to-eat and home-cooked meals based on the same recipes |
| 10:15 - 10:30 | ***Csongor Mátyás Lei, Gabriella Kun-Farkas***<br>Brewing industry relevant properties of Brettanomyces yeasts |
| 10:30 - 10:45 | ***Firas Alarawi, Olivia Csernus, Quang D. Nguyen***<br>Effect of pH and temperature on the activity of different commercial proteinase enzyme preparations |
| 10:45 - 11:00 | ***Vi Vu, Csilla Farkas, Vijai Kumar Gupta, Quang D. Nguyen***<br>Developing efficient microbial consortium for the pretreatment of different agriculture residues |
| **Session 8:**<br>**Nutrition / Food Safety** | Chair: ***Gabriella Kiskó***<br>*(K building, room K2)* |
| 10:00 - 10:15 | ***Judit Tormási, Mária Berki, Éva Lengyelné Kónya, Rita Tömösköziné Farkas, Katalin Nagy, László Abrankó***<br>Assessment of nutrient bioaccessibility by digestion simulation – a potential tool for functional food development |
| 10:15 - 10:30 | ***Erika Bujna, Bianka Megyeri, Karina Békési, Quang D. Nguyen***<br>Effect of prebiotics on the viability of probiotic microorganism in fermented fruit juices during storage |
| 10:30 - 10:45 | ***Igor Gáspár, Ivana Pajčin, Flóra Vitális, Vanja Vlajkov, Aleksandar Jokić, Dragoljub Cvetković, Jovana Grahovac***<br>Testing high temperature 3D printing filaments from food safety aspect |
| 10:45 - 11:00 | ***Gyöngyi Györéné Kis, Gabriella Soós, Andrea Lugasi***<br>Consumer perceptions towards organic food in Hungary |

11:30 - 12:00: *Closing / Poster Award*
**Livia Simon Sarkadi,** conference chair, MATE
**József Felföldi**, conference chair, MATE
*(K building, Ceremony Hall)*

12:00 - 13:00: *Farewell lunch*
*(K building, Ceremony Hall)*

# Lectures

**Registration number 41**

## Mycotoxin determination by immunosensors

Nóra Adányi, Krisztina Majer-Baranyi[b],

Food Science Research Group, Hungarian University of Agriculture and Life Sciences (MATE), H-1022 Budapest, Hungary

[b]Corresponding author e-mail: majerne.baranyi.krisztina@uni-mate.hu

**Abstract:** Mycotoxins are low molecular weight and thermally stable secondary metabolites of molds that mainly belong to the genera *Aspergillus*, *Penicillium*, *Alternaria*, and *Fusarium*. They can infect a variety of foods before and after harvest, such as cereals, nuts, coffee, oilseeds, beans, and fruits. Mycotoxins can be produced by one or more fungal species, and sometimes one species can generate more than one kind of mycotoxins. Approximately 100 different species of mycotoxins producing fungi have been identified so far, which can produce more than 400 toxic metabolites.

According to the Food and Agriculture Organization of United Nations (FAO), more than 25% of the global agricultural products are contaminated with mycotoxins, which is a serious concern to public health and animal health through the food chain because of their teratogenic, mutagenic, and carcinogenic effects triggering severe economic losses.

Common methods for mycotoxin determination including thin-layer chromatography (TLC), high-performance liquid chromatography (HPLC) and gas chromatography (GC) equipped with effective detectors (fluorescence, mass spectrometry, diode array detectors, etc.) are currently used for accurate and sensitive detection of mycotoxins, which has been validated and accepted by official authorities. Although they allow very sensitive detection of mycotoxins, their use in screening procedures is limited due to their time-consuming and labor-intensive nature, the need for qualified personnel to perform the analysis, and the high operating costs. Therefore, it is extremely important to develop convenient, fast, economical, and sensitive methods for routine analysis of mycotoxins in foods.

Due to their high sensitivity, excellent selectivity, ease-of-use, low cost, quick response and diverse signal-transducing mechanisms (optical, electrochemical, thermal, etc.), biosensors have emerged as the most promising tool, and meet most of the requirements of an efficient analytical device for mycotoxins monitoring.

In this presentation we provide an overview of the recent advances and current trends in biosensor development for mycotoxin determination and the latest results of our immunosensor developments.



**Keywords:** mycotoxins, biosensors, immunosensors

**Acknowledgements:** The research was supported by the National Research, Development and Innovation Fund within the project 2020-1.2.4-TÉT-IPARI-2021-00001.

**Registration number 8**

# Effects of meat substitution with oyster mushroom on the quality characteristics of sausages

Meltem Boylu[1b], Géza Hitka[2], György Kenesei[1]

[1]Department of Livestock Products and Food Preservation Technology, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary
[2]Department of Postharvest, Supply Chain, Commerce and Sensory Science, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: Boylu.Meltem@phd.uni-mate.hu

**Abstract:** One of the challenges in modern society is the reduction of meat consumption as well as the formulation of new meat products, considering health and sustainability aspects. In this regard, mushrooms are considered a promissory source of bioactive compounds, essential nutrients and dietary fibers to be used in the production of healthier meat products in addition to their low level of lipids. In this study, it was aimed to investigate the effects on the product characteristics of replacing meat with fresh oyster mushroom (*Pleurotus ostreatus*) up to 100% in sausage formulations. 11 sample groups with increasing ratios of fresh oyster mushroom were produced as follows: 0P:0% mushroom (control); 1P:10% mushroom; 2P:20% mushroom; 3P:30% mushroom; 4P:40% mushroom; 5P:50% mushroom; 6P:60% mushroom; 7P:70% mushroom; 8P:80% mushroom; 9P:90% mushroom; 10P:100% mushroom. On the produced sausage samples, moisture content, $a_w$, pH, color and texture profile analyses were performed. The changes in the condition of meat proteins in the sausage formulations were followed by a differential scanning calorimeter (DSC). According to the results, a significant increase was detected in the moisture content of sausage samples with increasing fresh mushroom ratios in the formulations. No significant difference was found in pH and $a_w$ values of the sausage samples. It was observed that the increasing amount of oyster mushroom caused a decrease in $L^*$ and $a^*$ values, leading to a darker and less red colour of the sausage samples, while $b^*$ values were slightly changed. Texture was modified by use of mushroom, resulting in softer sausages. The DSC curves were analyzed using the unit's own software where denaturation heat was determined, and the calculated enthalpy values were in accordance with the visual observations on the diagrams. In conclusion, the use of fresh *Pleurotus ostreatus* mushroom as a meat substitute is a feasible strategy for the development of healthier sausage formulations, however, further research is needed to improve the quality characteristics of the obtained products.



**Keywords:** sausage, meat substitute, oyster mushroom, *Pleurotus ostreatus*, DSC

**Acknowledgement:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 82**

## Sensory evaluation of fruit tea infusions with the Napping method

Zoltán Kókai[b], Melinda Bálint, Blanka Bérczi

Faculty of Food Science, Department of Postharvest, Supply Chain, Commerce and Sensory Science, Hungarian University of Agriculture and Life Sciences, H-11118 Budapest, Hungary

[b]Corresponding author e-mail: kokai.zoltan@uni-mate.hu

**Abstract:** Sensory evaluation is a complex and multidisciplinary science, which relies on the human perception and contributes to the better understanding of complex food quality. There is a growing demand for such methods, which are rapid and give a holistic viewpoint on the analysed products. Napping is a special type of sensory descriptive analysis, where assessors place the samples on a tablecloth (in French nappe), thus demonstrating the perceived similarity or difference of those. This sorting procedure is followed by an additional characterization of the samples with descriptive sensory terms, which might be selected from a pre-determined list or can be freely chosen by the panellist.
In the current study we have investigated fruit infusion teas. These products have a growing market share in the Hungarian market. Most of them contains only dried fruit ingredients, but there is a segment, which is made of flavoured black tea. For the analysis we have chosen six, commercially available samples. One of those was a flavoured black tea, the other five contained dried fruits.
We have used CompuSense Academic software to design and implement the test. Samples were labelled with three-digit random codes and served in a randomized order. Panellists worked in individual booths under standard white lighting. The test protocol facilitated the positioning of the samples on the serving tray and simultaneously recording the sample's relative position on the tablets' screen. Characterization of the samples was performed with the selection of attributes from a pre-defined list, but assessors could also add their own individual expressions.
Test data was analysed with SensomineR, a free software, which is based on the R language. Multiple Factor Analysis (MFA) helped in the discrimination of the samples. Our results show, that assessors were able to discriminate between the flavoured black tea and the fruit infusions. Confidence ellipses showed that the difference among several fruit infusion samples was also significant.



**Keywords:** sensory analysis, Napping, fruit infusion, tea

**Registration number 154**

## Development and investigation of a prebiotic egg white based drink

Adrienn Varga-Tóth[1,b], Csaba Németh[2], Majd Elayan[1] Munkhnasan Enkhbold[1], Attila Nagy[2], Annamária Barkó[1], Tamás Csurka[1], István Dalmadi[1], László Friedrich[1]

[1]Department of Livestock and Food Preservation Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary
[2]Capriovus Ltd, H-2317 Szigetcsép, Hungary

[b]Corresponding author e-mail: toth.adrienn@uni-mate.hu

**Abstract:** Today's consumers follow new, alternative diets, which are often free from dairy products. In this aspect, a current challenge for food industry is to replace the functionality (like pre- and probiotic effects) of dairy products. In our study the techno-functional and bioactive properties of an egg white based, red berries flavoured dairy alternative drink are investigated. The aim of this research is to develop a favourable flavoured drink and investigate its polyphenolic and antioxidant compounds and analyse its sensorial and techno-functional properties.
Our experiment was carried out by the application of a central composite design (CCD). The two variables of CCD were red berries concentration and inulin concentration. After a heat treatment of samples, the sensorial attributes (by the involvement of 12 untrained panellists and objective colour measurement in CIE Lab colour space) and rheological attributes were investigated. The polyphenolic content was determined by the Folin-Ciocalteu′s method and antioxidant concentrations were determined by the application of FRAP method.
Our results showed that the colour of the investigated drinks was highly influenced by the specific fruit concentration used, but not by inulin addition. A slight decrease in antioxidant concentration was observed directly after heat treatment.
Sensorial attributes and colour were significantly influenced by fruit concentrations, but the rheological properties were just slightly influenced by the two investigated parameters.
Concluding our results, the examined egg white based drinks contain a high concentration of protein and bioactive compounds, which leads to several potential health prevention effects.



**Keywords:** egg white, protein, lactose-free, whey protein-free

**Acknowledgements:** The research was supported by the ÚNKP-21-4 New National Excellence Program of the Ministry for Innovation and Technology from the source of the National Research, Development and Innovation Fund and 2020-1.1.2-PIACI-KFI-2020-00027 project. We are very grateful for this support

**Registration number 34**

## Studying the shelf-life of a probiotic fermented egg white milk product

Reem Mourad[1,2b], Barbara Csehi[1], Erika Bujna[2]

[1]Department of Livestock Products and Food Preservation Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary.
[2]Department of Bioengineering and Alcoholic Drink Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary.

[b]Corresponding author e-mail: Reemmd91@gmail.com

**Abstract:** Nowadays, consuming functional food had become more popular and essential due to its beneficial effect on health and the lifestyle-changing. Functional food includes food that contains probiotics and prebiotics. Lactose intolerance is a disease causing a digestion problem to some people after consuming milk and milk product, thus, dairy product should be excluded from their daily diet. Egg white is considered as a good alternative to milk-based products. It is a rich source of functional proteins such as ovomucoid and lysozyme. The aim of our study was to produce a fermented egg-white drink using probiotic *L. casei* 01 and to examine the effect of addition of different carbohydrates including fructose and fructooligosaccharides as a prebiotic, on the cell count, viscosity, protein content, and composition. These properties were determined after fermentation and during refrigerated storage for 3 weeks. The results indicated that egg white milk was suitable for *L. casei* 01 to grow. The cell count was higher than 8.4 log10 CFU/mL throughout storage time in all samples with or without sugar addition. It can be concluded that during 3 weeks of storage there was no significant difference between the survival of probiotics in fermented egg-milk supplemented with different sugars. On the other hand, there were other significant differences between samples with and without sugar addition. After 24 hours of fermentation, the pH of samples without sugar addition was significantly higher (pH 5.91±0.02 $p<0.05$) compared to samples with fructooligosaccharides or fructose addition (pH down to 4.1).
The protein content of samples with prebiotic addition after 24 hours of fermentation was significantly higher ($p <0.01$) compared to the other samples, and samples without sugar addition had significantly the lowest protein content. The viscosity of the fermented egg white drinks showed a pseudoplastic behavior with the highest values for the fermented egg white without sugar (11.45 mPa.s at a low shear rate of 10/sec) throughout storage. Protein profile showed no significant difference, the bands were of the same density during the 3 weeks of storage in all samples with or without sugar addition, nevertheless, the bands of fresh unfermented samples had the highest concentration (46 KDa) of ovalbumin. Lysozyme content was not affected by the fermentation (14.4 KDa).



**Keywords:** Probiotics, prebiotics, egg-white, ovomucoid, functional

**Acknowledgements:** The research was supported by Capriovus Ltd. and the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science.

**Registration number 47**

# Effect of cassava starch coating blended with gelatine and plasticizers on egg quality during storage

Thanh Tung Pham[1], László Baranyai[1,b], Lien Le Phuong Nguyen[1], Adrienn Tóth[1], Csaba Németh[2], László Friedrich[1]

[1]Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary
[2]Capriovus Ltd, H-2317 Szigetcsép, 2317, Hungary

[b]Corresponding author e-mail: baranyai.laszlo@uni-mate.hu

**Abstract:** Egg degradation happens during storage, resulting in quality reduction. Gas exchange through the shell contributes significantly to quality and characteristics of egg. Therefore, many preservation techniques have been developed to increase the shelf-life and ensure the safety of eggs. Biopolymer-based coating materials have been applied to a wide range of food products and were found to be an efficient technique for food preservation. The purpose of this study was to assess the influences of cassava starch coating on the quality of eggs stored at 20 °C for 4 weeks. Eggs were coated with cassava starch at different concentrations (2%, 3% and 4%, w/v) combined with gelatine (0.5%, w/v), sorbitol (3%, w/v) and glycerol (0.5%, v/v). The quality of coated and uncoated eggs was evaluated by weight loss, Haugh unit, yolk index and albumen pH. Collected data for treated and control groups have been compared and evaluated to test effectiveness of coating.

**Keywords:** cassava starch, coating, egg preservation, egg quality.

**Acknowledgements:** The research was supported by the Doctoral School of Food Science of the Hungarian University of Agriculture and Life Sciences.

**Registration number 74**

## Modified atmosphere packaging of 1-MCP treated fresh-cut apple

Gergő Szabó[1,b], Zsuzsanna Horváth-Mezőfi[1], Mónika Göb[1], Lien Le Phoung Nguyen[1,2] Tamás Zsom[1], Géza Hitka[1]

[1]Institute of Food Sciences and Technology, Hungarian University of Agriculture and Life Sciences, H-2100 Gödöllő, Hungary
[2]Institute of Biotechnology and Food Technology, Industrial University of Ho Chi Minh City, 700000, Ho Chi Minh, Viet Nam

[b]Corresponding author e-mail: szabogergo717@gmail.com

**Abstract:** Fruit and vegetable market is increasing. There is a trend that consumers want to eat fresh and minimally processed food. The aim of this research was to find ideal soaking, packing and storage conditions for fresh-cut apples. Two initial gas compositions were compared: atmospheric (20.9% $O_2$, 78.8 $N_2$,) and modified (5.0% $O_2$, 95.0% $N_2$). Gas diffusion rate was measured using 0, 1, 2, and 3 microperforations on the foil. Two groups of apples: namely control and 1-MCP treated (SmartFresh™) were created. After technological processes (like washing, cutting, soaking, packing), samples were stored at 5 °C for 10 days. Soaking solution contained citric acid, ascorbic acid, calcium-chloride and sodium chloride. Texture analysis, gas concentration in the box, pH, water-soluble solid content (Brix°), colour, total plate count (TPC) and weight loss were measured during storage. Gas composition was followed during the first 5 days, then on the 7$^{th}$ and 10$^{th}$ day. The other parameters were measured initially and on the 3$^{rd}$, 7$^{th}$ and 10$^{th}$ day. Data show that 1-MCP treated group, packed with 5% $O_2$ gave the best results.

**Keywords:** fresh-cut, apple, modified atmosphere packaging, post-harvest, 1-MCP



**Acknowledgements:** The research was supported by the Ministry for Innovation and Technology from the National Research, Development and Innovation Fund. The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 90**

## Hydrolysis of milk proteins by different classes of protease: antioxidant capacity, anti-angiotensin activity, allergenicity activity

Arijit Nath[1,b], Attila Csighy[1], Krisztina Albert[1], Krisztina Takács[2], Emőke Szerdahelyi[2], Abraham Amankwaa[1], Asma Yakdhane[1], András Koris[1]

[1]Department of Food Process Engineering, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary
[2]Food Science Research Group, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1022 Budapest, Hungary

[b]Corresponding author e-mail: Arijit.Nath@uni-mate.hu, arijit0410@gmail.com

**Abstract:** Milk protein is recognized as a high-quality protein because it contains all essential amino acids necessary for human diet and nutrition. Contradictorily, milk proteins are listed among the "big 8" allergens due to the presence of linear and conformational epitopes in protein structure. Enzymatic hydrolysis of milk proteins reduces allergenic activity and produces peptides with unique biological activity. Milk protein-derived bioactive peptides with unique biological values have been catapulted to large numbers of consumers around the world due to their unique nutritional and economic importance. Enzymatic hydrolysis of milk proteins can be controlled by the selection of specific enzyme, reaction condition and operating parameters.

Milk proteins are hydrolysed by different classes of proteases, such as trypsin (serine protease), papain and bromelain (cysteine protease) by batch-mode isothermal condition. Effect of concentration of proteolytic enzyme, reaction time and temperature have been varied. Antioxidant capacity in enzyme-treated milk protein has been measured with the Ferric reducing ability of plasma (FRAP) and the 2,2-diphenyl-1-picryl-hydrazyl-hydrate (DPPH) assays. Anti-angiotensin activity in enzyme-treated milk protein has been measured with substrate (Abz-FRK(Dnp)-P) and recombinant angiotensin converting enzyme. Allergenic activity has been measured by sandwich type of enzyme-linked immunosorbent assay (ELISA). 3p Factorial design has been adopted to find optimum operating condition. Statistica 11 has been used to develop factorial design and response surface diagram.

Results show that antioxidant capacity and anti-angiotensin activity have increased with the increase of the concentration of the enzyme. Allergenic activity of enzyme-treated milk protein has been reduced with increase of the concentration of the enzyme. Application of papain is considered to be the most suitable for increasing of mentioned biological activities and reducing allergenic activity. Reduction of allergenic activity has been influenced by concentration of papain rather than hydrolysis time and temperature. Correlation of the reduction of allergenic activity and concentration of papain had a linear fit. Results of the present investigation will be useful in dairy industry and in reducing the limitation of milk consumption.



**Keywords:** milk protein, papain, trypsin, bromelain, antioxidant capacity, anti-angiotensin activity, allergenic activity

**Acknowledgements:** Authors acknowledge support from the EFOP-3.6.3-VEKOP-16-2017-00005 and Food science doctoral school in MATE. A. Nath acknowledges Hungarian state postdoctoral scholarship.

**Registration number 49**

# Food associated stress tolerance of allochthonous bacteria with antibiotic resistance originated from dairy products

Éva Laslo[b], Éva György, Károly-Arnold Unguran

Department of Food Science, Faculty of Economics, Socio-Human Sciences and Engineering, Sapientia Hungarian University of Transylvania, Miercurea Ciuc, Romania

[b]Corresponding author e-mail: lasloeva@uni.sapientia.ro

**Abstract:** Antibiotic resistance represents one of the major public health threats globally. Bacterial strains occurring on foods are showing increased tolerance to multiple antibiotics. These microbes also, during food processing and storage, are exposed to different stress factors such as osmotic pressure, acids, temperature, food additives and disinfectants.
Many reports reveal an interaction, a possible correlation between the antibiotic resistance and food associated stress tolerance.
Our aim was to identify, based on16S rDNA gene sequencing, the most representing bacteria isolated from dairy product samples with antibiotic resistance, and to study their tolerance to different food-related stress conditions.
Our findings suggest that the analysed food samples harbor multidrug-resistant bacteria with food associated stress tolerance.

**Keywords:** antibiotic resistance, dairy products, food associated stress

**Acknowledgements:** We would like to thank the Sapientia Foundation—Institute for Scientific Research for financial support.

**Registration number 57**

## Effect of bacterial growth phase on the resistance to antimicrobials

Gabriella Kiskó[1,b], Anna Jánosity[1], Anja Klančnik[2], Sonja Smole Možina[2], Andrea Taczmanné Brückner[1], József Baranyi[3]

[1]Department of Food Microbiology, Hygiene and Safety, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary.
[2]Department of Food Science and Technology, University of Ljubljana, Ljubljana, Slovenia
[3]Institute of Nutrition, University of Debrecen, H-4032 Debrecen, Hungary

[b]Corresponding author e-mail: kisko.gabriella@uni-mate.hu

**Abstract:** The bacterial efflux mechanism was studied as a function of added carvacrol, a well-known antimicrobial. The aim was to establish whether this mechanism depends on the growth phase of the cells (slow-, fast- and non-growing cultures were tested). The cells in the initial phase of growth are in a transition state when the regulatory and metabolic networks are being "rewired", and then they enter the fast-growing phase. Cells in either phase are less robust to stress than when they are in the non-growing stationary state.
*Escherichia coli* strains were used in this study, including clinical and foodborne isolates. Intracellular Ethidium Bromide (EtBr) accumulation indicated the bacterial efflux activity. Carvacrol was used as a natural antimicrobial and its efflux inhibition was measured and modelled at the three phases of the culture. The membrane damaging effect of carvacrol was also quantified by a fluorescence assay.
Carvacrol can modulate the bacterial resistance, by inhibiting the efflux pumps (EPs). At the optimum concentration, the carvacrol effect is significant but does not compromise the integrity of the cell membrane extraordinary. However, the value of its optimum depends on the growth phase of bacteria. For all three phases, carvacrol relative (per unit-volume) efficiency on the efflux inhibition was the highest between 0.15 and 0.35 MIC values.
The EP inhibitor activity of carvacrol and the effect of bacterial growth history on its optimum concentration was proven by predictive microbiology methods. We provided an empirical model describing the EP inhibition as a function of the growth phase of the bacteria.
The abrogation of efflux mechanisms affects the resistance to antimicrobials. Bacteria with strong efflux have the advantage of developing resistance. A better understanding and quantification of the resistance induced by the growth phase of the bacterial culture will be key in future research.

**Keywords**: efflux mechanism, growth-phase-dependent resistance, *Escherichia coli*

**Registration number 12**

# Applying redox potential measurement based method in the study of the enhanced heat resistance

Oktay Haykir[1,b], Csilla Mohácsi-Farkas[1], Tekla Engelhardt[2]

[1]Department of Food Microbiology, Hygiene and Safety, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences (MATE), H-1118 Budapest, Hungary
[2]Digital Food Chain Education, Research, Development and Innovation Institute, University of Veterinary Medicine, H-1078 Budapest, Hungary

[b]Corresponding author e-mail: oktay.haykir@gmail.com

**Abstract:** Heat resistance of *Listeria monocytogenes* or its surrogate *Listeria innocua* was investigated by different studies in the last decades. Generally, traditional microbiological methods and the D-value (time required for one log deduction in the number of microorganisms) were used to understand the heat resistance of the bacterium to the heat stress conditions. However, these traditional methods require at least 24 hours or more to enumerate the number of microorganisms. Therefore, emerging methods have been developed to find time-effective solutions to assess microbial hygiene conditions in the food industry. Lately, a redox potential measurement-based rapid method was developed for the qualitative and quantitative determination of microbial contamination and activity. This study aims to explore the applicability of this method in the study of enhanced heat resistance after the sub-lethal heat treatment. The enhanced heat resistance of *L. innocua* after the sub-lethal heat treatment will be studied by the redox potential measurement-based method and the traditional method. The results will be compared to examine the advantage of the new method over the traditional method.

**Keywords:** redox potential measurement, enhanced heat resistance, *Listeria innocua*



**Acknowledgements:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 125**

## Antimicrobial potential of chokeberry and blackcurrant juices against *Bacillus* spp.

Kamil Królak[b], Edyta Kordialik-Bogacka, Sylwia Ścieszka, Tomasz Szczygieł, Katarzyna Dybka-Stępień, Anna Otlewska, Maciej Ditrych

Faculty of Biotechnology and Food Sciences, Lodz University of Technology, Lodz, Poland

[b]Corresponding author e-mail: kamil.krolak@dokt.p.lodz.pl

**Abstract:** Some species belonging to the genus *Bacillus*, naturally inhabiting soils, have been found to be part of the microbiota of plant raw materials used as ingredients for many foods. The risk of bacterial contamination in plant-based final products, therefore, is of high possibility, which raises real concerns about food safety, production, and storage. The growth of pathogenic and non-pathogenic *Bacillus* species in food is regarded as a genuine threat to human health or a significant factor negatively affecting the sensory properties of a product. It has been previously reported that *B. subtilis* might be associated with foodborne illness, whereas the growth of *B. amyloliquefaciens*, which is visible as unappealing slime, entails the degradation of chemical compounds leading to the formation of off-flavors. On the other hand, food producers nowadays face the challenge of supplying products without chemical preservatives due to consumers' growing concern over their harmful effects. Concomitantly, there has been great interest in finding agents of natural origin that might help to extend the shelf-life and improve the safety of various food products. Among the considered options, fruit juices are easily available and represent a rich source of many bioactive compounds, including polyphenols, vitamins, and organic acids with potential antimicrobial activities. The aim of this study was to determine the antimicrobial potential of two selected fruit juices against *Bacillus* spp. *B. subtilis* ATCC 6633 was used as reference strain, whereas *B. megaterium* AK4 and *B. amyloliquefaciens* AK5 were food driven isolates. For the experiments cold-pressed NFC chokeberry and blackcurrant commercial juices were used. The antimicrobial potential was assessed by incubating the 24-h bacterial culture in TSB medium (Merck, Germany) at 30 °C in the presence of the juices at final concentrations of 4.4 and 18% (*v/v*). Bacterial survival was investigated by sampling the cultures 10 times during the incubation period of 0-168 h (7 days), then using a standard plate count method. The results indicate that both juices might be successfully exploited as natural antimicrobial agents against investigated *Bacillus* spp., nevertheless, their final concentration appears to be a crucial factor affecting the dynamics of microbial growth. It was noted that the concentrations of 4.4% (*v/v*) had virtually no effect on the bacterial growth compared to the controls, whereas the implementation of both juices, especially chokeberry, at the concentration of 18% (*v/v*) caused a rapid and significant decrease in the level of viable cells already after 3 days of incubation.



**Keywords:** *Bacillus* species, food contamination, fruit juices, antimicrobial activity

**Acknowledgements:** The research was supported by the National Centre of Research and Development under the project "Development and implementation of innovative kombucha production technology" POIR.01.01.01-00-0910/20-00

**Registration number 54**

## Removal of *Pseudomonas aeruginosa* biofilm in plastic bottles filled with different beverages

Andrea Taczman Brückner[b], Ivett Juhász, Vivien Dancs, Hajnalka Erdős, Botond Surányi, Tamás Kocsis, Gabriella Kiskó

Department of Food Microbiology, Hygiene and Safety, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: bruckner.andrea@uni-mate.hu

**Abstract:** In everyday life, we often use plastic bottles to store and transport drinking water or other beverages to meet our daily fluid needs. Bottles are cleaned during repeated use, but the effectiveness of the cleaning methods is questionable.
The aim of this work was to compare the biofilm formation of *Pseudomonas aeruginosa* on model polyethylene terephthalate (PET) and polypropylene (PP) surfaces. Biofilm formation and the efficiency of removal of different age biofilms in PET and PP bottles filled with water or tea was investigated using three different everyday cleaning methods.
Methods: In preliminary experiments biofilms were formed on PET and PP surfaces in *Pseudomonas aeruginosa*-inoculated R2A medium. On days 0, 2 and 6 of incubation, the microbial concentration on the PET and PP surfaces was determined by swab sampling and culture methods.
Following the preliminary experiment, PET and PP bottles filled with sterile tap water/flavoured green tea were inoculated with *Pseudomonas aeruginosa*. During six days of storage, the bacterial counts in the water/tea and on the surface of the bottles was monitored. The emptied bottles were subjected separately to different cleaning procedures - scrubbing with a kitchen sink brush, rinsing with cold water, rinsing with warm water - and the amount of *Ps. aeruginosa* remaining on the bottle surface was examined.
Results: In preliminary experiments a concentration of $10^5$ CFU/cm$^2$ was measured on both surfaces on day 2, followed by a slight decrease on day 6.
The microbial concentration of water stored in the two types of plastic bottles varied in the same way: $10^6$ CFU/ml on day 2 of storage and $5x10^5$ CFU/ml on day 6 of storage. The microbial concentration on the inner surface of the bottles showed an increasing trend throughout storage, with an increase of $6x10^6$ CFU/bottle surface by the 6th day of storage.
In terms of cleaning efficiency, scrubbing and rinsing with warm water proved to be significantly more effective than cold water rinsing on both types of plastic surfaces.
Growth of *Pseudomonas aeruginosa* both in tea and on the inner surface of plastic bottles was less intensive compared to water.

**Keywords:** removal of biofilm, plastic bottles, *Pseudomonas aeruginosa*

**Acknowledgements:** The research was supported by the grant EFOP-3.6.3-VEKOP-16-2017-0005. The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 46**

# Revealing water spectral pattern changes in sunflower honey as a result of heat-treatment using NIR

Zsanett Bodor[1,b], Balkis Aouadi[2], Csilla Benedek[1,] Zoltán Kovács[2]

[1]Department of Dietetics and Nutrition, Faculty of Health Sciences, Semmelweis University, H-1085 Budapest, Hungary
[2]Department of Measurements and Process Control, Institute of Food Science, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: bodorzsanett.se@gmail.com

**Abstract:** Honey is a natural sweetener and is used since ancient times as a food and a medical product. Honey is generally present in a liquid form, however, depending on its composition it can be crystallized. As crystallization is not preferred by the consumers and beekeepers, honey is often heated at lower (≤40 °C) or higher temperatures. Heating at high temperatures (>50 °C) can influence its quality. The detection of heat treatment of honey is often performed with the measurement of hydroxymethylfurfural (HMF) content. However, it is not sensitive enough to detect heat treatment at lower levels, which can affect significantly the composition of honey, as well. Therefore, in this research, our aims were to determine the applicability of near infrared spectroscopy (NIRS) and aquaphotomics for the detection of heat treatment of honey and to reveal how the water spectral pattern of honey changes as a result of heat treatment. Unprocessed sunflower honey was used as control, moreover, honey was heated at 40 °C, 60 °C, 80 °C, and 100 °C for 60, 120, 180, and 240 minutes. Therefore, in total 17 levels of heat treatment were investigated. HMF content of the honey was analyzed using the Winkler method described in the method book of the International Honey Commission. The NIRS analysis was performed using a handheld instrument. Two-way ANOVA analysis was used to reveal the effect of time, temperature, and their interaction on the HMF content of honey. Data analysis of the NIRS was carried out using chemometrics. In this regard, principal component analysis (PCA), PCA-linear discriminant analysis (PCA-LDA), and partial least square regression (PLSR) models were built (using the spectral range of the 1300–1600 nm spectral range). Aquagrams were used to visualize the water spectral pattern changes using the most contributing wavelengths of the previous models. PCA-LDA models revealed better classification accuracies in the case of models that were built for the classification of temperature levels, compared to the time interval models. The results showed that heat treatment highly induced the formation of free and/or less H-bonded water with the increase of the temperature and time. Moreover, NIR and aquaphotomics were more sensitive for the detection of lower heat treatment levels compared to the HMF determination.



**Keywords:** honey, heat treatment, NIR, auqaphotomics

**Acknowledgements:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study. Authors are owing thanks to Chiraz Ghdir for the help in the laboratory work.

**Registration number 10**

## Depth-resolved optical characterization of dry aged beef meat and the relationship with quality properties

David Tjandra Nugraha[b], Annelies Postelmans, Wouter Saeys

KU Leuven, Belgium

[b]Corresponding authors e-mail: dtdavidtjandra@gmail.com

**Abstract:** During dry aging of meat, the tissue layers undergo enzyme driven changes, influenced by the environment conditions. These processes are governed by the gradients from the outside to the inside of the meat. Understanding meat optical properties characteristics at different tissue depths would give better understanding on light propagation, as well as the subsurface absorption and scattering tendency of meat. Therefore, the bulk optical properties (BOP) of Holstein bovine muscles dry aged for periods up to 60 days were investigated in the 400-950 nm wavelength interval. Next, the optical properties were associated with quality parameters (moisture content and tenderness). As a heterogenous sample with uneven distribution of components, scanning limited area of the meat might not yield consistent results, as well as raises concerns about depth-of-light penetration that affects absorption and scattering behavior. The inconsistency is evident in the aged meat due to protein degradation and structural changes. Addressing this, depth-resolved BOP of the meat was determined from thin tissue slices (0.2 mm) sampled at five depths with intervals of 1.5 mm. The two main myoglobin absorption peaks were apparent at 540 and 575 nm, with the former having lower extinction point. Flattening of the latter peak was observed in the outer layers of the meat for longer aging times. The reduced scattering coefficient was found to increase during aging and was higher for the deeper meat layers. These results indicate the potential of depth-resolved BOP measurement to assess the quality of dry aged beef. The obtained insights could lead to the development and optimization of optical sensors for non-intrusive meat quality evaluation, and dry aging process control.



**Keywords:** dry aged meat, bulk optical properties, depth-resolved, optical sensing

**Registration number 118**

## Developing rapid monitoring methods for fish, yoghurt and cowpea using near infrared spectroscopy

John-Lewis Zinia Zaukuu[1,b], Abena Boakye[1], Tenge Theophilus[2], Adjei-Boateng Daniel[3], Antoinette Simpah[1], Selassie Kaanan[1], Tetteh Eric[1], Lois Adofowaa[1], Ellis William Otoo[1] and Ibok Oduro[1]

[1]Department of Food Science and Technology, Kwame Nkrumah University of Science and Technology (KNUST), Kumasi-Ghana.
[2]Savana Agriculture Research Institute, Council for Scientific and Industrial Research Institute (CSIR-SARI), Nyankpala – Ghana.
[3]Department of Aquaculture and Watershed Management, Kwame Nkrumah University of Science and Technology (KNUST), Kumasi-Ghana

**Abstract:** Proteineous foods such as fish, yoghurt and cowpea can be considered as sustainable foods due to their health and economic values. Therefore, quality control and monitoring mechanisms instituted to guarantee their safety must be continuously validated and optimized. Tilapia (*Oreochromis niloticus*) is a freshwater fish harvested either from rivers and lakes or cultured in ponds and tanks. However, there is limited information on the impact of growth conditions on its physical and physico-chemical properties. Yoghurt is suspected to be adulterated by some producers with cassava starch (*tapioca*) for increased economic gains. Additionally, different cowpea varieties have been produced by the Savannah Agricultural Research Institute in Ghana to combat certain biotic and abiotic stress of the crop during growth but the differentiation of these varieties with rapid methods remains a challenge. This study aimed to develop classification models for monitoring Tilapia growth conditions, yoghurt adulteration and cowpea varietal differences using a handheld near infrared spectrophotometer (NIRS). Using a three-fold cross-validation approach in linear discriminant analysis, five different tilapia samples from the same pond could not be distinctly classified when scanned in the fresh, dried and powered state. This proves the uniformity of the growing environment. The head, flesh and bones were however distinct, suggesting their varying physico-chemical content. Also, tapioca concentrations of 0, 0.25, 0.5, 1, 3, and 5% w/w *tapioca* could be distinctly classified with average accuracies above 80% and using varying wavelength ranges including the second overtone of water. Different cowpea varieties could also be classified with average accuracies above 90% even after cross-validation. The results suggest that these studies could be further explored for their industrial application in the food industry as the handheld NIRS provides an added advantage of remote analysis.



**Keywords:** Classification, diary-foods, fish, proteins, NIRS, Spectroscopy

**Acknowledgements:** The research was supported by Kwame Nkrumah University of Science and Technology (KNUST) Research Fund.

**Registration number 51**

# Monitoring of banana optical properties by laser light backscattering imaging technique during drying

Zinabu Hailu Siyum, Tung Pham Thanh, Eszter Vozáry, Tímea Kaszab, Lien Le Phuong Nguyen, László Baranyai

Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[a]Corresponding author e-mail: Siyum.Zinabu.Hailu@phd.uni-mate.hu

**Abstract:** Drying is the most common preservation method that is used to extend the shelf life and maintain the quality of food products. The main objective of this work was to evaluate the laser light backscattering imaging technique for monitoring banana optical properties during the drying process. The 10 mm thick banana disc slices were treated with and without 4% ascorbic acid, and dried at 50 °C. Back scattering images have been taken before and after the drying of all banana slice samples. The scattering profiles were characterized by the Gaussian- Lorentzian cross product (GL) distribution function, and optical properties were determined by Farrell's diffusion theory model from backscattered images captured at six different wavelengths of 532, 635, 780, 808, 850, and 1064 nm. Near infrared (NIR) spectra were acquired in the range of 740–1700 nm. A partial least squares regression was performed to predict the quality attributes of the samples. The electrical impedance property of the banana slices was also determined at a frequency interval of 10–100 MHz. The coefficient of determination ($R^2$) for absorption, reduced scattering, total attenuation, and effective attenuation coefficient at all wave lengths except 635 and 1064 nm was greater than 0.93 and the Root Mean Square Error (RMSE) was less than 0.2 /cm. The scattering profile parameters had an $R^2 > 0.95$ and a RMSE < 8.5 at all laser wavelengths. The absorption and effective attenuation coefficients decreased, while reduced scattering and total attenuation coefficients increased with time at wavelengths from 635 to 850 nm. On the other hand, while the firmness, weight loss, and electrical impedance increased, the lightness, chroma, and hue angle decreased with the drying time. The partial least squares regression model predicted the absorption and effective attenuation coefficients at $R^2 > 0.80$ and RMSE <0.004. Furthermore, the model predicted firmness ($R^2 = 0.942$ and RMSE = 0.385 N), weight loss ($R^2 = 0.977$ and RMSE = 2.33%), lightness ($R^2 = 0.90$ and RMSE = 1.80), and impedance parameters such as resistance ($R^2 = 0.996$ and RMSE = 62.172 mega ohm) and relaxation time ($R^2 = 0.948$ and RMSE = 0.0275). The drying time and pre-treatment significantly ($p<0.05$) affected the weight loss, firmness, color, and optical properties changes of banana slices. The laser scattering imaging technique detected the changes in the optical properties of the banana slices during the drying process.

**Keywords:** Banana-drying, backscattering, optical properties

**Acknowledgements:** The authors would like to acknowledge the Hungarian University of Agriculture and Life Sciences' Doctoral School of Food Science for the support in this study.

**Registration number 87**

## Development of an ultrasonic monitoring system for milk coagulation

István Kertész[b], Danya Brito, Tímea Kaszab

Department of Food Measurements and Process Control, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding authors e-mail: kertesz.istvan@uni-mate.hu

**Abstract:** Non-destructive measurement methods, including ultrasonic tests are a field of great interest for food process monitoring and quality control as they do not affect attributes of the product and allow quality evaluation without sampling.
Earlier measurements conducted at our department showed great promise for estimating viscosity during enzymatic curdling of cheese. On-line viscosity measurement is a difficult task and has great benefits for the industry, as viscosity change is a good indicator of the sol-gel conversion process, and monitoring requires a lot of experience without suitable instrumentation. Our experiments resulted in a model with excellent fit (R2 = 0.97) and a high predictive power (RPD = 5.85) with immersed 250 kHz pulser-receiver couple in through-transmission setup, using a chirp signal.
These results proved the applicability of the method and led to the construction of a non-contact measurement system for viscosity monitoring. The experimental system works in a pitch-catch setup with air-coupled piezoelectric transducers, and measurements were compared to the results of oscillatory viscometry using different rennet concentrations. The non-contact nature of this setup allows application in a hygienic environment that can be the basis of an industrial prototype.

**Keywords:** ultrasound, milk, gelation, coagulation, quality control

**Registration number 160**

## Electrical impedance for food characterization

Uwe Pliquett

Institut für Bioprozess- und Analysenmeßtechnik e.V., Heilbad Heiligenstadt, Germany

**Abstract:** The typical food as product of natural growing processes consists of cellular structures with distinct electrical behavior. Using electrical impedance measurement but also nonlinear characterization allows fast and non-destructive assessment of food quality and yields process relevant properties.
Fresh, cell-based products like meat, fish, vegetables, or fruits exhibit a cytosolic fraction surrounded by insulating cell membranes. At low frequency, electric current can only flow around the cells. However, with higher frequency, an increasing fraction of the current can enter the cell interior due to the decreasing capacitive resistance of the cell membranes. Measuring the impedance over a wider range in order to obtain the impedance spectrum yields information about the intra- and extracellular fluids and even more important, the fraction of a tissue surrounded by intact cell membranes. This will be a direct link to freshness, since living cells are always intact and, therefore, insulating membranes. Moreover, because cell membranes, for instance in meat, are an important structure for keeping the water, impedance spectroscopy can easily predict water holding capacity or drip loss.
Fruits and vegetables degrade during storage, which changes electrical properties due to dehydration and change of membrane permeability – both are simple to detect by means of electrical measurements. However, it should be noted that single measurements at unknown time after harvest may be misleading, while frequent assessment of impedance during storage is suitable for prediction of the actual quality parameters like water content, stiffness or metabolic state.
Food processing involves more and more the use of high electric field for membrane destruction for better pulping and extraction of ingredients. Moreover, very short electric pulses of very high field strength are used for microbial decontamination. It is essential for process control to know the success of the treatment that is not easily visible. Since mostly membranes are permeabilized by means of the electric field, the electric impedance correlates well with the level of membrane destruction.



**References:**

Pliquett, U. Bioimpedance: a review for food processing. *Food engineering reviews*, 2010, 2. Jg., Nr. 2, S. 74-94.
Pliquett, U. Biophysics and Metrology of Electroporation in Tissues, (2016) in: D. Miklavcic, Handbook of Electroporation, Springer International Publishing, DOI 10.1007/978-3-319-26779-1_71-1

# Poster presentations

| | |
|---|---|
| **P4002** | Bringing the conventional sensory laboratory into virtual reality for food sensory evaluation<br>**Abdul Hannan Bin Zulkarnain*,** Zoltán Kókai, Attila Gere |
| **P4007** | FB1 and DON contamination of Hungarian maize flour and canned maize samples<br>Tamás Schieszl*, Judit Szabó-Fodor, Melinda Kovács |
| **P4009** | Viability of protein microencapsulated Lactobacillus plantarum 299V during in vitro digestion process<br>Weizhe Sun*, Erika Bujna, Quang Duc Nguyen |
| **P4011** | Does strawberry scent influence gazing behaviour and choice?<br>Dorina Szakál*, Orsolya Fehér, Dalma Radványi, Attila Gere |
| **P4013** | Investigation of extraction methods of walnut cake polyphenol components for further usage in edible coatings<br>Pradeep Kumar*, Lilian Gimes, Dóra Székely, Mónika Máté |
| **P4014** | A review: nutritional and sensory evaluation of alternative cereals and their possible application in processed foods<br>Hala Roumia*, Csilla Benedek, Zoltán Kókai |
| **P4019** | Optimization of ultrasound-assisted extraction of antioxidant compounds from Hawthorn using response surface methodology<br>Areej Alsobh*, Gyula Vatai, Szilvia Bánvölgyi |
| **P4020** | Possible opportunities of palm fat replacement<br>Anikó Kovács*, Vivien Nagy, Szabolcs Homolya, Katalin Badakné Kerti |
| **P4021** | Effect of heating rate on different confectionary fats' thermal behaviour<br>Szabolcs Homolya*, Panna Penczer, Katalin Badakné Kerti, Anikó Kovács |
| **P4023** | Gas chromatographic determination of fatty acid composition in breast milk<br>Miaomiao Zhang*, Livia Simon Sarkadi, Márta Üveges, Judit Tormási, Eszter Benes, Réka Vass, Sandor G. Vari |
| **P4025** | Fermentation of different type of apple juices with probiotic Lactobacillus strains<br>Sofia radja Ziane*, Tímea Tímea György, Erika Bujna, Quang D. Nguyen |
| **P4026** | Effect of digestive enzymes on digestibility and biological value of mechanically deboned turkey meat<br>Emőke Szerdahelyi, András Nagy, Otilia Antal, Krisztina Takács* |
| **P4027** | Development of sunflower seed based milk analogue<br>Ivett Jakab*, Zsuzsanna Mednyánszky, Anita Soós, Lilla Nagy, Anikó Meretei |
| **P4028** | Influence of quinoa adjunct on the sweet and hopped wort composition<br>Jean Vasconez* |
| **P4029** | Biodegradation of polylactic acid-based polymers<br>Ákos Kilin*, Csilla Kohári-Farkas, Anikó Jordán, Péter Tamaskó, Viktória Harcsa, Quang Duc Nguyen, Gábor Laszlovszky |
| **P4030** | Improvement of shelf-life of beef using lactic acid, Na-ascorbate mixture and potassium sorbate<br>Munkhnasan Enkhbold*, Attila Lőrincz, Majd Elayan, László Friedrich, József Surányi, Adrienn Tóth |
| **P4032** | Polyphenol extraction from Olive pomace of Montenegrin Olive variety Žutica as the initial step in waste-valorisation strategy<br>Angela Maldonado*, Ana Mardjokic, Szilvia Bánvölgyi, Gyula Vatai |
| **P4033** | Effect of high hydrostatic pressure and heat treatment sequence on color, texture and water holding capacity of meat batter<br>Gábor Jónás*, Eszter Balázs, Koppány Majzinger, Anna Visy, Karina Hidas, Annamária Barkó, László Friedrich |
| **P4035** | Characteristics of potato-based seasoned flavoured sticks concerning the used oil<br>Győri Zoltán*, Moshen Mardani, Katalin Badakné Kerti, Anikó Kovács, Györgyné Kóczán |
| **P4036** | Development of a DNA-based quick test for the detection of soy in food<br>Erika E. Szabó*, Judit Perjéssy, Anna Jánosi |

| | |
|---|---|
| **P4038** | Investigation of Monilinia fructigena fungal infection in sour cherries with hyperspectral imaging<br>Flóra Vitális*, Venet Nici, Juan Pablo Aguinaga Bósquez, Zoltán Gillay, Marietta Petróczy, Zoltán Kovács |
| **P4040** | Development of an innovative supplement for muscle building<br>János Orosz*, Krisztina Takács, Zsuzsa Mednyánszky |
| **P4043** | Effect of different inoculation media on L-asparaginase produced by *Aspergillus niger* F.00721<br>Stefan Savo Micevic*, Erika Bujna, Quang Duc Nguyen |
| **P4045** | Fatty acid composition of traditional sausage produced in Kosovo<br>Kaltrina Berisha*, Albert Gashi, Zsuzsanna Mednyánszky, Hysen Bytyqi, Livia Simon Sarkadi |
| **P4050** | Colour stability of crossbred elderberry genotypes after heat treatment<br>Efaishe Kavela, Anna Miklovicz, Mónika Máté, Lilla Szalóki-Dorkó* |
| **P4052** | The effect of temperature and sodium chloride on the growth of *Listeria monocytogenes*<br>Sabrine Labidi*, Gabriella Kiskó, Csilla Mohácsi-Farkas |
| **P4053** | Tracing the geochemical origin of fruits grown in different regions of Hungary, with data analysis of metal content<br>My Ban Thi*, Jordán Győző, Hitka Géza, Quang D. Nguyen |
| **P4055** | Microencapsulation of extra virgin olive oil by freeze drying: effect of wall materials composition and emulsification method<br>Donia Chaabane*, Asma Yakdhane, Arijit Nath, Krisztina Albert, Andras Koris, Vatai Gyula |
| **P4056** | Digestibility of powdered milk protein concentrate – an in vitro study<br>Fanni Bilkei, Mária Berki, Éva Lengyelné Kónya, Rita Tömösköziné Farkas, Judit Tormási, László Abrankó* |
| **P4058** | Evaluation of microencapsulation of flaxseed oil performed using membrane emulsification along with spray-drying and freeze-drying technologies<br>Asma Yakdhane*, Eya Yakdhane, Donia Chaabane, Arijit Nath, András Koris |
| **P4059** | Effect of aeration and manganese concentration on pigment production by Yarrowia yeast<br>Gizella Sipiczki*, Erika Bujna |
| **P4060** | Enhanced biological biotreatment of wheat bran using two consortiums of fungal strains<br>Riyad Ouahab*, Csilla Farkas, Vijai Gupta, Quang Duc Nguyen |
| **P4062** | The performance of microtester as a redox potential measurement for microbial detection and quantification<br>Eya Yakdhane*, Dóra Tőzsér, Katalin Szakmár, László Baranyai, Gabriella Kiskó |
| **P4063** | Analyzing the effect of culture media composition on Gram-positive bacteria's peptide mass fingerprint<br>Botond Surányi*, Tekla Engelhardt, Csilla Mohácsi-Farkas |
| **P4064** | Comparative study of coffee subtitutes<br>Nóra de Jonge*, Katalin Kóczán-Manninger, Vivien Szatmári, Ildiko Szedljak, Katalin Badak-Kerti |
| **P4065** | Examination of the effect of relative humidity on different properties of pork loin during curing and ageing<br>Anna Visy*, Gábor Jónás, Zsuzsanna Mezőfi-Horváth, Karina Ilona Hidas, Annamária Barkó, Koppány László Majzinger, Lászkó Ferenc Friedrich |
| **P4066** | Effect of enrichment with monofloral pollens on the total phenolic and flavonoid content of baked goods<br>Rita Végh*, Mariann Csóka, Éva Stefanovits-Bányai, László Sipos |
| **P4068** | Development of a social inclusive immersive virtual reality exergame to promote physical activity<br>Abdul Hannan Bin Zulkarnain, Alin Totorean, Attila Gere*, Brian Horsak, Eduardo Cruz, Linda Lancere, Mark Simonlehner, Mihaela Crișan-Vida, Rita Fernandes, Vanessa Leung, Yasmine Sterckx |

| | |
|---|---|
| **P4069** | Evaluation of the presence of IDH gene and patulin production of Aspergillus and Penicillium strains isolated from Hungarian apples<br>Emelin Leandro Rodrigues*, Judit Kosztik, Ákos Tóth, József Kukolya, Ildikó Bata-Vidács |
| **P4071** | New insights into the acidification techniques of fruit mash during fermentation process<br>Fatjona Fejzullahu*, Rajmund Ujszászi, Olívia Csernus, Szilárd Kun |
| **P4072** | Application of near infrared spectroscopy for the detection of honey adulteration<br>Mariem Majadi*, Zsanett Bodor, Zoltán Kovács |
| **P4073** | Effect of HHP treatment on lipid oxidation processes in mangalica bacon<br>Koppány László Majzinger*, Karina Ilona Hidas, Anna Visy, Annamária Barkó, Zsuzsanna Horváth-Mezőfi, László Friedrich, Gábor Jónás |
| **P4075** | The study of the antagonistic activity of yeasts isolated from fruits belonging to Rosaceae family against *Galactomyces geotrichum*<br>Giseli Cristina Da Costa Arruda*, Andrea Pomázi, Mónika Kovács |
| **P4076** | Potential of edible flowers to be used in biscuits<br>Beatrix Szabó-Nótin*, Enikő Izsó |
| **P4077** | Change is just around the CornEr<br>Dalma Radványi*, Pamela Nolz, Nelson Carriço, Sergiu-Valentin Galatanu, Maira Leščevica, Fátima Nunes Serralha, Anderluh Alexandra, Mesbahi Zahra, Xafis Alexandros, Sarah De Coninck |
| **P4078** | The effect of different sucrose concentrations on the rheological and functional properties of frozen-thawed liquid egg yolk<br>Karina Ilona Hidas*, Csaba Németh, Anna Visy, Annamária Barkó, Zsuzsanna Horváth-Mezőfi, Adrienn Varga-Tóth, Koppány László Majzinger, László Ferenc Friedrich, Ildikó Csilla Nyulas-Zeke |
| **P4079** | Establishing the impact of improved feeding on the quality of dairy products using correlative analytical technologies<br>Haruna Gado Yakubu, Juan Pablo Aguinaga Bósquez, Zoltán Kovács, Róbert Roszkos, Tamás Tóth, George Bazar* |
| **P4081** | **The effect of mild heat treatment on inactivation of pathogenic Enterococcus faecalis in model nutrition media and chicken breast**<br>Endrit Hasani*, Gabriella Kiskó, István Dalmadi, György Kenesei |
| **P4083** | Good practice of colour masking in sensory research<br>Dániel Szabó*, Ágnes Urbin, Balázs Vince Nagy Balázs Vince, László Sipos |
| **P4084** | Characterization of coffee capsules and prediction of sensory attributes by e-tongue<br>Juan Pablo Aguinaga Bósquez*, Haruna Gado Yakubu, György Bázár, Zoltán Kovács |
| **P4085** | Investigation of tomato pomace extract as a potential antimicrobial agent<br>Faraja Gonelimali*, Fruzsina Zsólyomi, Beatrix Szabó-Nótin, Mónika Máté |
| **P4086** | Can Aquaphotomics ascertain the authenticity of Tomato powder extracts?<br>Balkis Aouadi*, Mariem Majadi, Juan Pablo Aguinaga Bosquez, Josephine Mensah, John-Lewis Zinia Zaukuu, Zoltán Kovács |
| **P4088** | Effect of 1-MCP treatment on tomato postharvest physiological behavior<br>Zsuzsanna Horváth-Mezőfi*, Gergő Szabó, Emese Bátor, Mónika Göb, Géza Hitka, Tamás Zsom |
| **P4089** | Effect of UV and Ozone treatment on the microbiological properties of microgreens<br>Monika Göb* |
| **P4091** | Leaching processes applied for the extraction of betalain colour compounds from microwave oven-dried beetroot leaf<br>Moh Moh Zin*, Szilvia Bánvölgyi |
| **P4092** | Analysis of texture properties of deep frozen ToTu dumplings<br>István Dalmadi*, Nikoletta Bodzán, Csaba Németh, György Kenesei |
| **P4093** | Sensory and quality characteristics of artisanal breads<br>Andrea Lugasi* |
| **P4105** | Diet and physical activity of university students during COVID-19 pandemic measured by semi-quantitative food frequency questionnaire |

| | |
|---|---|
| | Andrea Lugasi*, Anna Gódor-Kacsándi, Lajos Biró |
| **P4114** | Determination of correlation between the electrical impedance parameters and the rheological parameters of carrot<br>Biborka Gillay*, Eszter Vozary |
| **P4121** | Technologies for ensuring crop safety and quality in the food supply chain<br>Kitti Annamária Bognár*, Flóra Vitális, Viktória Zsom-Muha, Zoltán Kovács |
| **P4126** | Preparation of tea extracts for kombucha production<br>Edyta Kordialik-Bogacka*, Hubert Antolak, Paulina Legumina, Anna Michalska, Katarzyna Dybka-Stępień, Anna Otlewska, Sylwia Ścieszka, Maciej Ditrych, Kamil Królak |
| **P4127** | Infusion parameters determining microbiological purity of tea brew for kombucha production<br>Katarzyna Dybka-Stępień*, Hubert Antolak, Anna Otlewska, Sylwia Ścieszka, Kamil Królak, Maciej Ditrych, Edyta Kordialik-Bogacka |
| **P4128** | How the pineapple based marinade influences the characteristics of sous-vide pork chops<br>György Kenesei*, Odett Által, István Dalmadi |
| **P4131** | Effect of enrichment with high biological value animal products on techno-functional properties of ice creams<br>Tamás Csurka*, Karina Ilona Hidas, Klára Pásztor-Huszár |
| **P4151** | Food and food spoilage detection by non-destructive technologies<br>Suliman Khan* |
| **P4152** | Consumption of the bio and gluten free product – produced by Abonett<br>Edina Lendvai*, Diána Dobos-Nagy |
| **P4153** | Comparative analysis of meat raw materials<br>József Mihalkó* |
| **P4155** | Bioaccessibility of amino acids and antioxidant properties in heat- and lactase- treated milk during in vitro digestion<br>Arijit Nath, Muriithi Grace Wanjugu, Emőke Szerdahelyi, Mária Berki, Éva Kónya-Lengyelné, Rita Tömösköziné Farkas, Judit Tormási, László Abrankó* |
| **P4156** | Food and language<br>Esmeralda Sherko*, Elsa Zela |
| **P4157** | Development of high-fiber flour mixtures<br>Eszter Szőke-Trenyik*, Antal Véha, Balázs P. Szabó |
| **P4159** | Determination of chitin content in insects<br>Enikő Horváth- Szanics*, Éva Lengyel-Kónya, Rita Tömösközi-Farkas |

**Registration number 2**

## Bringing the conventional sensory laboratory into virtual reality for food sensory evaluation

Abdul Hannan Bin Zulkarnain[1,ab], Zoltán Kókai[1], Attila Gere[1]

[1]Department of Postharvest Science, Trade, Supply Chain and Sensory Evaluation, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[a]Presenting author,
[b]Corresponding author e-mail: Zulkarnain.Abdul.Hannan.Bin@phd.uni-mate.hu; abdulhannanzul@gmail.com

**Abstract:** While there are emerging technologies in food sciences, food consumption is still a comprehensive sensory experience affected by many factors. Traditional consumer testing has a drawback in that isolated booth environments lack construct validity and user participation in perception formation. Virtual reality (VR) technology has grown increasingly available, sophisticated, and popular in recent years. VR is a new way to replicate various environments, and with the advancement of VR technology, it has the potential to bring up endless possibilities for food and consumer behaviour research, allowing researchers to expand on current approaches while also developing new ones.
The aim of the research is to create a virtual sensory lab for food sensory evaluation. In addition, the idea is to incorporate the traditional sensory laboratory into virtual reality and to see what differences there are, as well as how VR affects customer responses, particularly in sensory analysis. The virtual sensory laboratory was virtualized and designed using Unreal Engine 4.27.2, with HTC VIVE Pro (VR gear) and Leap Motion Controller compatible with the software. The environment is designed to be as identical as possible to the Hungarian University of Agriculture and Life Sciences' (MATE) sensory booth system, which was established in accordance with ISO 8589. Key discoveries in order to undertake food sensory evaluation research, VR was used to create complex and realistic contextual environments. New data mining methods will be used to analyse the gathered variables in order to establish the correlations between VR and sensory evaluation.
As VR technologies continue their advancement, greater degrees of immersion, expanded use of multisensory stimuli, and more delicate integrated measuring methods will be combined to provide smoother user experience. Beyond using VR to establish the effectiveness in product sensory evaluation, future sensory and consumer science potential lay in changing consumer behaviour to enable people live healthier, more sustainable lifestyles. It is an interesting opportunity for food-related VR research as there are growing accessibility and availability of equipment and software.



**Keywords:** Virtual reality, virtual sensory, sensory analysis, software development, experimental design

**Acknowledgements:** AHZ and the authors thank the support of Doctoral School of Food Sciences, Hungarian University of Agriculture and Life Sciences. AG thanks the support of János Bolyai Research Scholarship of the Hungarian Academy of Sciences and National Research, Development and Innovation Office of Hungary (OTKA, contract No. FK137577).

**Registration number 7**

# Fumonisin $B_1$ and Deoxynivalenol contamination of Hungarian maize flour and canned maize samples

Tamás Schieszl[1, b], Judit Szabó-Fodor[2], Melinda Kovács[1,2]

[1]Hungarian University of Agricultural and Life Sciences Kaposvár Campus, Institute of Physiology and Nutrition, Guba S. Str. 40., 7400 Kaposvár, Hungary
[2]MTA-KE-SZIE Mycotoxins in the Food Chain Research Group, Guba S. Str. 40., 7400 Kaposvár, Hungary

[b]Corresponding author e-mail: schieszltamas95@gmail.com

**Abstract:** The mycotoxins -secondary metabolites of molds- are common contaminants of cereals. Fusarium toxins, such as FB1 (fumonizin B1) and DON (deoxinivalenol) are frequently detected in Hungarian corn. These contaminants can cause serious diseases, like oesophageal cancer, liver damage, etc. According to a BIOMIN 2020 study, DON and FB1 are the most common mycotoxins in Europe.

In a larger study we measured the DON, ZEA (zearalenon), FB1 and FB2 (fumonizin B1 and B2) contamination of various cereal-based foods. We found that apparently, DON and FB1 occurred most frequently. We detected these mycotoxins mainly in corn flour and canned corn. In this poster we focus on the results of samples collected between 2019 and 2021 for these two foodstuffs.

FB1 and DON concentration of maize flour (n=56) and canned maize (n=20) samples commercially available from the shelves of various store chains (Auchan, Tesco, Coop, etc.) were determined by HPLC/MS (High Pressure Liquid Chromatography/ Mass Spectroscopy) method.

In 21.4% of maize flour samples the FB1 concentration was under LOD (Limit of Detection) (0.031 mg/kg), 51.8% was under LOQ (Limit of Quantification) (0.093 mg/kg) and 26.8% was above LOQ, average: 0.189 mg/kg. In 66% of maize flour samples the DON concentration was under LOD (0.053 mg/kg), 32.2% was under LOQ (0.160 mg/kg) and one sample (0.468 mg/kg) was above LOQ. In 95% of canned maize samples the FB1 concentration was under LOD (0.031 mg/kg) and 5% was under LOQ (0.093 mg/kg). In 70% of canned maize samples the DON concentration was under LOD (0.053 mg/kg), 25% was under LOQ (0.160 mg/kg) and one sample (0.257 mg/kg) was above LOQ.

Conclusions: 78.6% of maize flour samples was contaminated with FB1 and 34% was contaminated with DON. Only 5% of canned maize samples was contaminated with FB1 and 30% was contaminated with DON. The incidence of DON appears to be similar for the two foods, however, there appears to be a difference in the incidence of FB1. Further investigations are needed to understand the different FB1 contamination of different maize-based foods.



**Keywords:** FB1, DON, maize flour, canned maize

**Acknowledgements:** The research was supported by the GINOP 2.3.2-15-2016-00046 project, the Hungarian Academy of Sciences and the Eötvös Lóránd Research Network (MTA-KE-SZIE Mycotoxins in the Food Chain Research Group).

BIOMIN (2020) a: World Mycotoxin Survey: Impact 2020 https://www.biomin.net/science-hub/world-mycotoxin-survey-impact-2020/ Program: Google, Keywords: 2020, World Mycotoxin Survey Impact, Downloaded: 2021.03.03.

**Registration number 9**

## Viability of protein microencapsulated *Lactobacillus plantarum* 299V during *in vitro* digestion process

Weizhe Sun, Erika Bujna, Quang Duc Nguyen[b]

Department of Bioengineering and Alcoholic Drink Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: nguyen.duc.quang@uni-mate.hu

**Abstract:** Due to the health crisis COVID-19 pandemic and global economic slowdown, there is an increasing demand for healthy eating habits and higher functionality of foods. Bioactive ingredients, supplements, and nutraceuticals are commonly the first choice of ordinary people to support the immune system. However, most functional compounds are sensitive to adverse conditions during the processing, storage, and digestion process. Hence, microencapsulation can serve as a problem-solving technology with a huge impact, transforming essential and conventional foods into fortified foods for effective nutritional, functional, and controlled delivery. Among those technologies, lyophilization is a process that can sublimate the water in the ice-formed samples to a gaseous state under vacuum conditions to effectively dehydrate the samples. Whey protein (WP) and denatured whey protein (DWP) with specific wall material formulations and the different core-to-wall ratios between coating materials and probiotics were applied on the samples that needed to be lyophilized. Consequently, the *in vitro* simulated gastrointestinal test was carried out by adding encapsulated probiotic samples into simulated gastric juice (SGJ) and simulated intestinal juice (SIJ) during the digestion process. The living cell number was checked by using a plate-counting method by taking samples based on the incubation time at 0 h, 0.5 h, 1 h, 2 h, 3 h, and 0 h, 3 h, 6 h for SGJ and SIJ samples, respectively. As for the simulated gastric juice experiment, after 3 hours of digestion, for samples with core-to-wall ratio of 1:1 with increased content of DWP, the viability loss decreased. The same trend could be observed for samples with core-to-wall ratio of 1:1.5. Besides, the highest viabilities were obtained for samples with core-to-wall ratios of 1:1 and 1.5 with WP and WP:DWP ratio of 3:1, with viable numbers of 10.13 log CFU/g and 10.23 log CFU/g, respectively. As for the simulated intestinal juice experiment, the viabilities for each sample had significant differences between 0 h and 3 h incubation, but no significant ($p>0.05$) differences were detected in further incubation. Besides, after 6 hours of incubation, samples with core-to-wall ratio of 1:1 with WP and with core-to-wall ratio of 1:1.5 with WP:DWP ratio of 1:3 in each group had the lowest viability loss with 0.35 log CFU/g and 0.78 log CFU/g, respectively. The results of our research are very promising and may provide some insight on the simulated *in vitro* digestion process of probiotic microcapsules by lyophilization.



**Keywords:** *In vitro* digestion, viability, microencapsulation, probiotics, lyophilization

**Acknowledgements:** This work was supported by the New Széchenyi Plant Project No. EFOP-3.6.3.-VEKOP-16-2017-00005, by Stipendium Hungaricum Program, as well as Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science.

**Registration number 11**

## Does strawberry scent influence gazing behaviour and choice?

Dorina Szakál, Orsolya Fehér, Dalma Radványi, Attila Gere[b]

MATE, Hungary

[b]Corresponding authors e-mail: Gere.Attila@uni-mate.hu

**Abstract:** Stimuli from our environment can influence our choices, including elements of the store atmosphere, such as music and different smells. However, we do not fully understand how these affect our decisions. The aim of this study is to show how strawberry scent influences our gazing behaviour and food choices. The study involved spraying the essential oil into the air using a diffuser and recording the eye movements of 62 participants using a static eye-tracker. Half of the participants completed the eye-tracking study in an odourless environment, while the other half completed the same study but in a scented room. The study sought to answer two questions: i) whether it was true for each of the product categories tested (chocolate, muesli bar, tea and yoghurt) that participants chose the product they looked at most often, and ii) whether the strawberry scent had an effect on the chosen product. Our results suggest that in all cases, participants chose the product they looked at most often and the presence of the scent did not influence their choice. Regardless of whether there was a scent and regardless of the flavour of the product, participants chose each product with the same frequency.

**Keywords:** sensory, eye-tracker, scent, consumer-decision, choice

**Acknowledgements:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 13**

## Investigation of extraction methods of walnut cake polyphenol components for further usage in edible coatings

Pradeep Kumar[b], Lilian Gimes, Dóra Székely, Mónika Máté

[1]Department of Fruit and Vegetable Processing Technology, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: pradiip06@gmail.com

**Abstract:** Walnut oil cake is the primary byproduct obtained during the processing of walnuts for oil. This cake is usually discarded, it is densely packed with nutrients and natural preservatives, especially polyphenols. These polyphenols can be applied as an antioxidant and/or antimicrobial agent in the coating of walnut kernels, to extend the shelf life of walnuts without negatively affecting the nutritional profile of walnuts. The coating based on these polyphenols also have the potential to arrest the oxidation of the unsaturated fatty acids present in the walnuts.
In our experiments, walnut cakes from two different Hungarian varieties 'Alsószentiványi 117' (A) and 'Milotai 10' (M) were used. First, they were soaked in 70% ethanol with 3 different sample:solvent ratios (1:10, 1:20 and 1:30) for 1 hour and then water bath (W, at 40℃ for 1 hour) and ultrasonication (U, at 35 KHz for 30 minutes) were used to extract polyphenols. After the extraction, color values (L*, a*, b*) and TPC values (Singleton and Rossi, 1965) were measured control (C) without treatment after water bath (W) and after ultrasonic treatment (U).
The extraction methods had no significant effect on the color values of the extracts in our studies. The TPC content (Table 1.) of extract obtained using the ultrasonic method was higher. There was no distinguished effect of sample:solvent ratio on TPC in our experiments.
We found that ultrasonic method was better for walnut extraction compared to water bath.



Table 1: Total Polyphenol Content (TPC) of walnut extracts

| Sample code | sample:solvent ratio | TPC (mg/100 g) | Sample code | sample:solvent ratio | TPC (mg/100 g) |
|---|---|---|---|---|---|
| 'Alsószentiványi 117' | | | 'Milotai 10' | | |
| AC | 1:10 | 18.39 | MC | 1:10 | 26.46 |
| AC | 1:20 | 24.09 | MC | 1:20 | 18.25 |
| AC | 1:30 | 25.56 | MC | 1:30 | 23.22 |
| AW | 1:10 | 20.83 | MW | 1:10 | 28.66 |
| AW | 1:20 | 25.78 | MW | 1:20 | 23.98 |
| A W | 1:30 | 43.52 | MW | 1:30 | 30.91 |
| A U | 1:10 | 20.34 | MU | 1:10 | 28.41 |
| A U | 1:20 | 29.56 | MU | 1:20 | 36.44 |
| A U | 1:30 | 27.67 | MU | 1:30 | 30.09 |

**Keywords:** walnut, polyphenols, extraction, ultrasonication, edible coatings

**Acknowledgements:** This work is supported by the New Széchenyi Plant Project No. EFOP-3.6.3.-VEKOP-16-2017-00005 and the Doctoral School of Food Science, Hungarian University of Agriculture and Life Sciences.

**Registration number 14**

# A review: nutritional and sensory evaluation of alternative cereals and their possible application in processed foods

Hala Roumia[1], Csilla Benedek[2,] Zoltán Kókai[1b]

[1]Faculty of Food Science, Department of Postharvest, Supply Chain, Commerce and Sensory Science, Hungarian University of Agriculture and Life Sciences, Villányi út 35-43, 1118 Budapest, Hungary
[2]Faculty of Health Sciences, Department of Dietetics and Nutrition, Semmelweis University, Vas u. 17, 1088 Budapest, Hungary

[b]Corresponding author e-mail: kokai.zoltan@uni-mate.hu

**Abstract:** Alternative cereal species have recently gained an increasing interest, where several studies showed the importance of those species in cereal foods' quality, including their nutritional value and sensory properties.
Since cereal products are the most consumed products in the human diet, many beneficial properties can be harnessed in different ways, leading to the development of innovative cereal foods or cereal ingredients. Therefore, increasing cereal cultivation diversity and supporting alternative cereal systems can improve and foster agriculture, manufacturing, marketing and food consumption.
This work aims to review the most recent studies that can form the foundation for future applied research and provide a better understanding of the advantages and disadvantages of alternative cereals' application in food products. This is to promote methods of alternative cereal utilisation to make a substantial contribution to the human diet. There are cereal species, which currently have minor importance, but due to their nutritional potential, they might be used more widely in the future.
Purple wheat and blue wheat show a high content of anthocyanins and total phenol content that might be utilised for food fortification. The soluble dietary fibre and protein content of spelt wheat cultivars tested were higher than in common wheat and durum wheat. Sorghum wheat contains important phenolic and antioxidant compounds. Hybrids can also be a promising raw material for quality wheat breeding where contents of macronutrients and micronutrients in wheat grain were shown to be increased by crossbreeding *T. aestivum* and *T. spelta*.
Some alternative cereal species have appealing sensory attributes where consumers gave higher preference scores for spelt and purple grain bread samples. Thus, product characteristics and consumer preferences are better understood by performing sensory tests that contribute to producing more acceptable and sustainable cereal foods.



**Keywords:** alternative cereals, wheat, nutritional, sensory, cereal products

**Acknowledgement:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 16**

## Testing high temperature 3D printing filaments from food safety aspect

Igor Gáspár[1,b], Ivana Pajčin[2], Flóra Vitális[1], Vanja Vlajkov[2], Aleksandar Jokić[2], Dragoljub Cvetković[2], Jovana Grahovac[2]

[1]Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary
[2]Faculty of Technology Novi Sad, University of Novi Sad, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

[b]Corresponding author e-mail: gaspar.igor@uni-mate.hu

**Abstract:** 3D printing is a new additive technology with exponential expansion of usage. Like many other industries, food industry is also implementing this new method into their existing manufacturing processes. Using 3D printed parts in the food industry does not mean they will always have a direct contact with the food (for example 3D printed gears, pipe holders etc.). However, in some cases it is required that 3D printed objects have direct contact with the food, but attention must be paid to food safety, mostly in terms of prevention of bacterial contamination in gaps between the 3D printed layers. Our earlier experiments proved that, by default, a 3D printing objects are not food safe after longer usage and direct contact with the food (even though the food safe filaments were used), but there are solutions for this problem. One of the solutions is coating a 3D printed surface with two component epoxy resin, and we have already proved that an object coated with epoxy resin is easily cleanable like any other smooth injection moulded object. Unfortunately, there are several disadvantages of this method, and one of them is that it is hard to coat some complex objects at each surface point, especially inside.
In this work some basic food safe 3D printing objectives are mentioned, like basic aspects of food safe materials and what is the correct processing time-line of the filament from unboxing to the extrusion through the nozzle. Additionally, a new method for prevention of bacterial contamination was tested: usage of high temperature-resistant filaments to obtain 3D printed objects, which can be cleaned using boiling water. NonOilen™ is a PLA (polylactic acid)-like filament, which has food safe certificate, and it can withstand temperatures up to 110 °C, meaning that the 3D printed parts can be cleaned in boiling water. The results of this study have shown a significant reduction of the bacterial presence on the 3D printed objects previously used for milk storage and cleaned in boiling water compared to standard cleaning procedures including chemical cleaning, indicating the potential of heat-resistant 3D printing filaments to be used for production of food safe 3D printed objects for food storage.



**Keywords:** food industry, 3D printing, food safety, heat-resistant filaments

**Acknowledgements:** The research was supported by the Hungarian and Serbian bilateral scientific and technological cooperation project funded by the Hungarian National Office for Research, Development and Innovation (NKFI, 2019-2.1.11-TÉT-2020-00249) and the Ministry of Education, Science and Technological Development of the Republic of Serbia. The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 18**

# Developing efficient microbial consortium for the pretreatment of different agriculture residues

Vi Vu[1,b], Csilla Farkas[1], Vijai Kumar Gupta[2], Quang D. Nguyen[1]

[1]Department of Bioengineering and Alcoholic Drink Technology, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary
[2]Biorefining and Advanced Materials Research Center, Scotland's Rural College (SRUC), Kings Buildings, Edinburgh, UK

[b] Corresponding author e-mail: vivnh@hcmuaf.edu.vn

**Abstract:** Lignocellulosic biomass is an attractive resource for industrial biotechnology because of its abundance and potentially containing a large amount of energy, which provide the alternative for depleting fossil fuels. In order to access the carbon source for the biorefinery, microbial consortia based on biological routes draw more attention because of their stability in severe conditions, the capability of complicated substrates utilization and multiple derivatives production in one process. In our study, filamentous fungi, cellulolytic and ligninolytic bacteria and yeast species were employed to evaluate the degradation of lignocellulosic biomass in the solid stage procedure. Diverse synthetic microbial communities were constructed and the synergism on agricultural residues (wheat bran, wheat straw) as lignocellulosic substrates was investigated. The result of the investigation implies that the consortium was structurally stable with the co-existence of up to eight microbes, comprising aerobic bacteria (*Bacillus subtilis, Rhodococcus opacus, Pseudomonas putida*) along with filamentous fungi (*Aspergillus niger, Trichoderma viride, Penicillium chrysogenum*) and yeast strains (*Yarrowia divulgata, Pichia stipilis*); providing an improvement in enzymatic activities including total cellulase, endo-glucanase, xylanase and laccase; along with superior sugar conversion in comparison with monocultures. Additionally, our findings suggest that different mixed cultures could display similar degradation effects to a different source of lignocellulosic substrates. Our research presents the first report on synthetic construction of functional consortia including bacteria, fungi and yeast species together with characterizing their degradation profiles applicable for biomass degradation.



**Keywords**: lignocellulose degradation, pretreatment, microbial consortium

**Acknowledgements**: The authors acknowledge KFI_16-1-2017-0077, TKP2021-NV and EFOP-3.6.3-VEKOP-16-2017-00005 projects, the Hungarian University of Agriculture and Life Sciences' Doctoral School of Food Science for the support in this study.

**Registration number 19**

## Optimization of ultrasound-assisted extraction of antioxidant compounds from Hawthorn using response surface methodology

Areej Alsobh[b], Gyula Vatai, Szilvia Bánvölgyi

Department of Food Process Engineering, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, Budapest, Hungary

[b]Corresponding authors e-mail: areejalsobh@gmil.com

**Abstract:** Ultrasonic-assisted extraction (UAE) is a novel, green, and rapidly developing technology, which is suitable for upscaling and improving the extraction efficiency of bioactive compounds. Ultrasound mainly acts by producing cavitation bubbles in the biological matrix. Ultrasound and response surface method (RSM): were used to optimize the hawthorn extraction process. Two numerical factors were studied (extraction time (A) (3,6 and 9 minutes) and sample ratio(B) (5, 7.5, and 10 g of sample /100 mL solvent). The (UAE) process was performed with 100 W using distilled water and ethanol of 10% as solvents. Total phenolic content (TPC), total flavonoid content (TFC), and antioxidant activity (AA) were measured by spectrophotometric methods. The regression model ($P<0.05$) was obtained through the Central-Composite experimental design. The optimal extraction condition was found to be at: 7.423 minutes, 10 g of the sample/100 mL distilled water as a solvent, and 7.219 minutes and 9.922 g of the sample/100 mL 10 v/v% ethanol as solvent. Under these conditions, the obtained extracts exhibited contents of phenolic compounds of (6.26 and 8.397 mg gallic acids equivalents/g dry matter), contents of flavonoids compounds of (5.482 and 6.497 mg quercetin equivalents/g dry matter), with antioxidant activities of (5.577 and 7.484 mg ascorbic acid equivalents/g dry matter) by using distilled water and 10 v/v% ethanol, respectively.



**Keywords:** Hawthorn, Optimization, Response surface methodology, Total phenolic and flavonoid contents, Ultrasound-assisted extraction.

**Acknowledgement:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 20**

## Possible opportunities of palm fat replacement

Anikó Kovács[b], Vivien Nagy, Szabolcs Homolya, Katalin Badakné Kerti

Department of Grain and Industrial Crop technologies, University of Hungarian Agriculture and Life Science, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: kovacs.aniko94@uni-mate.hu

**Abstract:** From year to year the food industry has to follow the new food trends, the consumers' new demands, the possible changes of the ingredients and the supply system. Likewise, in recent years in many products' marketing, palm oil free mark is a positive sign for the costumers. This is due to the assumed negative impact of the palm oil cultivation on the rain forests, animal species, environment and human health. To this new trend the food industry has to adapt. All palm fat using companies have two choices. One is to only buy this ingredient from sustainable sources, and to join the Roundtable on Sustainable Palm Oil (RSPO). The other option is to use other fats instead of palm fat. However, due to the unique fatty acid composition and the several possible usages of palm fat, the substitution will be difficult, and the opportunities have to be investigated by product categories. In confectionary applications, one opportunity could be the mixing of fully hydrogenated fat with oil or with lauric fat. However, the suitability of the replacement needs to be examined from many perspectives, like rheological, textural, thermal behaviour and from sensory points of view.
Therefore, the goal of our research was to investigate the thermal and texture behaviour of palm fat and two different fat mixtures, as possible palm fat replacers. For substitution, we used fully hydrogenated rapeseed oil mixed in one case with 65% sunflower oil and in the other case with 95% coconut fat. The mixing ratios were determined based on previous experiences. We followed the thermal behaviour with differential scanning calorimetry and the texture behaviour with penetrometry using conical pressure head at 25 °C.
According to our results, the three fats' DSC curves showed different heating and cooling behaviours due to the different fat acid and triacyl glycerol compositions of the samples. However, for the crystallization behaviour all samples showed two peaks, and the coconut sample peak temperatures were close to the palm fat's. In case of texture measurement, we recorded the hardness, work of penetration and adhesiveness values. The results showed that the coconut sample values were very similar to the palm fat values in every parameter. There were no significant differences between these two samples. The sunflower sample showed higher values in all cases than the palm fat.
In conclusion, the coconut fat sample showed very promising values in the measured parameters. Further analyses are needed to decide the coconut fat mixture sample suitability as palm oil replacement, especially looking at its shelf life.



**Keywords:** substitution, palm fat, DSC, texture analyses

**Acknowledgements:** The research was supported by the Europian Union through the EFOP-3.6.3-VEKOP-16-2017-00005 project and by the Doctoral School of Food Science.

**Registration number 21**

## Effect of heating rate on different confectionary fats' thermal behaviour

Szabolcs Homolya[b], Panna Penczer, Katalin Badakné Kerti, Anikó Kovács

Department of Grain and Industrial Plant Processing, Hungarian University of Agriculture and Life Science, Budapest, Hungary

[b]Corresponding author e-mail: szabolcs.homolya@gmail.com

**Abstract:** Plant and animal fats are commonly used ingredients is many food technologies, for example in confectionary, bakery, dairy and meat productions. They influence the viscosity and texture properties of the foods due to their different chemical and physical characteristic. One of the most important physical attributes is the melting and crystallization behaviour of the fats. The achieved crystal structure is depending on the type of the fat and the fatty acids, their distribution in the lipid molecule and the crystallization circumstances like the temperature and heating rate. If the circumstances are changing the crystal habits, size and number are changing, too. This has an influence on the final product. Therefore, studying the thermal behaviour of fats are essential in the food industry.
The goal of our research was to investigate the effect of different heating rates on the crystallization and melting behaviour of 3 different kinds of fat. Palm fat, coconut fat and milk fat were studied with a differential scanning calorimeter. The same temperature program was used and only the heating/cooling rate during the measurements were changed. For each sample 1-5-10 K/min heating and cooling rates were applied, and we compared the achieved results.
In correlation with the literature, our results also showed that the applied temperature profile (1/5/10 K/min) determined melting and crystallization, the size of the peaks and the enthalpy changes. Analysing the melting curves, we could see that the faster we change the temperature, the steeper and sharper the peaks are for every sample. The crystallization curves showed that fast cooling rate was not beneficial, as due to the fast temperature change there is not enough time for the transition of the different crystal forms, which led to data loss. However, the very slow cooling rate is also not the best option, because the slow temperature change results low peak and enthalpy change values. According to these, in our research the 5 K/min curves proved to be the best, independently of the type or source (animal or plant) of the fat.
In conclusion, our results are consistent with the literature data, too slow and too fast cooling and heating rates both had disadvantages. Therefore, the selection of the optimal rate is very important for the analysis of fat crystal forming and melting behaviour. Also, in the industry the temperature should be carefully controlled to achieve the appropriate crystal forms for the product.



**Keywords:** fat crystallization, fat melting, DSC, thermal behaviour

**Acknowledgements:** The research was supported by the Europian Union through the EFOP-3.6.3-VEKOP-16-2017-00005 project and by the Doctoral School of Food Science

**Registration number 22**

# Effect of pH and temperature on the activity of different commercial proteinase enzyme preparations

Firas Alarawi[1,2,*], Olivia Csernus[1], Quang D. Nguyen[1]

[1]Department of Bioengineering and Alcoholic Drink Technology, Institute of Food Science and Technology, the Hungarian University of Agriculture and Life Sciences, Budapest, Hungary
[2]The Second Faculty of Agriculture, Damascus University, Damascus, Syria

*Presentation author: firas.alarawi.94@gmail.com

**Abstract**: Dietary proteins and peptides exhibit distinct biological activities besides their nutritional value. In recent years, they gained increasing attention due to their special bioactivities. Bioactive peptides are considered the new generation of bioregulators that play a significant role in human health, including antihypertensive, cytotoxic, anticancer, anti-inflammatory, antidiabetic, antioxidants, and antimicrobial effects as well as promoting the treatment of various diseases and disorders, thus improving the quality of life. Some of the bioactive peptides exist in free form in nature, but a vast amount of them are encrypted in the structure of the parent proteins so they can be harvested naturally or produced by the endo-proteinase activity. In the enzymic process, the pH and temperature play a significant role in the formation of products as well as the cost, so this study focuses on the effect of these two parameters on the commercial proteinase activity to determine the optimum conditions for the bioconversion process. Proteolytic activity of trypsin, pepsin, and chymotrypsin proteases was determined in a reaction using 2% casein as a substrate at a pH range of 5 - 10 (in steps of 0.5 pH-units) and temperatures ranging from 20 °C to 60 °C in steps of 5 °C.
The results showed a gradual increase in enzyme activity (between 20 °C to 37 °C) and then a decrease in enzyme activity (between 37 °C to 60 °C). Also, there was a gradual increase in enzyme activity, from pH 5 to 8, stabilized approximately between pH 8 and 8.5, and then it decreased from pH 8.5 to 10. The optimum pH and temperature of commercial enzyme preparations were determined to be between pH 8 and 8.5 and 37 °C for incubation of 10 minutes, respectively. Our results are preliminary, but they can serve as a very good basis for the design and implementation of bioprocesses for protein hydrolysate production.



**Keywords:** Bioactive peptides, casein, pH, protease, temperature.

**Acknowledgments:** The research was supported by GINOP_PLUSZ-2.1.1-21-2022-00048, EFOP-3.6.3-VEKOP-16-2017-00005, and TKP2021 projects. The authors acknowledge the Hungarian University of Agriculture and Life Sciences' Doctoral School of Food Science for its support in this study.

**Registration number 23**

## Gas chromatographic determination of fatty acid composition in breast milk

Zhang M[1,2], Simon Sarkadi L[1,b], Üveges M[2], Tormási J[2], Benes E[2], Vass R[3], Vari SG[4]

[1]Department of Nutrition, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, Budapest, Hungary
[2]Department of Food Chemistry and Analytical Chemistry, Faculty of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, Budapest, Hungary
[3]Department of Obstetrics and Gynecology, Medical School, National Laboratory for Human Reproduction, University of Pécs, Pécs, Hungary
[4]International Research and Innovation in Medicine Program, Cedars-Sinai Medical Center, Los Angeles, CA, USA

[b]Corresponding author e-mail: simonne.sarkadi.livia@uni-mate.hu

**Abstract:** Breast milk is the most ideal food for newborns and infants. One of the most important substances in breast milk is fat, which ensures the proper development of children during the prenatal, postnatal and infant stages [1]. Maternal characteristics, such as obesity [2], may alter the fatty acid content of breast milk. The aim of the present study was to evaluate the fatty acids profile of breast milk in normal, obese and diabetic mothers.
Mothers' breast milk samples were received from the University of Pécs, Hungary. Mothers represented four groups: Normal Body Mass Index (nBMI); Obese (O); nBMI with Gestational Diabetes (nBMI+GD); Obese with GD (O+GD). Fatty acid composition of breast milk was analyzed by gas chromatography coupled with a flame ionization detector (GC-FID) based on a slightly modified ISO 16958:2015 reference method.
We found significant differences in the fatty acid composition of the milk of mothers with different health status. The main fatty acids were oleic acid (C18:1n-9c; 26-38%), palmitic acid (C16:0; 20-34%) and linoleic acid (C18:2n-6c; 7-23%). Saturated and polyunsaturated fatty acid content showed high variation within the four groups. Saturated fatty acids had the highest levels in obese milk samples, while polyunsaturated ones had the lowest levels. The monounsaturated fatty acids contents were similar within the samples. The n-6/n-3 ratio was significantly higher in the obese group (86.5%) than in the nBMI group (34.4%). Maternal obesity and health status have greatly influenced the fatty acids composition of breast milk, which is why it is worth investigating the relationship between nutrition and health factors.



**Keywords:** breast milk, diabetes, obesity, fatty acid composition, GC-FID

**Acknowledgements:** The research was supported by the Association for Regional Cooperation in the Fields of Health, Science and Technology (RECOOP HST Association), RECOOP Grant # 016 Pregnant Obesity and GDM changing human milk secretory cytokines, and altering IgG-IgA N-glycans and fatty acids. We are also grateful for the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study and the Stipendium Hungaricum scholarship provided to PhD student.

**References:**

[1]. Tijerina-sáenz, A.; Innis, S.M.; Kitts, D.D. (2009): Antioxidant capacity of human milk and its association with vitamins A and E fatty acid composition. *Acta Paediatr*, *98(11)*, 1793–1798.
[2]. Panagos, P.G.; Vishwanathan, R.; Penfield-Cyr, A.; Matthan, N.R.; Shivappa, N.; Wirth, M.D.; Hebert, J.R.; Sen, S. (2016): Breastmilk from obese mothers has pro-inflammatory properties and decreased neuroprotective factors. *Journal of Perinatology*, *36(4)*, 284–290.

**Registration number 25**

## Fermentation of different types of apple juices with probiotic *Lactobacillus* strains

Sofia R. Ziane, Tímea György, Erika Bujna[b], Quang D. Nguyen

Department of Bioengineering and Alcoholic drink Technology, Hungarian University of Agriculture and Life Sciences, Budapest, Hungary.

[b]Corresponding author e-mail: Bujna.Erika@uni-mate.hu

**Abstract:** Functional foods are the products providing basic nutrition and improving health. Among functional foods, the foods with probiotic microorganisms are of great importance. Probiotic fruit juices allow the consumption of these beneficial microorganisms by people intolerant to lactose, allergic to milk proteins, hypercholesterolemic, strict vegetarian, or resident in places where dairy products are not accessible.

The aim of this study is the screening and selection of lactic acid bacteria (LAB) strain for the apple juice fermentation, the investigation of the peptone supplementation as a nitrogen source that will affect the acid production and thus the sensorial properties of the apple juices, and determination of the fruit variety effect on the efficiency of apple juice fermentation.

The apple juice was fermented with 1% and 5% inoculum of 3 different strains of lactic acid bacteria (*L. brevis* HA112, *L. plantarum* 299v and *L. acidophilus* La5), the fermentation was conducted for 48 hours during which the pH and cell growth were measured 3 times (0, 24 h and 48 h). The juices inoculated with only 1% of each strain culture did not show any biomass production or the production was negligible during the time of fermentation. The juice fermented with 5% inoculum of *L. plantarum* 299v showed the highest cell growth ($8.45\times 10^9$ CFU/ml). Thus, 5% inoculum of *L. plantarum* 299v was used for the fermentation of two apple juices obtained from different apple varieties (Golden Delicious and Idared) with peptone to evaluate the effect of the nitrogen supplementation on the fermentation parameters. It can be concluded that the apple juices supplemented with peptone had higher cell growth and lower pH than the juices without peptone supplementation after 24 h.

The results of this study show that *L. plantarum* 299v (5%) was the most efficient lactic acid bacteria strain for apple juice fermentation. Furthermore, the supplementation of apple juice with a nitrogen source has a positive effect on the viability of the LAB. Considering the type of apple, the cultivar Golden Delicious was more suitable as substrate for the growth of microorganisms than Idared. Further research on the effect of nitrogen supplementation on the bacterial metabolites and the physicochemical and sensory profiles of the fermented apple juice are needed.



**Keywords:** apple juices, fermentation, peptone, probiotics, bacterial growth, supplementation

**Acknowledgements:** This work was supported by Project No. GINOP-2.2.1-18-2020-00025, as well as the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science.

**Registration number 26**

## Effect of digestive enzymes on digestibility and biological value of mechanically deboned turkey meat

Emőke Szerdahelyi, András Nagy, Otília Antal, Krisztina Takács[b]

Food Science Research Group, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1022Budapest, Hungary

[b]Corresponding author e-mail: takacs.krisztina@uni-mate.hu

**Abstract**: Enzymatic hydrolysates of mechanically deboned meat (MDM) for a long time have been used as flavouring and functional food ingredients in the food industry and as the bases of formula foods for special dietary uses. The aim of the present study was to produce MDM hypo-antigenic products with improved digestibility and high biological value using as a milk protein alternative.
Turkey MDM was treated with digestive enzymes (trypsin and/or a-chymotrypsin, or pancreatin). MDMs were adjusted to 2, 6 and 12% (w/v) of meat protein substrate concentration in 0.1% $NaHCO_3$ buffer solution (pH 7.5), homogenised by Ultra Turrax device, and then the proper enzyme was added with continuous stirring at 37 $^oC$.
Our task was to optimise the reaction parameters of the hydrolysis, which meant to determine the appropriate substrate concentration and to select the digestive proteases and reaction time (60, 80, 100, 120 min) for the subsequent production. In all cases, the efficiency of hydrolysis was assessed by SDS-PAGE and confirmed by TNBS method (Degree of hydrolysis, DH, %). The modification of immune reactive binding sites in MDM hydrolysate products was then checked by immunoblot using cow's milk, chicken egg or meat allergic human patients' sera. According to our overall results, turkey product treated with trypsin and α-chymotrypsin, and turkey product treated with pancreatin were selected for the *in vivo* animal feeding studies to determine the biological value and digestibility of the produced meat-based hydrolysates.
The optimised reaction conditions of hydrolysis were at 6% (w/v) of meat protein for 60 min. Among the applied enzyme modifications, pancreatin enzyme (at 37 °C, pH 7.5) provided sufficient degree of hydrolysation (39.4%). According to the results of animal feeding experiments, turkey meat pancreatic hydrolysates had the highest biological value (BV Mean%: 84) and digestibility (TD Mean%: 94). The product did not react with cow's milk, chicken egg, or meat allergenic human sera (IgE). Based on these results, food grade pancreatin is recommended for the production for milk-derived food substitution, which showed decreased allergenicity. The hydrolysed product was accepted by test-consumers in the sensory survey, no complaint was raised regarding taste, smell, or consistency. The final product was characterised by 39.2 g/100 g protein, 48.7 g/100 g fat, and 5.28 g/100 g ash contents.

**Keywords**: turkey meat, enzymatic hydrolysis, digestibility, biological value

**Acknowledgement:** This research was supported by the "Thematic Excellence Programme" TUDFO/51757-1/2019- ITM.

**Registration number 27**

## Development of sunflower seed based milk analogue

Ivett Jakab[b] , Zsuzsanna Mednyánszky, Anita Soós, Lilla Nagy, Anikó Meretei

Hungarian University of Agriculture and Life Sciences, H-1118nBudapest, Hungary

[b]Corresponding author e-mail: jakab.ivett@uni-mate.hu

**Abstract:** Proteins of cow milk is one of the most frequent causes of food allergy in the case of infants and adults as well. Different clinical symptoms of the milk protein allergy have been established. In today's world, plant-based milk alternatives are a rising trend. But majority of these milk alternatives lack nutritional balance when compared to bovine milk. Their sensory acceptability is also a major limiting factor.

On the other hand, these plant based beverages contain functionally active, health promoting components as well. Therefore, the challenge for the future in this fast growing segment is to select the most valuable raw materials to produce a milk analogue with a nutritional profile and organoleptic properties very similar to milk. And this is the aim of our study, too.

Two types of preparation method (filtration after wet milling and dry milling) were used in developing sunflower seed milk analogue. Main raw materials were unroasted- and slightly roasted sunflower seeds. Roasting was done by visual inspection. Seeds and plant based beverages were examined for macronutrients level and for subjective acceptability attributes.

The amino acid composition of the sunflower seeds (unroasted, roasted) and beverages were determined by Ingos 400 Automata Amino acid Analyser and their total protein content by Kjeldahl method (ISO 8968).

Sunflower protein products are deficient in lysine (wet milling: 0.65 mg/g protein; dry milling: 1.24 mg/g protein), isoleucine (wet milling: 0.44 mg/g protein ;dry milling: 1.19 mg/g protein) and cystein (wet milling: 0.27 mg/g protein; dry milling: 0.61 mg/g protein).

Sample preparation method had an effect on the total protein content of the samples (seeds: 41.1 g/100 g). In the case of the dry milling preparation, protein values were higher (milk alternative after wet milling: 4.53 g/110 g; after dry milling: 1.93 g/100 g). There were no significant differences ($P \geq 0.05$) between unroasted and roasted samples.

The sensory analysis was performed at the laboratory of the Hungarian University of Agriculture and Life Sciences, in one step with the overall participants. 90% of the panellists have tasted a milk alternative, but only 35% consume it regularly.

In the sensory test, panellists evaluated the overall acceptability of each sample and JAR levels for the product attributes. Milk analogues from dry milled seeds were estimated to be the most liked samples.

A Rancimat test was used in this study to measure the oxidative stability of final products by measuring cold-pressed sunflower seed oils. The tests were carried out with 3.00±0.01 g of oil at 120 °C and with an air flow of 15 l/h. Analysed cold-pressed oils' oxidative stability in Rancimat was shorter (2.52 h) compared to the result obtained for HOSO by Matthäus (2006).

**Acknowledgement:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

# Registration number 28

## Influence of quinoa adjunct on the sweet and hopped wort composition

Jean Carlo Vasconez[b], Zsuzsanna Kiss, Szilard Kun, Gabriella Kun-Farkas

Department of Bioengineering and Fermentation Technology, Hungarian University of Agriculture Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: jeancarlovasconez@hotmail.com

**Abstract:** Recently, the development of new types of beer made of raw materials other than barley malt has been a common trend among brewers. Quinoa is a pseudocereal, which can be used as adjunct in the brewing process to bring novel organoleptic properties to beer. The chemical composition of quinoa differs from malt, and it may influence the final beer product; especially the high content of protein in this pseudocereal.
Different grist mixtures made up of quinoa (10, 20, 30, 40%) and barley malt fractions were used in micro mashing tests. The pH, haze, extract and free α-amino nitrogen (FAN) contents were followed during the obtaining of wort, and they were evaluated in sweet and hopped wort (sweet wort after boiling and hop addition).
When pH was adjusted between 5.4–5.6 (in order to favour degrading enzymes), the haziness reduced, and the extract and FAN content increased compared with results when no pH adjustment was performed in sweet and hopped wort samples. On the other hand, when the quinoa fraction was increased in the grist, the haziness reduced, the extract fluctuated, and FAN content increased in sweet wort samples. Furthermore, the haziness reduced, the extract fluctuated, and FAN content decreased in hopped wort samples.
The best treatment resulted from using 30% of quinoa and initial pH adjustment. Mash was also treated using proteolytic and brewing commercial enzymes. The proteolytic enzyme increased FAN content in both sweet and hopped wort samples, and increased extract in hopped wort. The brewing enzyme decreased haze in sweet wort samples. When no enzyme was used, pH adjustment increased the extract content of sweet wort, and reduced haze in hopped wort.
In conclusion, the application of quinoa in brewing can open new possibilities for the development of new types of beers. The use of 30% of quinoa in the grist with an initial pH between 5.4–5.6 showed acceptable values of pH (5.83), extract (17.40 °P), haze (49.2 FTU) and FAN (228.17 mg/L) in the hopped wort. Thus, it can be used without enzyme addition with agreeable results, since the enzymes from malt can compensate for the lack of degrading enzymes to obtain suitable wort needed in the fermentation process.



**Keywords:** quinoa, malt, haziness, beer, enzymes

**Acknowledgements:** The research was supported by the Department of Bioengineering and Fermentation Technology of the Hungarian University of Agriculture and Life Sciences. The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for supporting the participation at the conference.

**Registration number 29**

## Biodegradation of polylactic acid-based polymers

Ákos Kilin[1,b], Csilla Kohári-Farkas[1], Anikó Jordán[1], Péter Tamaskó[1], Viktória Harcsa[1], Quang Duc Nguyen[1], Gabor Laszlovszky[2]

[1]Department of Bioengineering and Alcoholic Drink Technology, Hungarian University of Agriculture and Life Sciences, Budapest, Hungary
[2] Piringer Ltd., Budapest, Hungary

[c]orresponding author e-mail: Kilin.Akos@uni-mate.hu

**Abstract:** The scope of the present work focuses on the microbial degradation of polylactic acid-based plastics (PLA).
Polylactic acid is a common representative of bio-based polymers, because it is a recyclable and biodegradable polyester produced by lactic fermentation process from natural resources such as corn starch, cellulose or even from wastes. PLA has a high similarity in physical and mechanical properties to conventional synthetic polymers, and it is mostly resistant to microbial attacks under ambient conditions. Therefore, the post-use degradation in nature is a slow process, it may take a long time, often for at least some months, years or even decades. The efficiency of biodegradation depends not only on the characteristics of the polylactic-based plastics, but also on the abiotic and biotic conditions of the surrounding environment, including the presence of water and moisture, temperature, acidity conditions, presence of living systems with depolymerase activity etc. Increasing attention is being paid to the potential polylactic acid-degrading actinomycetes, bacteria and fungus, which can enzymatically cleave the esters bonds and release digestible water-soluble oligomers, dimers and monomers. Typically, inducers such as some protein substances, peptides and amino acids can stimulate the synthesis of depolymerase enzymes.
Total of 21 filamentous fungal strains from Aspergillus, Penicillium, Rhyzopus, Trichoderma genera and 24 bacteria strains from Bacillus, Pseudomonas, Rhodococcus, Sphingobacterium, Sphingobium, Thermobifida, Thermus were screened for the synthesis of extracellular depolymerase enzymes. The selected strains were applied in monoculture and consortia under submerged conditions, and in the presence of some inducers, such as gelatin, casein and olive oil, the secretion of the key enzymes: cutinases, lipases and proteases were increased. Furthermore, some consortia were more efficient than monocultures due to the synergistic interactions. Compared the degradation ability of pure polylactic acid-based plastic samples with two types of their composite forms: polylactic acid/corn starch and polylactic acid/spent grain, we found that the lignocellulosic filler improved the effectiveness of the biological treatment. Our results serve very good base for development of microbial degradation of PLA-base bioplastics.



**Keywords:** bio-based, bio-degradable, polylactic acid, biodegradation, eco-friendly

**Acknowledgements:** The research was supported by KFI_16-1-2017-0077 and EFOP-3.6.3-VEKOP-16-2017-00005 projects. The Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study

**Registration number 30**

## Improvement of shelf-life of beef using lactic acid, Na-ascorbate mixture, and potassium sorbate

Munkhnasan Enkhbold[1, b], Attila Lőrincz[2], Majd Elayan[1], László Friedrich[1], József Surányi[1], Adrienn Tóth[1]

[1]Department of Livestock and Food Preservation Technology, Hungarian University of Agriculture and Life Sciences, Menesi st 44, H-1118 Budapest, Hungary
[2]VADEX Mezőföldi Erdő- és Vadgazdálkodási Zrt., Petőfi Sándor st. 275, 8123 Soponya, Hungary

[b]Corresponding author e-mail: munkhnasan.e@gmail.com

**Abstract:** The objective of this study was to evaluate the impact of lactic acid, Na-ascorbate, and potassium sorbate treatments in beef surface on meat quality parameters colour and microbiological load. Certain parameters are considered as markers of fresh meat shelf life. The treatment was performed by spraying method. A mixture of 2% lactic acid with 0.5% Na-ascorbate, 2% lactic acid with 1% Na-ascorbate, 2% lactic acid with 2% Na-ascorbate and 1%, 2%, and 3% potassium sorbate was applied to beef surface. After vacuum packaging, immediately the samples were stored at 0.5-3 °C for 20 days. Quality parameters was measured on day 0, 4, 11 and 20.
The results indicate that the use of organic acids decreases microbial loads on beef samples. Colour measurement data indicate that there was not noticeable colour change in control sample during the 20 days display, while there was a little colour change in the other treated samples. Therefore, lactic acid, Na-ascorbate, and potassium sorbate treatments may be an alternative to extend beef shelf life.

**Keywords:** Lactic acid, Na-ascorbate, potassium sorbate, beef ageing

**Acknowledgements:** The research was supported by the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science, EFOP-3.6.3-VEKOP-16-2017-00005 and 2020-1.1.2-PIACI-KFI-2020-00027.

**Registration number 31**

## The Effect of Storage on Fortified Liquid Egg Products Properties

Majd Elayan[1,b], Csaba Németh[2], Munkhnasan Enkhbold[1], Adrienn Tóth[1]

[1]Department of Refrigeration and Livestock Products Technology, Mate University, H-118 Budapest, Hungary
[2]Capriovus Ltd., H-2317 Szigetcsép, Hungary

[b]Corresponding authors e-mail: Elayan.majd10@gmail.com

**Abstract:** Eggs are well known for their low cost and high nutritional value. an egg can provide the human body with almost 75 kcal per egg. Due to its high digestibility, egg proteins are considered as a high-quality protein for humans. According to European regulations, egg products term can only be used for food products that are made from processing of egg, or of various components or mixtures of eggs, or from the further processing of such processed products that are only intended for human consumption. To produce egg products, eggs are individually broken using machines that can separate the white and yolk as well as remove the shell. After separation, egg white, yolk or whole eggs are filtered and pasteurized to produce liquid egg products or spray dried to produce egg powders. This study is designed to evaluate the physical and chemical properties of liquid whole egg (LWE) and liquid egg white (LEW) after fortifying both products with powdered egg white protein and heat treat products at different temperatures and store. LWE and LEW were fortified with powdered egg white protein with different percentages 0, 3, 5 and 10% w/w and heat treated at three different temperatures 60, 65, and 70 °C for LWE and 50, 55, and 60 °C for LEW for 15 minutes, then cooled down and stored at 4 °C for 21 days. pH, color and viscosity were measured to evaluate the effect at days 1, 7, 14, and 21.
The lightness of all LEW decreased with the increase of the added protein and temperature, on the other hand, it was the opposite for LWE at day 1. Similar changes were detected throughout the whole storage time. pH was changed and affected by storage time, viscosity was affected significantly throughout the whole experiment.



**Keywords**: Liquid egg products, liquid whole eggs, liquid egg white, heat treatment, storage

**Acknowledgement:** Our research was carried out with the support of the RD 2020-1.1.2-PIACI-KFI_2020-00027 project, and the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study, which we would like to thank.

**Registration number 32**

# Polyphenol extraction from olive pomace of Montenegrin olive variety Žutica as the initial step in waste-valorisation strategy

Angela Maldonado[b], Ana Mardjokic, Gyula Vatai, Szilvia Bánvölgyi

Department of Food Processing Engineering, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b] Corresponding author e-mail: maldonado.espinel.angela.estefania@stud.uni-mate.hu

**Abstract:** Olive oil industry generated more than 3 million tons of olive oil in 2020 altogether with more than 30 million $m^3$ of wastewater and 20 million tons of solid residue, called pomace. The amount of waste generated depends on the production technology employed. In practice, and according to the EU regulations for waste management, two-phase centrifugation system is the preferred technology, as it requires a lower amount of additional water for the processing. Consequently, it is considered as an "ecological" way of production that results in the wet pomace as the most relevant by-product.
Wet pomace contains polyphenols as bioactive compounds, which have become a major concern because of their environmental impact. Moreover, polyphenols hinder various valorisation techniques, such as fermentation, digestion, or biological composting. Nevertheless, different studies have shown the importance of phenolic compounds in prevention of diseases related to oxidative stress (e.g., cardiovascular disease and cancer) due to their potential activity as antioxidants.
In this regard, this study focuses on the extraction of polyphenols from olive pomace obtained from the two-phase process of the autochthonous variety Žutica from Montenegro. This represents the initial step in obtaining added-value compounds that could be used in different industries such as pharmaceutical, cosmetology or food industries.
Pomace moisture was reduced below 10% by means of a tunnel dryer at 40 °C. Central composite design of experiment (CCD) was used for the evaluation of three factors during solvent extraction at constant stirring rate during 120 min. The evaluated factors were temperature (40 – 80 °C), ethanol concentration (10 – 90 v/v%) and solids concentration (2 – 12 g/100 mL). Moreover, the effect of the drying temperature was assessed via additional extractions, using 5 g/100 mL of pomace dried at 40 °C and 60 °C, with pure solvents, for 60 min at 70 °C. Determination of total phenolic content (TPC) was done through spectrophotometric Folin-Ciocalteu method.
The highest concentration of polyphenols of 503 mg GAE/L extract was obtained at 50 % ethanol, 60 °C and 12 g/100 mL solids concentration. Response surfaces of these factors were generated, thus revealing that the highest change in TPC is obtained with the variation of the solids concentration. Furthermore, the effect of the temperature during extraction seems to be more relevant at higher ethanol concentrations. On the other hand, the lowest drying temperature resulted in the highest polyphenol content.



**Keywords:** olive pomace, alperujo, waste management, polyphenols, solvent extraction.

**Acknowledgements:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 33**

# Effect of high hydrostatic pressure and heat treatment sequence on color, texture and water holding capacity of meat batter

G. Jónás[b], E. Balázs, K. Majzinger, A. Visy, K. Hidas, A. Barkó, L. Friedrich

Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: jonas.gabor@uni.mate.hu

**Abstract:** The aim of this experiment was to investigate the effects of pressure/heat treatment combinations, i.e. heat treatment before pressure treatment (H-P), pressure treatment before heat treatment (P-H) on meat batters. Heat treated and non-pressurized (H) meat batter was used as control. Pressure treatments were carried out at 450 and 600 MPa at room temperature with 5 mins holding time. Heat treatments were performed to +72 °C core temperature. After treatments, color, texture and water holding capacity (WHC) were determined. Statistical analysis was performed by analysis of variance (ANOVA) with sequence of pressure/heat treatments and pressure levels as factors ($p<0.05$). Independently of the sequence of treatments, the pressure treatment at 600 MPa significantly increased the lightness (L*) and decreased the redness (a*) of meat batters. P-H combination significantly increased the hardness of meat batters compared to H-P and H samples. The H-P and P-H combinations improved the cohesiveness of meat batters. The H-P treatment combination improved the water holding property of meat batters compared to P-H and H samples.
Industrial relevance: Heat treatment is a common process in meat industry. Application of high hydrostatic pressure in meat production has a lot of potential. The heat and pressure treatments can be combined in production, which might positively affect the properties of meat batter. Information on the effects of the sequence of high hydrostatic pressure and heat treatments helps meat industry to select the most suitable treatment combination.



**Keywords:** pressure, heat, meat, batter

**Acknowledgements:** This work was supported by the Thematic Excellence Program TKP2020-NKA-16 of Hungarian University of Agriculture and Life Science, awarded by Ministry for Innovation and Technology and also was supported by GINOP PLUS-2.1.1-21 Progressing Business Research, Development and Innovation. The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 35**

## Characteristics of potato-based seasoned flavoured sticks concerning the used oil

Zoltán Győri[b], Mohsen Mardani, Katalin Badakné Kerti, Anikó Kovács, Györgyné Kóczán

[b]Corresponding authors e-mail: zoltan.gyoeri@gmail.com

**Abstract:** Lipid oxidation is one of the major causes of deterioration of fats and oils, leading to losses of nutritional value, overall quality and the development of unpleasant flavours. Vegetable oils play a major functional role in the oxidative stability of foods, thus, it is important to understand the comparative shelf stability of oils that are used in producing different food products. The objective of our study was to compare the oxidative stability of different vegetable oils used in the production of potato-based seasoned sticks (produced in Intersnack Hungary Ltd., Győr, Hungary), whether being used in the dough of the product or sprinkled on the surface of the product after baking. A further objective was to study if the change in oil had any effect on the textural attributes or the NIR spectra of the products.
The study revealed that palm oil showed the highest stability among all oils and it can be used in the dough of the final products to reduce the final cost of the product and increase the shelf life of the final product. Using high oleic sunflower or high oleic rapeseed oil has also benefits, however, they showed different results for the measured parameters. According to these accelerated tests, all oils could be used in the production of potato-based salty sticks, however, organoleptic tests have to be conducted to test consumer acceptance.

**Keywords:** substitution, palm fat, NIR, texture analyses

**Acknowledgements:** The research was supported by the European Union through the EFOP-3.6.3-VEKOP-16-2017-00005 project and by the Doctoral School of Food Science. The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study

**Registration number 36**

## Development of a DNA-based quick test for the detection of soy in food

Erika E. Szabó[b], Judit Perjessy, Anna Jánosi

Hungarian University of Agriculture and Life Sciences, Food Science Research Group, H-1022 Budapest, Hungary

[b]Corresponding author e-mail: koppanyne.szabo.erika@uni-mate.hu

**Abstract:** Food allergy is an increasingly serious problem affecting around 1-2% of the population worldwide. In most cases it requires a strict diet, i.e. the elimination of allergenic ingredients from the diet. Soy contains a number of allergenic proteins that reduce the positive health effects of soy and cause allergic symptoms in soy-allergic individuals. Due to the general labelling requirements for allergens, the presence of soy must be indicated on the label of products containing soy and the exemption must be regularly checked. In our research, we aimed to develop a rapid, specific and highly sensitive assay method for the detection of soy content. First, we adapted two DNA-based simple PCR methods. We compared the methods (chloroplast AtpA gene-specific and LecI gene-specific) to see which one is more suitable to detect the DNA of a Hungarian soybean variety, Pannonia kincse, at the lowest possible concentration. We found that the AtpA gene-specific primers were more sensitive. Secondly, a lateral flow soybean DNA assay was developed based on the selected chloroplast AtpA primer pair. The assay is based on recombinase polymerase amplification. The proper functioning of the developed soy-specific DNA assay was successfully demonstrated by testing meat products with and without soy component. It was found that this developed test can be easily performed in situ under non-laboratory conditions, e.g. in shops, industry or restaurants. It requires no complex technical background and gives results after only 30-45 minutes.



**Keywords:** DNA, PCR, Field-test, soy-allergy

**Acknowledgement:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 37**

## Effect of prebiotics on the viability of probiotic microorganisms in fermented fruit juices during storage

Erika Bujna[b], Bianka Megyeri, Karina Békési, Quang D. Nguyen

Department of Bioengineering and Alcoholic Drink Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: Bujna.Erika@uni-mate.hu

**Abstract:** Functional foods including probiotics and prebiotics have some additional beneficial effects beyond the traditional ones such as improve health status, prevent and/or reduce the nutrition-related diseases, promote the benefits of physical and mental well-being. Recently, probiotic dairies predominate in the market due to many technofunctional advantages of milk. However, there is an increase in consumer demand for alternative functional food products such as cereal, vegetable and fruit based fermented drinks. Generally accepted opinion is that the probiotics can effectively exert their beneficial effects if they are delivered to the gastrointestinal tract in highly viable form ($10^6$-$10^7$ CFU/g or mL). Several factors could limit probiotic viability and survival such as intrinsic food parameters, processing parameters and microbiological factors. There are some strategies to protect the probiotic cells to improve survival in plant matrix such as encapsulation, fortification or incorporation of food with some prebiotics etc.

In this study, the effect of various types of prebiotics on the viability of the probiotic cells in fruit juices during storage under different conditions was investigated. The fermentations were carried out in both tropical and local fruit juices (plum, sour cherry) by probiotic *Lactobacillus* and *Bifidobacterium* strains. After 24-hour fermentation, the juices were stored at room (25 °C) and cold (4 °C) temperatures with or without addition of prebiotics. The viable cell counts and pH were monitored at regular time intervals. During storage, the pH decreased continuously making fermented juices more acidic. In case of tropical fruit juices, fructooligosaccharide and resistant starch were used as protective agent in different concentrations during storage. After storage at room temperature, the cell counts of juices with or without prebiotics supplementation were still $10^7$ CFU/mL at the end of month #1 and $10^5$ CFU/mL at month #2. During cold storage for 6 months, the viability was retained at the minimum daily amount required for it to confer specific health benefits. Similar findings could be observed in case of local fruit juices. This phenomenon was also observed in the case of xylooligosaccharide. The bifidobacteria are more sensitive to the harsh conditions compared to lactobacilli under both aerobic and anaerobic storage. Summarising, it can be concluded that the temperature is the most critical factor during storage of probiotic juices, and the supplementation with prebiotics did not support significantly the survival of probiotics in fermented fruit juices. The fruit juice rich in phytochemicals such as polyphenols, acids, dietary fibers etc. may also have protective effect on the viability of probiotics, thus, studies in this direction are suggested.



**Keywords:** fruit juice, fermentation, probiotics, prebiotics, storage

**Acknowledgements:** The research was supported by EFOP-3.6.3-VEKOP-16-2017-00005, GINOP-2.2.1-18-2020-00025, NKFIH-831-10/2019 and TKP2021-NVA-22 projects.

**Registration number 38**

# Investigation of *Monilinia fructigena* fungal infection in sour cherries with hyperspectral imaging

Flóra Vitális[1, b], Venet Nici[1], Juan-Pablo Aguinaga Bósquez[1], Zoltán Gillay[1], Marietta Petróczy[2], Zoltán Kovács[1]

[1] Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary
[2] Institute of Plant Protection, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b] Corresponding author e-mail: vitalis.flora@phd.uni-mate.hu

**Abstract:** Sour cherries are one of the most nutritionally and agronomically important stone fruits. However, its production, harvesting and storage are not without challenges. The significant losses in postharvest technologies are usually due to airborne fruit diseases among which *Monilinia* spp. causing brown rot are of key importance. The fluctuations in environmental conditions can damage tissues and reduce the resistance of stored fruits. The aim of the study was to determine the applicability of non-destructive and non-contact hyperspectral image processing for the detection of *M. fructigena* fungal infection.

In the study, sour cherries of the "Érdi bőtermő" and Újfehértói" varieties were infected with *M. fructigena* conidial suspensions of different concentrations (~$10^5$, $10^4$, $10^3$, $10^2$ conidia/mL), with or without injuring the fruits. Together with the sound control samples, half of the 90 fruits (10 control, 40 injured, 40 intact) per variety were stored at 5 °C and the other half at 24 °C. Desktop Headwall XEVA-1648 XC134 (Specim spectrograph, Xeneth InGaAs 14-bit sensor, 256 × 320 px spectral and spatial resolution) hyperspectral imaging system was used during the seven days of storage to obtain spectral and spatial information. Segmentation of fruit-related pixels was done with a department-developed software, which extracted the mean absorbances from nine spatial areas simultaneously. Spectral data were evaluated in the 1000-1650 nm wavelength range. Following different spectral pre-treatments, principal component analysis-based linear discriminant analysis (LDA) models were developed to assess the detectability of *Monilinia* infection.

The spread of *Monilinia* infection varied between the sour cherry varieties. Only fruits stored at 24 °C, injured and inoculated with a suspension of ~$10^5$ or ~$10^4$ conidia/mL showed signs of infection. After combined spectral pre-treatment, for both storage conditions, the LDA models classified fairly well the infected fruits on the first day of storage. In the present research, to date, we have applied solely the tools of hyperspectral image processing to detect changes during storage of sour cherries infected by *M. fructigena* in different ways. With models built on large digitised and properly pre-processed data, even fruit in the early stages of infection could be sorted.

**Keywords:** sour cherry, brown rot, contactless analytical rapid method, chemometrics

**Acknowledgements:** The authors acknowledge the Doctoral School of Food Science (Hungarian University of Agriculture and Life Sciences), the KDP-2021 (C1769369) Cooperative Doctoral Programme of the Ministry for Innovation and Technology from the source of the National Research, Development and Innovation Fund and by the European Union for the support in this study.

**Registration number 39**

# Comparison of organoleptic characteristics of ready-to-eat and home-cooked meals based on the same recipes

Mohannad AlOudat[1,b], Livia Simon Sarkadi[2], Hedvig Hidvégi[3], Anikó Balog-Sipos Szőcze[3], Andrea Lugasi[3]

[1]Doctoral School of Food Science, Hungarian University of Agriculture and Life Sciences, Buda Campus, H-1118 Budapest, Hungary
[2]Department of Nutrition, Hungarian University of Agriculture and Life Sciences, Buda Campus, H-1118 Budapest, Hungary
[3]Department of Hospitality, Faculty of Commerce, Hospitality and Tourism, Budapest Business School, H-1055 Budapest, Hungary

[b]Corresponding author e-mail: MohannadM.AlOudat@Gmail.com

**Abstract:** Globally, there has been an increased intake of energy-dense foods high in fat and sugars, such as ready-to-eat (RTE) meals. The RTE meals market is growing steadily around the globe. Alongside this growth, there is a rise in obesity and non-communicable diseases. Thus, highlighting the urgent need for studies that investigate the composition, healthiness, and acceptability of such meals. Therefore, we compared the organoleptic characteristics of RTE meals prepared by the catering industry and the same homemade (HM) meals cooked in the experimental kitchen of Budapest Business School (BBS).

Ten RTE meals were obtained from three different food delivery companies. The meals were mainly traditional Hungarian main courses (*e.g.* beef stew with red wine and tarhonya (special Hungarian pasta), roasted chicken liver with boiled potatoes, meat casserole with cauliflower, grilled chicken breast, cream cheese sauce, jasmine rice). The HM meals were exactly the same meals but prepared in the kitchen of the Hospitality Department in BBS by following the ingredients listed on the RTE meals' manufacturers' websites and the cuisine traditions in Hungary. The RTE meals were delivered and HM meals were prepared at three different times, thus, we had three independent replicates for each meal. Trained sensory reviewers tasted the meals by following the Hungarian Standard MSZ ISO 6658:2018. The sensory evaluation covered the meals' appearance, consistency, smell, and taste rated from one to five. The score is multiplied by a predefined weight factor for each trait; the results are summed to give a total score. A multivariate analysis of variance (MANOVA) was used to check if there is a significant difference between both meals' organoleptic characteristics. Moreover, we used independent samples t-test to compare the total score of both meals.

There was a statistically significant difference between RTE and HM meals on the combined dependent variables at $p < 0.001$. When we considered the results for the dependent variables separately, we noticed significant differences in all variables, appearance ($p<0.001$), consistency ($p<0.001$), smell ($p<0.001$), and taste ($p<0.001$). The means of the HM meals were higher than the RTE ones in all dependent variables; appearance (4.82 vs 3.94), consistency (4.63 vs 3.54), smell (4.74 vs 3.72), and taste (4.59 vs 3.42). The t-test showed that the HM meals ($M=18.79$, $SD=1.31$) were significantly more acceptable according to the MSZ standard than the RTE ones ($M=14.55$, $SD=2.86$); $p<0.001$.

**Keywords:** ready-to-eat meals, home-made meals, sensory evaluation, organoleptic, Hungary

**Acknowledgment:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 43**

## Effect of different inoculation media on L-asparaginase produced by *Aspergillus niger* F.00721

Stefan Savo Micevic[b], Erika Bujna, Quang D. Nguyen

Department of Bioengineering and Alcoholic Drink Technology, Hungarian University of Agricultural and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author's e-mail: stefansavo@gmail.com

**Abstract:** Being a natural compound, acrylamide, a probable human carcinogen, is formed when the temperature exceeds 120 °C, through the Maillard reaction (L-asparagine reacts with reducing sugars). L-asparaginase hydrolyzes the amide group of the side chain of asparagine, resulting in aspartic acid and ammonia. This enzyme displays potential in the food industry because of the reduction of consumed acrylamide in starchy food such as potatoes, toast, root vegetables, etc. Fungal L-asparaginase is positively enthralling to the food industry, on account of filamentous fungi transpiring as enzyme-producing powerhouses. Optimization of the process is the first step toward accomplishing the goal of mass application. This research focused on the effect of different inoculation media on the activity of L-asparaginase produced by the *Aspergillus niger* F.00721 strain.
Four different fermentation media were used to compare the effects of opposing inoculation media: Modified Czapek-Dox fermentation medium with 1% L-asparagine and 0.2% glucose (MCDAG), and no glucose (MCDA), 0.2% glucose with 1% peptone (MCDPG), and no glucose with 1% peptone (MCDP). Enzyme activity was assayed by the Nesslerization method.
The *Aspergillus niger* F.00721 strain synthetized L-asparaginase in all investigated media. In the case of supplementation with 1% L-asparagine, 0.207 U/ml and 0.011 U/ml L-asparaginase activities were assayed in the case of potato dextrose broth (PDB) and Czapek-Dox broth (CDB), respectively. With the addition of 0.2% glucose, the culture in the PDB medium showed higher enzyme activity (0.207 U/ml) than 0.011 U/ml in the case of CDB. Low enzyme activities were detected in the cultures without added glucose; 0.070 U/ml (CDB) and 0.165 U/ml (PDB). Meanwhile, 0.069 U/ml for CDB was detected for the sample with 1% peptone and no glucose, whereas 0.174 U/ml was for PDB. This trend was not observed in the case of 1% peptone and 0.2% glucose supplementation, where 0.168 U/ml and PDB 0.132 U/ml were detected for PDB and CDB, respectively.
The results are preliminary, but they provide a good basis for the production of L-asparaginase to reduce acrylamide in foods.



**Keywords:** L-asparaginase, *Aspergillus niger*, optimization, medium composition, modification of media

**Acknowledgements:** The research was supported by GINOP_PLUSZ-2.1.1-21-2022-00048, EFOP-3.6.3-VEKOP-16-2017-00005, and TKP2021 projects, as well as the Hungarian University of Agriculture and Life Sciences' Doctoral School of Food Science.

**Registration number: 45**

## Fatty acid composition of traditional sausage produced in Kosovo

Kaltrina Berisha[1,2], Albert Gashi[1], Zsuzsanna Mednyánszky[1], Hysen Bytyqi[3], Livia Simon Sarkadi[1,b]

[1]Department of Nutrition, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary
[2]Department of Food Technology with Biotechnology, University of Prishtina ''Hasan Prishtina'', Prishtina, Republic of Kosovo
[3]Department of Animal Sciences, University of Prishtina ''Hasan Prishtina'', Prishtina, Republic of Kosovo

[b] Corresponding author e-mail: simonne.sarkadi.livia@uni-mate.hu

**Abstract:** Based on classification of sausages given by Savic (1985), traditional sausage of Kosovo falls in the group of precooked non fermented sausages. It is a meat product produced from ground beef, combined with salt, spices, and other flavourings, and wrapped in a skin. This sausage does not go under fermentation or smoking process, since it is only dried. The aim of this study was to determine the fatty acid composition of this traditional sausage. Fatty acids were detected by gas chromatography. The main saturated fatty acids were palmitic acid (C16:0; 30.25%) and stearic acid (C18:0; 18.78%). Oleic acid (C18:1; 34.37%) was the main representative of the monounsaturated fatty acids, while linoleic acid (C18:2; 2.27%) was of polyunsaturated fatty acids. The ratio of the total saturated fatty acids and total unsaturated fatty acids was 0.7, which is lower than data reported in the literature. Our data shows a lack of healthy polyunsaturated fatty acids and high amount of saturated fatty acids in traditional sausage of Kosovo compared to the data in the literature for the same type of sausage. Those differences are affected by the sausage making technology, emphasizing the need for improvement of the technological process of sausage production in order to produce more nutritional and healthier product.



**Keywords:** Fatty acid, sausage, monounsaturated, polyunsaturated, saturated fatty acids

**Acknowledgements:** We are grateful for the Stipendium Hungaricum scholarship provided to PhD students and for the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Reference:** Savic, I. V. (1985). Small-scale sausage production, FAO Animal Production and Health Paper, 52, ISBN: 92-5-102187-2 Accessed: 31.03.2022 https://www.fao.org/3/x6556e/x6556e00.htm

**Registration number 50**

## Colour stability of crossbred elderberry genotypes after heat treatment

Efaishe Kavela, Anna Miklovicz, Mónika Máté, Lilla Szalóki-Dorkó[b]

Department of Fruit and Vegetable Processing Technology, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: szaloki-dorko.lilla@uni-mate.hu

**Abstract:** Elderberry (*Sambucus nigra L.*) is a good source of anthocyanins, therefore, a preferred source of natural food colourant in the food industry. Anthocyanins are not very stable, some factors such as heat can affect their concentration in berries and their products during processing. Furthermore, different varieties should be studied to select elderberries with high and stable pigment concentration.
The aim of this study was to evaluate the colouring potential and colour stability of different crossbred elderberry genotypes after heat treatment (85 °C for 3 minutes). Haschberg (H) variety was used as control and three different crossbred genotypes were seleced for the experiments: Haschberg×Sampo (HS), Haschberg×Samocco (HSC) and Haschberg×Wild (HW). Total anthocyanin concentration was evaluated using pH differential method (AOAC Official Methods 2005.02). Colour parameters were determined by Konica Minolta digital colorimeter, water soluble solid values were measured by digital refractometer.
According to the results, untreated samples indicated higher anthocyanin concentrations (ranged 5944-4300 mg CGE/L) than treated samples (ranged 4530-2148 mg CGE/L). In terms of elderberry samples, pigment content decreased by 26% in case of Haschberg, by 46% in case of HS, by 56% in case of HSC and only by 13% in case of HW (Table 1).

Table 1. Total anthocyanin concentration of the elderberry samples

| Variety/Genotypes | Total anthocyanin content (mg CGE/L) | |
|---|---|---|
| | Untreated | Heat-treated |
| Haschberg (H) | 4299.96 ± 271.59 | 3183.92 ± 69.52 |
| Haschberg×Sampo (HS) | 5944.81 ± 23.62 | 3217.32 ± 126.44* |
| Haschberg × Samocco (HSC) | 4867.73±106.27 | 2148.59 ± 69.52* |
| Haschberg×Wild (HW) | 5193.35 ±221.02 | 4530.96 ± 217.29 |

*Representing significant differences ($P<0.05$) between untreated and heat-treated samples.

The calculated colour difference values (ΔE*) ranged 1.62-2.02, so the differences between the untreated and treated samples were noticeable. Water soluble solids decreased by ca. 6-8% after heat treatment in case of each sample.
In summary, heat caused considerable change in total anthocyanin concentration, which influences the colouring ability of elderberry. Based on the measurements, Haschberg×Wild genotype has a good potential for use as food colouring.

**Keywords:** elderberry, colour, anthocyanin, colouring food, heat

**Acknowledgements:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science and EFOP-3.6.3-VEKOP-16-2017-00005 for the support in this study.

**Registration number 52**

## The effect of temperature and sodium chloride on the growth of *Listeria monocytogenes*

Sabrine Labidi[b], Gabriella Kiskó, Csilla Mohácsi-Farkas

Department of Food Microbiology, Hygiene and Safety, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding authors e-mail: Labidi_sabrina@yahoo.fr

**Abstract:** *Listeria* species are widespread in the environment including soil, raw foods, stream water, silage, sewage, plants, and animals. However, *Listeria monocytogenes* is a pathogen that can cause infections in humans, thus representing a major concern for public health and from economical aspect. Our aim was to study the effect of temperature and sodium chloride on the growth of *Listeria* strains and their associated biofilms. Therefore, the biofilm formation of two strains of *Listeria monocytogenes* in M9 Minimal Medium with a high concentration of sodium chloride (15%) and at a low temperature (1°C) was examined. It could be noticed that *L. monocytogenes* strains formed decreasing amounts of biofilm when treated with low temperature and high concentration of sodium chloride. However, the weak biofilm forming strain was less sensitive to the temperature than the strong biofilm forming strain.

**Keywords***:* *Listeria monocytogenes*, temperature, sodium chloride

**Acknowledgements:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study. The Project was supported by the European Union and co-financed by the European Social Fund (grant agreement no. EFOP-3.6.3-VEKOP-16-2017-00005).

**Registration number 53**

# Tracing the geochemical origin of fruits grown in different regions of Hungary with data analysis of metal content

My Ban Thi[1,b], Győző Jordán[2], Géza Hitka[3], Quang D. Nguyen[1]

[1]Department of Bioengineering and Alcoholic Drink Technology, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary
[2] Eötvös Loránd University (ELTE), H-1053 Budapest, Hungary
[3]Department of Postharvest, Trade, Supply Chain and Sensory, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding authors e-mail: banthimy@gmail.com

**Abstract:** Food traceability is a critical aspect of the industry worldwide, and it has gained increasing interest in the global food supply chain at the international level. Among the traceability methods, chemical analysis methods of soil and related food bring many accurate results, where the interaction between soil and plants such as fruits and vegetables can be represented. The soil versus fruit metal element content is considered effective for food traceability related to geographical conditions, and it has already shown promising tracing accuracy.
Hungary is the ninth largest fruit producer in the EU, with about 1.27 million tons (3%) of total EU fruit production in 2020. Fruit output is an essential part of the economy, and it contributed to 4.4% of the agricultural output in 2020, which equals 1.2% of the EU27. In accordance with the sustainable development goal, and in response to the food safety needs and challenges facing modern business and food production, the GINOP project has been conducted to determine the fruit and vegetable origin grown in soils in Hungary. Based on the thorough soil and plant (apple and pear) sampling campaign in 6 regions, a model of environmental factors influencing the traceability of fruits and vegetables is proposed, highlighting differences between the geographies of the studied fruit producing regions. Our initial results are encouraging, supported by a systematic series of activities (experimental design, selecting sampling locations, developing sampling strategies and sample handling procedures, post-collection data processing, and advanced data analysis), indicating that the metal element content is applicable to distinguish the food geographies of fruits. Further origin tracing methods can be elaborated based on the analysis of a broader list of chemical elements studied, or isotopic ratios, or based on the various forms of chemical elements in the soil-plant system.



**Keywords:** food traceability, geological origin, designed sampling experiment, chemical composition, fruit origin

**Acknowledgments:** This work is supported by the New Széchenyi Plan Project No. EFOP-3.6.3.-VEKOP-16-2017-00005, the projects No. GINOP-2.2.1-18-2020-00025, and No. NKFIH-831-10/2019, TKP2021-NVA-22 as well as by the Doctoral School of Food Science, Hungarian University of Agriculture and Life Sciences.

**Registration number 55**

## Microencapsulation of extra virgin olive oil by freeze drying: effect of wall materials composition and emulsification method

Donia Chaabane[b], Asma Yakdhane, Arijit Nath, Krisztina Albert, András Koris, Gyula Vatai

Department of Food Engineering, Faculty of food science, Hungarian University of Agriculture and Life Sciences (MATE), H-1118 Budapest, Hungary

[b]Corresponding author e-mail: donia.chaaben@gmail.com

**Abstract:** The objective of the study was to investigate the microencapsulation of extra virgin olive oil by freeze drying to increase its stability and application area. The effect of homogenization methods in terms of rotor–stator (RSH) and cross flow membrane emulsification (CFME) and the effect of wall materials composition were examined on physical properties of microencapsulated extra virgin olive oil powder (MEVOP). Maltodextrin (MD), carboxymethyl cellullose (CMC) and gum arabic (GA) were used as wall materials, and micro- encapsulation was carried out in a laboratory type freeze dryer.
The physical properties of MEVOP obtained either by RSH or CFME have been discussed.
As result, the optimal process parameters were chosen from experimental design settings for economical modelling. Furthermore, characterization of microcapsules from different aspects, particle sizes and distributions, encapsulation efficiency and moisture content had been discussed.

**Keywords:** Emulsification, olive oil, bioactive ingredient, wall materials, microencapsulation, freeze drying

**Acknowledgements:** This project is funded by the European Union and co-financed by the European Social Fund (Grant agreement number: EFOP-3.6.3-VEKOP-16-2017-00005). We would like to acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 56**

## Digestibility of powdered milk protein concentrate – an *in vitro* study

Fanni Bilkei[b], Mária Berki, Éva Lengyelné Kónya, Rita Tömösköziné Farkas, Judit Tormási, László Abrankó

Department Food Chemistry and Analysis, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Science, H-1118 Budapest, Hungary

[b]Corresponding authors e-mail: bfannii96@gmail.com

**Abstract:** Milk protein concentrates (MPCs), which are produced from pasteurised milk applying membrane filtration, evaporation and spray drying, represent a relatively new category of dairy ingredients and are increasingly used to provide nutritional and functional benefits in various dairy and food products. In terms of nutritional value, MPCs are conventionally characterised by their protein contents, which figure alone does not provide a fully realistic picture on the nutritional value of a given protein. In this work, a deeper insight on the nutritional value of a commercially available MPC80 product (Sole-Mizo, Csorna, Hungary) is presented. For this purpose, *in vitro* digestion simulation of the product using the Infogest method, an international consensus protocol for the simulation of human gastrointestinal digestion is carried out to determine the *in vitro* protein digestibility (IVPD%) of the protein content. The amino acid profile of the product as well as the bioaccessible protein fraction isolated by methanolic precipitation of the digest are also studied using microwave assisted acidic hydrolysis and UHPLC-UV method after derivatisation with an AQC reagent. Based on the determined attributes, the protein digestibility corrected amino acid score (PDCAAS) and the digestible indispensable amino acid score (DIAAS), two internationally acknowledged figures to characterize the nutritional value of protein, can be calculated. Results of the above study will be detailed in the poster.



**Keywords:** digestion, milk protein concentrate, MPC

**Acknowledgements:** The financial support of the OTKA K135 294 and GINOP_PLUSZ-2.1.1-21-2022-00048 grants are kindly acknowledged.

**Registration number 58**

# Evaluation of microencapsulation of flaxseed oil performed using membrane emulsification along with spray-drying and freeze-drying technologies

Asma Yakdhane[1,b], Eya Yakdhane [2], Donia Chaabane [1], Arijit Nath[1], András Koris[1]

[1]Department of Food Engineering, Faculty of Food Science, Mate University, H-1118 Budapest, Hungary.
[2]Department of Microbiology and Biotechnology, Faculty of Food Science, Mate University, H-1118 Budapest, Hungary.

[b]Corresponding author e-mail: asma.yakdhane@gmail.com

**Abstract:** Flaxseed oil is considered an important food ingredient and increasing attention has been paid to its potential health benefits. The aim of this work was to evaluate the effect of different combinations of wall materials with different ratios of maltodextrin, gum arabic and modified starch, and the use of two different drying technologies on the encapsulation of flaxseed oil through the evaluation of emulsion properties and encapsulation efficiency.
As a first step, oil-in-water emulsion preparation was carried out by membrane emulsification using a 1.4 µm microporous membrane and following a cross-flow design, during which the aqueous suspension of wall material and soya lecithin, used as emulsifier in all formulations, was considered as a continuous phase, and flaxseed oil was used in the dispersed phase.
Subsequently, spray-drying and freeze-drying were adopted for preparation of microcapsules.
The effect of different wall materials on emulsion properties was investigated by determining the emulsion stability.
A comparison between the characteristics of powders produced using spray-drying technology and those produced using freeze-drying technology was done through the evaluation of microencapsulation efficiency, bulk density, powder wettability and moisture content.



**Keywords:** Flaxseed oil, emulsion, membrane emulsification, spray drying, freeze drying

**Acknowledgements:** Authors acknowledge the support from the European Union project (grant agreement no. EFOP-3.6.3-VEKOP-16-2017-00005). A. Yakdhane, E. Yakdhane, and D. Chaabane acknowledge the support of Doctoral School of Food Science, MATE University, Hungary.

**Registration number 59**

## Effect of aeration and manganese concentration on pigment production by *Yarrowia* yeast

Gizella Sipiczki[b], Erika Bujna

Department of Bioengineering and Fermentation Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: gizisipi@gmail.com

**Abstract:** Natural and synthetic pigments are widely used in the food industry, the textile industry, the paper industry, agriculture and water science. Natural pigments not only increase the marketability of products but also have beneficial biological activities as antioxidant and anti-cancer agents, while synthetic pigments have harmful toxicological side effects (Malik et al., 2012). *Y. lipolytica* is known for its ability to produce melanin pigments from L-tyrosine naturally. The pigments produced by *Y. lipolytica* are presumably pyomelanins, which are formed via the homogentisic acid (HGA) intermediate. HGA accumulates outside the cell, where it undergoes autooxidation and polymerization to form pyomelanin (Tahar et al., 2019).
In this research, the pigment production of different *Yarrowia* strains (*Y. lipolytica*, *Y. porcina*, *Y. divulgata*) were examined. The pigment production was monitored spectrometrically at 400 nm during the fermentation. The fermentation was carried out at different agitation rates - 0, 100, 130and 160 rpm - in buffered medium (pH 8) to follow pigment production. Based on the results of the optical density, it can be concluded that the maximal absorbance values were different at each shaking speed, and the highest value was detected at 160 rpm. In case of 100 rpm and 130 rpm, there was no significant difference between the maximum values. The results of pigment production after one week of fermentation showed that the best producing strain was *Y. lipolytica* in all settings. There is a significant difference in the pigment production at various agitation rates. The maximum absorbance for fermentation without shaking was half of the fermentations' at 100 rpm and 160 rpm. The highest absorbance value was measured at an agitation rate of 130 rpm, which is about twice the maximum of at 100 and 160 rpm. For *Y. porcina* and *Y. divulgata*, the maximum absorbance remained below 0.5 with no significant effect of shaking rates, however, *Y. porcina* proved to be a better pigment producer. The inducing effect of manganese on pigment production at four different concentrations - 0, 0.1, 0.2 and 0.5 g/L - was investigated at 130 rpm in a pH 8 buffered medium for one week. It can be concluded that the pH increased continuously during fermentation for all investigated strains. Based on the absorbance values, *Y. lipolytica* proved to be the best pigment producer at the different manganese concentrations, and the highest absorbance value was measured in the media supplemented with 0.2 g/L manganese. For *Y. porcina* and *Y. divulgata* strains, the maximal production could be reached at concentration of 0.5 g/L. Of these two previous strains, *Y. porcina* proved to be a more efficient pigment producer, but both strains' values lag behind pigment production *of Y. lipolytica* .



**Keywords:** *Yarrowia*, pigments, pyomelanin, aeration, manganese

**Acknowledgements:** The research was supported by the ÚNKP-21-3 New National Excellence Program by of the Ministry of Innovation and Technology and the Doctoral School of Food Science.

**Registration number 60**

## Enhanced biological biotreatment of wheat bran using two consortiums of fungal strains

Ouahab Riyad[1,b], Csilla Farkas[1], Viaji Kumar Gupta[2], Quan D. Nguyen[1]

[1]Department of Bioengineering and Alcoholic Drink TechnologyHungarian, University of Agriculture and Life Sciences, H-1118 Budapest, Hungary
[2]Department of chemistry and biotechnology, Scotland's rural college, Parkgate, Scotland

[b]Corresponding author e-mail: ouahab.Riyad@phd.uni-mate.hu

**Abstract:** Lignocellulosic biomass is one of the most abundant renewable resources on Earth. It provides an attractive feedstock for ethanol production due to its richness in carbohydrate compounds (about 55-75% dry basis). Due to the complex structure, this biomass needs pre-treatment, and recently for that purpose thermal/chemical methods are frequently used. However, these technologies usually need expensive corrosion-resistant reactors, processing large volumes of the waste stream, extensive washing of treated solids, and detoxification of compounds inhibitory to ethanol-fermenting microorganisms.
From both economic and environmental perspectives, fungal pre-treatment with lignin-degrading microorganisms, primarily white-rot fungi, have attracted interest as an alternative to thermal/chemical pretreatment for cellulosic ethanol production.
In this study, the effect of a consortium formed by different genera of fungi (*Aspergillus*, *Penicillium* and *Trichoderma*) on the bio-pretreatment of wheat bran was investigated. The highest soluble carbohydrate content (215.2 mg/gds) was released after 3 days of pre-treatment by the consortium of *T. viride* F.00795, *Aspergillus awamori* F.00720, and *Penicilium granulatum* F.00913. The optimal ratio of liquid to solid, pH and temperature as well as inoculum ratio were determined to be 7:1, pH 6.25, 45 °C, and 33:33:33% in total $6.10^5$ conidia of *A. awamori*, *P. granulatum*, and *T. viride*, per gram dry substrate. The addition of *Thermothelomyces thermophila* TK38 on the second day of pretreatment improved total sugar yield to 238 mg/gds. Our results are very promising and can serve as a good basis for development of microbial pre-treatment method for lignocellulosic biomass.



**Keywords:** Biotreatment, fungal consortium

**Acknowledgments:** The research was supported by KFI_16-1-2017-0077, TKP2021-NVA-22 and EFOP-3.6.3-VEKOP-16-2017-00005 projects. Riyad is PhD student in the Doctoral School of Food Science, Hungarian University of Agriculture and Life Sciences

**Registration number 61**

## Brewing industry relevant properties of *Brettanomyces* yeasts

Csongor Mátyás Lei[1,b], Gabriella Kun-Farkas[1]

[1]Department of Bioengineering and Alcoholic Drink Technology, Hungarian University of Agriculture and Life Sciences, Institute of Food Science and Technology, Budapest, Hungary

[b]Corresponding author e-mail: leicsongor@gmail.com

**Abstract:**
Traditionally, two types of yeast (top and bottom fermenting) have been used in brewing technology, but recently wild yeast are also included in the fermentation process. These yeasts are most commonly found in nature, on the skins of fruits, but also distributed for industrial application. Their most common representatives are the strains of *Brettanomyces bruxellensis*, *Brettanomyces claussenii*, *Brettanomyces lambicus*, *Brettanomyces buchneri* or *Torulaspora delbrueckii* spieces. Since these microorganisms have been mostly considered as spoilage yeasts in brewing and winemaking, there have been few scientific studies on how they behave when used deliberately for fermentation of brewery wort.
Our experiments compared the fermentation properties of two Brettanomyces strains during fermentations with different inoculation times and parameters.
The used strains belong to the *Brettanomyces bruxellensis*, *Brettanomyces claussenii* and *Saccharomyces cerevisiae* species.
The flocculation and sedimentation abilities of the yeasts have technological importance, therefore co-flocculation, the interaction of pH and flocculation, and sedimentation in both mixed and monoculture fermentation environments were also investigated.
Beside carbohydrates, the change of free alpha-amino nitrogen (FAN) content is a general measure of the metabolic activity of yeast cultures, and therefore FAN contents were measured and its changes were monitored during fermentation.
Brettanomyces strains have a lower amino acid requirement than brewer's yeast, because it is likely to use different or multiple sources of nitrogen or does not prefer amino acids as brewer's yeast.
Different strains of yeasts utilize the carbohydrate content of wort in different ways and at different rates, and competition also affects that. The initial carbohydrate spectrum and the changes during fermentation were determined using HPLC system.
The alcohol and alpha-acid tolerance of yeasts are important technological aspects, so these properties were also determined by microfermentation assays.



**Keywords:** Brettanomyces, competition, beer, organoleptic properties

**Acknowledgements:** The research was supported by the New National Excellence Programme of the Ministry of Innovation and Technology, code number ÚNKP-21-2-I, funded by the National Research, Development and Innovation Fund
The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 62**

# The performance of Micro-Tester as a redox potential measurement for microbial detection and quantification

Eya Yakdhane [1,b], Dóra Tőzsér[2]; Katalin Szakmár[2]; László Baranyai[3]; Gabriella Kiskó[1]

[1]Hungarian University of Agriculture and Life Sciences (MATE), Faculty of Food Science, Department of Food Microbiology and Biotechnology, Budapest, Hungary
[2]Department of Food Hygiene, University of Veterinary Medicine, H-1078 Budapest, István u. 2. Hungary
[3]Hungarian University of Agriculture and Life Sciences (MATE), Faculty of Food Science, Department of Physics-Control, H-1118 Budapest, Somlói út 17, Hungary

[b]Corresponding author e-mail: yakdhane.eya@phd.uni-mate.hu

**Abstract:** The major challenge we still face is to ensure the food safety and to detect the source of contamination in a rapid and efficient way. Since plate counting, which is the conventional technique, is a time-consuming method, it can affect the rapid detection of emergency risks. Thus, several techniques were developed for a faster microbial detection. The main goal of this study was to have an overview about the performance of using Micro-Tester as a redox potential measurement unit for microbial quantification and identification. Within this study, we could establish a comparison based on previous studies between four microbial counting methods: the conventional method, the impedimetric method, the REAL-TIME PCR method, and the redox potential method, according to several aspects such as accuracy, selectivity, repeatability, reproducibility, and time-consumption, etc. We have concluded that redox potential technique is an easy, rapid, and an accurate method. It has also shown a good selectivity, repeatability, and reproducibility, same as the other methods. However, for samples that contain several bacterial species, it should be combined with another technique such as REAL-TIME PCR method for distinguishing the species present. Nevertheless, from comparing the shape of redox potential curves of several bacteria that have been studied previously, we could detect some differences especially for Escherichia coli. It has a unique, remarkable, and easy distinguishable shape.



**Keywords:** Food safety, plate counting method, impedimetric method, REAL-TIME PCR method, Micro-Tester, redox potential, E. coli.

**Acknowledgements:** Authors acknowledge the support from European Union project (grant agreement no. EFOP-3.6.3-VEKOP- 16-2017-00005). E. Yakdhane acknowledge the support of Doctoral School of Food Science, Hungarian University of Agriculture and Life Sciences, Hungary.

**Registration number 63**

# Analyzing the effect of culture media composition on peptide mass fingerprints of Gram-positive bacteria

Botond Surányi[1,b], Tekla Engelhardt[2], Csilla Mohácsi-Farkas[1]

[1]Department of Food Microbiology, Hygiene and Safety, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary
[2]Digital Food Institute, University of Veterinary Medicine, H-1078 Budapest, Hungary

[b]Corresponding author e-mail: botondsuranyi@hotmail.com

**Abstract:** In recent years, Matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS) has been used to differentiate and characterize microbes based on their peptide mass fingerprints. Different growth conditions such as culture medium composition affect protein expression, enzyme levels, cell physiology and composition, thus can have an impact on bacterial mass spectra as well.
As revealed by our previous examinations, a visible variability in the mass spectra of microbes grown under different conditions can be obtained.
The aim of our study was to examine the impact of culture medium on the mass spectra of Gram-positive bacteria.
In this study, *Staphylococcus aureus* strains were cultivated on different culture media, and generated mass spectra were identified by MALDI-TOF MS. These bacterial strains were obtained from the National Collection of Agricultural and Industrial Microorganisms (Hungarian University of Agriculture and Life Sciences). During identification, this technique produces characteristic mass spectral fingerprints of each isolate to identify the microorganism.
Several culture media were used to have a variety of culture medium compositions. High-nutrient (TSA), low-nutrient (R2A) and high-nutrient for waterborne bacteria (Yeast extract agar), as well as the validated culture medium for the identification of *S. aureus* (Baird-Parker agar) were used during the experiments. Discriminant analysis was used to determine the effect of culture medium on the identification.
Our measurements suggest that mass spectral changes of *S. aureus* strains cultured on different media can be detected by discriminant analysis.



**Keywords:** MALDI-TOF MS, culture media, rapid identification, *Staphylococcus aureus*

**Acknowledgements:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 64**

## Comparative study of coffee substitutes

Nóra de Jonge, Katalin Kóczán-Manninger[b], Vivien Szatmári, Ildikó Szedljak, Katalin Badak-Kerti

Department of Grain and Industrial Plant Processing, University MATE, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: koczan.gyorgyne@uni-mate.hu

**Abstract:** Coffee is one of the most consumed drinks in the world. However, beside its positive effects, some of its nutritional attributes are not fulfilling everyone's requirements. The market of coffee substitutes therefore is a fast growing market.
In our research substitutes found on the market and our own samples made with barley as base material were compared. The existing solutions to replace coffee are based either on using tubers as chicory or cereals as barley (or malted barley). We used non-malted barley roasted to different degrees, using surface response method design.
Physico-chemical parameters (e.g. color, pH) and organoleptic parameters (as odor, taste..etc) were identified of drinks made of the roasted barley samples. We also included samples from the market in our comparison.
Although promising results were obtained, the best coffee substitute is yet to be found.
Barley samples were roasted at 250 °C for 10, 15, 20 minutes. In each case, the roasting process was followed by a rest period of 15 minutes. During this time, the samples were cooled to 60 °C.
The grinding of the samples was designed so as not to cause excessive heating. Each sample was ground for 2 minutes using a Dyras CFFG-I 10 Finesto coffee grinder.
Coffee drinks were prepared in two different ways.
First, the 10, 15 and 20-min ground roasted samples were cooked in a Klarstein Aromatica coffee machine, but this did not yield adequate results.
A French Press coffee machine was then used. Roasted and ground samples were processed for 10, 15 and 20 minutes, for which 40.0 g of sample and 300 $cm^3$ of hot water were measured after several preliminary experiments. This process has already brought an enjoyable taste and a color close to coffee.
Using a Konica Minolta CR-310 colorimeter, we measured the color characteristics of the roasted samples. During the measurement, the grounds as well as the brewed beverages were examined. A sample of 10.0 g was weighed from the grounds and 40.0 g from the beverages. PH measurements were performed using the TESTO 206-pH2 starter set. For each sample, 5-5 parallel measurements were performed.
We also made a sensory comparison between the barley coffees we made and the commercially available coffee substitutes. The classification of barley coffee has yielded good results, but it can be noted that the addition of sugar and milk increases the enjoyment value, which is worth considering.



**Keywords:** barley, chicory, coffee substitutes

**Acknowledgements:** The research was supported by the Doctoral Scool of Food Science and by the European Union and co-financed by the European Social Fund (grant agreement no.EFOP-3.6.3.-VEKOP-16-2017-00005).

**Registration number 65**

## Examination of the effect of relative humidity on different properties of pork loin during curing and ageing

Anna Visy[b], Gábor Jónás, Zsuzsanna Horváth-Mezőfi, Karina Ilona Hidas, Annamária Barkó, Koppány László Majzinger, László Friedrich

Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: visy.anna@uni-mate.hu

**Abstract:** In this study, the effects of relative humidity during meat curing and ageing of pork loin *(Longissimus dorsi)* on the quality characteristics, salt and mass transport processes, protein denaturation and structural changes were investigated. Boneless, cut pork loin weighing approximately 1 kg were used to perform the experiment. The samples were salted with 10% nitrite salt by weight of meat. The experiment was carried out in ageing chambers at 65%, 75% and 85% relative humidity and controlled temperature (curing: 3 °C, 7 days; ageing: 12 °C, 21 days). The measurements were carried out on the following days: 0, 1, 5, 7, 14, 21 and 28. Effects of relative humidity on NaCl content and diffusion in pork loin, colour, water activity, protein denaturation and meat tissue microstructure were examined. At the end of the experiment, the NaCl contents of the samples treated at three different relative humidity levels were 8-9 g/100 g, but there were no significant differences between the samples. For meat samples cured and aged at lower relative humidity, salt and water diffusion was found to be faster. There were no significant differences in water activity values between samples with 65%, 75% and 85% relative humidity. At the end of the ageing period, colour differences between the 65%, 75% and 85% samples appeared, which were already statistically significant, mainly in the red (a*) colour. The measurements of protein denaturation show that relative humidity has no significant effect on the changes in the state of meat proteins. This change is due to the effect of curing, which denatures the proteins. The SEM images show the swelling of muscle fibres due to the curing in addition to the forming of salt crystals. During the ageing process, the muscle bundles dehydrate, making it difficult to see the sharp boundaries between the fibres.



**Keywords:** pork loin, curing, ageing, relative humidity

**Acknowledgements:** This work was supported by the Thematic Excellence Program TKP2020-NKA-16 of the Hungarian University of Agriculture and Life Science, awarded by the Ministry for Innovation and Technology. The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 66**

## Effect of enrichment with monofloral pollens on the total phenolic and flavonoid contents of baked goods

Rita Végh[1,b], Mariann Csóka[1], Éva Stefanovits-Bányai[2], László Sipos[3]

[1]Department of Nutrition, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary
[2]Department of Food and Analytical Chemistry, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary
[3]Department of Postharvest and Sensory Science, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: Vegh.Rita@phd.uni-mate.hu

**Abstract:** Pollen pellets collected by honeybees (*Apis mellifera* L.) have become increasingly widely consumed, mainly due to their antioxidant properties. Compared to other apicultural products, pollen can be harvested in relatively large quantities. Consequently, it can be used efficiently and economically to fortify foods with potentially beneficial nutrients. The aim of our work was to investigate the effect of the addition of pollen on the total phenolic content (TPC) and flavonoid content (FC) of biscuits. The products were prepared according to the official AACC method. Pollen from oilseed rape (*Brassica napus* L.), lacy phacelia (*Phacelia tanacetifolia* Benth.) and sunflower (*Helianthus annuus* L.) were selected for fortification, because these plants bloom over a large area at a given time, allowing beekeepers to harvest them monoflorally. Enrichment was carried out by supplementing the wheat flour with 2, 5 and 10% of ground pollen of each type. The total phenolic and flavonoid contents of aqueous methanolic extracts of pollen pellets and biscuits were determined spectrophotometrically. Besides, the polyphenol content of aqueous extracts of biscuits was also determined. Based on our results, it appears that the pollen of lacy phacelia contains more polyphenols than rapeseed and sunflower pollens, and enrichment with it also resulted in the highest values for biscuits. Our results suggest that honeybee collected pollens are suitable for the fortification of bakery goods, as 10% enrichment of all three pollen types significantly increased the amount of phenolic compounds in the aqueous extracts compared to the control. In the case of phacelia, 5% of enrichment was sufficient for statistically significant increasement. In order to evaluate the developed products more comprehensively, our plan is to further investigate their nutritional properties, physical parameters and organoleptic characteristics.



**Keywords:** bee pollen, biscuit, antioxidant, flavonoid, total phenolic content

**Acknowledgements:** This research was supported by the National Research, Development and Innovation Office of Hungary (OTKA, contracts No. 135700). The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 67**

## Consumer perceptions towards organic food in Hungary

Gyöngyi Györéné Kis[1b], Gabriella Soós[2], Andrea Lugasi[2]

[1]Research Institute of Organic Agriculture, H-1033 Budapest, Hungary
[2]Faculty of Commerce, Hospitality and Tourism, Budapest Business School, H-1054 Budapest, Hungary

[b]Corresponding author e-mail: gyorene.kis.gyongyi@gmail.com

**Abstract:** The world market of organic products has increased significantly in recent years. The expansion is partly due to the significant increase in consumer interest in healthy foods due to the COVID-19 pandemic. In Hungary, the market share of organic products is low, estimated at only 0.5% of the total food turnover. The "National Action Plan for the Development of Organic Farming" program aims to double the average domestic consumption of organic products per capita by 2027.
The aim of the research is to assess the consumer habits of Hungarian consumers related to organic products. The research examined the awareness of organic foods, the frequency of consumption of each product, the preferred sales channels, the target groups involved, and consumer motivations. In addition to the above, we analyzed how the pandemic affected the consumption of organic food.
The consumer behaviour of organic food was examined in the framework of an on-line questionnaire survey. A total of 555 responses were received, the data of which were evaluated using the SPSS statistical program.
The majority of respondents consume organic products on a monthly basis. Most of them are well acquainted with the logos of the two Hungarian inspection bodies and are, on average, knowledgeable about the EU organic label. The majority of respondents consider organic products to be significantly more expensive than their conventional counterpart products. At the same time, the majority of respondents would be willing to pay a maximum of 20% more for organic products than for conventional products. An important aspect in the choice of organic food is healthy lifestyle, production free of synthetic chemicals and that their production pollutes the environment less. Quality, product composition and price play a decisive role in the purchase of organic food. Reducing consumer prices, widening access (in several shops, restaurants) and further scientifically proving the health benefits of these products can help to further increase the consumption of organic products.

**Keywords:** organic food, consumer behaviour, food market, preferences

**Registration number 68**

# Development of a social inclusive immersive virtual reality exergame to promote physical activity

Abdul Hannan Bin Zulkarnain[1], Alin Totorean[2], Attila Gere[1,b], Eduardo Cruz[3], Brian Horsak[4], Linda Lancere[5], Lukas Schöffer[5], Mark Simonlehner[4], Mihaela Crișan-Vida[2], Rita Fernandes[3], Yasmine Sterckx[6]

[1]Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary
[2]Politehnica University Timisoara, Timisoara, Romania
[3]Polytechnic Institute of Setúbal, Setúbal, Portugal
[4]St. Pölten University of Applied Sciences, St. Pölten, Austria
[5]Vidzeme University of Applied Sciences, Valmiera, Latvia
[6]UC Leuven-Limburg University of Applied Sciences, Genk, Belgium

[b]Corresponding author e-mail: gere.attila@uni-mate.hu

**Abstract:** Physical activity is directly linked to health conditions, well-being, and labour productivity. The COVID19 pandemic is a still ongoing limitation to physical inactivity particularly because it limits the opportunity to go to gym, rehabilitation centres, and creates long waiting times to health care specialists. This situation is even increased for people who are living in sparsely populated areas. Many countries in Europe have high unmet needs for medical examination due to financial, geographic, or waiting time reasons. Currently there is a strong drive in the development of virtual reality (VR) applications, so called “VR exergames” that intend to support people at home in getting more physically active. However, existing solutions of VR for physical activity to date do not provide elements of socializing during the physical remote exercises. Socializing is an important element for human well-being. We can assume that VR solutions for indoor physical activities with socialising elements could increase the potential of such technologies to motivate users for indoor physical activities. Our offered solution focuses on the prevention of the above stated medical and mental conditions by means of a VR platform to increase physical activity level and to increase socialization in the population with sedentary lifestyle. The platform provides a unique and holistic approach to the physical and mental aspects possible to realize in remote conditions. The proposed project involves 6 European countries from different regions of Europe thus providing a unique perspective on well-being and digital tool acceptance across the whole Europe reinforcing the national government efforts to improve the well-being of the society. This is an innovative technological platform providing a holistic approach for the citizens – from the physical and mental perspectives based on objective wearable sensor real-time data.



**Keywords:** virtual reality, software development, active aging, healthy life, well-being

**Acknowledgements:** The authors thank the support of E[3]UDRES[2], a European University Alliance that follows the idea "From Europe – For Europe" by developing European solutions to regional problems.

**Registration number 69**

## Evaluation of the presence of *IDH* gene and patulin production of *Aspergillus* and *Penicillium* strains isolated from Hungarian apples

Rodrigues L. Emelin[b], Judit Kosztik, Ákos Tóth, József Kukolya, Ildikó Bata-Vidács

Research Group for Food Biotechnology, Institute of Food Science and Technology, Hungarian University **of** Agriculture and Life Sciences, H-1022 Budapest, Hungary

[b]Corresponding author, e-mail: leandro.rodrigues.emelin@phd-uni-mate.hu

**Abstract:** Mycotoxins produced by fungal species are harmful secondary metabolites to humans and animals. Patulin (PAT) is one of the toxins that can be found in different food products but especially in apples and their derivates. The most common mould producers of this compound belong to the species of *Aspergillus clavatus* and *Penicillium expansum*. The key enzyme in the patulin biosynthesis pathway is the isoepoxydon dehydrogenase enzyme (idh), encoded by *IDH* gene.
This work aimed to detect the presence of the *IDH* gene in different strains of *Aspergillus* and *Penicillium* and to subsequently evaluate the actual production of PAT using thin-layer chromatography (TLC) by those strains that harbour this gene. All investigated strains were originally isolated from apple and belong to the individual collection of our research group: 8 species of *Aspergillus (A. clavatus* Br1*; A. parasiticus; A tamarii* F2*; A. niger; A.* F2/3*; A.* F3*; A. versicolor* 1943 and *A. versicolor* 584,65) and 6 species of *Penicillium* (*P. brevicompactum* JR-3, *P. brevicompactum C'-3b, P. brevicompactum P-3, P. expansum* A, *P. expansum* C-4/1, and *P. expansum*). The tested strains were grown aerobically for 72 h in Malt extract broth (MEB) at 35 °C and 150 rpm. DNA extraction was done using MasterPure™ Yeast DNA Purification Kit (Biozym). PCR reaction was carried out to amplify the *IDH* gene with the primers 5'- CAA TGT GTC GTA CTG TGC CC-3' and 5'-ACC TTC AGT CGC TGT TCC TC-3'. The amplified products were separated by electrophoresis in 1% agarose gel. The strains *Aspergillus clavatus* B1, *P. brevicompactum* P-3, *P. expansum* A and *P. expansum* F'2B presented positive results for the *IDH* gene.
The *IDH* positive strains were grown again in MEB under the same conditions as before for 7 days. PAT extraction was carried out twice from the culture media with ethyl acetate as solvent using twice the sample volume. The solvent was evaporated, and the samples were re-suspended in acetonitrile. After the extraction, the samples were developed on TLC plates using toluene:ethyl acetate:formic acid (6:3:1) as the mobile phase and 3-methyl-2-benzothiazolinone hydrazone as revealing agent. From fungal strains encoding the *IDH* gene, *A. clavatus* B1, *P. expansum* A and *P. expansum* F'2B were able to produce patulin. Although *P. brevicompactum* P-3 carried the gene for toxin synthesis, it did not produce detectable amount of patulin under the studied conditions.

**Keywords:** Patulin, *Aspergillus, Penicillium, IDH* gene, TLC

**Acknowledgements:** The research was supported by project 2020-1.2.4-TÉT-IPARI-2021-00001 – „Mikotoxinok egészségi kockázatának csökkentése élelmiszerekben mikrobiológiai megelőzéssel, lebontással és mentesítéssel" and Tempus Public Foundation –Stipendium Hungaricum Scholarship. The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 70**

## Assessment of nutrient bioaccessibility by digestion simulation – a potential tool for functional food development

Judit Tormási[b], Mária Berki, Éva Lengyelné Kónya, Rita Tömösköziné Farkas, Katalin Nagy, László Abrankó

Department Food Chemistry and Analysis, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Science, H-1118 Budapest, Hungary

[b]Corresponding authors e-mail: tormasi.judit@uni-mate.hu

**Abstract:** According to the current practice, the nutritional value of food is assessed from the amount of nutrients (e.g. protein, fat, carbohydrate) in the raw materials and certain ingredients. However, the amount of nutrients measured in each ingredient is not equivalent to the proportion that is released in the gastrointestinal tract during digestion and then absorbed from there and become available to the body. Moreover, processing technology of the raw material and applied kitchen operations and more interestingly, interplay of components of a meal made can influence the accessibility of nutrients. In our research, we investigate the bioaccessibility of triglycerides, proteins, or certain bioactive components by *in vitro* modeling of digestive processes in the mouth, stomach, and small intestine. In this work, we present the platforms we use to investigate the proportion of bioaccessible fatty acids and proteins in digestions. Some examples of real food (fish, pasta) will also be presented to show the differences in the total and bioaccessible fat and protein contents of the tested meals and to show some revealed interactions of the components that influence the accessibility of protein and fat in consumed complex meals.

**Keywords:** bioaccessibility, digestion simulation, nutrient, protein



**Acknowledgements**: The financial support of the OTKA K135 294 grant is kindly acknowledged.

**Registration number 71**

## New insights into the acidification techniques of fruit mash during fermentation process

Fatjona Fejzullahu, Rajmund Ujszászi, Olívia Csernus, Szilárd Kun[b]

Department of Bioengineering and Alcoholic Drink Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: Kun.Szilard@uni-mate.hu

**Abstract:** The production of alcoholic beverages, especially alcoholic fermentation, is accompanied by a number of concerns, such as spoilage and undesirable changes in flavour associated with the metabolic activity of undesirable microorganisms. It is well known that lower acidity and higher pH generally support the growth of microorganisms, including several unwanted or spoilage species. Therefore, it is essential to monitor the pH and acidity of the medium throughout the fermentation. The most common practice of acid management worldwide includes the addition of organic acids at the start of alcoholic fermentation in order to prevent the proliferation of spoilage microorganisms (LAB and other bacteria, moulds, foreign yeasts). Nowadays, as both science and industry are open to innovation, new alternatives that offer acid protection of the fermentation medium are being researched. Attention is being paid to specific microorganisms that can offer a natural acidification and rapid pH drop by producing mostly lactic acid and other organic acids as part of their metabolism. The goal of this study was to test the efficiency of different chemical and microbial acidification techniques in the process of fermenting fruit mash and the impact on the quality of the final spirit. Apart from conventional acidification (addition of different ratios of phosphoric and lactic acid), *Lachancea thermotolerans* and two strains of *Lactobacillus plantarum* were used as bioregulators and acidifying agents. Apple mash was used as a fermentation matrix. The changes in dry matter content, reducing sugar content, titratable acidity, pH, individual sugars and organic acids (HPLC) were monitored throughout the fermentation. At the end of fermentation, the volatile acid and alcohol contents were measured. After distillation, ester contents of the collected low wines were quantified. The volatile organic compounds that resulted from the fermentation trials were evaluated by GC-FID. According to the results, regardless of the acidification technique, the profile of refraction and the concentration of reducing sugars in all samples followed the same decreasing trend. Our focus was on the changes in pH and acidity during fermentation. *Lb. plantarum* (LB-1) produced the highest amount of lactic acid. Although it was noted that in the samples inoculated with *L. thermotolerans* and *Lb. plantarum* (Sour Pitch), the overall acidity was low and the pH value didn't drop as expected. Volatile acid and alcohol contents were comparable. Gas chromatographic examination of the low wines has revealed the presence of many volatile constituents, which collectively act as flavour congeners. Improvements in the fermentation process are directly linked to improvements in product quality, and these tested strains offer a promising acidification alternative, which needs to be further investigated, clarified, and optimized.



**Keywords:** acidification, fermentation, *L. thermotolerans*, *Lb. plantarum*

**Acknowledgements:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 72**

## Application of near infrared spectroscopy for the detection of honey adulteration

Mariem Majadi[1,b], Zsanett Bodor[1,2], Zoltán Kovács[1]

[1]Department of Measurements and Process Control, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary
[2]Department of Dietetics and Nutrition, Faculty of Health Sciences, Semmelweis University, H-1085 Budapest, Hungary

[b]Corresponding author e-mail: Majadi.Mariem.2@phd.uni-mate.hu

**Abstract:** Food adulteration for economic gain is becoming a huge concern in many countries as a result of growing global trade. Various food adulteration scandals have occurred around the world leading to international impacts. Nowadays, honey is one of the most likely food products to be a target for adulteration. Consequently, there is an increasing demand for appropriate methods to ensure a fair competition among producers and to protect consumers against fraud. Recently, near infrared spectroscopy (NIRS), which is a relatively rapid, simple, low-cost, and environmentally friendly method, has been applied for detection of honey authentication. In the framework of our research, we investigated the possibility of detecting syrup-blended adulteration of three types of Hungarian honeys using near infrared spectroscopy. Rape, honeydew, and sunflower honeys were deliberately adulterated with three types of syrup (high fructose-corn syrup (HFCS), rice syrup and self-made glucose-fructose syrup (GFS)) at levels of 0%, 3%, 5% and 10% (w/w). Samples were prepared in triplicates resulting in a total of 99 samples (including syrups). The detection of honey adulteration was done with near infrared spectroscopy in the transflectance mode using a benchtop MetriNIR spectrometer in the wavelength range of 740-1700 nm. The full discrimination between the four levels of adulteration (0%, 3%, 5% and 10%) was performed by applying principal component analysis-linear discriminant analysis (PCA-LDA). Partial least square regression (PLSR) models were built to quantify the degree of adulteration and predict the content of adulterant in the honey samples. Overall, the obtained classification models showed a high accuracy in both recognition and prediction. Another relevant outcome of this study was that very good classification models could be obtained, irrespective of the type of honey used. Moreover, it was shown that despite their coming from diverse floral origins, authentic samples present shared characteristics that allowed differentiating them from adulterated honeys. PLSR models for the prediction of high fructose corn syrup (FS), rice syrup (RS) and glucose-fructose (GF) content in honey showed high ability to accurately estimate the level of adulteration. Near infrared spectroscopy coupled with chemometrics have proven to be an effective and rapid technique for honey quality monitoring in terms of adulteration and estimation of adulterant content in honey.



**Keywords:** honey; adulteration; NIRS; chemometrics; PCA-LDA; PLSR

**Acknowledgements:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 73**

## Effect of HHP treatment on lipid oxidation processes in mangalica bacon

Koppány László Majzinger[b], Karina Ilona Hidas, Anna Visy, Annamária Barkó, Zsuzsanna Horváth-Mezőfi, László Friedrich, Gábor Jónás

Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: majzinger.koppany@gmail.com

**Abstract:** Food industry is facing increased consumer expectations, so permanent innovation has a major role to play. Consumers want both enjoyable and nutritious, aesthetic, preservative-free and affordable products at the same time. High hydrostatic pressure treatment can provide a suitable solution to meet all these requirements, but it is also worth investigating the possible side effects caused by the pressure. The preservative process can catalyse certain chemical and biochemical reactions that can lead to taste and odour defects. These degrading processes include lipid oxidation, commonly known as rancidity. In addition to the fact that oxidation adversely affects the organoleptic properties of the product, it also poses a serious risk to health, so it is necessary to slow down and inhibit its course as much as possible.

To perform the experiment, pre-chilled, vacuum-packed mangalica bacon was used, which, after the proper preparation, was subjected to a hydrostatic preservation process of 500 MPa for 5 minutes. After the treatment, a storage test was performedfor six months. During the measurements, a predetermined work plan was followed, the lipid oxidation values of the pressure-treated and non-hydrostatic samples were determined separately. In all cases, the instrumental examination was followed by a sensory qualificationwith the involvement of twenty people.

The progress of lipid peroxidation was detected by determining the number of thiobarbituric acid in the samples. This is because thiobarbituric acid condenses with malonialdehyde in an acidic medium, and the resulting product undergoes a tautomeric conversion to a red compound, which can be examined spectrophotometrically. Although the reaction is not selective, its extent can be considered characteristic of lipid peroxidation.

As lipid oxidation is a thermodynamically controlled phenomenon, so heat plays a significant role in the reduction of activation energy in endothermic reactions, an important temperature-based approach to lipid degradation was also considered. During the experiment, three different household temperatures were selected, which differed by 10 °C, so when evaluating the results, we had the opportunity to determine the coefficient characterizing the temperature dependence of the reaction, the Q10 value.

In addition to the high hydrostatic pressure preservation process, the germicidal and enzyme inactivating effect, and the ability to tender in certain pressure ranges, it has been clearly established that it can be a catalyst for undesirable processes. The concentration of malonial dialdehyde characterizing the degree of lipid oxidation showed a visible difference between the control and the samples exposed to the conservation method. The difference was seen at each measurement time point, but the extent was different. For this reason, I think it is worth splitting the final assessment into two parts. In my opinion, the first part, the really relevant period, lasted from day zero to day 60 of the test, as this time interval is the one that can provide a product that is still fit for consumption in case of adequate refrigerated storage and after the necessary thermal exposure. The measured data for the first two months showed that the magnitude difference in the TBA number at the very first time of measurement increased further by the end of the first month but decreased on the sixtieth day. In the second half of the experiment, thiobartituric acid number values increased for both untreated and pressure-treated samples, but the difference decreased. Subjective reviews that complemented the instrumental analysis also yielded interesting results. Critics only stated in the fourth test that they had experienced a foreign taste or odour, albeit only slightly. Based on these feedbacks, it was concluded that the limit of sensory detection is

lipid degradation at 2.5 mg MDA/kg. During the sixth and seventh tests, we entered the range of clearly perceptible rancidity, the lower value of which was determined to be 3.7 mg MDA/kg TBA.
In addition to the effect of HHP treatment on lipid oxidation, we also wanted to map the role of temperature in the degradation processes of animal fat. Our hypothesis that higher storage temperatures will result in higher thiobarbituric acid numbers has been confirmed. By increasing the storage temperature by 10 degrees Celsius, the concentration of malonial dialdehyde doubled over the one-month period studied.

**Keywords:** mangalica, HHP, lipid oxidation, rancidity

**Acknowledgements:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 75**

## Study of the antagonistic activity of yeasts isolated from fruits belonging to *Rosaceae* family against *Galactomyces geotrichum*

Giseli Cristina da Costa Arruda[b], Andrea Pomázi, Mónika Kovács

Department of Food Microbiology, Hygiene and Safety, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: da.costa.arruda.giseli.cristina@phd.uni-mate.hu

**Abstract:** Postharvest losses of fruits can be quite significant if handling, processing, and storage conditions are not optimal. The principal method of controlling postharvest diseases is to use synthetic chemical fungicides. However, synthetic pesticides are being restricted because of concerns regarding their potential impact on human health and environment. Biocontrol is one of the potential alternatives to the use of chemical pesticides. The plant family *Rosaceae* consists of over 100 genera and 3,000 species that include many important fruit, nut, ornamental, and wood crops. Yeasts are naturally present on fruit surfaces, and have been especially emphasized regarding their role as biocontrol agents. The primary justification for conducting biocontrol research is to reduce or replace synthetic chemicals, thus the present study aims to investigate different yeast species isolated from fruits belonging to the *Rosaceae* family. Their antagonistic activity against *Galactomyces geotrichum*, a yeast found in various habitats such as soil, grass, silage, plants, fruits, feeding stuffs, insects, man and other mammals, was investigated.

The yeasts were isolated from the following fruits on selective media: Golden apple, dog rose, grape, quince, medlar, and sloe fruit. Further they were cultivated on RBC agar medium and on YEPD agar medium. Incubation took place for 3 days at 25 °C. For the screening and identification of antagonism activity, the contact method was used. The concentration of suspension of *G. geotrichum* strain was adjusted to $10^6$ CFU/mL and spread on YEPD medium. The yeast strains examined were inoculated in spots on the surface of the plates.

In total, 129 yeast strains were obtained from the different fruits. Preliminary results showed that the antagonist yeasts were capable of inhibiting the growth of *G. geotrichum*. Further investigation is necessary in order to define the exact mechanisms of antagonism and to test the activities of yeasts against other microorganisms (other yeasts, moulds and bacteria).



**Keywords:** *Galactomyces geotrichum*, yeast, antagonism, *Rosaceae*, fruits

**Acknowledgements:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 76**

## Potential of edible flowers to be used in biscuits

Enikő Izsó, Beatrix Szabó-Nótin[b]

Department of Fruit and Vegetable Processing Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: szabo-notin.beatrix@uni-mate.hu

**Abstract:** Nowadays, the development of new foods is a rapidly growing industry. Engineers face an ever increasing challenge when creating a unique range of products. In this work, biscuits were made with edible flower petals (marigold, tea rose) to increase the polyphenol content and the valuable components of the biscuits, in addition to their enjoyment value. The aim of the work was to examine how the added dried and ground flower petals affect the physical (texture) and chemical characteristics of the biscuit. The control for the experiment was a plain biscuit variant that did not contain any flowers. Other biscuits were made containing different amounts of tea rose (0,5%, 1%, 2%) and marigold (1%, 2.5%, 5%).

Moisture content, water activity, color and total polyphenol content (TPC) were measured and sensory evaluation was also performed. In order to accurately evaluate the results, a detailed statistical analysis was performed. One-sample analysis of variance was used to study the marigold and tea rose biscuits for the effect of petal concentrations and the deviation from the plain biscuits. In case of significant difference, a pair-wise comparison in Past4.07b was used. After 2 weeks of storage, the biscuits were re-examined, and the differences were evaluated with a paired sample t-test.

Water activity data provides information on the amount of free water and microbiological stability. Biscuits with marigold petals showed lower (0.315, 0.302, 0.395), while tea rose biscuits showed higher water activity values (0.339, 0.379, 0.407). Compared to natural biscuits, marigold and tea rose products have become darker in color with the increase of the concentration of petals. After 2 weeks of storage, the biscuits became harder with higher moisture content and water activity. This may be because the margarine in the dough has become harder due to its high fat content (70%). In terms of hardness, it was also an unusual result that the biscuit with marigold hardened, while the product with tea rose, softened. The total polyphenol content (TPC) of the biscuits was also determined using Folin-Ciocalteu method, and the results were expressed as TPC mg/100 g biscuit. Marigold biscuits contained much less (10, 12, 16 mg/100 g biscuit) TPC than tea rose variations (23, 30, 38 mg/100g biscuit). At the end of the 2 weeks storage, polyphenol content was reduced in all samples. Polyphenols have anti-inflammatory properties, so biscuits provide not only enjoyment value but also health-promoting properties. By eating 100 grams of biscuits a day, the tea-rose versions can provide the highest TPC content.

Based on the sensory evaluation results, the biscuit containing 2% tea rose received the most votes, and since both men and women judged, an independence test was used to determine if there was a correlation between gender and taste preference.



**Keywords:** edible flower, biscuit, marigold, tea rose, product development

**Acknowledgements:** The project is supported by the European Union and co-financed by the European Social Fund (grant agreement no. EFOP-3.6.3-VEKOP-16-2017-00005)

**Registration number 77**

## Change is just around the CornEr

Dalma Radványi[1,b], Pamela Nolz[2], Nelson Carriço[3], Sergiu-Valentin Galatanu[4], Maira Leščevica[5], Fátima Nunes Serralha[3], Anderluh Alexandra[2], Mesbahi Zahra[2], Sarah De Coninck[6]

[1]Hungarian University of Agriculture and Life Sciences
[2]St. Pölten University of Applied Sciences
[3]Polytechnic Institute of Setúbal
[4]Poitehnica University Timisoara
[5]Vidzeme University of Applied Sciences
[6]UC Leuven-Limburg University of Applied Sciences

[b]Corresponding author e-mail: gerene.radvanyi.dalma@uni-mate.hu

**Abstract:** The Change **C**orn**E**r´s (CE: Circular Economy) aim is to convey the message that "*change is just around the CornEr*", showing that a transition to a circular economy starts with small steps in daily life and in the region of citizens and stakeholders. The six university members in CE are located in Sankt Pölten (Austria), Setúbal and Barreiro (Portugal), Budapest (Hungary), Diepenbeek (Belgium), Timişoara (Romania), and Valmiera (Latvia), and also form the consortium of the E³UDRES² project - Engaged and Entrepreneurial European University as Driver for European Smart and Sustainable Regions.
Circular economy in cities aims to create a sustainable system that allows for the optimal use of city assets and products through reusing, refurbishing, remanufacturing, recycling, and other circular actions. The implementation of such actions at regional level, as well as offering good practices and concrete recommendations for promoting circularity is one of the main goals of the E³UDRES² consortium.
The CE research group focuses on two main topics: 1) sustainable mobility/logistics and 2) waste management and resource efficiency.
The Change CornEr idea has been born to fulfil the following challenging objectives:

- Increase community awareness, among the public and private sectors, academia, NGOs, civil society, and citizens, to the importance of circular economy;
- Improve stakeholder engagement for circular economy;
- Develop concepts and measures for the two referred topics (1) sustainable mobility/logistics and 2) waste management and resource efficiency);
- Create new circular economy business model ideas.

The Change CornEr is expected to reach the following outcomes:

- Conduct state of the art in **citizen research** (e.g., lab experiments, focus groups) **on a regional scale** with students and stakeholders
- Increase the **awareness of circular economy** among citizens and stakeholders
- **Develop and evaluate novel concepts** with respect to sustainable mobility and resource efficiency (e.g., waste management) going beyond the state of the art

Novel concepts and approaches in sustainable mobility and in waste management and resource efficiency are being developed and evaluated.



**Keywords:** Change corner, waste management, sustainability, resource efficiency, circular economy

**Acknowledgements:** The research is part of the E³UDRES² project which receives funding from the European Union.

**Registration number 78**

# The effect of different sucrose concentrations on the rheological and functional properties of frozen-thawed liquid egg yolk

Karina Ilona Hidas[1,b], Csaba Németh[2], Anna Visy[1], Annamária Barkó[1], Zsuzsanna Horávth-Mezőfi[1], Adrienn Varga-Tóth[1], Koppány László Majzinger[1], László Ferenc Friedrich[1], Ildikó Csilla Nyulas-Zeke[1]

[1]Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, Budapest, H-1118 Hungary
[2]Capriovus Ltd., H-2317 Szigetcsép, Hungary

[b]Corresponding author e-mail: Hidas.Karina.Ilona@uni-mate.hu

**Abstract:** The composition and structure of egg yolk are complex and varied, with a natural protein-lipid supramolecular structure. Under certain conditions, such as heating and salting, this structure breaks down, and the protein conformation changes, resulting in different yolk gels. The main proteins and molecular forces involved in the gel formation process differ in different processes, resulting in different types of yolk gel structures. Although the freezing point of egg yolk is −0.65 °C, an irreversible change in its fluidity occurs at −6 °C. At this temperature or lower, egg yolks become paste-like, which makes them difficult to handle, for example during transport and mixing. The most common explanation for this gelation during freezing is that the large ice crystals concentrate the components of the yolk, which results in the accumulation of plasma LDL. Gelation during freezing can be prevented or reduced by the addition of various cryoprotective agents such as sucrose.
In our study, egg yolk samples with different sucrose concentrations (0; 1; 2; 5; 7; 9, and 10%) were prepared. Samples were frozen at −24 °C for and thawing was performed at 4 °C after 60 days. The measurement of pH, color, rheological properties, and turbidity was performed before freezing and after the thawing process.
In our study, we found that the addition of sucrose did not result in a significant change in the pH of the samples, but the effect of freezing and thawing was significant. The samples became slightly darker at higher sucrose concentrations when it was added to the samples prior to freezing. However, samples became lighter after freezing and thawing. The addition of sucrose did not significantly change the rheological parameters of egg yolk samples. After freezing, a cryoprotective effect was observed. The lowest shear stress values were measured at 9-10% sucrose concentrations. The result of turbidity measurement also shows that the samples containing 9 and 10% sucrose have the lowest turbidity, so these samples have the best emulsion forming properties.



**Keywords:** egg yolk, freezing, flow curve, gelation, cryoprotective agent

**Acknowledgements:** This work was supported by the Thematic Excellence Program TKP2020-NKA-16 of Hungarian University of Agriculture and Life Science, awarded by the Ministry for Innovation and Technology. The authors acknowledge the Doctoral School of Food Science of Hungarian University of Agriculture and Life Sciences and Capriovus Ltd. for the support in this study. Our research is supported by the project KFI_16-1-2017-0551, VEKOP-2.1.1-15-2016-00149 and EFOP-3.6.3-VEKOP-16-2017-00005 projects, we are very thankful for that.

**Registration number 79**

## Establishing the impact of improved feeding on the quality of dairy products using correlative analytical technologies

Haruna Gado Yakubu[1], Juan Pablo Aguinaga Bósquez[2], Zoltán Kovács[2], Róbert Roszkos[4], Tamás Tóth[3, 4], George Bazar[4,b]

[1]Institute of Physiology and Animal Nutrition, Hungarian University of Agriculture and Life Sciences, H-7400 Kaposvár, Hungary
[2]Institute of Food Science and Technology. Department of Measurements and Process Control, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary
[3]Agricultural and Food Research Centre, Széchenyi István University, H-9026 Győr, Hungary
[4]ADEXGO Kft., H-8230 Balatonfüred, Hungary

[b]Corresponding author e-mail: bazar@agrilab.hu

**Abstract:** Animal feed improvement or enhancement techniques have long been reported as having the potential to improve the nutritional quality of dairy products. This has led to the development of some functional food products in the dairy industry, to enrich dairy food with bioactive compounds that are good for healthy life. The organoleptic properties (e.g. smell and taste) of these products could also be improved or impaired as a result of the increase in concentration of aromatic compounds in the dairy product. Over the years, conventional laboratory methods have been the most widely used in analyzing both the nutritional and organoleptic properties of these foods. The main challenges associated with these traditional methods are cost, time of analysis or fatigue, and the likelihood of subjectivity, especially in the case of sensory evaluation. Rapid correlative methods have been developed to compliment or in some cases completely replace these traditional methods. They are fast, cost-beneficial and guarantee high accuracy of analysis. In this study, the potential of two rapid correlative techniques: the near infrared spectroscopy (NIRS) and electronic nose (e-nose) were tested to assess the quality influence of improved feeding on bovine milk and yogurt produced from the improved bovine milk containing significantly increased level of n-3 polyunsaturated fatty acids. The two correlative techniques have been proven to be efficient in establishing the quality influences improved feeding has on dairy products.



**Keywords:** improved feeding, functional foods, dairy, NIR, machine sensing

**Acknowledgement:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 80**

# The effect of high hydrostatic pressure treatment on the physico-chemical and technofunctional properties of suspensions made of protein powders of animal origin

Annamária Barkó[1,b], Adrienn Varga-Tóth[1], Klára Pásztor-Huszár[1], Karina Hidas[1], Barbara Csehi[1], Tamás Csurka[1], Zsuzsanna Mednyánszky[2]

[1]Department of Animal Product and Food Preservation Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary
[2]Department of Food Chemistry and Nutrition, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b] Corresponding author e-mail: annamariabarko@gmail.com

**Abstract:** There is a growing demand for natural-based food supplements among those living a healthy lifestyle. Quality and reliability are of paramount importance among people who need some special diet due to their physiological condition. The market for products for these people is narrow. Therefore, the technological, nutritional and scientific evaluation of these products produced for these target groups is important. The impact of certain minimal processing technologies plays an important role. There are some food processing technologies whose effects on food are less understood and poorly determined.
In our experiment, on powdered products of animal origin (whey, egg, pork blood) bulk and tapped density measurements were performed, and then the solubility of the products was determined. A 10% suspension of the different powders was prepared, and the samples were subjected to high hydrostatic pressure (HHP) treatment in the pressure range of 200-600 MPa for 2 minutes. The colour of the products was determined by Minolta CR-400, viscosity of samples was measured by Anton Paar MCR 92 rheometer applying share rate between 10 and 1000 1/s, and protein denaturation was monitored by SDS-PAGE gel electrophoresis.
For each sample, a difference was observed between bulk and tapped densities. We were able to categorize the products based on their flow properties. In the solubility study, we found that products with higher protein content showed better solubility properties. The samples darkened as a result of HHP treatment, but their rheological properties did not change. In the electrophoretic gel image, the major protein fractions remained identifiable at different pressure values.
The flow and solubility properties obtained during the measurement of powder products have shown that products with a higher protein content are easier to handle for the user. As a result of HHP treatment, gelation was observed at higher pressure range (500–600 MPa) due to the sensitive proteins. The 600 MPa pressure was insufficient for complete protein denaturation and the protein fractions were identifiable for each sample.



**Keywords:** powders of animal origin, food protein, HHP

**Acknowledgements:** This work was supported by the Hungarian Government through project No. EFOP-3.6.3-VEKOP-16-2017-00005. The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 81**

# The effect of mild heat treatment on inactivation of pathogenic *Enterococcus faecalis* in model nutrition medium and chicken breast

Endrit Hasani[1,b], Gabriella Kiskó[2], István Dalmadi[1], György Kenesei[2]

[1]Department of Livestock Products and Food Preservation Technology, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary
[2]Department of Food Microbiology, Hygiene and Safety, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: endrithasani96@gmail.com

**Abstract:** Sous vide technology is a well-established cooking method to preserve food products using vacuum packaging and strictly monitored temperature and time parameters. Due to the application of low temperatures in the sous vide cooking process, the microbial safety of these products is a challenge for producers. Numerous sous vide recipes can be found on the internet, apps, and chief guides using temperatures between 42-60 °C. Moreover, in recent years innovative sous vide techniques have been developed using pre-step low temperatures to achieve better quality attributes of ready-to-eat meat products. Therefore, it is necessary to examine the effectiveness of these sous vide treatments using heat-resistant pathogenic bacteria. In this study, we used pathogenic *Enterococcus faecalis* to validate the sous vide treatments that use various temperatures between 45-60 °C. The experiments were conducted in model nutrition medium and chicken breast. Higher log reductions of *Enterococcus faecalis* were demonstrated in model nutrition medium compared to chicken breast. This pathogenic bacterium proved to be a good indicator of meat preservation by the sous vide cooking method.

**Keywords:** *Enterococcus faecalis*, sous vide, model media, chicken breast.



**Acknowledgements:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study. The research was supported by the European Union and co-financed by the European Social Fund (grant agreement no. EFOP-3.6.3-VEKOP-16-2017-00005).

**Registration number 83**

## Good practice of colour masking in sensory research

Dániel Szabó[1], Ágnes Urbin[2], Balázs Vince Nagy[2], László Sipos[1,b]

[1] Department of Postharvest, Supply Chain, Commerce and Sensory Science, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest Hungary

[2] Department of Mechatronics, Optics and Mechanical Engineering Informatics, Faculty of Mechanical Engineering, Budapest University of Technology and Economics, H-1111 Budapest Hungary

[b]Corresponding author e-mail: sipos.laszlo@uni-mate.hu

**Abstract:** Standard sensory testing with trained and expert assessors requires assessors with normal vision, reproducible lighting conditions and reproducible visual inspection conditions (ISO 11037:2011).
Normally sighted assessors shall be in good general health and shall not have any deficiencies that could affect their perception or the reliability of their assessments. The assessor's vision is basically determined by three factors: visual acuity, contrast sensitivity and color vision. These factors need to be tested to select judges with normal vision for sensory testing. Methods and testing protocols for these factors have been developed (Sipos et al. 2020; ISO 8586:2012). Reproducible illumination conditions are determined by the photometric and spectral nature of the light source, the photometric and spectral nature of the sample environment, and the adaptation state of the visual system. The reproducible ophthalmic exposure conditions are determined by the relative positions of the light source, the specimen, and the eye, i.e., the test geometry. For sensory testing of colored products, it is recommended to implement a testing environment where color differences between products do not influence the assessors' judgement of other sensory parameters (taste, smell, texture) (ISO 11037:2011). Several methods for color masking have been used in international practice, but all of them are subject to varying degrees of error: product coloring, eye-binding, black test beakers, spectrally fixed colored illuminations, color filter lenses.
In our research, we describe on the one hand the masking methods used so far in international practice, and on the other hand we demonstrate good practices of color masking through examples of product groups with spectrally controllable light booths using the new approach. Our research will cover the testing of the suitability of sensory assessors, spectral characterization of products, sensory testing of light environments, and the limitations and potential of these methods.



**Keywords:** standardized sensory tests, sensory assessor, masking, spectral characterization, spectrally controllable light booth

**Acknowledgements:** The research was supported by the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science.

**Registration number 84**

## Characterization of coffee capsules and prediction of sensory attributes by e-tongue

Juan Pablo Aguinaga Bósquez[1,b], Haruna Gado Yakubu[2], György Bázár[3], Zoltán Kovács[1]

[1]Institute of Food Science and Technology. Department of Measurements and Process Control, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary.
[2]Hungarian University of Agriculture and Life Sciences, Kaposvár Campus, H-7400 Kaposvár, Hungary
[3]ADEXGO Kft., H-8230 Balatonfüred, Hungary

[b]Corresponding author e-mail: Aguinaga.Bosquez.Juan.Pablo@phd.uni-mate.hu

**Abstract:** Coffee industry seeks to deliver products with a diverse range of flavors and preparations to satisfy the demands of consumers. This endeavor resulted in the product development of coffee in capsules to adapt to new consumption habits and the need for convenience. The evaluation of coffee organoleptic characteristics is of fundamental importance to meet the needs of the consumer. Electronic tongue (e-tongue) is a device comprised of an array of sensors with partial specificity and cross-sensitivity and a reference electrode, which are sensitive to soluble compounds of liquid solutions. This equipment simulates the role of the human tongue, and it can be used to objectively assess the sensory properties of liquid food matrices. The objective of the present study was to determine the applicability of the e-tongue for the characterization of coffee samples brewed from different types of coffee capsules. Further aim was to build regression models to predict the main organoleptic characteristics of the coffee samples with the e-tongue. Eight different types of coffee capsules from Nespresso were tested: Arpeggio, Capriccio, Ethiopia, India, Ristretto, Ristretto decaffeinato, Volluto and Volluto decaffeniato. Coffee was brewed using De´Longhi Nespresso U coffee machine, and the obtained 40 ml liquid was 10 times diluted for e-tongue measurements. The experiments were performed with an Alpha Astree e-tongue. The different types of coffees were brewed in three replicates ($n_{sample}$ = 24) and each sample was measured three times with the e-tongue ($n_{measurement}$ = 72). Data analysis was performed using different chemometric techniques: Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA) and Partial Least Square Regression (PLSR). Three-fold cross-validation was used for LDA and PLSR to attain robust models. PCA analysis results showed a clear trend of separation between most of the eight types of coffee. LDA model built for the classification of the coffee types showed an average recognition of 95.40% and average prediction of 88.24%. The groups of India, Arpeggio, Ristretto and Ethiopia presented 100% correct classification, while misclassification was observed between the other groups. PLSR results of organoleptic characteristics of the coffee types showed values of determination coefficients above 0.70 and 0.65 for training and cross-validation, respectively. Acidity showed the best prediction model with determination coefficients of 0.97 and 0.95 and root mean square errors of 0.15 and 0.17 for training and cross-validation, respectively. On the other side, the weakest model corresponds to Intensity. In conclusion, e-tongue combined with chemometrics is suitable to discriminate the different types of coffees brewed from the chosen capsules and to predict their main organoleptic characteristics with good accuracy.



**Keywords:** Sensory evaluation, chemometrics, PCA, LDA, PLSR

**Acknowledgements:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 85**

## Investigation of tomato pomace extract as a potential antimicrobial agent

Faraja Gonelimali, Fruzsina Zsólyomi, Beatrix Szabó-Nótin, Mónika Máté[b]

Department of Fruit and Vegetable Processing Technology, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: mate.monika.zsuzsanna@uni-mate.hu

**Abstract:** During the food processing of tomato (*Solanum lycopersicum* L.), in addition to the main product (juice, concentrate), a large amount of by-products are also produced. Tomato pomace contains a number of valuable components and can be further utilized in other forms in various areas of the agricultural sector.

The aim of this research was to investigate the effectiveness of acetone, ethanol and methanol as extraction solvents for extracting the valuable components of pomace and to study their antibacterial effects in case of the industrial hybrid tomato cultivar 'Heinz 1015 F1'. The extraction conditions used in the experiments were as follows: sample: solvent ratio 1:10 and 1:30, extraction temperature: 20 and 60 °C, ultrasonic treatment time: 0 and 30 min, 35 kHz). 24 extraction combinations were performed, and their efficiency was evaluated by assessing the total polyphenol content and antioxidant capacity. Antimicrobial activity was tested by agar well diffusion test for inhibition of *E. coli*, *S. aureus*, and *L. innocua*.

The results showed that the total polyphenol content of the extracts ranged from 1.36 to 3.21 mg GE/100 g DW, while the total antioxidant capacity ranged from 0.23 to 2.42 mg AA/100 g DW. Table 1 shows the values of the five extracts with the best results. Ethanol proved to be the most effective of the solvents tested, when used in a 1:30 ratio at 60 °C, supplemented by a 30 min ultrasonic treatment.



Table 1. Antioxidant capacity (FRAP) and total polyphenol (TPC) content of tomato pomaces

| Solvent | sample : solvent ratio | Temperature (°C) | Ultrasonic treatment (min) | FRAP (mg/100g DW) | TPC (mg 100/g DW) |
|---|---|---|---|---|---|
| ethanol | 1:30 | 60 | 30 | 2.42 | 3.21 |
| ethanol | 1:30 | 20 | 30 | 1.12 | 3.01 |
| ethanol | 1:30 | 60 | 0 | 2.22 | 2.55 |
| methanol | 1:30 | 60 | 30 | 1.85 | 2.53 |
| acetone | 1:30 | 20 | 30 | 2.41 | 2.25 |

In case of the five extracts with the best extraction values, no antimicrobial effect was detected against any of the tested microbes.

In conclusion, the results obtained are promising. In the future, it is worth to study the combined effect of solvents. In addition to the antimicrobial activity, investigation of the antioxidant activity and flavonoid composition of the extracts is suggested.

**Keywords:** tomato, pomace, antimicrobial, antioxidant capacity, total polyphenol content

**Acknowledgements:** The Project is supported by the European Union and co-financed by the European Social Fund (grant agreement no. EFOP-3.6.3-VEKOP-16-2017-00005). The authors acknowledge the Hungarian University of Agriculture and Life Science's Doctoral School of Food Science for the support in this study.

**Registration number 86**

## Can Aquaphotomics ascertain the authenticity of tomato powder extracts?

Balkis Aouadi[1,b], Mariem Majadi[1], Juan Pablo Aguinaga Bosquez[1], Josephine Mensah[1], John-Lewis Zinia Zaukuu[2], Zoltán Kovács[1]

[1]Department of Measurements and Process Control, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary
[2]Department of Food Science and Technology, Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana

[b]Corresponding author e-mail: aouadi.balkis@phd.uni-mate.hu

**Abstract:** As a culinary essential, tomato's year-round availability often leads to a surplus, that is processed into a panoply of products. The powdered form, one of tomato's prime commodities is widely incorporated in several food and beverage preparations but is not, however, exempt from adulteration practices.
In the lookout for efficient fraud detection tools, non-targeted methods, comprising but not limited to spectroscopic methods, hold premise as suitable alternatives to conventional tools. In this context, our primary objective was to test the joint applicability of NIRS and Aquaphotomics in detecting common adulterants, namely annatto powder (AP), corn flower (CF) and food colorant (FC) in three tomato powder varieties.
Mixtures comprised both single (AP, CF, and FC) and dual (AP+FC and CF+FC) adulterants. The latter were added in concentrations of 0,5%, 1%, 2%, 5%, 10%, 15% up to 20%. Besides authentic samples, the prepared mixtures were solubilised, diluted then syringe-filtered. Upon extraction, these aqueous solutions were stored in the freezer prior to analysis.
The tomato extracts were scanned with a benchtop Rapid Liquid Analyser (XDS-RLA, Metrohm) operating in transmission mode over the range 400-2500 nm. While focalising on water's overtone range, the NIR-acquired spectra were subjected to chemometric modelling via principal component analysis (PCA) for pattern recognition, linear discriminant analysis (LDA) for classification by adulteration levels, partial least squares regression (PLSR) for estimation of the adulterants' concentrations. LDA and PLSR models were validated by applying 3-fold cross-validation and by leaving one group out cross-validation, respectively. As per the aquagrams, they served as tools for visualising water spectral fingerprints.
Results showed that authentic extracts could be discriminated from their adulterated counterparts with classification accuracies that depended on the type of added adulterant. The predictive models enabled the quantification of the studied adulterants, also with varying performances. The water spectral pattern revealed peculiar fingerprints of the pure tomato varieties but also highlighted the gradual adulteration levels.
Collectively, the findings confirm the efficiency of NIR-based Aquaphotomics in authenticating tomato powder extracts.



**Keywords:** tomato powder extracts, adulteration, aquagrams, chemometrics.

**Acknowledgements:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study. The authors would also like to thank Metrohm Ltd. for supplying the instrument.

**Registration number 88**

## Effect of 1-MCP treatment on tomato postharvest physiological behavior

Zsuzsanna Horváth-Mezőfi[b], Gergő Szabó, Mónika Göb, Emese Bátor, Géza Hitka, Tamás Zsom

Department of Postharvest, Commerce, Supply Chain and Sensory Science, Hungarian University of Agriculture and Life Sciences, H-2100 Gödöllő, Hungary

[b]Corresponding author e-mail: Horvath-Mezofi.Zsuzsanna@uni-mate.hu

**Abstract:** The most important fresh vegetable in the world is tomato. Continuing changes in shopping and eating habits justify increasing the storage potential of tomatoes. There is, therefore, a need to develop postharvest technologies, including anti-ripening treatments. Post-ripening ability is well indicated by the change in respiration intensity of the fruit or vegetable. Tomatoes are a post-ripening vegetable and are, therefore, characterised by climacteric respiration. During ripening, the metabolic processes of these fruits accelerate after the pre-climacteric minimum, their respiration intensity increases, and then decreases steadily after the climacteric maximum. Ethylene plays a key role in initiating and accelerating the ripening-related processes that are perceived as various qualitative changes (e.g. colour, hardness, acidity and flavour) in tomatoes. Tomatoes, unlike many other climacteric fruits, need a constant ethylene effect to progress ripening. In the light of this, it is possible to use growth regulators that prevent ethylene binding at different stages of ripening. In our study the measurements were carried out by applying an anti-ripening treatment with 1-MCP (1-methylcyclopropene) to tomatoes at different stages of ripeness and then by studying the qualitative changes of the tomatoes during postharvest storage. During the 2-week storage, we monitored, respiration among several other parameters. By examining the results obtained, it was concluded that in tomatoes at a stage of ripening prior to climacteric maximum, the anti-ripening treatment helped to flatten the maximum of the curve, with less increase in respiration intensity. Taking all this into account, the anti-ripening treatment is less effective on tomatoes at the stage of ripening that no longer contain green pigment or contain just a little amount. At these maturity stages, the difference between the respiration curve of treated and untreated tomatoes is smaller.



**Keywords:** Postharvest, 1-MCP, tomato, anti-ripening, SmartFresh™

**Acknowledgements:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study. This research was supported by the European Social Fund (grant agreement no. EFOP-3.6.3-VEKOP-16-2017-00005).

**Registration number 89**

## Effect of UV and ozone treatment on the microbiological properties of microgreens

Mónika Göb[b], Zsuzsanna Horváth-Mezőfi, Gergő Szabó, Géza Hitka

Institute of Food Science and Technology, Department of Postharvest, Supply Chain, Commerce and Sensory Science, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: gobmonika@gmail.com

**Abstract:** The main topic of the research is to determine the development directions that help increasing the shelf life of products and to increase their food safety, in addition to study the processing parameters in the production of fresh cut salad products and microgreens.
Microgreens are extremely sensitive plants and cannot be washed after harvest. As a result, possibilities to improve their food safety parameters are limited.
The appropriate microbiological parameters of the finished product can only be achieved by using impeccable preparation and cultivation operations.
Red Mizuna and Radish Red Sango seeds were used for the study. During the experiment, one group was treated with UV and ozone before sowing. The control group was sown in the conventional way, without treatment.
After harvest, the change in the numbers of moulds and yeasts in each group was examined by colony counting method.
According to the results obtained, the microbiological values improved following the treatments.

**Keywords:** food safety, salads, microgreen, mould, yeast



**Acknowledgements:** The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 91**

## Leaching processes applied for the extraction of betalain colour compounds from microwave oven-dried beetroot leaf

Moh Moh Zin[b], Szilvia Bánvölgyi

Department of Food Engineering, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: zinlay.net.mm@gmail.com

**Abstract:** Nitrogen-containing betalain colour compound, which is known as natural chromo-alkaloid abundantly found in Amarathacae species, has replaced the synthetic azo dyes in food processing recently. In this study, the contemporary approach for the leaching process of betalain colour compounds from microwave oven-dried beetroot leaf was realized with new extraction techniques, in which continuous extractions were performed with 50% aqueous ethanol (1:50 peel-to-solvent ratio) at 30 ºC, 40 ºC, 50 ºC and 60 ºC for from 30 min to 120 min. Likewise, control samples were prepared with pure water and acidified water (citric acid) solvents. Meanwhile, the implementation of multiple extractions were done with the peel-to-solvent ratio of 1:50 at 30 ºC for 30 min and the extractions were repeated three times with fresh solvents. The applied solvents were 50% aqueous ethanol, pure water, and acidified water. Total betalain (betacyanin and betaxanthin) contents in different extracts and their respective antioxidant activities were examined spectrophotometrically. For both extraction techniques, aqueous ethanol solvent was observed to be the most effective. Among the continuous extractions, the final leaf-ethanol extract at 30 ºC exhibited the maximum amount of total betalains i.e, 31.99±0.5 mg/g dry matter. The measured antioxidant activity was 109.21±0.69 mg ASE/g dry matter. Similarly, the highest amounts of total betalains (30.36±1.74 mg/g dry matter) were recovered with aqueous ethanol with antioxidant activity of 65.65±4.4 mg ASE/g dry matter in the multiple extractions. Being a plant secondary metabolite with antioxidant-rich properties, the application of betalain colour compounds in food and pharmaceutical industries can be expected to be widened.



**Keywords:** betalain, beetroot leaf, microwave oven-dried, antioxidants

**Acknowledgements:** The project is supported by the European Union and co-financed by the European Social Fund (grant agreement no. EFOP-3.6.3-VEKOP-16-2017-00005), the Tempus Public Foundation under the Stipendium Hungaricum Scholarship Program. The authors acknowledge the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 92**

## Analysis of texture properties of deep frozen ToTu dumplings

István Dalmadi[1,b], Nikoletta Bodzán[1], Csaba Németh[1,2], György Kenesei[1]

[1]Department of Livestock Products and Preservation Technologies, Hungarian University of Agricultural and Life Sciences, H-1118 Budapest, Hungary
[2]Capriovus Ltd., H-2317 Szigetcsép, Hungary

[b]Corresponding author e-mail: Dalmadi.Istvan@uni-mate.hu

**Abstract:** Egg white is one of the most ideal sources of protein. It is rich in essential amino acids with full biological value. It can be used in all areas of healthy eating. ToTu is a cottage cheese-like product made from egg white using an acidic process, which can be perfectly integrated into low-carbohydrate diets. People who are allergic to milk can also consume it.
In our research, we aimed to increase the level of processing of the egg white product by using a mild physical preservation process. We chose the popular product of Hungarian cuisine, cottage cheese dumplings, which we preserved by quick-freezing in a semi-finished state.
Three products were performed for our tests. As control sample, quick-frozen mini cottage cheese dumplings were obtained from commercial trade. For the comparison, our own samples were prepared with a similar diameter and weight (20 g/pc) to the control sample based on an industrial cottage cheese dumpling recipe. We made cottage cheese and ToTu versions, too. After mixing the ingredients with a food processor (cottage cheese/ToTu, semolina, water, granulated sugar, salt, vanilla sugar, lemon flavor, edible starch), we formed 20 g of the dumplings by hand into the desired size and shape. After forming, the dumplings were frozen in an intense air flow at -24 °C and stored at -18 °C until analysis. Prior to testing, the dumplings were cooked in boiling hot salted water for 8 minutes, then cooled down to room temperature in cold water and covered with plastic foil to protect the products from drying.
Textural analyses were performed with a SMS TA.XT Plus texture analyser by using three different measurement methods. Textures were tested with (1.) a Warner-Bratzler knife, (2.) a 5 mm cylinder head, and (3.) a 35 mm disc probe in relaxation mode.
The results show that there were large differences between the individuals in the 3 sample groups. With all three measurement techniques, the control dumplings proved to be the softest followed by the cottage cheese version. The highest mechanical resistance was noticed in case of the ToTu product. Based on the measurement results, it is recommended to modify the recipe. When using fat-free ToTu, it is necessary to add fat to the mix.



**Keywords:** ToTu, dumpling, texture

**Acknowledgements:** The research was supported by the project of Development of functional egg products in accordance with nutritional trends (2020-1.12-PIACI-KFI-2020-00027) and was funded by the European Union and co-financed by the European Social Fund (grant agreement no. EFOP-3.6.3-VEKOP-16-2017-00005).

**Registration number 93**

## Sensory and quality characteristics of artisan breads

Andrea Lugasi[a]

Department of Hospitality, Faculty of Commerce, Hospitality and Tourism, Budapest Business School, Alkotmány street 9-11, H-1054 Budapest, Hungary

[a]Corresponding author e-mail: lugasi.andrea@uni-bge.hu

**Abstract:** The results of some scientific studies indicate that bread made with non-industrial yeast and technology but with a slow-fermented (wild) sourdough process is easier to digest and presumably has health benefits. Wild sourdough is nothing more than a fermented mixture of flour and water, in which the fermentation is caused by a "wild" microbial colony that can be considered to vary in its composition. Nowadays, we are increasingly confronted with the communication that artisan baked products made with wild sourdough can be well tolerated and consumed by gluten-sensitive people due to their long fermentation process. However, this claim has not been substantiated, so if gluten-sensitive people consume these products without any restrictions, they could face serious health consequences. Within the framework of the present research, laboratory and organoleptic examinations of 32 artisan/wild sourdough breads and 9 traditional (according to Codex Alimentarius Hungaricus) breads were performed. Both artisan and traditional technology products included gluten-free breads.
The examination of the breads included the verification of compliance with the requirements of the relevant Codex Alimentarius Hungaricus (e.g. the presence of mandatory labelling elements), quality and sensory tests, and the confirmation of presence or lack of gluten by accredited laboratory measurement.
The labelling of artisan breads is incomplete, does not provide consumers with adequate information. The salt content of artisan breads is higher than the value prescribed in the Codex Alimentarius Hungaricus, and their organoleptic characteristics do not differ significantly from those produced with large-scale technology. The most important result of the study is that the gluten content of artisan sourdough breads cannot be determined by the accredited test method, because the amount of gluten present in these products is several times higher than the gluten-free limit required by the relevant legislation (20 mg/kg). The results confirmed that promotion of artisan breads and bakery products as "gluten-free" or "can be consumed by gluten sensitive persons" is illegal and hazardous, consumption of these products by affected people can cause serious health problems for them.



**Keywords:** artisan bread, large-scale bread, gluten-free, sensory characteristics, Codex Alimentarius

**Acknowledgements:** The research was supported by the Scientific Fund of Budapest Business School.

**Registration number 94**

# Technological innovations for realization of sustainable food production especially in the situation of energy crisis and high inflation rate

Quang D. Nguyen[b], László Friedrich

Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding authors e-mail: nguyen.duc.quang@uni-mate.hu

**Abstract:** The world global population expected to reach 8.6 billion by 2030 that requires a larger amount of food produced. Because of the COVID-19 pandemic and a peaceless world, in the last few years, the inflation rate and energy price increased drastically with values in 2022 4-5 times higher than the ones in 2020. Additionally, according to the Sustainable Development Goals Report of 2021, the global extreme poverty rate rose for the first time since 1998, from 8.4% in 2019 to 9.5% in 2020 as well as more than 2 billion or 25.9% of the global population experienced moderate or severe food insecurity. These factors threat and put our food systems under pressure as they indirectly reduce purchasing power and the capacity to produce and distribute food, which affects primarily the most vulnerable groups. It is one of the most important challenges faced by many countries and the answer can be found in sustainable food systems that comprise of 4 phrases: preproduction, production, supply chain and consumption. The aim of sustainable production is to ensure that the production of goods conserves resources and preserves the regenerative capacity of the environment, and sustainable food systems are fundamental to ensuring that future generations are food secure and eat healthy diets. The sustainable food production depends on many factors including quality and availability of raw materials, technology, machines, energy and water consumption, environmental issues etc., and technological innovations are a critical enabler.
Technological innovations present solutions for all these challenges, particularly those related to production of food. Emerging technologies such as Data-driven Production, Artificial Intelligence, Internet of Things and Big data can help develop monitoring capabilities and platforms to support the development of sustainable food production systems. These can help to improve the quality of foods, reduce loss and wastes as well as energy and water consumptions. In this presentation, technological innovations and emerging food technologies are covered and reviewed.



**Keywords:** innovations, sustainability, emerging technology, sustainable food production

**Registration number 105**

# Diet and physical activity of university students during COVID-19 pandemic measured by semi-quantitative food frequency questionnaire

Andrea Lugasi[1,b], Anna Gódor-Kacsándi[1], Lajos Biró[2]

[1]Budapest Business School, Faculty of Commerce, Hospitality and Tourism, Department of Hospitality, Alkotmány street 9-11, H-1054 Budapest, Hungary
[2]Semmelweis University, Faculty of Health Sciences, Department of Dietetics and Nutrition Sciences, Vas street 17, H-1088 Budapest, Hungary

[b]Corresponding author e-mail: lugasi.andrea@uni-bge.hu

**Abstract:** Since March 2020, coronavirus disease (COVID-19) has been spreading steadily, resulting in overwhelmed health-care systems and numerous deaths worldwide. To counter these outcomes, many countries introduced strict lockdown measures, requiring the temporary closure of all but essential sites and causing an unprecedented disruption of daily life. This study aimed to evaluate the dietary habits and physical activity among university students at Budapest Business School (Budapest, Hungary) during the period of lockdown due to the first and second waves of the COVID-19 pandemic.
Data collection for measuring dietary habits was carried out by an online electronic semi-quantitative food frequency questionnaire (SQFFQ), capable of collecting information in a convenient, efficient and reliable manner. The SQFFQ inquired demographic information (age, gender), anthropometric data (reported weight and height) and dietary habits information (daily intake of certain foods, food frequency). Physical activity of the respondents was assessed by the International Physical Activity Questionnaire (IPAQ). Nutritional status of the subjects was classified according to WHO (2003). The survey was conducted in spring and in autumn in 2020. University students with Hungarian mother language, studying at BBS on full-time BSc programmes in the field of economics were involved in the study.
Two hundred seventy-five students completed the SQFFQ and IPAQ (24% men, 76% women). Overweight was twice as common among men as women (21.0 % vs 10.5%), and obesity rate was also higher among men than women (7.6% vs 5.2%). The average energy intakes for men and women were 3699 kcal/day and 2428 kcal/day, respectively. The ratio of the main energy-providing nutrients to total energy was nearly the same in men and women. Similar to data from previous population-level nutritional measurements in Hungary, fat energy% (men: 40.9 E%, women: 40.6 E%) was higher and carbohydrate energy% (men: 42.2 E%, women: 43.0 E%) was lower than national and international recommendations (fat: less than 30 E%, carbohydrate: 55-75 E% according to WHO). Added sugar energy ratios were 8.1% and 8.2% for men and women, respectively. Dietary sodium intake was extremely high both in men (7186 mg/day) and women (4541 mg/day). Calcium intake was sufficient in men (1246 mg/day) and women (941 mg/day), as well. No gender differences were observed in terms of physical activity, average energy intake did not increase with increasing physical activity, either in total or in either gender.
The known and unhealthy eating pattern of the Hungarian adult population was also recognizable in the case of the SQFFQ measurement among university students during covid pandemic.



**Keywords:** covid, nutrients, semi-quantitative food frequency questionnaire, International Physical Activity Questionnaire, dietary habits

**Acknowledgements:** The research was supported by the Research Fund of Budapest Business School.

**Registration number 114**

# Determination of correlation between the electrical impedance parameters and the rheological parameters of carrot

Bíborka Gillay[b], Eszter Vozáry

Department of Food Measurements and Control, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: Gillay.Biborka@uni-mate.hu

**Abstract:** During the food industrial processes it is often necessary to know the physical properties of food in order to solve various control problems. Online measurement of different physical parameters is often difficult during different processes. Measurement of electrical parameters such as electrical impedance is relatively easy to solve. If we know the relationships between electrical and other physical parameters, we can also give the values of other physical parameters by measuring the electrical impedance.
The aim of the present work is to determine the relationships between rheological and electrical impedance parameters of carrots.
The carrots were purchased from the local vegetables store. The carrot was sliced and the electrical impedance spectrum in both the transport and storage tissues was determined on each slice and the relaxation curves were measured at constant deformation. Measurements were made both in the direction of the longitudinal axis and in the direction of the radius of the carrot.
The magnitude and the phase angle of the electrical impedance were measured with an HP 4284A LCR analyzer in the frequency range of 30 Hz to 10 MHz at 1 V measuring voltage. WPI Ag/AgCl electrodes with a diameter of 2 mm were placed on the surface of the carrot at a distance of 1 cm. After open-short correction, the corrected spectra were approximated by the series connection of a distributed element and one resistor with the Solver function of Excel. Resistances, relaxation time, and exponent parameter were determined.
Rheological measurements were performed with a Stable Microsystem TA-XT plus texture analyzer. The diameter of the used probe was 2 mm. After determining the yield point, the relaxation curves were recorded under deformation less than the yield point. For the relaxation curve, the sum of a stretched exponential functions and an equilibrium constant was fitted with the Excel Solver function. The values of the parameters describing the constant and the stretched exponential functions were determined.
A linear relationship was found between the viscosity parameters and the resistances and between the elastic parameters and capacities.
Based on the obtained results, it seems that the values of the rheological parameters can be deduced from the values of the electrical parameters.

**Keywords:** carrot, electrical impedance, rheological properties

**Registration number 121**

## Technologies for ensuring crop safety and quality in the food supply chain

Kitti Annamária Bognár[1, b], Flóra Vitális[1],Viktória Zsom-Muha[1], Zoltán Kovács[1]

[1]Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: kover.kitti.annamaria@phd.uni-mate.hu

**Abstract:** Information technology (IT) plays an important role in the food supply chain, aiming to improve product safety and quality and support the smooth food supply. In addition to traditional analytical methods for food analysis, increasingly used advanced rapid analytical technologies can be well integrated into optimal harvest, logistics, processing and more. Effective traceability and authentication could be ensured through sophisticated mathematical modeling based on data measured in different stages of the supply chain. It can be said that vibrational spectroscopic techniques can be used to predict in a correlative way the quality and quantity of nutrients in complex and inhomogeneous foodstuffs such as fruits and vegetables. Thanks to the success of miniaturization, near infrared (NIR) spectroscopy is increasingly moving towards the development of portable and hand-held devices. Such instruments can be used to monitor the agricultural raw materials along the entire food supply chain. An Italian study has demonstrated the ability to distinguish between two post-harvest handling procedures of *Annurca* apples. Portable instrument based on linear variable filter (LVF) technology was found to be suitable for field analysis of different horticultural products as presented in another study. VIS/NIR spectroscopy (550-1100 nm) could discriminate between three different tomato varieties (*Ekram*, *Harver* and *Izmer*). Results of principal component analysis (PCA) presented clear differences among the three tomato varieties possessing different values in quality traits such as soluble solids content (SSC), titratable acidity (TA),taste (SSC/TA) and firmness. The PLS (partial least squares) regression method has been found useful to predict these quality parameters based on the NIR spectra. NIR spectroscopy can be used not only to predict quality parameters but also to classify fruits of different varieties. Using hyperspectral image processing (HSI), contactless spectral and spatial information can be obtained about the different crops pixel by pixel. Among others, the HIS technology has been proven to be useful in the on-site monitoring of quality characteristics (soluble solids, flesh firmness) of apricots, kiwifruit and grapes and the determination of physiological state of citruses and stone fruits. Such analyzes rely on the evaluation of large digitized and pre-processed datasets which fundamentally fit into the data-driven technology and management reform of the “Industry 4.0” and the Digital Agri-Food Strategy. These noninvasive or contactless analytical measurement techniques can support the long-term goal to have transparent information about the quality and quantity of a crop across the entire food supply chain.



**Keywords:** harvest maturity; raw material quality; rapid analytical methods; chemometrics

**Acknowledgements:** The research was supported by the Hungarian University of Agriculture and Life Sciences’s Doctoral School of Food Science

**Registration number 126**

## Preparation of tea extracts for kombucha production

Edyta Kordialik-Bogacka[b], Hubert Antolak, Paulina Legumina, Anna Michalska, Katarzyna Dybka-Stępień, Anna Otlewska, Sylwia Ścieszka, Maciej Ditrych, Kamil Królak

Institute of Fermentation Technology and Microbiology, Faculty of Biotechnology and Food Sciences, Lodz University of Technology, Lodz, Poland

[b]Corresponding author e-mail: edyta.kordialik-bogacka@p.lodz.pl

**Abstract:** Kombucha is a beverage obtained by fermentation of sugar-dissolved tea (*Camellia sinensis* L.), commonly black tea, by symbiotic culture of acetic acid bacteria, lactic acid bacteria and yeasts. Other tea types, namely green and oolong tea are the popular alternatives to black tea. Both the tea type and the method of tea extract preparation have a large influence on tea brew composition and consequently kombucha properties.
The aim of this study was to determine the impact of infusion conditions on tea ingredients extraction. The extraction efficiency at various infusion parameters such as temperature (5 °C, 20 °C, and 85 °C), time (2, 6, and 12 hours as well as 10 and 30 minutes), different water type (tap water versus distilled water) and various tea types (Black Kenia, Oolong, Green Sencha and the mixtures of Yunnan and Green Sencha as well as the mixtures of white tea and Green Sencha) and their form (whole leaves or powder) was compared. For all tea extracts soluble substance content, colour, pH, acidity, nitrogen content, polyphenol content and antioxidant capacity were measured.
Hot infusion showed higher extractive power. However, cold infusion made for several hours resulted in similar extraction efficiency. The employment of a brief hot infusion step followed by cold water addition may represent an alternative approach for industrial tea extract preparation for kombucha fermentation.



**Keywords:** tea, infusion conditions, extraction efficiency, kombucha

**Acknowledgements:** The research was supported by the National Centre of Research and Development under the project “Development and implementation of innovative kombucha production technology” POIR.01.01.01-00-0910/20-00

**Registration number 127**

## Infusion parameters determining microbiological purity of tea brew for kombucha production

Katarzyna Dybka-Stępień[b], Hubert Antolak, Anna Otlewska, Sylwia Ścieszka, Kamil Królak[1], Maciej Ditrych, Edyta Kordialik-Bogacka

Institute of Fermentation Technology and Microbiology, Faculty of Biotechnology and Food Sciences, Lodz University of Technology, Lodz, Poland

[b]Corresponding author e-mail: katarzyna.dybka@p.lodz.pl

**Abstract:** Herbal infusions have been used traditionally over many years as health-promoting beverages. Kombucha is a slightly sweet, acidic and alcoholic beverage produced from the sweetened tea infusion (*Camellia sinensis* L.), fermented by a symbiotic culture of bacteria and yeasts (SCOBY). Parameters determining the preparation of tea infusion (temperature, time, type of water, type of tea and its form – whole leaves or powder) affect the extract content, chemical composition and antioxidant stability of the brew. Typically, tea infusion is conducted at 85 °C for up to 30 minutes. Alternatively, cold brewing, which does not decompose bioactive compounds, may be implemented. Herbs are known for possible heavy microbiological contamination. Preparation of tea infusions at low temperature in combination with sugar addition may enhance the growth of undesirable microorganisms and impact the overall microbiological quality of kombucha and consequently its sensory attributes. In addition, the presence of pathogens may be observed. Recognizing potential microbial hazards is also important in reference to the popularity of home-brewed kombucha.

The aim of the research was to determine the impact of the cold brewing parameters on the microbiological purity of tea infusions.

The research involved the analysis of infusions (n=130) obtained from three types of tea - Black Kenia, Green Sencha and Black Oolong. Infusions (5 g/L) of a given type of tea were brewed with tap water or distilled water. Each type of tea was infused at 5 °C and 20 °C for 2, 6 and 12 hours as well as at 85 °C for 10 and 30 minutes.

Microbiological purity of tea infusions was determined using the standard pour plate method. The total viable count of mesophilic and psychrotrophic bacteria, the total number of fungi, the number of *Enterobacteriaceae*, as well as the total number of acid-forming bacteria were determined. Amongst the isolates from tea infusions (n=100), the most frequently occurring bacteria (as dominating microflora) were identified by 16S rRNA gene sequencing.

The results indicated varying levels of microbiological purity of the analysed samples. Parameters of infusion process influenced the number of microorganisms in the tested samples. 16S rRNA gene sequencing revealed that tea infusions were dominated by bacteria belonging to *Bacillus* spp.



**Keywords:** tea infusion, kombucha, microbiological purity

**Acknowledgements:** The research was supported by the National Centre of Research and Development under the project “Development and implementation of innovative kombucha production technology” POIR.01.01.01-00-0910/20-00

**Registration number 128**

## Using pineapple based marinade for sous-vide meat products

György Kenesei[b], Odett Által, István Dalmadi

Department of Livestock and Food Preservation Technology, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Ménesi út 43-45., Hungary

[b]Corresponding author e-mail: kenesei.gyorgy@uni-mate.hu

**Abstract:** Pineapple, in addition to its beneficial effect on meat quality parameters, also has a beneficial effect on human health. It has a significant content of bromelain, a cysteine endopeptidase belonging to the group of hydrolases, is thus able to break down meat proteins into smaller units through its protein-degrading activity, causing a change in the structure of the meat.
Sous-vide cooking is a 'low temperature long time' type of heat treatment resulting in a meat product with special sensory properties.
With the experimental design of a central complex rotation arrangement (CCD) we were able to study the interaction of the two variables (marinating time and pineapple juice concentration). Several quality parameters were measured (color, water holding capacity (WHC), weight loss, dry matter content, texture, and thermo-analytical measurement of proteins by DSC).
Based on the results of the factorial experimental design, it can be stated that the marinating time and the concentration of the applied marinating solution have a strongly significant effect ($p < 0.001$) on the weight, dry matter content and color (all L*, a*, b* parameters) of cooking water and water retention ($p < 0.01$), time and concentration have a significant effect on pH at $p < 0.05$, but the combined effect of the two is not significant. The complex effect of time and concentration on the results of the texture measurement did not have a significant effect at $p < 0.05$ either. The results obtained for each parameter of meat quality are correlated. Based on the 3D models the pH decreases, the cooking loss increases and the water holding capacity becomes worse. The lower pH causes drip loss, thus increasing the dry matter content, and lightening the meat color. Thus, for the color parameters, the brightness factor (L*) increases, while the reddish hue (a*) of the samples decreases and the yellowish hue begins to dominate (b*). Thermograms of DSC measurements of the samples confirm that protein degradation occurs, which is more intense for samples marinated for a longer period and at higher concentrations. As the concentration of the solutions increases and the time progresses, the recorded curve becomes more and more close to the baseline. The peaks of myosin, connective tissue proteins, and actin are flatter at higher concentrations and prolonged marinating, suggesting that the protease-active enzyme bromelain disintegrates the proteins into smaller pieces, and that the pineapple juice may have an acidic denaturing effect. Most properties are strongly influenced by the time of marinating and the concentration of the marinating solution and their combined effect.



**Keywords:** pineapple, marinade, sous-vide, CCD

**Acknowledgements:** This research was funded by the European Union and co-financed by the European Social Fund (grant agreement no. EFOP-3.6.3-VEKOP-16-2017-00005).

**Registration number 131**

# Effect of enrichment with high biological value animal products on techno-functional properties of ice creams

Tamás Csurka[1,2,b], Karina Ilona Hidas[1,2], László Ferenc Friedrich[1], Klára Pásztor-Huszár[1]

[1]Hungarian University of Agriculture and Life Sciences, Institute of Food Science and Technology, Department of Livestock Products and Food Preservation Technology, Budapest, Hungary
[2]Hungarian University of Agriculture and Life Sciences, Doctoral School of Food Sciences, Budapest, Hungary

[b]Corresponding author e-mail: csurka.tamas@uni-mate.hu

**Abstract:** Ice cream is one of the most popular sweets worldwide. In Hungary as well, consumption is estimated at three to four litres per person per year. Thus, ice cream is a good opportunity to make products and by-products with high biological value acceptable. At the same time, ice cream is a complex food matrix with refrigerated storing requirement. It is an ideal way for utilisation of high biological value animal products, which provide an excellent substrate for pathogenic microorganism under normal conditions. Because of the complex colloid system of ice cream and specific processing technology with heat-treatment and freezing, investigation of the effect of enriching with high biological value products on techno-functional properties can give us novel information to understand the texturization effects of different proteins. Beside the investigation of techno-functional attributes, which support the industrial utilisation of blood and egg products, the second aim of this research is to promote the development of functional foods with similar processing technologies, which can prevent or handle the iron deficiency anaemia, in which 1.6 billion people are affected, mostly children and pregnant women, and protein deficiency, which is predicted to become an increasing problem in the near future. 10 g/100 g concentration of six different blood and egg products (whole blood, haemoglobin fraction, blood plasma fraction, liquid whole egg, liquid egg yolk, liquid egg white) were added to the same ice cream base (control) recipe in our investigation. Ice creams were produced under laboratory conditions with the same technological parameters. In case of ice creams, both liquid and frozen texture are important for the industry. Liquid texture because of fluidisation parameters and pump energy consumption calculation, hard texture because of the portioning and formatting and of course, both because of the sensory compliance. Thus, the liquid texture was measured via rotational viscometry (Couette type method) by Physica MCR 91, Anton-Paar rheometer (CC27 concentric cylinders) and rheological behaviour was described by Herschel-Bulkley model. Hard texture was characterized by the hardness of samples, which was measured via a cutting test with constant cutting speed and uniform sample shape by TA-XT Plus equipment (Warner-Bratzler 'V' blade). Color was measured by Minolta CR-400. Besides, dry matter content and pH were measured. Effects of enrichments caused statistically significant changes, but not in the texture, which would affect the rheological behavior and organoleptic properties of the material.



**Keywords:** animal by-product, animal blood, egg, texture, techno-functional properties

**Acknowledgements:** The research was supported by the Hungarian University of Agriculture and Life Sciences, Doctoral School of Food Sciences.

**Registration number 132**

## Bio-preservative potential of commercial fruit juices

Maciej Ditrych[b], Tomasz Szczygieł, Sylwia Ścieszka, Kamil Królak, Anna Michalska, Katarzyna Dybka-Stępień, Anna Otlewska, Edyta Kordialik-Bogacka

Faculty of Biotechnology and Food Sciences, Institute of Fermentation Technology and Microbiology, Lodz University of Technology, Lodz, Poland

[b]Corresponding author e-mail: maciej.ditrych@p.lodz.pl

**Abstract:** Currently, consumers are increasingly concerned about the addition of stabilisers and other chemical additives to food and beverages. Consequently, clean-labelled products creep up in popularity and become more commercially attractive. Thus, the stabilisation of food and beverages with agents of natural origin – bio-preservatives - has a great scientific and commercial potential. This study aimed at exploring the potential role of natural fruit juices as stabilisers with particular focus on their antioxidative and phenolic properties. Eight cold-pressed NFC (not from concentrate) fruit juices from organically controlled cultivation (Batom®, Poland) were selected for the study: cherry (*Prunus cerasus* L.), elderberry (*Sambucus nigra* L.), raspberry (*Rubus idaeus* L.), bilberry (*Vaccinium myrtillus* L.), chokeberry (*Aronia melanocarpa* Michx. Elliott), cranberry (*Vaccinium macrocarpon* Aiton), kamchatka berry (*Lonicera caerulea* L. var. *kamtschatica*) and blackcurrant (*Ribes nigrum* L.). Antioxidative activity was determined by DPPH and ABTS assays, which were carried out by utilizing 96-well microplates. The collected data were discussed in relation to pH, total acidity, phenolic content. The highest antioxidative activities (both in DPPH and ABTS assays) were displayed by chokeberry (*Aronia melanocarpa* Michx. Elliott), blackcurrant (*Ribes nigrum* L.) and elderberry (*Sambucus nigra* L.) juices. These three juices were further selected for the investigation of their potential antimicrobial properties in relation to the stability of fermented food and beverage products.



**Keywords:** fruit juices, antioxidative activity, polyphenols, bio-preservation

**Acknowledgements:** The research was supported by the National Centre of Research and Development under the project “Development and implementation of innovative kombucha production technology” POIR.01.01.01-00-0910/20-00

**Registration number 151**

# Food and food spoilage detection by non-destructive technologies

Suliman Khan

Pakistan

Corresponding authors e-mail: sulimanbiotech315@gmail.com

**Abstract:** The rising global population has led to increased food demand. Quality food and food products are important for healthy living. Food fraud is one of the most urgent and active topics of food industries. More food fraud opportunities have been created by the increasing concerns regarding the food supply chain, reducing customer trust. Demand for instrumental finding systems such as Raman spectroscopy, Hyperspectral imaging technique, NMR, NIRS, EM, E-nose, E-eye, and Electronic tongue coupled with chemometric approaches has greatly increased, because they have been demonstrated as a promising alternative for detection and monitoring food fraud and food spoilage. Food fraud and food spoilage are closely related to food-borne diseases. Food-borne diseases affect one out of every ten people (600 million a year), and about 420, 000 people die per year. The aim of this review was to discuss the detection and controlling of food fraud and food spoilage by non-destructive technologies. Similarly, food control is important because food fraud sometimes has unfortunate consequences, for instance, the adulteration of milk powder reported in China in 2008, which caused the death of six children and the hospitalization of thousands of others.

**Keywords:** food fraud, food spoilage, non-destructive techniques

**Registration number 152**

## Consumption of the bio and gluten free product – produced by Abonett

Edina Lendvai[1,b], Diána Dobos-Nagy[2]

[1]Engineering Management and Economy Institute, Faculty of Engineering, University of Szeged, H-6720 Szeged, Hungary
[2]Food Engineering Institute, Faculty of Engineering, University of Szeged, H-6720 Szeged, Hungary

[b]Corresponding authors e-mail: lendvai@mk.u-szeged.hu

**Abstract:** Health consciousness has become one of the most influential behavioural trends of our time and is having a greater impact on consumer habits. The aim of our study is to understand the factors of health consciousness that are influencing consumer behaviour and trends in food consumption. In our research, we conducted a structured interview with the manager of Abonett Ltd., an online questionnaire survey on consumers' purchasing habits, and a description of the advantages and disadvantages of competitors in the market for alternative bread substitutes, which were based on studies from ~~my~~our secondary research. The information gained from our research can be used to help the company plan its marketing strategies and analyse consumer behaviour.

**Keywords:** consumers' habit, extruded products, sandwiches snacks, online questionnaire

**Registration number 153**

## Comparative analysis of meat raw materials

József Mihalkó[1,2,b]

[1]Department of Food Engineering, Faculty of Engineering, University of Szeged, H-6720 Szeged, Hungary
[2]Doctoral School of Food Sciences, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: mihalko@mk.u-szeged.hu

**Abstract:** Animal food, especially meat, has played an important role in the history of mankind. Beside lean meats, mechanically deboned meat (MDM) and mechanically separated meat (MSM) can also be used in meat products. However, the latter does not qualify as meat because of the damage to the muscular structure caused by the high pressure applied during the separation, therefore, cannot be included in the meat content of products.
The aim of the experiment was to compare whole and minced meat, MDM and MSM from turkey (raw and in the form of meat paste). Whole turkey drumsticks, minced turkey drumsticks (particle size: 3 mm), mechanically deboned meat made from turkey drumsticks and MSM made from turkey backs were obtained from Gallfood Ltd. (Kecskemét, Hungary).
Preparing of meat paste: 100 g of sample (minced, MDM and MSM) and 0 mL, 10 mL, 20 mL, 30 mL, 40 mL, 60 mL, 80 mL, and 100 mL of water were used to prepare the meat paste. Paste production was performed for 20 seconds.
Technofunctional tests (water-holding and -binding capacity), colour and colour stability measurements, chemical composition (moisture, protein and fat content) determination, electron microscopic recording were performed for raw samples; for meat paste, rheological properties and colour values were measured.
Summarizing the results, it can be stated that MSM differs from whole meat, minced meat and MDM both in the raw state and as a raw material for meat paste. Water activity and pH results are not significantly different from MDM. However, differences in key properties can be detected. In terms of technofunctional properties – water-holding and water-binding capacity -, MSM has worse properties due to high levels of muscle cell destruction. It had higher pressing, cooking and roasting loss compared to the other samples. Electron micrographs of MSM show a complete change in muscle structure compared to minced meat and MDM (cause: high pressure applied). In the case of surface colour characteristics, it can be observed that MSM is a lighter, redder and yellower colour both in the raw form and in the form of meat paste. These properties cannot be kept stable over time. The rheological properties (e.g. elasticity) of MSM meat paste are less favourable than those of other raw materials. These defects can also occur during the production of meat products which must be compensated for e.g. with natural additives or physical impact (high pressure).



**Keywords:** mechanically separated meat, meat, mechanically deboned meat, comparative analysis

**Acknowledgements**: The author acknowledges the Hungarian University of Agriculture and Life Sciences's Doctoral School of Food Science for the support in this study.

**Registration number 155**

# Bio accessibility of amino acids and antioxidant properties in heat- and lactase- treated milk during *in vitro* digestion

Arijit Nath[1], Muriithi Grace Wanjugu[1], Emőke Szerdahelyi[2], Mária Berki [3], Éva Kónya-Lengyelné [3], Rita Tömösköziné Farkas [3], Judit Tormási[3], László Abrankó[3,b]

[1]Department of Food Process Engineering, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary
[2]Food Science Research Group, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1022 Budapest, Hungary
[3]Department of Food Chemistry and Nutrition, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary

[b]Corresponding author e-mail: abranko.laszlo.peter@uni-mate.hu

**Abstract:** Heat treatment of milk influences the nutritional value by altering the native structure of proteins in milk and by influencing the digestibility among others by non-enzymatic lactosylation of proteins. According to the literature, the nutritional quality of milk decreases with an increase of the degree of lactosylation in milk proteins. Lactosylation of proteins is the first stage of the Maillard reaction, where a lactose attaches to the ε-$NH_2$ group of lysine. Enzymatic hydrolysis of lactose to produce lactose-free milk is also a routine industrial processing method in diary industry that might also have additional auxiliary effect on the nutritional properties of milk proteins such as reversing the degree of lactosylation.
In present investigation, *in vitro* digestion simulation was used to study such effects in pasteurized, ultra-heat treated and lactose-free milk samples. A HPLC-ESI-TOF mass spectrometric method was set up using deconvolution of acquired intact protein mass spectra for detecting lactosylation of milk proteins in pasteurized milk, ultra-heat treated milk and lactose-free ultra-heat treated milk. Pasteurized milk and ultra-heat treated milk were obtained from an industrial plant. Ultra-heat treated milk was hydrolysed with commercially available lactase at 42 °C for 4 h. Mass shift of +324 (characteristic for lactose attachment) and +162 (characteristic for glucose or galactose attachment) with respect to the unmodified casein, α-lactalbumin and β-lactoglobulin was considered for assessing the change of molecular mass of casein due to lactosylation. No lactosylated milk proteins were observed in pasteurized milk, whereas these proteins were found in ultra-heat treated milk and in lactose-free ultra-heat treated milk. *In vitro* digestion simulation was performed to evaluate protein digestibility of all types of milks using the Infogest protocol. Antioxidant capacity of ultra-heat treated milk increased due to surface hydrophobicity. Results of amino acid profiling of *in vitro* digesta showed that bioaccessibility of lysine, leucine, phenylalanine and tyrosin were reduced to 45%, 33%, 33% and 24% for ultra-heat treated milk compared to pasteurized milk. In lactose-free ultra-heat treated milk, bioaccessibility of amino acids were recovered.



**Keywords:** pasteurized milk, ultra-heat treated milk, lactose-free ultra-heat treated milk, lactosylation of protein, bioaccessibility of amino acids, *in vitro* digestion

**Acknowledgements:** Financial support of OTKA K135294 is kindly acknowledged. A. Nath acknowledges Hungarian state postdoctoral scholarship. J. Tormási acknowledges the Food science doctoral school of MATE.

**Registration number 156**

# Food for thought: food and language

Esmeralda Sherko[1,b], Elsa Zela[1]

[1]Department of Foreign Languages, Agricultural University of Tirana, Tirana, Albania
[1]Department of Foreign Languages, Agricultural University of Tirana, Tirana, Albania

[b] Corresponding author e-mail: esherko@ubt.edu.al

**Abstract:** Food and language have inextricably been related to each other. People speak the universal language of food all over the world. The evolution of dishes has been likened to the evolution of languages (Whitfield, 2005). Language and culinary art are both transmitted consciously and unconsciously through generations, they evolve separately as well as in relation to other surroundings. They enrichen though borrowings where geography plays a crucial role. As language and the power of thoughts shape our identity, our brain is active 24/7 even when we sleep, so is the need for food and our metabolism. Just like our brain has an immense capacity to produce countless combinations of structures and sentences to generate and convey human experience and give life to every single perspective, it also puts these thoughts in action while cooking and trying new recipes through endless fusions of ingredients. *Culinary linguistics* is *defined* as a qualitative study of *language* in *food* traditions or eating habits through the *linguistic* paradigm (Jabonillo, 2016). In addition, food has contributed to vocabulary expansion internationally with new words, borrowings, toponyms, eponyms, compounding and idioms. This study focuses on the interrelation between food and language and explores food idioms in OED (Oxford English Dictionary) as well as their etymology, word formation, similarities and discrepancies among different languages. Idioms will be analyzed in source versus target language in order to highlight the importance of sociolinguistics in shaping people.



**Key words**: people, food, language, idioms, sociolinguistics

**Registration number 157**

## Development of high-fiber flour mixtures

Eszter Szőke-Trenyik[b], Antal Véha, Balázs P. Szabó

Department of Food Engineering, Faculty of Engineering, University of Szeged, Szeged, Hungary

[b]Corresponding author e-mail: trenyik.eszter@mk.u-szeged.hu

**Abstract:** Nowadays, consumers are paying more and more attention to healthy eating, and unfortunately, insulin resistance and type 2 diabetes are affecting many people. They are paying more attention to the consumption of fiber-rich foods. In our article, we developed high-fiber ready-to-bake flour mixture blends using purple wheat flour (white and wholemeal). For fiber fortification, inulin, chia seed flour and psyllium husk flour were used. After determining the main nutritional parameters of the raw materials, 4 series of experiments were carried out to prepare bread rolls and to test the finished products. The correct mixing ratio of the enriching agents were tested, and the final flour mixtures were tested. At the end of our research, three blends (white purple wheat flour + 4% inulin + 2% psyllium husk flour; wholemeal purple wheat flour + white purple wheat flour + 4% inulin + 4% chia seed flour; wholemeal purple wheat flour + 4% inulin + 4% chia seed flour) were developed. The Figure shows the final products.

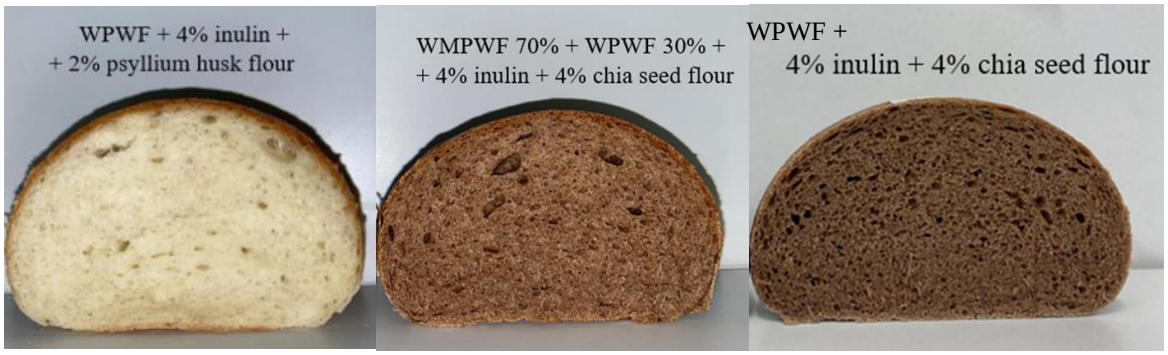


Figure: a.) The crumb of the final phase sample made of white purple wheat flour. b.) The crumb of the final phase sample made of wholemeal and white purple wheat flour. c.) The crumb of the final phase sample made of wholemeal purple wheat flour and containing 4% inulin and 4% chia seed flour
WPWF: White Purple Wheat Flour, WMPWF: Wholemeal Purple Wheat Flour. (left to right a.); b.); c.))

**Keywords:** Purple wheat, flour mixtures, bread roll, inulin, chia seed flour

**Acknowledgements:** Supported by the ÚNKP-21-2-SZTE-318 new national excellence program of the ministry for innovation and technology from the source of the national research, development and innovation fund.

**Registration number 159**

## Determination of chitin content in insects

Enikő Horváth-Szanics, Éva Lengyel-Kónya, Rita Tömösközi-Farkas

Hungarian University of Agriculture and Life Sciences, H-1022 Budapest, Hungary

[b]Corresponding author e-mail: Horvathne.Szanics.Eniko@uni-mate.hu

**Abstract:** Various insect-derived foodstuffs are often heralded as sources of protein for the diet. Edible insects may contain a high amount of protein, but true protein levels can be overestimated when the substance chitin is present. In insect protein research, it seems that when extracting protein from insects, chitin may be also extracted, which may interfere with most protein analyses. Quantification of chitin is therefore becoming increasingly important in food and feed analyses. Chitin is a high molecular weight polymer, and it is insoluble in water and most solvents, so direct quantification of chitin is almost impossible. The conventional methods for the quantification of chitin content are based on its hydrolysis, and the assessment of the monomer, glucosamine. The rate-limiting step of this chitin analysis is the preparation of chitin hydrolysates. The maximum hydrolysis of chitin and glucosamine recovery can be obtained under conditions of 6-8 M hydrochloric acid at 100-110 °C for 4-13 hours.
The purpose of this work was to develop a rapid microwave hydrolysis method for preparation of chitin hydrolysates. During acid hydrolysis of chitin, the concentration of HCl, temperature, and heating time are prime attributes affecting glucosamine recovery. The optimum conditions of microwave hydrolysis of chitin were found at 120 °C with 6 M hydrochloric acid for 40 min. To determine insect chitin concentration, a derivatization-based RP-HPLC method was adapted and validated.

**Keywords:** chitin, glucosamine, HPLC